Myanmar Universities’
RESEARCH CONFERENCE 2019

Nation Building through
Quality Research and Innovation

24-25 May, 2019
University of Yangon
Yangon, Myanmar
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“Research is important in higher education. Research is finding new ways. Research is not an end. It is the beginning of new ways and means. Our education policy includes the encouraging of research. As we have ignored research for long, our inborn inventive minds became dull. That is why research has been given priority. Research must be conducted on topics and subjects that are appropriate for our country. Only then can our progress be practical. Only then can there be progress in our country. Only then can we and our education be abreast with the world. I don’t think I need to emphasise that many support materials are required to conduct a good research. I would like to say that the private sector can participate in this. In developed countries, businesses provide much support in research. We need to have that sort of support.”

Extraction of Speech by **State Counsellor, H.E. Daw Aung San Suu Kyi**
(2018 Conference on Implementing Education Development held at the Myanmar International Convention Centre (II) (MICC-II), Nay Pyi Taw, 24 August 2018)
“Ministry of Education has mainly encouraged university teachers to do applied researches and, in doing so, they can become qualified teachers who can write their research papers well in English and in ICT, and can also publish their researches in Research Journals based on their research outcomes. By teaching practical to students by such teachers in classrooms, students become graduates who can carry out practical jobs related to their specialisations. Therefore, Ministry of Education has been making efforts to nurture the students who are highly-skilled in the related fields to meet the needs of industries.”

Extraction of Speech by Union Minister for Education, H.E. Dr. Myo Thein Gyi (2018 Conference on Implementing Education Development held at the Myanmar International Convention Centre (II) (MICC-II), Nay Pyi Taw, 24 August 2018)
Foreword by Chairman of National Education Policy Commission

Myanmar Universities’ Research Conference (2019) was convened in Arts Hall, University of Yangon on 24 – 25 May, 2019 with the following objectives:

(1) To disseminate the findings of research work conducted by researchers of universities across the country,
(2) To perform applied quality researches by exchange of views and experiences among researchers, and
(3) To foster research culture in universities and provide supports improving university rankings.

At the Conference, under its theme of ‘Building Nation through Quality Research and Innovation’, 178 papers were orally presented and 50 papers displayed as posters. These papers came up from nine discipline areas of Arts and Science; Engineering and Technology; Economics and Business; Computer Studies; Medicine and Allied Health; Language, Culture and Arts; Agriculture, Veterinary Science and Forestry; and Education. As a parallel session, a ‘Talk on Research’ was held afternoon on the second day of the Conference, being contributed by seven scientists with the help of a senior moderator. Eighteen Best Paper
Awards (First Prize and Second Prize from each of nine disciplines) and nine Best Poster Awards (One best poster from each of nine disciplines) were conferred to the outstanding researchers concerned. As results I do hope invaluable research findings were shared among researchers, more applied research work are to be undertaken in future, young researchers would be inspired with new ideas, paper-presenting faculty were satisfied much with their work for their career development, and audience attending ‘Talk on Research’ would gain unprecedented knowledge of and insight into research. Being a first and foremost kind of such Conference, there might be some flaws in the exciting events that can be avoided or minimized next year by all-out efforts of all working committees. As per ‘Foreword’ by State Counselor in National Education Strategic Plan (2016 – 2021) stating ‘we are committed to developing a world class higher education system, with a strong focus on research and innovation, to meet the country’s social and economic development needs’, we ensure to continue to hold such conference annually better than the recent one in order to create a common stage where motivated young researchers can meet to shape their dreams for the country and its communities. As an important output, Proceeding Book of the Conference was finally realized for reference for those interested in research and innovation. We would like to do the plan for next round to have specific themes and objectives. These research projects would be working together by different disciplines.

In conclusion, I am very grateful to Union Minister for Education and responsible officials from Department of Higher Education for their kind support, and Judges and Reviewers evaluating papers submitted and presented, Chairs presiding over academic sessions, and talented speakers in a talk for their high academic contribution. The last, but not the least, I highly appreciate members of Working Committee and Sub-committees of the Conference for their untiring efforts without which the Conference would not come into being successfully.

Dr. Myo Kywe
Chairman of National Education Policy Commission
Foreword by Chair of Myanmar Rectors’ Committee

Her Excellency Daw Aung San Suu Kyi, State Counsellor of the Republic of the Union of Myanmar, addressed in her foreword for National Education Strategic Plan (2016 – 2021) that “We are committed to developing a world-class, higher education system, with a strong focus on research and innovation, to meet the country’s social and economic development needs.”

It is my great honour and pleasure to write this Foreword on behalf of the Rectors’ Committee to the Publication of the First Research Conference of Myanmar Universities, held in Yangon University, May 24 – 25, 2019. With the initiation of the National Education Policy Commission, the Rectors’ Committee and Department of Higher Education organized this First Annual Research Conference for 164 universities all over the country.

The theme of the conference is “Nation Building through Quality Research and Innovation”. The MURC (Myanmar Universities’ Research Conference) 2019 is aimed at providing an opportunity to present and disseminate the research results from the different universities, to bring researchers, academics and professionals together from all over the
country, to develop and promote the research activities and research culture in the higher education institutions and to collect recent basic, applied and social research findings to contribute nation building and reform in Myanmar.

We are privileged to acknowledge His Excellency Union Minister Dr Myo Thein Gyi for his great support and commitment for this Research Conference. We would also like to thank Dr Myo Kywe, Chairman of National Education Policy Commission, for his tremendous effort and support in all the detail process and program of the conference.

In this conference, more than 2000 participants from 164 universities participated whose interdisciplinary mix turned out to provide an exciting atmosphere stimulating fruitful discussions. There are nine parallel paper reading sections held in the nine different rooms around the Arts Hall of the Yangon University. Out of 639 papers, 181 for paper reading and 57 for poster presentation were selected by the 124 reviewers from 9 different subjects; Arts, Sciences, Education, Economy, Technology, Computer Science, Health Science, Agriculture and Livestock, and Language & Culture. The best paper and poster awards were chosen by the 47 judges from different professions. One of the successful programs of the conference with hundreds of audiences was Round Table Talk on “Nation Building through Quality Research and Innovation” with 1 moderator and 7 speakers.

With respect to the hard work of the committee, we would like to express our deep appreciation and gratitude to all the committee members, the paper reviewers and the judges that have made this conference a success, and especially to the Ministry of Education, the National Education Policy Commission and the Department of Higher Education that has supported the whole effort in making this conference. We would like to express our thanks to Yangon University for allowing us to hold this conference in prestigious Arts Hall and providing the venue for the event. We also really appreciate and value the speakers and the moderators who determined and energetically contributed to the research talk in this conference. We sincerely recognize the values of research findings which are applicable to contribute in development of Myanmar through great efforts of all researchers from various institutions.

Wishing to achieve a healthier, happier, pluralistic, prosperous, peaceful and democratic nation, Myanmar, through Application of Research Findings,

Dr. Zaw Wai Soe
Chair, Myanmar Rectors’ Committee
## CONTENT OF PROCEEDINGS

### 1. AGRICULTURE, VETERINARY SCIENCE AND FORESTRY

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Spatial Analysis on Variability of Yield Gap of Green Gram in Selected Area in Myanmar (Khin Mar Oo)</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Effect of heat treatments, packaging materials and storage duration on dormancy of sesame seeds (Sesamum Indicum L.) under ambient and cold storage conditions (Nyein Nyein Htwe)</td>
<td>7</td>
</tr>
<tr>
<td>4.</td>
<td>The prevalence of heartworm (Dirofilaria immitis) and its associated risk factors in dogs from Pyinmana township, Myanmar (Si Thu Aung)</td>
<td>25</td>
</tr>
<tr>
<td>5.</td>
<td>The Emerging Importance of Multidrug Resistant Escherichia coli in Broiler, Layer and Village Chicken Sampled from Zeyar Thiri Township, Nay Pyi Taw (Soe Soe Wai)</td>
<td>35</td>
</tr>
<tr>
<td>6.</td>
<td>Plant Growth and Yield of Tomato (Lycopersicon esculentum Mill.) as Effected by Integrated use of Compost and Inorganic Fertilizers (Win Su Min)</td>
<td>45</td>
</tr>
<tr>
<td>7.</td>
<td>Supply Chain Management of Sesame under Informal Contract Scheme in Aung Lan Township, Magway Region (Khaing Khaing Oo)</td>
<td>57</td>
</tr>
<tr>
<td>8.</td>
<td>Plant nitrogen content estimation in rice under different nutrient management practices using sensor technologies (Aung Naing Oo)</td>
<td>70</td>
</tr>
<tr>
<td>9.</td>
<td>Evaluation of Some YAU Improved Rice Varieties under Saline Condition (Kyi Mon Thein)</td>
<td>76</td>
</tr>
<tr>
<td>10.</td>
<td>Effect of Biochar with Inorganic Soil Conditioners on Rice Productivity in Salt-Affected Soils (Mar Mar Aung)</td>
<td>86</td>
</tr>
<tr>
<td>11.</td>
<td>Antagnistic Effect of Different Trichoderma Isolates on Growth of Rhizoctonia bataticola (Taub.) Butler in Vitro (Khin Kyi)</td>
<td>97</td>
</tr>
<tr>
<td>12.</td>
<td>Effects of Urea Molasses Mineral Blocks on the Nutrient Intake, Digestibility and Nitrogen Retention of Goats (Aung Aung)</td>
<td>106</td>
</tr>
<tr>
<td>13.</td>
<td>Empirical Study of the Profitability and Efficiency of Rubber Production System in Myanmar (Kyaw Myo Thu)</td>
<td>112</td>
</tr>
<tr>
<td>14.</td>
<td>Evaluation of Green Manure Effects on Tomato and Mustard Crops (Tin Tin Khaing)</td>
<td>122</td>
</tr>
<tr>
<td>15.</td>
<td>Study on antimicrobial resistance pattern of Escherichia coli isolated from layer farms within Pyin Oo Lwin Township (Hline Phyu Phyu Thant)</td>
<td>128</td>
</tr>
<tr>
<td>16.</td>
<td>Effect of the different extenders and cryoprotectants of the cryopreservation of Cirrhinus mrigala (Hamilton,1882) Spermatozoa (Thandar Soe)</td>
<td>136</td>
</tr>
<tr>
<td>17.</td>
<td>Comparison on performance between cattle fed on locally available forages and introduced forage in central dry zone area of Myanmar (Khin San Mu)</td>
<td>143</td>
</tr>
<tr>
<td>18.</td>
<td>Adoption Constraints for Soil Conservation Practices in Kyaukpadaung and Chaung U Townships, Dry Zone Region of Myanmar (Shwe Mar Thani)</td>
<td>151</td>
</tr>
<tr>
<td>19.</td>
<td>Diseases of Groundnut in Nay Pyi Taw Area and Effect of Different Fungicides on Cercospora Leaf Spots (Seint San Aye)</td>
<td>162</td>
</tr>
<tr>
<td>20.</td>
<td>Evaluation on the Efficacy of Vaccination Programmes against Infectious Bursal Disease Virus based on Specific Antibody Response in Commercial Broilers (Hlaing Hlaing Myint)</td>
<td>168</td>
</tr>
<tr>
<td>21.</td>
<td>Evaluation of duckweed meal (Lemma sp.) as replacement to sesame meal on production performance, carcass characteristics and digestibility of commercial meat ducks (Htet Lin Oo)</td>
<td>175</td>
</tr>
</tbody>
</table>
## II. ARTS

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Searching for the most effective method of intensive Myanmar language course</td>
<td>Mya Mya Win</td>
<td>183</td>
</tr>
<tr>
<td>23</td>
<td>Study on Importance of National Language Maintenance for Nation Building</td>
<td>Tun Aung Kyaw</td>
<td>199</td>
</tr>
<tr>
<td>24</td>
<td>The Comparative study of Arkar Proverbs and Myanmar Proverbs</td>
<td>Tin Mi Mi Naing</td>
<td>205</td>
</tr>
<tr>
<td>26</td>
<td>and Actual Implementation</td>
<td></td>
<td>216</td>
</tr>
<tr>
<td>27</td>
<td>A Study on the Paintings of Dhattaw Pagoda on Mandalay Hill and on their values</td>
<td>Yan Naing Lin</td>
<td>224</td>
</tr>
<tr>
<td>28</td>
<td>Beliefs and Practices: The Social Network of Bamar Society and Brass Gong Culture,</td>
<td>Lei Shwe Sin Myint</td>
<td>235</td>
</tr>
<tr>
<td>29</td>
<td>Mandalay Region, Myanmar</td>
<td></td>
<td>241</td>
</tr>
<tr>
<td>30</td>
<td>A Study on the Job Satisfaction of Employees as Related to Their Self-esteem and Work</td>
<td>George Ko Ko Naing</td>
<td>251</td>
</tr>
<tr>
<td>31</td>
<td>Preference</td>
<td></td>
<td>257</td>
</tr>
<tr>
<td>32</td>
<td>Information Literacy Skills of Library Professionals in Universities’ Central Library</td>
<td>Ohn Mar Oo</td>
<td>269</td>
</tr>
<tr>
<td>33</td>
<td>Academic Freedom of Faculty Members in Myanmar</td>
<td>Pa Pa Soe</td>
<td>279</td>
</tr>
<tr>
<td>34</td>
<td>Protecting the right to housing in Myanmar</td>
<td>Aye Mar Win</td>
<td>286</td>
</tr>
<tr>
<td>35</td>
<td>Importance of Monastic Education for Needy Family and Ethnic Children</td>
<td>Zin Mar Oo</td>
<td>294</td>
</tr>
<tr>
<td>36</td>
<td>Buddhism and Tolerance: Toward Living with Peace and Harmony of Multiculturalism</td>
<td>Myat Myat Htun</td>
<td>299</td>
</tr>
<tr>
<td>37</td>
<td>Study On Saline Water Intrusion Along The Delta Coast of The Ayeyarwady Region</td>
<td>Aung Swe</td>
<td>305</td>
</tr>
<tr>
<td>38</td>
<td>Traditional Forest Land Management Practices of Kayan Indigenous People in the Southern</td>
<td>Min Oo</td>
<td>318</td>
</tr>
<tr>
<td>39</td>
<td>Shan Highlands</td>
<td></td>
<td>324</td>
</tr>
<tr>
<td>39</td>
<td>Assessment on Flood Mapping in Bago River Basin in Myanmar Using HEC-Geo HMS</td>
<td>Khin Khin Htay</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>A Study of Research Methodology in Philosophy</td>
<td>Thawda Myint</td>
<td></td>
</tr>
</tbody>
</table>
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I. AGRICULTURE, VETERINARY SCIENCE AND FORESTRY

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Abstract— The average actual yield obtained by the farm level is being still low rather than potential. Reducing the gap between average and potential yields is critical because the maximum reliable yields achieved in farmers' fields decline in green gram production. Assessing the yield gap indicates that the possible extent of yield increase from actual values. Yearly survey interview was carried out to obtain farmers' actual yield at Nankale Village, Thonegwa Township (lower region of Myanmar) from 2016 to 2018 winter crop seasons to generate a yield gap mapping and to find out the causes for yield gap. Drone photos were consolidated and prepared for digitizing and analyzing with pix 4D software. ArcGIS software from Environmental Systems Research Institute (ESRI) was used to analyze the mapping on spatial variation of the yield gap of green gram in the selected area. The yield gaps of green gram observed in three consecutive years. A broader yield gap found when comparing potential yield and farmers' actual yield (Yield Gap I) in the 2016 and 2017 crop seasons. Similarly, the gap between demonstration plot yield and farmers' actual yield (Yield Gap II) was also wider in these years. It was noted narrower yield gaps observed in the 2018 crop season. The technology gap ranging from 0.19 to 0.30 ton ha⁻¹ and the extension gap between 0.27 and 0.52 ton ha⁻¹ has resulted in the study site. The total yield gap between potential yield from a research station and a farmer field is within the range of 0.50 to 0.71 kg ha⁻¹. The results obtained by the projection of yield gap maps indicated that the yield gap differs widely from location to location within a field and time series as well. Therefore, a spatial variation on the yield gap using GIS has responsible for a considerable scope to improve the productivity of green gram through innovative research interventions with appropriate policy support. It is essential to understand the farmers' actual constraints, encourage the adoption of good agriculture practices through adequate supplies of inputs and farm credit and incentive market access and strengthen the research and extension to narrow down the yield gaps.

Keywords— Green gram, Yield gap, Mapping, Spatial, Potential yield

I. INTRODUCTION

Green gram (Vigna radiata L.) is one of the major exportable pulses in Myanmar. It plays a vital role in the human diet and improving soil fertility by fixing atmospheric nitrogen into available form with the help of Rhizobia species present in the nodules of its roots [1]. It also comes to be popular as winter season crops after monsoon rice and cultivating large areas in lower and middle regions. Moreover, green gram has more extended markets such as China, Vietnam, Malaysia, Bangladesh, India, Indonesia and EU countries rather than a black gram and pigeonpea which depend almost entirely on India's demand [2].

In Myanmar, the green gram has grown on an area of 1.24 million hectares with an average yield of 1.27 ton ha⁻¹, and the total production was 1.58 million tons [3]. Depending on the kinds of pulse varieties, the yields targeted by the Ministry of Agriculture, Livestock, and Irrigation (MoALI) is 1.6 - 2.5 ton ha⁻¹ whereas the average actual yield at the farm level, is about 1.3 ton ha⁻¹ [4]. Thus, the yield per unit area of a green gram is still low due to the yield gap between the potential and the average actual
yields obtained by the green growing farmers in Myanmar.

Reducing the gap between average and potential yields is critical because the maximum possible yields achieved in farmers' fields decline in green gram production. Substantial efforts to minimize yield gap could be the possible strategy to increase productivity and production of green gram. The use of innovative approaches as spatial analysis using Geographic Information System (GIS) can provide the variability of crop yields and assess the underlying causes of yield gap which may assist in identifying strategies for narrowing the yield gaps [5].

Geographic Information System (GIS) is a system of hardware, software and geographic data designed to support the capture, management, manipulation, analysis, modeling and display of spatially referenced data for solving complex planning and management problems. Different from conventional maps, computerized GIS maps contain various layers of information as yield, soil survey maps, rainfall, crops, soil nutrient levels, and pests [6].

Spatial analysis is any set of methods, and the results change while the locations of the objects analyzed change. GIS has realized as a key to implementing methods of spatial analysis, making them more accessible to a broader range of users, and more widely used in making effective decisions and in supporting scientific research [7]. Once analyzed, this information is used to understand the relationships between the various elements affecting a crop on a specific site [8].

Analyzing the yield gap indicates that the possible extent of yield increase from actual values [9]. Since the crop growing communities have different levels of knowledge, practices, technologies, and perceptions of the value of the crop, the spatial and temporal variability exists in crop yields [10]. Without yield gap analysis coupled with the assessment of constraints to improve crop productivity, policy-makers and researchers will difficult to assess future food security [11]. Therefore, the present study was investigated to generate a yield gap mapping and to find out the causes for the yield gap.

II. MATERIALS AND METHODS

A. Study Site

The research conducted at Nankale Village, Thonegwa Township, the lower region of Myanmar, which lies between 16°73'01" - 16°74'68" N and 96°56'08" - 96°57'87" E during 2016 to 2018 winter crop seasons Fig. 1. Green gram is a major pulse grown just after the harvest of monsoon rice as double cropping and the total study area is 483 hectares.

B. Taking Sample Plots

Using a geographical information system (GIS) tools, the study area had laid with 300 m × 300 m geographic grids. A total number of 66 grids encompassed in the study area Fig. 2. The grids taken for the survey had cultivated with green gram and the rest excluded. One plot from each grid randomly selected as a sample plot. Accordingly, 43 farmers occupied in 50 sample plots were selected as sample farmers and interviewed with the help of a well-structured questionnaire.

C. Data Collection

The data collected were demographic characteristics of the respondents, yield and cultivation of green gram practiced by the respondents, source of seed availability and constraints of management practices related to green gram cultivation in the study area.

Field base map hardcopy used as the base layer and required secondary data gathered from the Department of Agricultural Land Management and Statistics (DoALMS), Thonegwa Township, Union of Myanmar were used by digitizing.

Figure 1. Study area at (a) Nankale Village, Thonegwa Township

Figure 2. Study area grid.
D. Drone Flying and Mapping

Using DJI Phantom 4, drone flying had done at an altitude of 120 meters above the ground. Drone photos were consolidated and prepared for digitizing and analyzing with pix 4D software to provide a digital base map of the study area. ArcGIS 10.5 software from Environmental Systems Research Institute (ESRI) was used to analyze the mapping on spatial variation of the yield gap of green gram in the selected area.

The spatial interpolation was conducted using Kriging, a deterministic interpolation method available in ArcGIS, Spatial Analyst toolbar.

E. Calculation

Following [12], Yield Gap I and Yield Gap II were calculated using (Eq. 1 and 2). The technology gap represents the difference between the potential yield and the demonstration yield. The extension gap denotes the difference between demonstration plot yield and farmers’ actual yield.

\[
\text{Yield Gap I} = \text{Potential yield} - \text{Farmers’ actual yield} \quad (1)
\]

\[
\text{Yield Gap II} = \text{Demonstration yield} - \text{Farmers’ actual yield} \quad (2)
\]

The potential yield of the green gram represents the maximum yield reported by the Department of Agricultural Research (DAR) during the release of corresponding green gram cultivars. The yield obtained from the previous demonstration trial investigated at the study area was considered to be a demonstration plot yield [13] while the actual yield of green gram recorded from respondents was reflected to be farmers’ actual yield.

III. RESULTS AND DISCUSSION

A. Cultivated Area and Field Experience

The major pulse grown in the study area was green gram (*Vigna radiata* L.). In Fig. 3, it was observed that 35 to 53% of the respondents cultivated green grams ranging from 0.8 to 7.0 ha from 2016 to 2018 crop seasons. Regarding the pulses cultivation experience, 58% of the respondent has experienced 21-30 years in pulses cultivation whereas 21% each has 10-20 years and 31-40 years, respectively in Fig. 4.

B. Seed Source and Cultivar Use

Figure 5 reveals that most of the respondents (92-94%) in Nankale Village, Thonegwa Township applied their seed and rarely used dealer seed and research station seed in each crop season. Due to the high price of seed in sowing time, the farmers in the study area wanted to store their seed for the next crop season. This pointed out that the necessity of a quality seed multiplication program should be undertaken with cooperative farmers by the Department of Agriculture (DoA).

In the 2016 and 2018 crop seasons, the green gram variety use in Nankale Village, Thonegwa Township was Yezin-1, Yezin-9, Yezin-11, and Yezin-14 while only two varieties Yezin-1 and Yezin-9 sown in 2017 Fig. 6. It was found that most of the farmers desired to use Yezin-1 and Yezin-9 more than the other two varieties, Yezin-11 and Yezin-14. The reasons why they did not like those varieties were short plant type with lesser number of pods per plant of Yezin-11 and easily bursting of the pods of Yezin-14 during pod picking time.
The gradual decline in the use of green gram variety Yezin-1 however somewhat increase in Yezin-9 were observed from 2016 to 2018 Fig. 6. It may more prefer the longer pod shape and bigger seed size of Yezin-9 among other green gram varieties. The suitable green gram varieties recommended by DoA is Yezin-1 for the study area.

C. Spatial Analysis on Variation of Yield Gap I of Green Gram

The potential yield of relevant green gram cultivar obtained from DAR was in the range of 1.37 to 2.02 ton ha\(^{-1}\). Spatial distribution of farmers’ actual yield in three consecutive years has displayed in Fig. 7. In this figure, the farmers’ actual yield achieved by the respondents was ranging from 0.20 to 2.00 ton ha\(^{-1}\) in 2016, 0.20 to 1.50 ton ha\(^{-1}\) in 2017 and 1.20 to 1.70 ton ha\(^{-1}\) in 2018 crop seasons respectively.

The yield gap I is the difference between potential yield and farmers’ actual yield of green gram. The spatial variation of yield gap I in the study area has shown in Fig. 8. The yield gap I with the range of 0.15-1.30 ton ha\(^{-1}\) was detected in 2016, 0.15-1.50 ton ha\(^{-1}\) in 2017 and 0.51-0.90 ton ha\(^{-1}\) in 2018 crop seasons. It indicates that the variation of yield gap occurs not only in spatial scales but also in time series.

D. Spatial Analysis on Variation of Yield Gap II of Green Gram

Fig. 9 presents the spatial analysis on the variation of yield gap II, which is the difference between demonstration plot yield and farmers’ actual yield of green gram. The demonstration plot yield of related green gram cultivar investigated by the previous demonstration trial at the study area was ranging from 1.53 to 1.65 ton ha\(^{-1}\) [13]. The similar trend to the yield gap I, the broader yield gap II was also observed in comparing three consecutive years, the wider yield gap I was noticed in 2016 and 2017 while the narrower in 2018. The large difference between potential yield and farmers’ actual yield of green gram has observed in the year 2016 and 2017. Perhaps the lesser farmers’ actual yield was associated with the various factors including physical, biological, technical, socio-economic, and institutional constraints. Yield gaps may be caused by technical insufficiencies but also by economic considerations [14].

Comparing three consecutive years, the wider yield gap I was noticed in 2016 and 2017 while the narrower in 2018. The large difference between potential yield and farmers’ actual yield of green gram has observed in the year 2016 and 2017. Perhaps the lesser farmers’ actual yield was associated with the various factors including physical, biological, technical, socio-economic, and institutional constraints. Yield gaps may be caused by technical insufficiencies but also by economic considerations [14].
2016 and 2017 crop seasons with the yield gap of 0.36-0.75 ton ha\(^{-1}\) in comparison with the yield gap of 0.18-0.55 ton ha\(^{-1}\) in 2018.

Figure 8. Spatial analysis on variation of yield gap I of green gram in Nankale Village, Thonegwa Township

Figure 9. Spatial analysis on variation of yield gap II of green gram in Nankale Village, Thonegwa Township

In the present study, the yield gap differs widely from season to season and even from location to location within a field. Thus, the variation of yield gaps exists across the study area and time series as well. The narrower yield gap I and II in 2018 crop season may assume the factors such as environmental conditions, crop management practices and the incentive market price of a green gram would favor the increase production of green gram. The wider yield gap might be due to differences in crop management practices at research stations and farmer fields Table 1 [13].

The technology gap represents the difference between the potential yield and the demonstration yield. The extension gap denotes the difference between demonstration plot yield and farmers’ actual yield. Yields, technology gap, and extension gap of a green gram for the study area have stated in Table 2. The technology gap was ranging from 0.19 to 0.30 ton ha\(^{-1}\), whereas the extension gap was from 0.27 to 0.52 ton ha\(^{-1}\). The total yield gap for three consecutive years was within the range of 0.50 to 0.71 ton ha\(^{-1}\). The narrower total yield gap observed in 2018 might be assumed that the improvement of crop management practices and technology dissemination by DoA.

Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield (ton ha(^{-1}))</th>
<th>Technology gap (ton ha(^{-1}))</th>
<th>Extension gap (ton ha(^{-1}))</th>
<th>Total yield gap (ton ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1.84</td>
<td>0.30</td>
<td>0.41</td>
<td>0.71</td>
</tr>
<tr>
<td>2017</td>
<td>1.72</td>
<td>0.19</td>
<td>0.52</td>
<td>0.71</td>
</tr>
<tr>
<td>2018</td>
<td>1.77</td>
<td>0.24</td>
<td>0.27</td>
<td>0.50</td>
</tr>
</tbody>
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Source: Khin Mar Oo et al., 2019

**E. Technology Gap and Extension Gap**
IV. CONCLUSION

The results obtained by the projection of yield gap maps indicated that the yield gap differs widely from location to location within a field and time series as well. Therefore, a spatial variation on the yield gap using GIS has responsible for a considerable scope to improve the productivity of green gram through innovative research interventions with appropriate policy support. Besides, the causes of the yield gaps might be due to differences in crop growing environments and crop management practices between the research stations and the farmer fields. Moreover, both technology and extension gap occurs for green gram production in 2016 and 2017. It is essential to understand the farmers’ actual constraints, encourage the adoption of good agriculture practices through adequate supplies of inputs and farm credit and incentive market access and strengthen the research and extension to narrow down the yield gaps.

ACKNOWLEDGMENT

The authors would like to thank the generous financial and technical training support of the Japan International Cooperation Agency (JICA) Project for Capacity Development of Yezin Agricultural University. We also gratefully acknowledge Chief Advisor Professor Dr. Yoshimura and Dr. Kazuo Watanabe for their intellectual support and valuable involvement in this study. We are also appreciative of the authorized persons from the Department of Agriculture (DoA) and the Department of Agricultural Land Management and Statistics (DoALMS) for data provision.

REFERENCES


Abstract—Dormancy is presented as a physiological state in which germination is blocked by a seed-related mechanism, as opposed to lack of germination due to inadequate environmental conditions. Breaking seed dormancy helps to increase uniformity in germination and shorten the time required for seeds to germinate. Therefore, the objective of the study was to evaluate the effect of different packaging materials and heat treatments on viability and dormancy of sesame seeds under different storage conditions. This experiment was carried out at the laboratory of Department of Agronomy, Yezin Agricultural University from August 2016 to March 2017. The tested variety was black sesame seeds (Samonnet) which were collected from Seed Production Farm, Department of Agriculture, Pwintphyu Township, Magway Region. A randomized complete block (RCB) design was laid out in $3 \times 3 \times 5$ factorial experiment with three replications. The treatments were: 3 heat treatments (non-treated, 60°C for 10 minutes and 50°C for 20 minutes), 3 packaging materials (woven polypropylene bag, IRRI super-bag and metal bin), and 5 storage durations (initial, 2, 4, 6 and 8-month storage) under cold storage ($10^\circ$C and 45% RH) condition. The recorded data were germination percentage, germination index, seedling vigour index I and II. All data were analyzed by using Statistix (version 8.0) and comparison of treatment means was done by using LSD test at 5 % level of significance. There were significant differences among heat treatments, packaging materials and storage durations in term of germination percentage, germination index, seedling vigor index I and II. The treatment of 50°C for 20 minutes gave the highest germination percentage, germination index, seedling vigor index I and II and lowest of these were observed in non-treated seed in both environments. Seeds stored in woven polypropylene bag showed the maximum dormancy release with highest germination percentage, germination index, seedling vigor index I and II while no significant difference was found between super bag and metal bin because of air tight storage. The increasing germination percentage as the storage duration increased indicated the release of dormancy during storage. Increasing trends of germination index, seedling vigor index I and II as the storage duration increased were observed under cold storage. Although increasing trend for germination was found during storage period, the lowest germination was occurred in four-month after storage because of reaching equilibrium moisture content, and highest germination percentage and germination index, seedling vigor index I and II were found in eight-month storage. The seeds stored in woven polypropylene bag and treated with 50°C for 20 minutes give the highest germination percentage, germination index, seedling vigor index I and II at 8-month storage. This study revealed the optimum storage condition for the farmers who want to stored their sesame seeds for next season with high viability and germinability.

Keywords—sesame, seed quality, heat treatment, packaging materials, storage environment

I. INTRODUCTION

Dormancy is presented as a physiological state in which germination is blocked by a seed-related mechanism, as opposed to lack of germination due to inadequate environmental conditions. This state can be induced by environmental and/or maternal effects during seed development or after dispersal, and can consist of many different mechanisms, which arrest continued development at any one of the steps necessary for seed germination (imbibition, activation of metabolism, visible growth) [1].

Effect of Heat Treatments, Packaging Materials and Storage Duration on Dormancy of Sesame Seeds (*Sesamum Indicum* L.) Under Cold Storage Condition

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Breaking seed dormancy helps to increase uniformity in germination and shorten the time required for seeds to germinate. Just as there are different types of dormancies, there are different methods to overcome it [2]. Physical dormancy may be easily overcome by making the seed coat permeable by use of heat [3]. However, to break physiological dormancy the seeds must be exposed to chemical treatments such as gibberelllic acids [4]. Acid scarification is one of the commonly used methods in breaking dormancy [5]. Temperature and relative humidity are important storage conditions that affect the rate of seed dormancy loss as well as seed viability loss in a number of species [6]. Temperature is a well-known environmental factor that affects the rate of dry after-ripening [7]. The application of heat during the dry after-ripening period typically accelerates dormancy loss, whereas dry storage at low temperatures tends to slow down or inhibit dormancy loss [8]. Temperature treatments of 60 °C for 15 minutes significantly increased germination of sunflower seeds over control by desiccating waxes, weakening the impermeable layer, and allowing water to be absorbed [9]. Mechanical scarification is tedious and time-consuming while heat treatments have greater potential for commercial application and have been found to be effective in improving both germination rate and capacity of okra [10]. Therefore, the objective of the study was to evaluate the effect of different packaging materials and heat treatments on viability and dormancy in sesame seeds under different storage conditions.

II. MATERIALS AND METHODS
The study was conducted at the Laboratory of Department of Agronomy, Yezin Agricultural University from August 2016 to September 2017.

Sample preparation and treatments
The tested variety was black sesame seeds (Samonnet) which were collected from Seed Production Farm, Department of Agriculture, Pwintphyu Township, Magway Region. The samples were taken out in two-month interval, then heat treatments were carried out and tested viability of seeds. The seed lots were treated by different temperature, at 60 °C for 10 minutes and at 50 °C for 20 minutes, in an oven to determine the seed dormancy release. A randomized complete block (RCB) design was laid out in $3 \times 3 \times 5$ factorial experiment with three replications. The treatments were: 3 heat treatments (non-treated, 60 °C for 10 minutes and 50 °C for 20 minutes), 3 packaging materials (woven polypropylene bag, IRRI super-bag and metal bin), and 5 storage durations (initial, 2, 4, 6 and 8-month storage) under cold storage (10°C and 45% RH) conditions.

Data collection and statistical analysis
The recorded data were: germination percentage, germination index, seedling vigour index I and II.

Germination percentage
The germination test was performed using the top paper method. Four replications of one hundred seeds were used per treatment which were randomly distributed on the wet filter paper in petri dishes 9 cm in diameter and placed into an incubator set to a constant temperature of 25°C throughout the testing period. The germinated seeds (2 mm radicle elongation) were counted daily up to the tenth day to calculate germination rate [11].

\[
\text{Germination percentage (\%) = } \frac{\text{no. of seed germinated}}{\text{no. of seed tested}} \times 100
\]  

Germination index
The germination index was computed by using the following formula [12]:

\[
\text{G.I.} = \frac{N_1}{D_1} + \frac{N_2}{D_2} + \ldots + \frac{N_n}{D_n}
\]

where,

- $N_1, N_2, \ldots, N_n =$ Number of seedlings on day 1st, 2nd and nth day after sowing
- $D_1, D_2, \ldots, D_n =$ Number of days after sowing

Seedling vigour index
This was calculated by determining the germination percentage and seedling length of the same seed lot. The seedlings were grown in between rolled towel paper method. Fifty seeds each in four replications were germinated in the moist towel papers in such a way that the micropyles were oriented towards bottom to avoid root twisting. The rolled towel papers were kept in the incubator maintained at a temperature of 25°C. After 10 days, towel papers were removed and five normal seedlings were randomly selected, their lengths was measured and mean seedling length was calculated. For dry weight determination, the seedlings were removed and dried in an oven at 100°C temperature for 24 hours, then cooled and
weighed. Seed vigour index was calculated by multiplying germination percentage and seedling length (mm) or seedling dry weight (g). The seed lot showing the higher seed vigour index was considered to be more vigorous [13].

Vigour index -I = Germination (%) × total dry weight of seedling (g)
Vigour index -II = Germination (%) × Seedling length (mm)

All data were analyzed by using Statistix (version 8.0) and comparison of treatment means was done by using LSD test at 5 % level of significance.

III. RESULTS AND DISCUSSION

A. Germination percentage

The effect of heat treatment on the dormancy break was significantly different (Table 1). The dormancy release was lowest in non-treated seed with 25.611% of germination, while higher dormancy break was found in 60°C treated seed with 64.789% of germination. The highest dormancy loss was resulted from seeds treated with 50°C by 74% germination. The dry heat treatment at 50°C for 24 hr gave significant results followed by untreated seed as compared with other heating and alternate chilling treatments in tomato [14]. The differences of dormancy release of sesame among packaging materials was significant (Table 1). Seeds stored in woven polypropylene bag showed the maximum dormancy loss with 65.35% germination, which was significantly higher than that of superbag (49.45%) and metal bin (49.6%). The effect of storage durations on the dormancy break of sesame was statistically different (Table 1). Although increasing trend for germination was found during storage period, the lowest germination (35.574%) was occurred in four-month after storage, it may be due to low moisture content of seed, and highest germination (76.935%) was found in eight-month. Environmental factors, especially the temperature of storage, have considerable effects on the length and rate of seed ripening; it means they break dormancy [15]. Low temperature (10°C) was responsible for preventing tanglehead seed after ripening [16]. Low storage temperatures are known to prevent or delay seed dormancy loss of dry-stored seeds [17], [18].

The temperature at which dormancy loss is prevented is species-specific.

The combination effect of temperature treatments, packaging materials and storage durations was also significant (Fig. 1). For no temperature treatment seed, the initial germination significantly increased with the advancement of storage duration in woven polypropylene bag. However, the germination was stable until four-month in superbag and metal bin, then increased and maximum germination was found in eight-month in each container.

The germination of seeds stored in woven polypropylene bag was significantly higher than other packages. For seeds of 60°C treatment, the maximum germination was resulted in six-month and eight-month after storage in all containers. However, the germination of seeds decreased in four-month after storage, which exhibited the lowest value in superbag and metal bin but not significant in woven polypropylene bag.

Dry heat treatment could stimulate seed germination of flamboyant, but it was not the maximum levels. Dry heat stimulated the damage of epidermal waxy cuticle, and induced crack on the testa; but the treatment did not produce the cracking through the macro-sclereid layer [18], so the impermeability of seed coat persists. The seeds germination of Cassia (Caesalpinioideae) could not be stimulated by dry heat methods because cracks that occur in the region of the seed coat was not at the point of water entry [19].

However, the different result of dry heat effect on seed dormancy was observed in other seeds, which is Swartzia madagascariensis (Leguminaceae) and Tamarindus indica [20], [21]. Dry heat caused a dormancy breaking on both seeds, and it was suggested that the structural difference among the seeds caused different respond due to their capability to germination. In 50°C seed treatment, the germination of seed at initial storage after treatment was not different with that of stored seed. Thus, this treatment was the most effective to break the seed dormancy for before storage seeds and seeds under cold storage (Fig. 1). The 60°C treatment cannot give fully dormancy in early storage period.
Although the seeds stored in superbag for eight-month under ambient condition showed deterioration after 50°C heat treatment, this result was not found in seed after heat treatment under cold storage. It can be suggested that the cold storage can maintain viability of seed in superbag for longer duration than ambient storage due to low temperature and relative humidity control. Relative humidity also plays a role in both the loss of seed dormancy and seed viability through seed moisture content. Together with temperature, seed moisture content influences dry after-ripening rates [22], [23]. Studies conducted on a number of species indicate that a specific range of seed moisture content is required for accelerated dry after-ripening at high temperatures [6]. Above or below this species-specific critical moisture threshold value, dormancy loss from dry after-ripening can be inhibited or delayed [7], [24]. Aside from seed dormancy loss, both temperature and seed moisture content can also impact the viability of dry-stored seeds.

Storage at low temperatures and low seed moisture content generally maintains seed viability [21]. In contrast, storage at high temperatures and high seed moisture content results in decreased seed viability as a result of accelerated aging [25].

B. Germination index

The mean germination index affected by temperature treatment for dormancy break was significantly different (Table 1). It was the same results with germination percent by indicating the highest germination index (19.093) in 50°C treatment followed by (16.597) in 60°C treatment and (6.612) in non-treatment. The effect of packaging materials on germination index of sesame seeds under cold storage was different. Woven polypropylene bag resulted the highest germination index (16.844), which was significantly higher than (12.705) in superbag and (12.753) in metal bin. The significantly different of germination index was observed among the effect of storage durations.

The germination index of seeds after temperature treatment increased with the time of storage except in four-month, 12.987 in initial storage, 13.445 in two-month, 8.97 in four-month, 16.368 in six-month, and highest value appeared in eight-month after storage.

It was similar with the germination percent; therefore, the germination rate was positively related with the germination percent. The combination effect of temperature treatments, packaging materials and storage durations was also significant (Table1). The germination index of non-heat treated seeds was significantly increased in two-month in woven polypropylene bag, however, it remained in stable until four-month after storage in superbag and metal bin. Although the maximum value appeared in eight-month after storage in all containers, woven polypropylene bag showed the statistically higher value than other two storage containers (Fig. 2). The germination index of seeds of 60°C treatment showed the maximum value in two-month after storage, which was similar with the value of eight-month and significantly higher than that of other analyzing periods in woven polypropylene bag. In superbag and metal bin, the maximum germination index was observed in six-month which differed with that of initial storage and four-month after storage.

After 50°C treatment, the highest germination index was resulted in before storage seeds, which was significantly higher than stored seeds. In both temperature treatments, the germination index of treated seeds of superbag and metal bin significantly dropped down to the lowest level in four-month after storage (Fig. 2). The heat treatment 50°C gave the best results not only for germination but also for germination rate of after harvest seeds.

C. Seedling vigour index I

The effect of different temperature treatments on the seedling vigour index I of sesame under cold storage was significantly different (Table 1). The 50°C temperature treatment gave the highest seedling vigour index I (0.126) followed by 60°C treatment (0.107) and non-temperature treatment (0.043). Seed treatments had a significant effect on seedlings dry weight. Maximum seedlings dry weight was recorded in seed priming with dry heat treatment 50°C followed by untreated seeds, while minimum seedling dry weight was achieved in seeds treated with Heating + Chilling + Heating for 24hr [14]. The differences of seedling vigour index I was found among packaging materials. The seedling vigour index I obtained in woven polypropylene bag (0.111) was statistically higher than that of superbag (0.083) and metal bin (0.083).
The effect of storage durations on the seedling vigour index I was significantly different with the ANOVA result of (Pr<0.0001). The seedling vigour index I occurred in initial storage, two-month and six-month after storage were similar statistically. Although decreased value was occurred in four-month storage, the maximum seedling vigour index I appeared in eight-month after storage.

The interaction was observed between the effect of temperature treatments and packaging materials, between temperature treatments and storage durations, and between packaging materials and storage durations. The combination effect of temperature treatments, packaging materials and storage durations was also significant (Table 1).

In non-temperature treatment, the seedling vigour index I increased during storage and highest seedling vigour index I was obtained in eight-month after storage in all packaging materials.

However, the seedling vigour index I did not change until four-month after storage in superbag, and six-month storage in metal bin, respectively. In 60˚C treatment, the highest seedling vigour index I that produced in two-month storage in woven polypropylene bag was not different from that in four-month and six-month storage.

In superbag, seedling vigour index was similar in all treatments except in four-month storage, which was significantly lower than others. Furthermore, the significantly lower value was obtained in this period in metal bin. In 50˚C treatment, the maximum seedling vigour index I that produced in two-month storage in woven polypropylene bag was not different from that in four-month and six-month storage.

D. Seedling vigour index II

The effect of temperature treatment was significantly different on the seedling vigour index II of sesame stored under cold condition (Table 2). The maximum seedling vigour index (683.84) was found in 50˚C treatment followed by 60˚C treated seeds (505.24) and non-treated seeds (179.21). When the root length of the treated black gram was compared, promotion in the growth was observed in 10 and 20 min. duration. The growth was much pronounced in seeds that were given heat stress for 20 min. for 50˚C, followed by 10 min. duration [25].
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination (%)</th>
<th>Germination index</th>
<th>Seedling vigour index I</th>
<th>Seedling vigour index II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (T)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No treatment</td>
<td>25.611 c</td>
<td>6.612 c</td>
<td>0.043 c</td>
<td>179.210 c</td>
</tr>
<tr>
<td>60 °C</td>
<td>64.789 b</td>
<td>16.597 b</td>
<td>0.107 b</td>
<td>505.240 b</td>
</tr>
<tr>
<td>50 °C</td>
<td>74.000 a</td>
<td>19.093 a</td>
<td>0.126 a</td>
<td>683.840 a</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>2.468</td>
<td>0.657</td>
<td>0.007</td>
<td>33.754</td>
</tr>
<tr>
<td>Packaging material (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woven polypropylene bag</td>
<td>65.350 a</td>
<td>16.844 a</td>
<td>0.111 a</td>
<td>531.360 a</td>
</tr>
<tr>
<td>Superbag</td>
<td>49.450 b</td>
<td>12.705 b</td>
<td>0.083 b</td>
<td>434.380 b</td>
</tr>
<tr>
<td>Metal bin</td>
<td>49.600 b</td>
<td>12.753 b</td>
<td>0.083 b</td>
<td>402.550 b</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>2.468</td>
<td>0.657</td>
<td>0.007</td>
<td>33.754</td>
</tr>
<tr>
<td>Storage duration (D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial storage</td>
<td>45.333 d</td>
<td>12.987 c</td>
<td>0.093 b</td>
<td>424.200 c</td>
</tr>
<tr>
<td>2-month</td>
<td>49.759 c</td>
<td>13.445 c</td>
<td>0.095 b</td>
<td>368.580 d</td>
</tr>
<tr>
<td>4-month</td>
<td>35.574 e</td>
<td>8.970 d</td>
<td>0.058 c</td>
<td>295.440 e</td>
</tr>
<tr>
<td>6-month</td>
<td>66.398 b</td>
<td>16.368 b</td>
<td>0.093 b</td>
<td>526.410 b</td>
</tr>
<tr>
<td>8-month</td>
<td>76.935 a</td>
<td>18.733 a</td>
<td>0.122 a</td>
<td>665.850 a</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>3.186</td>
<td>0.848</td>
<td>0.009</td>
<td>43.576</td>
</tr>
<tr>
<td>Pr &gt; F</td>
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<td>&lt;0.0001</td>
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</tr>
<tr>
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</tr>
<tr>
<td>D</td>
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</tr>
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</tr>
<tr>
<td>P x D</td>
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<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>T x P x D</td>
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<td>0.0062</td>
<td>0.0013</td>
</tr>
<tr>
<td>CV (%)</td>
<td>10.75</td>
<td>11.12</td>
<td>18.74</td>
<td>17.66</td>
</tr>
</tbody>
</table>

In each column, means having a common letter are not significantly different at 5 % LSD.
Figure 1. Combination effect of heat treatments, packaging materials and storage durations on germination percentage of sesame under cold storage

Figure 2. Combination effect of heat treatments, packaging materials and storage durations on germination index of sesame under cold storage
Figure 3. Combination effect of heat treatments, packaging materials and storage durations on seedling vigour index I of sesame under cold storage.

Figure 4. Combination effect of heat treatments, packaging materials and storage durations on seedling vigour index II of sesame under cold storage.
IV. CONCLUSION AND RECOMMENDATION

Regarding dormancy breaking of black sesame, the different temperature treatments (no treatment, 60˚C and 50˚C), packaging materials and storage durations was significantly affected on the dormancy release and viability of sesame under ambient storage in laboratory and cold storage. The effect of heat treatment with 50˚C showed the higher dormancy release by indicating higher germination percentage, germination index, seedling vigour index I and seedling vigour index II under cold storage of laboratory experiment. Woven polypropylene bag is the most suitable packaging material for storing od black sesame seed in terms of seed viability. Generally, the airtight storage can maintain viability of the seeds and quality of grain in many other crops. This finding pointed out the careful consideration of introduction of airtight storage to maintain the viability of seeds for sesame because it might be species-specific. Further studies are needed to conduct the validity of the finding. The rate of dormancy release of seeds under cold storage was slower than that of ambient storage. Because the duration of dormancy could be increased by lowering the temperature. Among dormancy breaking methods, the temperature treatment was cheaper and easier to conduct than other chemical treatments, thus, farmers and seed companies should be used this method to overcome the dormancy problem of black sesame.

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REFERENCES


Genetic Diversity and Population Structure Analysis of some Myanmar Mango (Mangifera spp. L.) Accessions using Simple Sequence Repeat Markers

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Abstract—Mango (Mangifera indica L.) is a favorite fruit in the world especially in the Indo-Pakistan sub-continent. It is a rich source of vitamins, β-carotene, minerals, and antioxidants. Mango is known as “the king of fruits” for its taste and flavor. It is native to Southern Asia, especially Burma and eastern India. Since Myanmar is one of the origins of mango. A wide genetic diversity may be found in Myanmar accordingly. Some phenotypic characterizations of Myanmar mangoes have been done but the information of genetic assessments is still limited. Therefore, the present study intended to make genetic assessments of some Myanmar mango accessions collected from different geographical regions using Simple Sequence Repeat markers (SSR). This study was carried out at the laboratory of the Department of Horticulture, Yezin Agricultural University (YAU). Fully grown mango leaf samples were used to extract total genomic DNA. The DNAs were extracted by modified CTAB method and checked purity and concentration with nano spectrophotometer. The sample DNAs were amplified using five pairs of SSR primers. One SSR (MSSR80) revealed as monomorphic marker among tested 94 mango accessions. The data were analysed using Structure 2.2 and Phylip software package. The phylogenetic tree was constructed by MEGA6 software program. According to population structure analysis, 94 mango accessions could be distinguished into three populations though four accessions were assessed as admixtures. Four accessions; Parr Phyu Thee (Kinda), Pann Bin Ga Lar (Kalar Gyi), Pyo Ta Ngon (Kinda) and Yin Kwae (Kinda) stood as admixtures. No correlation between the geographical distribution and population structure of mango was found. One accession, Sein Ta Lone (Pan Swae) stood as an outstanding accession in phylogenetic tree constructed by Phylip program although it was grouped together with Shwe Myo Sae, Ma Chit Su and others in population structure analysis. It was hard to say discrete population. Almost all accessions of a population possessed some alleles from other populations. It implied that cross pollination nature plays an important role in mango gene pool. Accordingly, wider genetic diversity would be expected among mango population in Myanmar.

I. INTRODUCTION

Mango (Mangifera indica L.) is a favorite fruit in the world especially in the Indo-Pakistan sub-continent. It is a rich source of vitamins, β-carotene, minerals, and antioxidants. Mango is known as “the king of fruits” for its taste and flavor. It natives to Southern Asia, especially Burma and eastern India. Hundreds of cultivated accessions have been introduced to other warm regions of the world. It is a large fruit-tree, capable of growing to a height of about 100 feet and trunk of more than 12 feet. Mango is now grown throughout the sub-tropical and tropical world in 99 countries with a total fruit production of 34.3 million tons of fruit per annum [1]. The Asia produced the majority (76%) of world mango production then followed by Americas (12%), and Africa (11.8%) which are the second and third largest producers. India is the largest producer, growing over 18 million tons (MT) primarily for domestic consumption. China produced (4.5 MT), Thailand (3.1 MT), Indonesia (2.6 MT), and Mexico (1.9 MT), respectively [1]. Although, Mexico is fifth in production it is first in export to the USA, which is 43% of the global import market [2].

Mangifera germplasm needs to be evaluated and conserved because the potential presence of
valuable resistance against different diseases and/or tolerance to adverse environment for future mango variety improvement practices. Phenotypic characterization of some Myanmar mangoes has been found to some extent [3]. Characterization of mango germplasm based on morphological features is inefficient. Information of genetic assessments of Myanmar mangoes is still limited. So, genetic assessment of Myanmar mango accession is in a dire need.

Simple sequence repeats (SSRs) are the markers of choice for crop improvement in many species because they are reliable and easy to score [4, 5]. The SSR markers are co-dominant, multi-allelic, and require only a small amount of DNA for scoring. The characterization of close siblings by SSR markers is also straightforward because this analytical method simplifies breed confirmation [6, 7]. Moreover, SSRs present a higher level of polymorphism and greater information content than AFLPs and RAPDs [8]. Owing to these considerations, and because they are Mendelian inherited with high reproducibility and reliability, the use of SSRs has been increasing [9].

For these reasons SSR markers were used with the following objectives:

1. To access the population structure of selected Myanmar mango accessions
2. To support information on genetic diversity of Myanmar mango accessions.

II. MATERIALS AND METHODS

A. Plant Materials

Newly mature leaves sample from 94 accessions of mango were collected from different locations of Myanmar (Table 1, Fig. 1).

<table>
<thead>
<tr>
<th>Acc No</th>
<th>Mango *Org. No</th>
<th>Mango *Org.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC01</td>
<td>Sein Ta Lone (Pann Swae) Kyaunk</td>
<td>ACC31</td>
</tr>
<tr>
<td>ACC02</td>
<td>Swe Myo Sue Kyaunk</td>
<td>ACC32</td>
</tr>
<tr>
<td>ACC03</td>
<td>Ma Chit Su Myinn</td>
<td>ACC33</td>
</tr>
<tr>
<td>ACC04</td>
<td>Shwe Ta Ngone Pathengyi</td>
<td>ACC34</td>
</tr>
<tr>
<td>ACC05</td>
<td>Shwe Phu Lar Pathengyi</td>
<td>ACC35</td>
</tr>
<tr>
<td>ACC06</td>
<td>Sate Noh Thee Kyaunk</td>
<td>ACC36</td>
</tr>
<tr>
<td>ACC07</td>
<td>Ma Naw Yezin</td>
<td>ACC37</td>
</tr>
<tr>
<td>ACC08</td>
<td>Thone Hnii Thi Mada</td>
<td>ACC38</td>
</tr>
<tr>
<td>ACC09</td>
<td>Pann Swae Pathengyi</td>
<td>ACC39</td>
</tr>
<tr>
<td>ACC10</td>
<td>Shwe Loat Sue Pathengyi</td>
<td>ACC40</td>
</tr>
<tr>
<td>ACC11</td>
<td>Thay Chate Kyaunk</td>
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<td>ACC12</td>
<td>Tha Yet Thu Khwar Kyaunk</td>
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<td>ACC13</td>
<td>Thone Lone Ta Daung Mada</td>
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<tr>
<td>ACC14</td>
<td>Ma Chit Su (Madyar) Mada</td>
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<td>ACC15</td>
<td>Nat Tae (Pyet) Kyaunk</td>
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<td>ACC16</td>
<td>Myaung Giang Yezin</td>
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<td>ACC17</td>
<td>Daw Thar Phyu Kyaunk</td>
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<td>Yin Kwa (Madyar) Mada</td>
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<td>ACC21</td>
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<td>ACC24</td>
<td>Man Hia Htal Magway</td>
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<tr>
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<td>Yin Kwar (Khan Tat Kone) Kyaunk</td>
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<tr>
<td>ACC29</td>
<td>Tan Chate Myint</td>
<td>ACC59</td>
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<tr>
<td>ACC30</td>
<td>Warso Pann Swar (Lon Kyaw) Kyaunk</td>
<td>ACC60</td>
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</tbody>
</table>
--- | --- | --- | --- | --- | ---
ACC61 | Bin GaLar | MadaY | ACC78 | Pa Da Myar | Horti, YAU
ACC62 | Taw Kyaung Twin Thee (Thay) | Patheingyi | ACC79 | R2E2 | Horti, YAU
ACC63 | Sa Lin Net Tae | Myitno | ACC80 | Ma Chit Su | Horti, YAU
ACC64 | H诸葛亮 Taw | Patheingyi | ACC81 | Nyu Ta Nge (Kiau Da) | Kinda, YAU
ACC65 | Lay Daunt Thee | Manaung | ACC82 | Nang Taw | Kinda, YAU
ACC66 | Mya Hin Thar | Thay | ACC83 | Taw Kyaung Twin Thee (Thay) | Patheingyi
ACC67 | Taw Kyaung Twin Thee | Patheingyi | ACC84 | Dr Win Naing | DAR
ACC68 | Sa Lin Net Tae | Myitno | ACC85 | Ma Chit Su | Horti, YAU
ACC69 | U Yaw Wa Ta | Myitno | ACC86 | Aung Din | Kinda, YAU
ACC70 | Wbaar Pann | Mothe (More Dac) | ACC87 | Kyaik | America
ACC71 | Yin Kwae | Aungbin | ACC88 | Thailan | (Kin Da)
ACC72 | Pann Bin GaLar | Kalar | ACC89 | Tha Yet Phyu | YAU
ACC73 | Nat Tho | Myitno | ACC90 | Ma Chit Su | (Shwe Li -1)
ACC74 | HanThar -1 | Kyaik | ACC91 | Ma Chit Su | (Shwe Li -2)
ACC75 | KinDar | Myitno | ACC92 | Aung | Dar
ACC76 | Kyaik Sein | Patheingyi | ACC93 | Aung \( \text{Shwe Li}-3 \) | YAU
ACC77 | Sein Ta Lone (Horti, YAU) | YAU | ACC94 | Ma Chit Su | (Shwe Li -4)

*Org: origin

**TABLE 1. LIST OF MICROSATELLITE PRIMERS USED IN THIS STUDY**

<table>
<thead>
<tr>
<th>No.</th>
<th>SSR</th>
<th>Sequence</th>
<th>T_a (°C)</th>
<th>Morp</th>
<th>Allele size (bp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MSSR-28</td>
<td>F: GACCCAACAAATCCACGCA</td>
<td>52</td>
<td>Poly</td>
<td>210-220</td>
</tr>
<tr>
<td>2</td>
<td>MSSR-28</td>
<td>R: ACTGTGCAAACACCAAG</td>
<td>52</td>
<td>Poly</td>
<td>110-130</td>
</tr>
<tr>
<td>3</td>
<td>MSSR-28</td>
<td>F: CCTGTTGTTTCATGCTCTAA</td>
<td>55</td>
<td>Poly</td>
<td>50-70</td>
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<tr>
<td>4</td>
<td>MSSR-28</td>
<td>R: GGACGCCACACACACACAC</td>
<td>55</td>
<td>Poly</td>
<td>120-140</td>
</tr>
<tr>
<td>5</td>
<td>MSSR-28</td>
<td>F: TGTATATACGAGCTGGTCTTC</td>
<td>55</td>
<td>Moto</td>
<td>-</td>
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<tr>
<td>6</td>
<td>MSSR-28</td>
<td>R: CCCCATACACACACACAC</td>
<td>55</td>
<td>Poly</td>
<td>150-180</td>
</tr>
<tr>
<td>7</td>
<td>MSSR-28</td>
<td>F: GCCCGATGTCATTGCTG</td>
<td>55</td>
<td>Poly</td>
<td>120-140</td>
</tr>
<tr>
<td>8</td>
<td>MSSR-28</td>
<td>R: ATTTCCACATTTGTGT</td>
<td>55</td>
<td>Poly</td>
<td>150-180</td>
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<tr>
<td>9</td>
<td>MSSR-28</td>
<td>F: CCGCGGCTTAAATACCTCTA</td>
<td>55</td>
<td>Poly</td>
<td>150-180</td>
</tr>
<tr>
<td>10</td>
<td>MSSR-28</td>
<td>R: ATCCGCTTAAACAGACAC</td>
<td>55</td>
<td>Poly</td>
<td>150-180</td>
</tr>
</tbody>
</table>

T_a: annealing temperature, Morp: morphism

**C. Methods**

Experiment was carried out at the laboratory of Department of Horticulture in ELB-2, YAU. We used modified CTAB method for DNA extraction (Fig. 2, 3).

The purity of DNA was determined by estimating the ratio of absorbance at 260nm to that at 280nm \( (A_{260}/A_{280}) \).

- **PCR amplification**

Five sets of SSR primers were used for DNA amplification. PCR reaction mixture (5μl) contained 0.5μl of 10x reactions buffer, 0.5μl of dNTPs mix, 0.25 μl of Taq DNA polymerase and 0.5μl each of forward and reverse primers. The reaction volume was adjusted with double distilled water (ddw). The amplification was carried out in a Pico-real thermal cycler using a program configured with a pre-denaturation step of 3 minutes at 94°C followed by 30 circles of (30 seconds at 94°C denature, 45 seconds at appropriate annealing temperature (55°C) and 45 second at 72°C extension). The program ended with one final extension at 72°C for 1minute).

**Fig. 1. The distribution of Mango accessions used in this study and the color imply inferred population of population structure analysis.**

**Fig. 2. DNA extraction, (A) Collecting mango leaf sample, (B) Cleaning the sample with 70% ethanol, (C) Grinding the sample (2 g) with 2000 μl CTAB, (D) Soaking the sample tube (2mm) in 65 °C hot water bath with shake for 1 hr, (E) Add 500 μl of PCI and shake 15 min, (F) Centrifuge 8000 rpm for 15 min, (G) Tube after centrifuge**
Fig. 3. DNA extraction continued, (A) Add 500 μl of 99% ethanol and shake for 10 min, (B) Centrifuge 8000 rpm for 10 min, (C) Remove supernatant and add 500 μl of 70% ethanol, (D) Centrifuge 8000 rpm for 5 min, (E) Remove supernatant and Drying the DNA sample over-night, (F) Add 100 μl TE and Store in refrigerator over-night, (G) Checking the DNA with nano-spectrophotometer, (H) Checking and adjusting DNA purity and concentration, (I) Adding 4 μl mastermix and 1 μl DNA, (J) PCR running, (K) Gel preparation (2% agarose), (L) Preparation for gel electrophoresis, (M) Gel electrophoresis, (N) Taking photo using UV image recorder.

- **Gel Preparation**

  The amplified product were separated by electrophoresis on an agarose gel containing TBE and then visualized by staining the gel with Eco dye. The beaker that is 2-4 times the volume of the solution was used and then 50ml electrophoresis buffer TBE and 0.5g agar were added into the beaker. The beaker was gently shooked to get well dissolved agarose. The beaker was covered with aluminum foil and then pierced a small hole in the aluminum foil for ventilation. It is heated in a microwave oven until the agarose dissolves (30 seconds for three times). The agarose solution can boil over very easily, so keep checking it. It is good to stop it after 45 seconds and give it a swirl. It can become superheated so wear insulated gloves and hold it at arm’s length. When the molten gel has cooled at about 60°C, add 4μl Eco dye and mix the gel solution thoroughly by gentle swirling. Warm agarose solution was poured into the mold. Check that no air bubbles are under or between the teeth of the comb. Allow the gel to set completely (one hour or more till the gel condensed) at room temperature, and then a small amount of electrophoresis buffer (0.5% TBE) was poured on the top of the gel and carefully removed the comb. The gel was mounted in the electrophoresis tank.

- **Gel Electrophoresis**

  The samples of DNA (2.5μl) and 2μl loading dye were mixed and slowly loaded the sample mixture into the slots of the submerged gel using a disposable micro pipette. The standard ladder was also loaded in the slots on both side of the gel. The lid of the gel tank was closed and attached the electrical leads so that the DNA will migrate toward the positive anode (red pole). If the leads have been attached correctly, bubbles should be generated at the anode and cathode. The electrophoresis was run until the DNA have migrate to an appropriate distance through the gel. The gel tray must be removed and placed directly on a UV image recorder. When UV is switched on, bands of DNA can be seen. The presence of Eco dye allows the gel to be examined by UV illumination at any stage during electrophoresis.

- **Data Analysis**

  The sample bands were compared with DNA ladder band appeared. We checked the basepairs in which the DNA bands were located. The resulted basepairs were computed by “Converter” program to achieve the input data for “Structure 2.2” program and as well as “Phylip” program. The recorded data (allele sizes in base pairs) were used to analyze population structure, genetic diversity analysis and to measure phylogenetic relationship among tested mango accessions. Population structure was constructed using “Structure 2.2” software program [11, 12] and the genetic distance was computed using “Phylip 3.696” software program [13] and phylogenetic tree was constructed using “MEGA6” software program.
III. RESULT AND DISCUSSION

A. Population Structure Analysis

One SSR marker (MSSR 80) revealed as monomorphic marker among 94 Mango accessions while others showed as polymorphic markers (Table 2). In the research of Begum et al. 2014, microsatellite intravarietal heterozygosity analysis, only 23 out of the 109 mango-specific simple sequence repeats (SSRs) were validated as polymorphic [10].

Ninety four mango accessions were divided into 3 populations by the structure 2.2 program represented as green, red and blue colours (Fig.4). Population (1) contains (24) accessions, population (2) contains (38) accessions and population (3) contains (28) accessions (Table 3). Previous study revealed that 77 mango accessions can be divided into seven clusters using fruit characters [3]. Although Sate Noh Thee (ACC06) was stand as outstanding in their fruit characters [3], it was seen in the same population (population 3) with Ma Naw (ACC07), Shwe Pha Lar (ACC05), Ma Chit Su (ACC14), Sein Sar Thee (ACC22) and others in this study. Yin Kwae (ACC18) and Sein Ta Lone (ACC77) could be seen as different genetic background that they stayed in different populations. Using 1054 SNP markers for 775 mango accessions had done for genetic mapping by Kuhn et al. 2017 in USA [2]. They identified 20 linkage groups in seven mapping populations in total. In our study, Pa Da Myar Nga Mauk (Horti, ACC78) and R2E2 (Horti, ACC79) were in the same group, group 2. Two American accessions; Keiitt (ACC87) and Tomyakin (ACC88) and one Indian accession Alphonso (ACC85) were also included in group 2. One accession from Israel was grouped together with Thone Hnit Thee (ACC08), Parr Ni Tha Yet (ACC46) and other 21 accessions as in group 1. It revealed that the genetic richness of Myanmar mango which includes similar alleles of mango from USA, India and Israel.

Although Kyauk Sein (Sein Sar, ACC49) and Sein Sar Thee (Myin Mu, ACC58) were presented in the same population (population 2), Sein Sar Thee (Kalar Gyi Chyan, ACC22) was presented in different population (population 3).

Three Yin Kwae mangoes from Madaya, Khan Tat Kone and Kyaukse were grouped in population 1 while other two Yin Kwae mangoes from Yatsout and Aungban were grouped in population 2. It can be seen that Yin Kwae mango from middle part of Myanmar and upper part of Myanmar (Shan State) are not in the same population. Some adaptive genetic changes could be expected in Shan State. On the other hand Mat Chit Su from Kyaukse, Myinmu and Madaya were grouped in different population (population 3) from Mat Chit Su from YAU, Yezin, Nay Pyi Taw area (population 1). It pointed out that does Mat Chit Su mango really evolve to adapt in such a different ecological zone. More rigorous sampling and condense makers will be needed to confirm the present result.

As shown in Fig. 4, it was so difficult to discriminate discrete populations. Almost all accession conserved some alleles from other group. It implied that high percentage of cross pollination nature plays an important role in mango gene pool. Accordingly, wider genetic diversity would be expected among mango population in Myanmar.

Four accessions; Parr Phyu Thee (Kin Da, ACC52), Pann Bin Ga Lar (Kalar Gyi, ACC72), Pyo Ta Ngon (Kin Da, ACC81) and Yin Kwae (Kin Da, ACC83) stood as admixtures.

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| Code  | Name                          | Score1 | Score2 | Score3 | Score4 | Score5 | Score6 | Score7 | Score8 | Score9 | Score10 | Score11 | Score12 | Score13 | Score14 | Score15 | Score16 | Score17 | Score18 | Score19 | Score20 | Score21 | Score22 | Score23 | Score24 | Score25 | Score26 | Score27 | Score28 | Score29 | Score30 | Score31 | Score32 | Score33 | Score34 | Score35 | Score36 | Score37 | Score38 | Score39 | Score40 | Score41 | Score42 | Score43 | Score44 | Score45 | Score46 | Score47 | Score48 | Score49 | Score50 | Score51 | Score52 | Score53 | Score54 | Score55 | Score56 | Score57 | Score58 | Score59 | Score60 | Score61 | Score62 | Score63 | Score64 | Score65 | Score66 | Score67 | Score68 | Score69 | Score70 | Score71 | Score72 | Score73 | Score74 | Score75 | Score76 | Score77 | Score78 | Score79 | Score80 | Score81 | Score82 | Score83 | Score84 | Score85 | Score86 | Score87 | Score88 | Score89 | Score90 |
| ACC91 | Ma Chit Su (Shwe Li -1) | 0.729 | 0.154 | 0.117 | 1 |
| ACC92 | Ma Chit Su (Shwe Li – 2) | 0.655 | 0.07  | 0.275 | 1 |
| ACC93 | Aung Din(Shwe Li - 3)   | 0.168 | 0.197 | 0.634 | 3 |
| ACC94 | Ma Chit Su (Shwe Li –4) | 0.616 | 0.07  | 0.273 | 1 |

*Pop; population

B. Genetic distance and phylogenetic tree

Nei genetic distance was calculated based on allele frequency and the neighbor-joining phylogenetic tree was drawn using MEGA6 program software [14]. There were two clusters and one outstanding accession in UPGMA (unweighted paired group arithmetic mean) tree (Fig. 5). Cluster 2 can be subdivided into three sub-clusters; sub-cluster 1, sub-cluster 2 and sub-cluster 3. Cluster 1 includes 12 accessions; ACC 04, ACC 12, ACC 17, ACC 20, ACC 45, ACC 88, ACC 25, ACC 52, ACC 82, ACC 24, ACC 79 and ACC 93. All other accessions (71 accessions) except ACC 1 were clustered as Cluster 2. Molecular characterization work of Kumar et al. in 2013 also shown that UPGMA cluster analysis broadly placed 10 mango cultivars into three major clusters [15]. Accession number one, Sein Ta Lone (Pann Swae, ACC01) stood as outstanding accession. It was clearly seen that Sein Ta Lone (Pann Swae) was totally different from others although structure result set it as in group 2. According to the “Phylip” result, Sein Ta Lone (Pann Swae) might possess some rare genes those do not have in other accessions. Those genes would be useful for future work in mango breeding or variety improvement activity. The result also supports information that one can select parents from different genetic cluster of phylogenetic tree.

IV. CONCLUSION

One out of five SSR markers expressed as monomorphic marker among 94 Myanmar mango accessions. Ninety four Myanmar mango accessions could be grouped into three populations. Almost all accessions conserved common alleles from other groups. Four accessions were defined as admixture. Sein Ta Lone (Pann Swae) could be rare accession. Myanmar mango possessed wider genetic background which illustrated that Myanmar as a part of origin of Mango. Present result supports information for breeders that one can select parents from different genetic cluster of phylogenetic tree.

ACKNOWLEDGMENT

We acknowledge Rector, Pro-Rector (admin), Pro-Rector (academic) of Yezin Agricultural University and Professor and Head of Department of Horticulture, Yezin Agricultural University for giving permission and support fund to do this research.

REFERENCES


Abstract— A total of 150 blood samples were collected to determine the prevalence of *Dirofilaria immitis* infection in dogs from Pyinmana Township. Among them, 109 and 41, dog blood samples were collected from downtown area and sub-urban area, respectively. These collected blood samples were examined for the presence of microfilaria of *Dirofilaria immitis* by using Direct Blood Examination (DBE), Rapid Test Kit (RTK), and Modified Knott’s Technique (MKT). This study revealed that the overall prevalence of *Dirofilaria immitis* was investigated as 7.3% (10/150), 18.7% (28/150) and 16% (24/150), when testing with DBE, RTK and MKT test methods, respectively. In downtown area, the prevalence was 5.5% (6/109), 16.5% (18/109) and 12.8% (14/109), when testing with DBE, RTK and MKT methods, respectively. In sub-urban area, positive cases were observed as 12.2% (5/41), 24.4% (10/41) and 24.4% (10/41), when testing with DBE, RTK and MKT methods, respectively. In sub-urban area, positive cases were observed as 12.2% (5/41), 24.4% (10/41) and 24.4% (10/41), when testing with DBE, RTK and MKT methods, respectively. The prevalence of canine heartworm infection in sub-urban area was numerically higher than that of downtown area although the prevalence of two places was not significantly different (p>0.05). According to the univariate analysis, the age and duration of stay in Pyinmana were found as the associated risk factors of canine heartworm infection in this study. The older the age and the longer the duration of stay in Pyinmana were higher the risks to get the infection. There was no association with sex, breed, hair type and routine deworming of dogs and use of insecticides at their environment, regarding to the prevalence of canine heartworm infection. Among the three tests using in this study, RTK was observed as the most sensitive test. *D.immitis* infection is one of the zoonotic diseases and *Dirofilaria* species are transmitted by several mosquito species belonging to a wide range of genera in different parts of the world. This work can assist in planning appropriate strategies for controlling and prevention of *D.immitis* infection in Myanmar. Further studies are required to investigate the occurrence of *D.immitis* in dogs across the nation and evaluate the spatial risk for human and animal dirofilariasis.

Key words: *Dirofilaria immitis*, dog, zoonotic, mosquito, Pyinmana

I. INTRODUCTION

*Dirofilaria immitis* is a cosmopolitan parasite, infecting domestic dogs, cats, and humans, as well as wild animals and commonly found in the pulmonary arteries and right ventricle of dogs and other canids and cause canine heartworm disease. Several studies have been reported the various species of mosquito belonging to a wide range of genera in different parts of the world, such as- Aedes, Anopheles and Culex, as natural vectors of *D. immitis* and *D. repens* [1, 2, 3, 4, 5]. The females of mosquito serve as the intermediate host by obtaining a blood meal from a dog with circulating microfilariae. Vectors ingest microfilariae, while feeding (blood sucking) on an infected host, which then cross the midgut wall and migrate to the Malpighian tubules where they develop from first to third
stage larvae (L₃). Later, the infective larvae L₃ migrate to the proboscis through which they slide while the mosquito is feeding on another host, becoming sexually mature within six months in the main pulmonary arteries and right ventricle [6].

Increase in the number of canine, feline and human dirofilariasis cases, particularly after year 2000, has resulted to be emerging zoonosis [5, 7]. Dogs and cats are human companion pets, and herewith cardiopulmonary dirofilariasis known as heartworm disease, caused by adult *D. immitis*, is a serious and potentially fatal disease [8, 9] and it also causes severe renal dysfunction [10, 11]. Heartworm disease usually develops a chronic progression, first showing vascular and pulmonary effects and eventually affecting the right chambers of the heart. The first lesion occurs on the walls of the pulmonary arteries, subsequently key to the development of pulmonary and cardiac pathology. After the arrival of worms in the pulmonary arteries, an enlargement of endothelial cells in the vascular tunica occurs, resulting in the narrowing of vessels (endarteritis). Typical signs of heartworm infection in dog include coughing, laboured breathing, weakness and tiring with exercise. With heavy infections, there may be circulatory distress and dyspnoea due to reduction of blood flow and pulmonary hypertension. In advanced stages, the heart, lungs, liver, and kidneys may be severely damaged. Eventually, heart failure can occur with overwork by the heart [12, 13]. From an epidemiological perspective, dirofilariasis is considered as an emergent parasitic disease of humans and animals. It is more prevalent in areas with temperate and tropical climates [5].

With regards to animal health, the canine and feline heartworm disease caused by adult *D. immitis* is severe and potentially fatal. Laboratory diagnosis of the disease can be done using blood tests that detect circulating microfilariae or adult antigen, however other diagnostic tests are needed to investigate the severity of the disease and treatment options [9]. The traditional method for diagnosing of *D. immitis* is by finding and identifying its larvae (microfilariae) in blood or skin samples [9, 14]. Another technique for the detection and identification of *D. immitis* microfilariae in canine blood is modified Knott’s test. This technique enables scientist to clearly distinguish between *D. immitis, D. repens* and *Acanthocheilonema* (*Dipetalonema*) species. Microfilariae of *D. repens* has conical front end and curve caudal end. *A. reconditum* has blunt front end and small hook at rear end [15]. *D. immitis* microfilariae has straight body and tail with tapered head [16]. In addition, several ELISA and immunochromatographic kits are commercially available to detect the presence of adult female circulating antigens in serum, plasma and whole blood of dogs and cats [17]. Each of these methods may present difficulties in the interpretation of results [14]. Molecular PCR and DNA sequencing techniques have been proposed for differentiating between different species of Dirofilaria with trustworthy result [18, 19, 20, 21, 22].

In the past 20 years, the geographic range of *D. immitis* infection has been profoundly increased [23]. Moreover, canine heartworm infection has been investigated more and more frequently in dogs in many countries, including Taiwan [24], United State [25], Sri Lanka [26], Czech Republic [27], Thailand [28], Slovak Republic [29] and China [30].

In Myanmar, the prevalence of *D. immitis* infection in dogs from Yangon was 17.26% [31]. Therefore, little attention has so far been given to the parasites of dogs, and limited information is available on the occurrence of canine heartworm infection in Myanmar. Nowadays, Pyinmana Township is located in Nay Pyi Taw area, and the population of dogs around this area is very tremendously increasing, and this issue to take care the health of dogs is a big concern for veterinary practitioners as well as public health point of view. Moreover, alert for the risk of zoonotic diseases especially from dog needs to be a crucial issue. As a result, the present study aimed at investigation into the prevalence of *D. immitis* infection and its associated risk factors in dogs from Pyinmana Township.

II. MATERIALS AND METHODS

A. Study area and study design

A cross-sectional study was carried out in Pyinmana Township. Blood samples of dogs from downtown area and sub-urban area were collected from March 2013 to July 2013. Dogs aged less than 6 months were excluded from the study considering the life cycle of *D. immitis*. 
B. Sample size calculation

For infinite population, the sample size was estimated using the following formula as described by [32].

\[ n = \frac{1.96^2 P_{exp}(1 - P_{exp})}{d^2} \]

Where, \( n \) = required sample size

\( P_{exp} \) = expected prevalence,

\( d \) = desired absolute precision

\( P_{exp} = 10\% = 0.1 \)

\( d = 5\% = 0.05 \)

\[ n = \frac{1.96^2 \times 0.15(1-0.15)}{0.05^2} \]

\[ = \frac{3.9416 \times 0.09}{0.0025} \]

\[ = 0.345744 \]

\[ n = 138.29 \]

\[ = 140 \]

The collected samples were 150 although the calculated sample size was 140.

C. Sample collection

Blood samples were collected by disposable syringe from cephalic vein of dogs and kept in EDTA tube. Each tube was labelled with name, age, sex of dog and time of blood collection. Blood samples were collected between 6:00 pm to 8:00 pm from 6 months and above aged dogs. All these collected samples were kept at 4˚C. Three tests methods such as Direct Blood Examination (DBE), Rapid Test Kit (RTK) and Modified Knott’s Technique (MKT) were applied to identify either presence or absence of microfilaria in these samples.

D. Direct Blood Examination

A drop of fresh venous blood was placed on a clean microscopic slide and covered with a cover slip and examined under low microscopic power. Microfilariae were seen throughout the movement among the red blood cells (Fig.1). Identification of microfilariae of *D. immitis* was done according to [14].

E. Examination by Rapid Test Kits

When specimens and test kits were stored at cold circumstances (2-8˚C), they were put at room temperature for 15-30 minutes before use. A device from a pouch was taken out and placed on a horizontal surface. One drop (40μl) of the blood sample was dispensed on each well of the test kit by using a micropipette. When the specimen was completely absorbed into the well, 2 drops (80μl) of buffer were dropped. The test results were read between 5-10 minutes. A red band should appear on the control line regardless of the test result. The presence of another band on the test line determines the result. If control line only appears, the test result is negative. If both test and control lines appear, the test result is positive. After 10 minutes, test result was invalid [33].

F. Modified Knott’s Technique

One millitre of blood was taken from the EDTA sample then 9ml of 2% formalin was added and shaken to help lyses of red blood corpuscles. The solution obtained was centrifuged for 5 minutes at 1500 revolution per minute, the supernatant was decanted from the centrifuged tube. Residue was stirred with a wooden applicator to free the microfilariae from the walls of the centrifuged tube. An equal volume of 1/1000 (or less) methylene blue dye was added after a few minutes, and a drop was mounted on a slide and covered with a coverslip and examined under a compound microscope. Identification of microfilariae of *D. immitis* was done according to [14] (Fig.2).
G. Determination of gold standard and calculation of sensitivity and specificity

In this study, the most reliable, gold standard test was determined among the three tests and the values of sensitivity and specificity were calculated by the following format and formulas (Table 1) [34].

<table>
<thead>
<tr>
<th>Test method</th>
<th>Reference Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Positive</td>
<td>a</td>
</tr>
<tr>
<td>Negative</td>
<td>c</td>
</tr>
<tr>
<td>Total</td>
<td>a+c</td>
</tr>
</tbody>
</table>

Sensitivity = \( \frac{a}{a+c} \)

Specificity = \( \frac{d}{b+d} \)

H. Questionnaire study and statistical analysis

Questionnaire survey forms were developed and filled up by the dogs' owners during every visit to their house. These forms included dog management, anthelmintic administration and application of insecticides at their house, knowledge of public health as well as abnormal signs and symptoms of dogs.

The collected information was entered into the Excel Spread Sheet and univariate analysis was done by using SPSS Version 17 software and Kappa values were also calculated.

III. RESULTS

A. Prevalence of Dirofilaria immitis in dogs

When examining the prevalence of heartworm infection in dogs, the overall prevalence in Pyinmana Township was (11/150) 7.3% by Direct Blood Examination, (28/150) 18.7% by Rapid Test Kit, and (24/150) 16% by Modified Knott’s Test. The prevalence in downtown area was (6/109) 5.5% by Direct Blood Examination, (18/109) 16.5% by Rapid Test Kit, and (14/109) 12.8% by Modified Knott’s Test. The prevalence in sub-urban area was (4/41) 12.2% by Direct Blood Examination, (10/41) 24.4% by Rapid Test Kit and (10/41) 24.4% by Modified Knott’s Test. The prevalence by hypothesized risk factors with three tests are shown in Table 2.

<table>
<thead>
<tr>
<th>Variables</th>
<th>% of +ve (No. +ve/Total samples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>Direct Blood Examination</td>
</tr>
<tr>
<td>Township overall prevalence</td>
<td>7.3 (11/150)</td>
</tr>
<tr>
<td>Downtown area</td>
<td>5.5 (6/109)</td>
</tr>
<tr>
<td>Suburban area</td>
<td>12.2 (4/41)</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
<tr>
<td>Breed</td>
<td>Local breed</td>
</tr>
<tr>
<td></td>
<td>Imported breed</td>
</tr>
<tr>
<td>Age</td>
<td>5-11 years old</td>
</tr>
<tr>
<td></td>
<td>0.5-4 years old</td>
</tr>
<tr>
<td></td>
<td>6-11 years old</td>
</tr>
<tr>
<td></td>
<td>0.5-5 years old</td>
</tr>
<tr>
<td></td>
<td>4-11 years old</td>
</tr>
<tr>
<td></td>
<td>0.5-3 years old</td>
</tr>
<tr>
<td>Duration of stay in Pyinmana</td>
<td>26.3 (5/19)</td>
</tr>
<tr>
<td></td>
<td>0.5-6 years</td>
</tr>
<tr>
<td>Hair type</td>
<td>Long</td>
</tr>
<tr>
<td></td>
<td>Short</td>
</tr>
<tr>
<td>Deworming type</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Use of insecticide</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

B. Determination of gold standard

In this study, the most reliable, gold standard test was observed among the three tests. Amidst the three tests, RTK showed the highest sensitivity according to its results observed in this study. It was the best evidence to be considered as the gold standard for the disease detection. When the sensitivity and specificity values of the rest two tests (MKT and DBE) were calculated by setting Rapid Test Kit as gold standard, the values sensitivity and specificity of MKT were observed as 0.86 and 1 and the sensitivity and specificity of DBE were 0.39 and
1. The statistic ranges with a kappa value of about 0.4 to 0.5 indicate moderate agreement. Higher kappa values are interpreted as good agreement [34].

C. Kappa Agreement among the three tests

When examining the kappa agreement between the tests in SPSS software by identifying the Kappa value, medium agreement was observed, between DBE and RTK, as well as between DBE and MKT (Kappa value = 0.524). Excellent agreement was found between RTK and MKT (Kappa value = 0.907) (Table 3, 4 and 5).

Table 3. Agreement between DBE and RTK

<table>
<thead>
<tr>
<th>DBE</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>11</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Negative</td>
<td>0</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>139</td>
<td>150</td>
</tr>
</tbody>
</table>

Kappa value = 0.513

Table 4. Agreement between DBE and MKT

<table>
<thead>
<tr>
<th>DBE</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>10</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>Negative</td>
<td>1</td>
<td>125</td>
<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>139</td>
<td>150</td>
</tr>
</tbody>
</table>

Kappa value = 0.524

Table 5. Agreement between MKT and RTK

<table>
<thead>
<tr>
<th>MKT</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Negative</td>
<td>4</td>
<td>122</td>
<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>122</td>
<td>150</td>
</tr>
</tbody>
</table>

Kappa value = 0.907

D. Univariate analysis of the hypothesized risk factors

When hypothesized risk factors put in the questionnaire form used in this study were analyzed by univariate test, age and duration of stay in Pyinmana were found significantly associated (p<0.05) with canine heartworm infection (Table 6). According to the univariate analysis, no associated factors were observed as gender, breed, hair type, practice of deworming and use of insecticide.

Dogs with age of 4-11 years old had 18 times more probability to get the infection than 0.5-4 years old dogs. The dogs which have stayed in Pyinmana for 5-11 years were 52 times more likely to get the infection than the dogs staying in Pyinmana for 0.5-5 years. The dogs which have stayed in Pyinmana for 6.1-11 years were 53 times more likely to get the infection than the dogs staying in Pyinmana for 0.5-6 years.

Table 6. Identification of associated risk factors based on results of RTK

<table>
<thead>
<tr>
<th>Variables</th>
<th>Prevalence (%)</th>
<th>No. of positive</th>
<th>Total samples</th>
<th>Odds ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1-11 years old</td>
<td>84.2</td>
<td>16</td>
<td>19</td>
<td>52.889 (13.459-207.839)</td>
<td>0.000</td>
</tr>
<tr>
<td>0.5-6 years old</td>
<td>9.2</td>
<td>12</td>
<td>131</td>
<td>52.25 (16.5-165.463)</td>
<td>0.000</td>
</tr>
<tr>
<td>5.1-11 years old</td>
<td>73.3</td>
<td>22</td>
<td>30</td>
<td>52.25 (16.5-165.463)</td>
<td>0.000</td>
</tr>
<tr>
<td>0.5-5 years old</td>
<td>5</td>
<td>6</td>
<td>120</td>
<td>18.783 (6.474-54.496)</td>
<td>0.000</td>
</tr>
<tr>
<td>4.1-11 years old</td>
<td>48.9</td>
<td>23</td>
<td>47</td>
<td>18.783 (6.474-54.496)</td>
<td>0.000</td>
</tr>
<tr>
<td>0.5-4 years old</td>
<td>4.9</td>
<td>5</td>
<td>103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of stay in Pyinmana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1-11 years old</td>
<td>84.2</td>
<td>16</td>
<td>19</td>
<td>52.889 (13.459-207.839)</td>
<td>0.000</td>
</tr>
<tr>
<td>0.5-6 years</td>
<td>9.2</td>
<td>12</td>
<td>131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1-11 years old</td>
<td>73.3</td>
<td>22</td>
<td>30</td>
<td>52.25 (16.5-165.463)</td>
<td>0.000</td>
</tr>
<tr>
<td>0.5-5 years old</td>
<td>5</td>
<td>6</td>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-urban</td>
<td>24.4</td>
<td>10</td>
<td>41</td>
<td>1.631 (0.681-3.908)</td>
<td>0.347</td>
</tr>
<tr>
<td>Downtown</td>
<td>16.5</td>
<td>18</td>
<td>109</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15.9</td>
<td>14</td>
<td>88</td>
<td>0.649 (0.284-1.48)</td>
<td>0.395</td>
</tr>
<tr>
<td>Female</td>
<td>22.6</td>
<td>14</td>
<td>62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local breed</td>
<td>22.6</td>
<td>12</td>
<td>53</td>
<td>1.482 (0.641-3.423)</td>
<td>0.385</td>
</tr>
<tr>
<td>Foreign breed</td>
<td>16.5</td>
<td>16</td>
<td>97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long hair</td>
<td>14</td>
<td>7</td>
<td>50</td>
<td>0.612 (0.241-1.556)</td>
<td>0.377</td>
</tr>
<tr>
<td>Short hair</td>
<td>21</td>
<td>21</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### IV. DISCUSSION

Canine dirofilariosis has been reported across the globe. For example, the prevalence of *D. immitis* is 19% in Spain [35], 20.9% in South Korea [36], 5.47% in Brazil [37], 30.8% in South Africa [38], and 1% in South Australia [39]. *D. immitis* is enzootic parasite in China [30, 40] and it is also a zoonotic disease threatening the health of human. According to the above reasons, this study was performed to investigate the prevalence and to improve the knowledge on disease situation in our country, on the other side, to improve the disease control or to reduce the occurrence of disease in animal and human. Moreover, this study was conducted to be aware of the public health importance of the *D. immitis* infection, which is considered as a zoonotic disease from companion animals such as dogs.

When comparing the finding of this study and the recent findings around the world, it was observed that the prevalence 18.7% (RTK) of the disease in Pyinmana Township was nearly the same with that observed in Thailand 18.2% [28] and higher than that of Argentina (4.4%), Peru (3.8-4.8%), Colombia (2%) and Brazil (2%) [41]. However, higher prevalence was stood in Sri Lanka (45%) [26]. In Myanmar, Win Win has investigated the prevalence of canine heartworm disease as 17.26% in 1996.

When the dogs were examined by the gold standard test (Rapid Test Kit), 18.7% of the total study population; 16.5% in downtown area; 24.4% in sub-urban area; 15.9% of the male population; 22.6% of the female; 22.6% of local breed; 16.5% of the imported breed; 48.9% of over 5 years old age group and 4.9% of the group of younger than 4 years were showed test positive results in this study. When comparing the disease prevalence between sub-urban and downtown areas, it was found out that the prevalence was higher in sub-urban area than downtown area. Moreover, it could be assumed that sub-urban area was more likely to have abundance of mosquito with favourable environment for mosquito breeding, and can be concluded as placing as the main reason favouring the occurrence of the disease.

There are many diagnostic tests to detect the disease which can be identified as surrogate tests such as Rapid Test Kit (RTK), Enzyme Linked Immunosorbent Assay (ELISA), Polymerase Chain Reaction (PCR) and pathopneumonic tests such as Modified Knott’s Test (MKT), and Direct Blood Examination (DBE) [42]. The comparing and defining the gold standard between the Modified Knott’s Test (MKT) and other surrogate tests were also performed in other countries [43].

This study reviewed the sensitivity and specificity of the three tests comparing the ability of the detection of *D. immitis* infection. Among three different tests used in this study, it was found out that one testing technique was used to detect the antigen of *D. immitis* (female) and the other two techniques to identify the larvae of *D. immitis*. When comparing the use of two pathopneumonic tests (DBE and MKT), the finding revealed that MKT used one ml of blood to detect the presence of disease while DBE need only one drop of blood and it can be concluded that the higher the volume of the blood used, the more confirmation of the test result appeared.

Even though the nature of the tests such as surrogate and pathopneumonic tests are different from each other, sensitivity of those are logically distinct: sensitivity of surrogate test is higher than that of pathopneumonic tests. However, both of the tests showed almost the same percentage of the positive results. According to this finding, surrogate test (RTK) is more preferable to use not only in the laboratory but also in the clinics whereas pathopneumonic test (MKT) is better to use only in the laboratory because of being a complicated test.

To describe the efficient tests for examining the disease, the Kappa values of the test were calculated in this study and the Kappa values were observed as followed: 0.513 when comparing the DBE and RTK, 0.524 when comparing DBE and MKT, 0.907 when comparing the RTK and MKT.
In this study, it was found out that the Kappa value was medium between RTK and DBE. It was also observed that the Kappa value was medium between the two pathopneumonic tests, namely MKT and DBE. It was necessary to use only a small amount of blood in DBE, but it was required to use a large amount of blood in MKT. Therefore, it can be concluded that MKT is more accurate test than DBE. The DBE has some disadvantages such as very low sensitivity, frequent false negative, no species diagnosis while MKT has the advantages of high sensitivity [14]. In this calculation, it was found out that the Kappa value was high between RTK and MKT.

From this study, it was found out that both of the tests such as RTK and MKT were more reliable tests than DBE as mentioned in [14]. Knowing the disease condition by detecting with the most reliable test (Rapid Test Kit) can improve the knowledge of the disease as well as the most trustworthy precaution and prevention method of the disease can be performed.

In the present study, rapid test kit (RTK) was determined as the gold standard for the disease detection to identify the associated risk factors of the disease and to observe how associate the factor and occurrence of disease. It was noted that the age factor was important for *D. immitis* without stratification of breed group. The older the age of dogs, the higher the incidence of Dirofilaria infection.

In this study, when describing the association between the factors and the occurrence of the disease, dogs with age of 5-11 years old had 18 times more probability to get the infection than 0.5-4 years old dogs; 6-11 years old dogs had 52 times more likely to get the infection than younger ages; and 7-11 years old group had 53 times more likely to get the infection than younger age group. Dogs staying in Pyinmana for 7-11 years had 53 times more likely to get the infection than the dogs staying in Pyinmana for less than 7 years. The dogs staying in Pyinmana for 6-11 years had 52 times more likely to get the infection than the dogs staying in Pyinmana for 1-5 years.

Similarly in Thailand, 2-4 years age of group got infection than less than 2 years old age groups. The older the animal, the higher the prevalence of canine heartworm infection [28]. In this study, the prevalence of 5-11 years old was 19.2% and 0.5-4 years old was 1.9%. So it was also found out that the older the animal, the higher the prevalence of canine heartworm infection. In 1996, Win Win also described that the prevalence of the disease in age group of over four years old was 24% while the prevalence of the disease in under one year old age group was 6.6%.

During this study, even though factors such as breed, sex, hair condition, history of deworming, use of insecticide were considered as the associated risk factors, it was observed that there was no significant difference between the above factors and disease occurrence. But, the prevalence of short hair was mathematically greater than that of long hair breed in this study. Dirofilariaasis is transmitted by a number of species of mosquitoes. Short hair dogs may have more chance to be bitten by mosquitoes than long hair dogs. In this study, the prevalence percentage of long hair dogs infected was lower than that of dogs with short hair dogs. Similarly, the prevalence of local breed was mathematically higher than imported breed in this study. Most of sample (local dogs) were in sub-urban area of Pyinmana Township. As a result, it could be assumed that the number of intermediate host (mosquito) might be more abundant in sub-urban area than that of downtown area. Moreover, imported breeds were administered monthly oral preventive treatment of microfilariacide such as ivermectin.

The number of intermediate host (mosquito) might be more abundant in sub-urban area than that of downtown area. Sub-urban area has more likely to have abundance of mosquito with favourable environment for mosquito breeding and can also be concluded as placing as the main reason favouring the occurrence of the disease. According to the findings about the relationship between the abundance of the mosquito and Dirofilaria infection around the world, it was evidently revealed that there was highly association between the disease occurrence and the abundance of mosquito [44]. The sub-urban areas have become the place of higher disease prevalence because these areas are feeble in drainage system, abundant bushes and swamps as well as poor awareness of the public hygiene, which favour for mosquito breeding.

As the abundance of mosquitoes and the rearing of dogs regarding as companion animals to humans have increased year by year, it can be considered as the potential hazard of dirofilariasis to public health concerned. Therefore, the Dirofilaria infection having
parasitic manifestation and being higher in human transmitted from its hosts, regular control of ectoparasite and endoparasite should be encouraged among dog owners as a strategy for reducing transmission of this filarial parasite and control programme of mosquitoes are urgently needed to be benefited in reducing dirofilariasis which plays significant role in public health.

V. CONCLUSION

*Dirofilaria immitis* of dogs exist in Pyinmana Township but in low prevalence rate based on the methods used in this study and RTK was the most sensitive technique and it can be concluded that the most reliable test were RTK and MKT. According to the univariate analysis, age and period of stay in Pyinmana were found significantly associated (p<0.05) with canine heartworm infection, but no associated factors were gender, breed, hair type, practice of deworming and use of insecticide. For public health point of view, the information on the disease is rarely distributed among our people and public awareness on the disease is scarce. As dirofilariasis is a zoonotic disease, it is urgently needed to disperse the knowledge on the disease and its control methods to the public so as to enhance the control of the disease spread between human and animal.

ACKNOWLEDGMENT

We are grateful to the dog owners for participation and cooperation. We are also thankful to the staff of Department of Pharmacology and Parasitology, University of Veterinary Science, Yezin, Nay Pyi Taw, Myanmar.

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The Emerging Importance of Multidrug Resistant Escherichia coli in Broiler, Layer and Village Chicken Sampled from Zeyar Thiri Township, Nay Pyi Taw

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Abstract—Nowadays, the emergence of antimicrobial resistance (AMR) in Escherichia coli has become an increasing threat to human and animal health globally. Livestock production in Myanmar is growing at a very rapid rate and broiler, layer and village chickens are becoming major components of the poultry industry across the country. From January 2017 to January 2018, this study was conducted in broiler and layer chickens representing the commercial poultry farms and village chickens representing the households and backyard farms located in Zeyar Thiri Township. The occurrence of E. coli and antimicrobial resistance patterns in poultry were investigated by means of standardized protocol and disc diffusion method using eleven antibiotics in accordance with the guideline of Clinical Laboratory Standard Institute (2012/13). The antimicrobial resistance levels, Multidrug-Resistance (MDR), and not-MDR were determined. The study disclosed the spread of AMR, as well as the emergence of MDR among the poultry population in Nay Pyi Taw area. The resistance levels are remarkably high against some antimicrobials, which is a signal calling for more attention to be paid. In brief, AMR and MDR are two main areas to focus if better community health and well-being is to be achieved. Therefore more in-depth analysis and comprehensive surveillance are necessary for the better understanding of AMR and control measures of them.

Keywords- Escherichia coli, broilers, layers, village chickens, antimicrobial resistance

I. INTRODUCTION

Antibiotics are becoming increasingly ineffective. Antimicrobial Resistance (AMR) is a huge public-health threat, having profound impact on food safety and security globally. It is linked with high frequency of disease occurrence and economic status of the people. AMR is a truly important ‘One Health’ issue which recognizes the connection between humans, animals and the environment on various aspects, including the antimicrobials used in human and veterinary medicine [1].

These days, livestock production in Myanmar is growing very rapidly and poultry meat has become the major source of protein with the highest consumption nationwide. Similar to many other countries, broiler, layer and village chickens are serving as the major components of poultry industry in Myanmar [2, 3]. Poultry production, especially broiler, layer and village chickens, accounts not only for a high percentage of quality protein, but also for good source of revenue to farmers and traders [3, 4]. However, chicken production has been faced with several constraints, including the bacterial infections such as Escherichia coli and Salmonella species that reduce overall production [5]. Moreover, strains of these bacteria are also zoonotic and have been described as the leading causes of food-borne illness worldwide [5, 6].

Escherichia coli spp. are Gram negative bacteria belonging to the family Enterobacteriaceae, which are naturally found in the environment and intestinal tracts of humans and animals. In general, most E. coli strains are harmless and are important to healthy human and animal intestinal tracts. However, on the other
hand, being part of the endogenous microbiota, *E. coli* can easily develop resistance to a variety of antimicrobials taken by humans and animals [7]. In that case, pathogenic *E. coli* in poultry has become a public health concern causing the hard-to-treat infections in humans and animals [8, 9].

In Myanmar, a number of studies have been conducted in different parts of the country focusing on the antimicrobial residues in food producing animals and their products, such as fish [10], cow’s milk [11] and chicken meat in Nay Pyi Taw [12, 13] and Yangon [14], all of which highlighted the widespread use and misuse of antimicrobials in food producing animals. Alongside the residue, following the misuse and prolonged use of antimicrobials, higher proportion of antibiotic resistant bacteria has been reported in fecal microbiota of drug-treated animals [15, 8]. Consequently, meat at marketing can be heavily contaminated with *E. coli* of poultry fecal origin, creating profound impact on human health through the direct contact with food producing animals [16, 1].

Regarding the antimicrobial resistance patterns in poultry, a few reports have been published in broilers and layers [17, 18, 19], village chickens [20] and layer chickens [21]. The extensive use of antibiotics in poultry as growth promoters, as well as misusing in treatment of diseases have been considered as the cause of emergence of multidrug resistant bacteria in poultry, which inevitably will exert negative impact on the treatment and management of infectious diseases in both humans and animals [1, 22].

When considering the antimicrobial resistance in food producing animals, poultry are recognized as an important source for dissemination of antimicrobial resistant *E. coli* in the community and environment [8, 23, 7]. Currently, there is no law-enforced veterinary prescription system in Myanmar and farmers can buy antimicrobials freely for their farm use. Most of antimicrobials are given in drinking water. In addition, village chickens are usually managed under the extensive system and they are neither vaccinated nor given any antibiotic medication [24, 25]. They mainly feed on left-over food, grasses and other waste which are dumped in the environment which expose them to receiving with pathogenic bacteria as well as antimicrobial resistant bacteria in the environment. Therefore, the objective of this study was to estimate the frequencies of contamination with multidrug-resistant (MDR) *E. coli* isolation and antimicrobial susceptibility testing of *E. coli* from commercial broiler and layer and free-range village chickens in Zeyar Thiri Township, Nay Pyi Taw.

**II. MATERIALS AND METHODS**

*Farm and sample collection*

A total of 100 cloacal swab samples, 49 from broiler, 11 from layer, and 40 from village chickens, were collected from January 2017 to January 2018 in Zeyar Thiri Township (Fig. 1). Broiler and layer samples represented commercial poultry farms, while village chicken samples represented households and small backyard farms. The samples were kept in Brain Heart Infusion (BHI) broth bottle, put into ice box (4–8°C), and transported to the Department of Veterinary Public Health, University of Veterinary Science within 30 minutes. Then the samples were subjected to isolation and identification processes.

![Fig. 1. Map of Zeyar Thiri Townships (Nay Pyi Taw Area)](https://www.themimu.info)

**Isolation and identification of *E. coli* from cloacal sample**

Collected cloacal swab samples were inoculated with BHI broth (Oxoid, Hampshire,
UK), directly streaked onto MacConkey agar No 3 (Oxoid, Hampshire, UK) plates, and incubated at 37°C for 24 hours. Colonies typical of lactose fermenter (pinkish colonies) were harvested and sub-cultured on nutrient agar (Oxoid, Hampshire, UK) at 37°C for 24 hours. Presumptive identification of *E. coli* was made based on the colonial morphology, gram-staining, oxidase and spot indole test, and it was further confirmed by analytical profile index (API, 20E) kits (BioMerieux, France) consisting of 20 biochemical tests for identification of *Enterobacteriaceae*. The reference strain *E. coli* ATCC 25922 was used as control. All field isolates and reference strains were stored at -80°C for further work.

**Antimicrobial susceptibility testing**

The antimicrobial resistance profiles of the 63 *E. coli* isolates from 63 chicken (20 broilers, 10 layers, 33 village chicken) were determined using disc diffusion method [26] on solid Mueller-Hinton medium following the guidelines of the Clinical and Laboratory Standards Institute (CLSI) [27, 28]. Susceptibility was tested against eleven antibiotics discs: amoxicillin/clavulanic acid (AMC) 20/10μg, ampicillin (AMP) 10μg, gentamicin (CN) 10μg, colistin sulphate (CT) 10μg, ceftiofur (EFT) 30μg, enrofloxacin (ENR) 5μg, cefoxitin (FOX) 30μg, cephalothin (KF) 30μg, neomycin (N) 30μg, sulfamethoxazole/trimethoprim (SXT) 1.25/23.7μg and tetracycline (Te) 30μg. They were purchased from Delta Science Co. Ltd, Myanmar (Oxoid UK products). Commercial antibiotic disks were purchased from Oxoid, UK. The plates were incubated at 37°C for 24 hours, after which the diameters of inhibition zones were measured and interpreted by referring to the reading table of Enterobacteria recommended by CLSI [27, 28]. The antimicrobial resistance levels were determined by European Food Safety Authority (ESFA), [15]. Terms used to describe the antimicrobial resistance level are; rare <0.1%, very low 0.1 to 1%, low >1 to 10%, moderate >10 to 20%, high >20 to 50%, very high >50 to 70% and extremely high >70% [15]. Multidrug-Resistant (MDR), not-MDR and susceptible strains were determined by international standard definition as previously reported [29].

**III. RESULTS**

*Occurrence of E. coli*

A total of 87 (87%) *E. coli* isolates were recovered from 100 swab samples, which were 89.8% (44/49) in broiler, 90.9% (10/11) in layer, and 82.5% (33/40) in village chicken.

*AMR patterns of E. coli isolated from broiler, layer and village chicken*

In broiler, AMR patterns were observed in all *E. coli* isolates. The isolates showed resistance to nine out of eleven antimicrobials tested, with the number ranging from four to nine. The isolates were extremely resistant to tetracycline (100%), enrofloxacin (100%), ampicillin (85%), sulfamethoxazole/trimethoprim (80%) and cephalothin (75%), highly resistant to gentamycin (50%), neomycin (45%) and amoxicillin/clavulanic acid (40%), moderately resistant to colistin sulphate (15%), and susceptible to cefoxitin and ceftiofur. In layer, the AMR patterns were observed in all *E. coli* isolates. The isolates showed resistance to eight out of eleven antimicrobials tested, with the number ranging from four to seven. The isolates were extremely resistant to ampicillin (100%), cephalothin (100%), tetracycline (90%), enrofloxacin (90%), highly resistant to amoxicillin/clavulanic acid (60%), highly resistant to sulfamethoxazole/trimethoprim (30%) and neomycin (30%), moderately resistant to gentamycin (10%), and susceptible to cefoxitin, ceftiofur, and colistin sulphate. In village chicken, the AMR patterns were observed in 31 out of 33 *E. coli* isolates. Two isolates (6.5%) were susceptible to all tested antimicrobials. The resistant isolates showed resistance to all antimicrobials tested, with the number ranging from one to ten. The isolates were extremely resistant to cephalothin (80.6%), very highly resistant to ampicillin (67.7%), tetracycline (58.1%), and enrofloxacin (54.8%), highly resistant to amoxicillin/clavulanic acid (41.9%), sulfamethoxazole/trimethoprim (32.3%), gentamicin and ceftiofur (29%) and neomycin (25.8%), moderately resistant to colistin sulphate (19.4%), and low resistant to cefoxitin (3.2%) (Table 1 and Fig. 2).
Table 1. Percentage of *E. coli* isolated from broiler, layer and village chicken showing resistance to types of antimicrobials

<table>
<thead>
<tr>
<th>No.</th>
<th>Antimicrobials (µg)</th>
<th>Resistance, no. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Broiler (n=20)</td>
</tr>
<tr>
<td>1</td>
<td>Tetracycline, TE (30)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>2</td>
<td>Enrofloxacin, ENR (5)</td>
<td>20 (100)</td>
</tr>
<tr>
<td>3</td>
<td>Ampicillin, AMP (10)</td>
<td>17 (85)</td>
</tr>
<tr>
<td>4</td>
<td>Sulfamethoxazole/trimethoprim, SXT (25)</td>
<td>16 (80)</td>
</tr>
<tr>
<td>5</td>
<td>Cephalothin, KF (30)</td>
<td>15 (75)</td>
</tr>
<tr>
<td>6</td>
<td>Gentamycin, CN (10)</td>
<td>10 (50)</td>
</tr>
<tr>
<td>7</td>
<td>Neomycin, N (30)</td>
<td>9 (45)</td>
</tr>
<tr>
<td>8</td>
<td>Amoxicillin/clavulanic acid, AMC (20/10)</td>
<td>8 (40)</td>
</tr>
<tr>
<td>9</td>
<td>Colistin sulphate, CT (10)</td>
<td>3 (15)</td>
</tr>
<tr>
<td>10</td>
<td>Ceftiofur, EFT (30)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>11</td>
<td>Cefoxithin, FOX (30)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

n = number of isolates

AMR level recommended by EFSA [15]: Extremely high\(^a\), Very high\(^b\), High\(^c\), Moderate\(^d\), low\(^e\) and S-susceptible
Fig. 2. Showing the percentage of E. coli isolates resistant to number of antimicrobials

A1=Resistant to 1 antimicrobials A6=Resistant to 6 antimicrobials
A2=Resistant to 2 antimicrobials A7=Resistant to 7 antimicrobials
A3=Resistant to 3 antimicrobials A8=Resistant to 8 antimicrobials
A4=Resistant to 4 antimicrobials A9=Resistant to 9 antimicrobials
A5=Resistant to 5 antimicrobials A10=Resistant to 10 antimicrobials

A total of 17, 5 and 23 different antibiotypes were detected in broiler, layer and village chickens, respectively. The most common antibiotype was TE-ENR-AMP-SXT in broilers, TE-ENR-AMP-KF-AMC in layers and AMP-KF-TE-ENR in village chickens. In broiler and layer, the multidrug resistance (MDR) was 100%; in village chicken, it was 61.3% while 32.3% were not-MDR (Fig. 3).

Fig. 3. Multidrug resistance percentage of E. coli in broilers, layers and village chickens

IV. DISCUSSION

Antimicrobial resistance is a worldwide major public health concern posing threats to humans and animals. It also has implication for food safety and food security, as well as producing negative impact on socio-economic status of farming households. The AMR contaminants are constantly growing and going across the boundaries that they spread among the countries [1, 33].

In the present study, the overall occurrence of E. coli isolated from broiler, layer farms and village chickens within Zeyar Thiri Township was 87%. The cloacal carriage of E. coli in broiler, layer and village chicken, were 89.8%, 90.9% and 82.5%, respectively, suggesting that there was no difference in isolation rates between different breeds of chicken in this study. Previously, there were some studies reporting the high occurrence of E. coli in broiler and layer chickens, which was 61% in Ayeyarwady Delta [19], 62% in Ayeyarwady Delta [17], 64% in Nay Pyi Taw [18], 100% in Pyawbwe, and Yamethine and Yezin [16, 21] respectively. There were previous studies in which E. coli occurrence was as high as 97% in village chicken from Yezin [20] and 98.5% in free-range chickens from India [24]. However, the occurrence in this study was higher than that of 72% in broiler and village chickens in Malaysia [30], 54.17% in Indonesia, 47% in Vietnam [31], and 36.8% in Thailand [5]. It is to note that the difference in occurrence of E. coli isolates might be due to difference in the type of sample collected, number of samples, identification procedure and geographical location, unhygienic condition of housing facilities, high fly population, presence of wild birds in the farm surrounding and lack of proper hygienic measures.

The high occurrence of E. coli in village chickens in this study can be explained that the local chicken in Myanmar are commonly reared under free-range conditions with little care, as chickens scavenge for food and water [25]. Hence there is chance of being exposed to environmental contaminants and MDR E. coli bacteria are higher in village chickens. Similar assumption was presented by Amadi et al. [24] revealing the high occurrence of AMR E. coli in village chicken despite the rare practice of vaccination or antibiotic treatment. It was attributed to their sources of feed, which includes the left-over food, grasses, animal manure and other environmental waste containing E. coli bacteria.
All the antimicrobials tested in this study were commonly used in poultry production and human medicine. By number, most of the E. coli isolates (98%) of this study were resistant to at least one antimicrobial and the maximum of ten was observed. In term of resistance pattern, all E. coli isolates from broiler and layer were sensitive to both cefoxitin and ceftiofur, but the isolates from layer chickens were more sensitive to colistin sulphate.

In term of the resistance level, E. coli isolates with extremely high level of resistance were recovered from all species of animals, that is, broiler, layer and village chicken. It was a signal indicating the overuse of antimicrobials in poultry, although a similar report, as high as 100% resistance to tetracycline, fluquinolones ampicillin and cephalothin, has been made by Soe Soe Wai et al. [21] in laying hens. Besides, these findings were also in agreement with previous reports in Myanmar that described extremely high AMR in broiler, layer, and village chicken in Nay Pyi Taw (88.9%) [18] and Ayeyarwady Delta (84.95%) [17], as well as other overseas reports, such as 66.7% in Vietnam [23] and 77.6% in Malaysia [30], 62.85% in Bangladesh [32] and 58.4% in Southeast Asian countries [31]. It is because tetracycline and fluoroquinolones are common therapeutic antimicrobials extensively used in commercial poultry farms [33] and the emergence of extremely high resistance could be due to excessive use of these drugs for the treatment of E. coli and other infections in poultry. However, as for village chicken, since they were kept as free-ranging and very rare or no use of antimicrobials is practiced with them, extremely high levels of resistance to cephalothin in this study was supposedly come from environment, probably the household soil and coop soil. Since village chickens are freely ranging and scavenging for food among the household, the acquisition of such resistance could be through transmissible mobile genetic elements from humans and environment.

Another category of resistance, that is, the high level of resistance in E. coli isolates (>20 to 50%), was detected in amoxacillin/clavulalic acid, sulfamethoxazole/trimethoprim, gentamycin and neomycin. Regarding the amoxacillin/clavulalic acid, findings from this study was in contrast to former studies in West Indies where the lowest resistance was detected against amoxicillin/clavulanic acid (0.5%) in E. coli isolates from free-range chicken [24]. This is an important point to be taken into account since the uses of these antimicrobials are not very common in veterinary medicine. However, for sulfamethoxazole/trimethoprim, finding from this study was lower compared to that of 70% in Myanmar [18] and 63% in China [34]. For gentamycin, high level of resistance (53.3%) was detected in poultry from this study, which was much higher compared to the previous studies reported on village chickens, 1% in Yezin [20] and 5.9% in West Indies [24], and on broiler and layer chickens, 18.68%, in Ayeyarwady Delta [19]. For neomycin, Khaing Thwe Latt, [35] and Soe Soe Wai et al. [21] reported the resistance of 61.4% in broiler and 100% in layer chickens, which was markedly higher than the finding of this study. However, Akond et al. [36] reported a much lower level of neomycin resistance (20%) in poultry from Bangladesh.

Following the extremely high and high level of resistance, it was observed that E. coli isolates from broilers and village chickens were moderately resistant to colistin (18.8%) and certiofur (12.9%), while low level of resistance to cefoxitin (3.2%) was detected in village chicken. Another finding, in which E. coli isolates from broiler and layer chickens were sensitive to cefoxitin, ceftiofur, and colistin agreed with the previous studies by Shwe Sin May Lwin Oo et al. [17] in Ayeyarwady Delta, Myanmar and Roseliza et al. [30] in Malaysia. Similarly, Ei Moh Moh Hmwe et al. [18] also reported that E. coli isolates from broilers and layers in Nay Pyi Taw were sensitive to ceftiofur, but resistant to cefoxitin. However, the results may vary depending on the geographical locations and antimicrobials used in each study. Although, village chickens rarely received antimicrobials, acquired resistance to β-lactam antibiotics in them is considered related to the transmissible mobile genetic elements, plasmids of transposons, from humans, animals, and environment.

Despite the presence of antimicrobial resistance patterns at various levels, 6.5% (2 out of 31) of isolates from village chicken were
found susceptible to all tested antimicrobials. It can be related to the organic farming which may limit the development and spread of antimicrobial resistance among food-borne bacteria. A study by Álvarez-Fernández et al. [37] revealed that antimicrobial resistance developed more quickly in commercially raised poultry than in organically farmed free-ranging ones. However, the occurrence of high resistance to some antimicrobials in village chickens in this study, with which no antimicrobials were used, suggested that antimicrobial-resistant *E. coli* strains were stable, able to transmit, and could persist in poultry even in the absence of selection pressure [38, 1, 33].

From this study, a total of 17, 5 and 23 different antibiotypes were detected in broiler, layer and village chickens, respectively. In broiler and layer, the multidrug resistance (MDR) was 100%; whereas in village chicken, it was 61.3% (MDR) vs 32.3% (not-MDR). It is important to note the occurrence of MDR *E. coli* in broiler, layer and village chickens in this study, since *E. coli*, being part of the endogenous microbiota, commensal and part of healthy intestinal tracts in general. This could be attributed to acquired resistance due to the intake of antimicrobials in humans and animals [7, 38, 33]. This can be seen in a previous study conducted in humans, in which a total of 38 (74.5%) *E. coli* isolates recovered from hospitalized patients in Yangon General Hospital showed 100% MDR (n=38) resistance to ampicillin, ciprofloxacin and nalidixic acid, as well as exhibiting high resistance (>80%) to cefotaxime, cephalotin, tetracycline, trimethoprim/ sulfamethoxazole, aztreonam and ceftazidime [22].

Indiscriminate use of antimicrobials has led to the emergence of AMR bacteria and over a prolonged period of time, MDR bacteria become prevalent among the population. It can be seen in this study that the MDR of *E. coli* in poultry has increased compared to that of previous study (17.5%) in Yezin areas [20], indicating that the prudent use of antimicrobials is in need to prevent the MDR significantly increasing over time [30].

Another explanation to the rise of AMR and MDR *E. coli* in poultry is the acquisition of resistant genes from contaminated sources in the environment, such as bacteria in water, caused by the overuse of antimicrobials for a prolonged period. Over time, the resistance traits in animal pathogens or commensal bacteria gradually spread following the exchange of DNA and finally become zoonotic and pure human pathogens [38, 7]. Therefore, it is important to restrict the misuse of antimicrobials in poultry by enforcing the regulations [19, 18, 39].

V. CONCLUSION

This finding highlighted the emergence of AMR in poultry, implying the risks of MDR *E. coli* to public health. Since village chicken are freely ranging and mainly feed on food remains and other waste materials in the environment, there is a chance to be easily exposed with the pathogenic bacteria, as well as antimicrobial resistant bacteria. This finding provides evidence regarding the emergence of AMR in free ranged village chickens despite the fact that the antimicrobials are rarely used in them. The occurrence of AMR in village chickens was to be revisited at the human-animal-environment interface since antimicrobials are rarely in them. Data from this study reinforce the importance of One Health approach in addressing the spread of antimicrobial resistance and emerging infections. The establishment of rules and regulations, alongside prudent use of antimicrobials, are deemed necessary.

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Abstract - Soil fertility plays an important role in the yield and quality of tomato. Nowadays, excessive and improper use of chemical fertilizers may lead to environmental pollution and soil deterioration. Combined application of organic and inorganic fertilizers enhances nutrient availability, improves crop productivity and soil fertility. To assess the plant growth and yield of tomato as effected by integrated use of compost and inorganic fertilizers was carried out at Horticulture Research Section, Department of Agricultural Research (DAR), Yezin during September to December (postmonsoon) 2017. The field experiment was arranged in a randomized complete block design (RCBD) with four replications for six treatments. The treatments were: straight fertilizer (SF) (114 kg N ha⁻¹, 114 kg P₂O₅ ha⁻¹, 222 kg K₂O ha⁻¹), ½ SF with compost, ½ SF with biocompost, ⅓ SF with compost, ⅓ SF with biocompost and compound fertilizer (15:15:15) with the rate of 56 kg N ha⁻¹, 56 kg P₂O₅ ha⁻¹, 56 kg K₂O ha⁻¹. The compost made from vegetable waste and biocompost made from vegetable waste with *Trichoderma harzianum* were applied at the rate of 54 t ha⁻¹. From this study, the plants applied with half dose of straight fertilizer with biocompost showed positive results in shoot and root fresh weight, shoot dry weight and yield of tomato although it was not significantly different from the plants applied with compound fertilizer and full dose of straight fertilizer. Moreover, this treatment also increased in uptake of nitrogen, phosphorus and potassium. The higher population density of *Trichoderma* species was also recorded from plants treated by ½ SF with biocompost than other treatments. According to these findings, integrated use of compost, biocompost and inorganic fertilizers could be applied for tomato production to support environmental friendly and sustainable agriculture.

Keywords: compost and biocompost, straight and compound fertilizers, plant growth and yield, tomato

Introduction

Tomato (*Lycopersicum esculentum* Mill.), a popular grown vegetable, belongs to the family Solanaceae and ranks third of worldwide vegetable production [1]. Tomato is a very important vegetable; it is used as an ingredient in many recipes, sauces, salads and drinks. It has much nutritional value with comparatively low prices than other vegetables. It was reported that tomato is an important source of nutrient and antioxidant such as lycopene and vitamin C [2].

Soil fertility plays an important role in the yield and quality of tomatoes [3]. Continuous use of chemical fertilizers may cause soil deterioration [4] and reduce the nutritional value and quality of edible fruits [5]. It can also reduce the dry matter content of tomato fruits [6] in addition to making the plants more susceptible to disease and insect attacks [7]. Nowadays, organic fertilizers
take a role in the use of inorganic fertilizers due to adverse effects on soil fertility and crop quality. Organic fertilizers such as compost and manures have a high ratio of organic matter to improve soil fertility and nutrient value [8] and they are farmyard manure, sewage sludge, crop residues and industrial waste [9]. These are used after composting which is a biological process by microorganisms convert organic materials into a dark humus-rich soil-like material called compost [10]. Quality composts can be produced from many different materials including feedstock, plant or animal material [11]. Their application increases soil organic matter content and improves the physical, chemical and biological properties of soil [12]. The effect of organic fertilizer to plants is similar to that of inorganic fertilizers [13] except that they release nutrients slowly [14] but can stay in the soil for longer periods. Organic fertilizers provide essential nutrients that improve crop growth and increase yield [15]. Organic fertilizers do not pollute the environment [16] which is beneficial to subsequent crops [15]. They suppress plant pest populations [17], control some crop diseases [18], prevent soil degradation and reduce the risk of water pollution [19]. They also increase the soil microbial biomass calcium, nitrogen, and phosphorus [20] by increasing the proportion of bacteria and decreasing the proportion of fungi [21]. Biofertilizer products containing living cells of different microorganisms, can prevent the depletion of the soil organic matter [22]. It has also been reported that application of biofertilizers increases yield and reduce environmental pollution [23].

The proper supply of nutrients in balance amount is very essential for maximum production of tomato. Chemical fertilizers are costly and sometimes may be unavailable that result in balance amount cannot be possible for crop growth. Almost all farmers are relying on commercial fertilizers for profitable yields, thus less or no buildup of organic matter occurs in the soil. Chemical fertilizers when applied continuously over the several years, it affects the physical properties of the soil and may not have the ability to produce more yields [24]. Under such circumstances, integration of chemical and organic fertilizers plays a key role to sustain soil fertility and produce maximum yield. Kumar and Sharma reported that the use of organic fertilizer sources with mineral nitrogen, phosphorus and potassium fertilizers were found more beneficial in terms of maximum yield and in providing macronutrients in tomato production [25]. Single source of nutrients such as mineral fertilizers, compost, animal manures and bio-fertilizers cannot meet the nutrient requirements of the crops for sustainable production; therefore, a suitable ratio of organic and inorganic fertilizers is necessary for higher crop yield [25]. There is few academic information on the integrated use of compost and inorganic fertilizers on tomato production. Therefore, the present study was conducted to assess the plant growth and yield of tomato as affected by integrated use of compost and inorganic fertilizers.

2. Materials and Methods

The field experiment was carried out at Horticulture Research Section, Department of Agricultural Research (DAR), Zayarthiri Township, Nay Pyi Taw during postmonsoon season from September to December 2017. Tomato seeds of hybrid variety (Platinum -701) were sown in seed tray filled with sandy loam soil added with well decomposed compost in the ratio of 3:1 by v/v. Twenty five days old age of seedling, uniform size and healthy plant was
transplanted in each pit. The unit plot size was 5 m × 1 m and spacing was 60 cm × 60 cm. The intercultural operations such as weeding, staking, irrigation, etc. were done if necessary.

The composts made from vegetable waste with or without *Trichoderma harzianum* compost were used in this experiment. The pits of making of compost by vegetable waste were done in the size of (2.0 m x 1.0 m x 1.0 m). For making of biocompost, 450 grams of *Trichoderma harzianum* substrates were mixed in each compost pit. Then it was left for 70 to 80 days for complete decomposition of original materials.

The field experiment was laid out in a randomized complete block design (RCBD) using six treatments with four replications. The treatments were: straight fertilizer (SF) (114 kg N ha⁻¹, 114 kg P₂O₅ ha⁻¹, 222 kg K₂O ha⁻¹), ½ SF with compost, ½ SF with biocompost, ⅓ SF with compost, ⅓ SF with biocompost and compound fertilizer (15:15:15) with the rate of 56 kg N ha⁻¹, 56 kg P₂O₅ ha⁻¹, 56 kg K₂O ha⁻¹. Straight fertilizers were applied in three splits as a basal, 25 and 40 days after transplanting for each plot [26]. The application of compost and biocomposts with the rate of 54 t ha⁻¹ was used to the soil before transplanting of the seedlings. For compound fertilizer of 15:15:15 was used in three equal splits similar to straight fertilizers application with the rate of 150 kg ac⁻¹.

The data were randomly collected from five sample plants in each plot. Plant height (cm), number of leaves and branches per plant, root and shoot fresh weight, root and shoot dry matter weight (g) per plant by oven dried at 70°C for 3 days were recorded at harvest. Number of trusses per plant and number of flowers per truss were determined during peak flowering stage. Mature and ripe tomatoes were harvested and weighed at 3 day intervals. The uptake of N, P, K and fruit quality data of firmness, TTA% and Brix% were measured after harvesting. Population density of *Trichoderma* spp. in the soil before and after growing was determined. Data analysis on variance and mean comparison were analyzed separately with statistical package CropStat version 7.2. The treatment means were compared by using the least significance difference (LSD) test at 5% level.

3 Results and Discussions
3.1 Plant growth characters of tomato as influenced by the integrated use of compost and inorganic fertilizer

The mean data of plant growth characters of tomato as influenced by compost and inorganic fertilizers showed in Table 1. The results showed that plant height, number of branches, number of leaves, root dry weight were not significantly different among the treatments. However, the highest values in plant height (98.99 cm), number of branches (4.55), number of leaves (15.60) and root dry weight (2.89 g) were obtained in plants treated with ½ dose of straight fertilizer and biocompost. Integrated use of biocompost and inorganic fertilizers were significantly affected on shoot and root fresh weight, shoot dry weight of tomato. Among the treatments, maximum shoot fresh weight (136.45 g) was obtained with the application of ½ dose of straight fertilizer and biocompost which was statistically similar to full dose of straight fertilizer (135.73 g) while not significantly different from compound fertilizer (133.71 g). The lowest shoot fresh weight of 121.69 g was recorded in ⅔ dose of straight fertilizer and compost which was not significantly different from ⅓
dose of straight fertilizer and compost (125.69 g) and \( \frac{1}{3} \) dose of straight fertilizer and compost treatments (124.90 g).

Shoot dry weight of 17.59 g was significantly higher in \( \frac{1}{2} \) dose of straight fertilizer and biocompost than others and that was not statistically different from full dose of straight fertilizer (14.93 g) and compound fertilizer (12.76 g). The lowest shoot dry weight (8.62 g) was found in \( \frac{1}{3} \) dose of straight fertilizer and compost which was statistically similar to \( \frac{1}{3} \) dose of straight fertilizer and biocompost (9.32 g) and that was not statistically different from \( \frac{1}{2} \) dose of straight fertilizer and compost (11.04 g).

Plants treated with \( \frac{1}{2} \) dose of straight fertilizer and biocompost and then full dose of straight fertilizer produced maximum root fresh weight of 16.37 g and 16.17 g respectively. These treatments were not statistically different from compound fertilizer (15.10 g). The minimum root fresh weight was found in plants treated with \( \frac{1}{2} \) dose of straight fertilizer and compost (14.29 g) which was statistically similar to \( \frac{1}{3} \) dose of straight fertilizer and compost (14.35g) and \( \frac{1}{3} \) dose of straight fertilizer and biocompost (14.44 g). Khan et al. reported that urea is a rich source of N for increasing vegetative growth of plants as compared to organic fertilizer sources but the combined use of these sources was found more effective [27]. Molla et al. reported that combined application of biofertilizers and chemical fertilizer enhanced vegetative and reproductive growth, yield and nutritional quality of tomato by slow and steady release of nutrient to the plants than the sole application of NPK fertilizer [28].
Table 1. Plant growth characters of tomato as influenced by the integrated use of compost and inorganic fertilizers

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant Height (cm)</th>
<th>No. of Branches plant(^{-1})</th>
<th>No. of Leaves plant(^{-1})</th>
<th>Shoot Fresh Weight plant(^{-1}) (gm)</th>
<th>Shoot Dry Weight plant(^{-1}) (gm)</th>
<th>Root Fresh Weight plant(^{-1}) (gm)</th>
<th>Root Dry Weight plant(^{-1}) (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>91.26</td>
<td>4.45</td>
<td>15.13</td>
<td>135.73 a</td>
<td>14.93 ab</td>
<td>16.17 a</td>
<td>2.56</td>
</tr>
<tr>
<td>(\frac{1}{2}) SF+compost</td>
<td>94.87</td>
<td>4.45</td>
<td>15.58</td>
<td>125.69 bc</td>
<td>11.04 bc</td>
<td>14.29 b</td>
<td>2.13</td>
</tr>
<tr>
<td>(\frac{1}{2})SF+biocompost</td>
<td>98.99</td>
<td>4.55</td>
<td>15.60</td>
<td>136.45 a</td>
<td>17.59 a</td>
<td>16.37 a</td>
<td>2.89</td>
</tr>
<tr>
<td>(\frac{1}{3})SF+compost</td>
<td>85.03</td>
<td>4.05</td>
<td>15.30</td>
<td>121.69 c</td>
<td>8.62 c</td>
<td>14.35 b</td>
<td>1.81</td>
</tr>
<tr>
<td>(\frac{1}{3})SF+biocompost</td>
<td>89.65</td>
<td>4.55</td>
<td>15.02</td>
<td>124.90 bc</td>
<td>9.32 c</td>
<td>14.44 b</td>
<td>1.93</td>
</tr>
<tr>
<td>CF</td>
<td>91.90</td>
<td>4.10</td>
<td>15.45</td>
<td>133.71 ab</td>
<td>12.76 abc</td>
<td>15.10 ab</td>
<td>2.13</td>
</tr>
</tbody>
</table>

Mean values in a column followed by the same letter are not significantly different at 5% LSD

ns = non significant, * = significant
straight fertilizer (SF)(114 kg N ha\(^{-1}\),114 kg P\(_2\)O\(_5\) ha\(^{-1}\), 222 kg K\(_2\)O ha\(^{-1}\)), \(\frac{1}{2}\) straight fertilizer (57 kg N ha\(^{-1}\),57 kg P\(_2\)O\(_5\) ha\(^{-1}\), 111 kg K\(_2\)O ha\(^{-1}\)) and compost (54t ha\(^{-1}\)), \(\frac{1}{2}\) straight fertilizer and biocompost (54 t ha\(^{-1}\)), \(\frac{1}{3}\) straight fertilizer (38 kg N ha\(^{-1}\),38 kg P\(_2\)O\(_5\) ha\(^{-1}\), 74 kg K\(_2\)O ha\(^{-1}\)) and compost (54t ha\(^{-1}\)), \(\frac{1}{3}\) straight fertilizer and biocompost (54 t ha\(^{-1}\)) and compound fertilizer (CF) (56 kg N ha\(^{-1}\), 56 kg P\(_2\)O\(_5\) ha\(^{-1}\), 56kg K\(_2\)O ha\(^{-1}\))

3.2 Yield and yield component characters of tomato as influenced by the integrated use of compost and inorganic fertilizer

Table 2 showed the data recorded on yield and yield component characters of tomato as affected by organic and inorganic fertilizers. The results showed that there were not significantly different in number of trusses per plant, number of fruit per plant and fruit setting percent of tomato among the treatments. But, the number of trusses per plant (7.75), number of fruit per plant (19.55) and fruit setting percent (46.42) of tomato plants treated with \(\frac{1}{2}\) dose of straight fertilizer and biocompost were greater than those of other treatments. The plants treated with \(\frac{1}{3}\) dose of straight fertilizer and compost showed the lowest number of trusses per plant (5.83) and then the minimum number of fruit per plant (10.95) and fruit setting percent (39.37) of tomato were observed in \(\frac{1}{3}\) dose of straight fertilizer and biocompost.

Fruit weight per plant and yield were significantly affected by the addition of compost and inorganic fertilizer. Among the treatments, maximum tomato fruit weight per plant of 0.63kg and fruit yield of 16.95 t ha\(^{-1}\) were recorded in the plants applied with \(\frac{1}{2}\) dose of straight fertilizer and biocompost that was not statistically different from full dose of straight fertilizer (0.52 kg, 13.94 t ha\(^{-1}\)) and compound fertilizer (0.51 kg, 13.72 t ha\(^{-1}\)). The lowest tomato fruit weight per plant (0.26 kg) and fruit yield (6.84 t ha\(^{-1}\)) were observed in \(\frac{1}{3}\)}
dose of straight fertilizer and biocompost which was not significantly different from ⅓ dose of straight fertilizer and biocompost (0.39 kg, 10.22 t ha⁻¹) and ½ dose of straight fertilizer and compost (0.41 kg, 11.03 t ha⁻¹).

The better performance of the tomato plants with compost and inorganic fertilizers may be due to increase nutrient availability. The same results were reported by Lal and Dayal that superior physical fruit quality might be due to the integrated effect of goat manure applied with inorganic fertilizers which enhanced the nutrients availability and improved the plant capability of more nutrients uptake from the surrounding soil [29]. The integrated application of biocompost or combination of biocompost and NPK gave the highest yield [30]. Hellemi and Azarovit reported that application of composted cattle manure about 30 to 40 t ha⁻¹ along with inorganic fertilizers was required to achieve higher yield in conventional tomato production [31].
Table 2. Yield and yield component characters of tomato as influenced by the integrated use of compost and inorganic fertilizers

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of Trusses plant(^{-1})</th>
<th>Fruit Setting Percent (%)</th>
<th>No. of Fruits plant(^{-1})</th>
<th>Fruit Weight plant(^{-1}) (kg)</th>
<th>Yield (t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>6.80</td>
<td>46.05</td>
<td>15.35</td>
<td>0.52 ab</td>
<td>13.94 ab</td>
</tr>
<tr>
<td>½ SF+compost</td>
<td>6.69</td>
<td>45.72</td>
<td>13.95</td>
<td>0.41 abc</td>
<td>11.03 abc</td>
</tr>
<tr>
<td>½ SF+bio compost</td>
<td>7.75</td>
<td>46.42</td>
<td>15.36</td>
<td>0.63 a</td>
<td>16.95 a</td>
</tr>
<tr>
<td>½ SF+compost</td>
<td>6.50</td>
<td>39.37</td>
<td>13.95</td>
<td>0.26 c</td>
<td>6.84 c</td>
</tr>
<tr>
<td>1/3 SF+bio compost</td>
<td>5.83</td>
<td>42.54</td>
<td>13.85</td>
<td>0.39 bc</td>
<td>10.22 bc</td>
</tr>
<tr>
<td>CF</td>
<td>7.85</td>
<td>39.83</td>
<td>14.25</td>
<td>0.51 ab</td>
<td>13.72 ab</td>
</tr>
</tbody>
</table>

Mean values in a column followed by the same letter are not significantly different at 5% LSD

ns = non significant, * = significant

straight fertilizer (SF)(114 kg N ha\(^{-1}\), 114 kg P\(_2\)O\(_5\) ha\(^{-1}\), 222 kg K\(_2\)O ha\(^{-1}\)), ½ straight fertilizer (57 kg N ha\(^{-1}\), 57 kg P\(_2\)O\(_5\) ha\(^{-1}\), 111 kg K\(_2\)O ha\(^{-1}\)) and compost (54t ha\(^{-1}\)), ½ straight fertilizer and bio compost (54 t ha\(^{-1}\)), 1/3 straight fertilizer (38 kg N ha\(^{-1}\), 38 kg P\(_2\)O\(_5\) ha\(^{-1}\), 74 kg K\(_2\)O ha\(^{-1}\)) and compost (54t ha\(^{-1}\)), 1/3 straight fertilizer and bio compost (54 t ha\(^{-1}\)) and compound fertilizer (CF) (56 kg N ha\(^{-1}\), 56 kg P\(_2\)O\(_5\) ha\(^{-1}\), 56kg K\(_2\)O ha\(^{-1}\))

3.3 Fruit quality of tomato as influenced by the integrated use of compost and inorganic fertilizer

Table 3 showed the fruit quality of tomato. There was no significantly different in fruit quality of tomato among the treatments. However, the mean value of the plants treated with ½ dose of straight fertilizer and bio compost increased the total soluble solid of fruit (4.40) followed by straight fertilizer (4.10). The minimum value of total soluble solid of tomato was observed in the application of ½ dose of straight fertilizer and compost treatment (3.80).

The maximum amount of titratable acidity content of 0.28 was recorded in ½ dose of straight fertilizer and bio compost, followed by the treatments ½ dose of straight fertilizer with compost and ½ dose of straight fertilizer with compost while the minimum amount of 0.25 was found in treatments ½ dose of straight fertilizer with bio compost, straight fertilizer and compound fertilizer. Among the treatments, combined application of ½ dose of straight fertilizer and bio compost treatment recorded a maximum fruit firmness of tomato (2.01) as compared to the full dose of straight fertilizer. The lowest fruit firmness of 1.88 was obtained from fruit of straight fertilizer treatment. Increase in quality parameters might be due to increased availability of nutrients, as they play a vital role in enhancing the fruit quality of tomato and...
minimum value might be due to lack of availability of sufficient nutrients. Meherunnessa et al. and Ibrahim and Fadni found that compost and chemical fertilizer alone or in combination has positive influence on fruit quality of tomato [32] [33]. Khan et al. reported that the yield and quality parameters of tomato fruits increased significantly with the integrated use of compost and inorganic fertilizers [27].

**Table 3. Fruit quality of tomato as influenced by the integrated use of compost and inorganic fertilizers**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Brix (%)</th>
<th>Total titratable acidity (%)</th>
<th>Firmness (kg cm⁻²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>4.10</td>
<td>0.25</td>
<td>1.88</td>
</tr>
<tr>
<td>½ SF + compost</td>
<td>3.80</td>
<td>0.26</td>
<td>1.96</td>
</tr>
<tr>
<td>½ SF + biocompost</td>
<td>4.40</td>
<td>0.25</td>
<td>2.01</td>
</tr>
<tr>
<td>⅓ SF + compost</td>
<td>3.98</td>
<td>0.26</td>
<td>1.93</td>
</tr>
<tr>
<td>⅓ SF + biocompost</td>
<td>4.03</td>
<td>0.28</td>
<td>1.93</td>
</tr>
<tr>
<td>CF</td>
<td>3.90</td>
<td>0.25</td>
<td>1.91</td>
</tr>
</tbody>
</table>

F-test ns ns ns
CV% 10.1 10.3 3.9
5%LSD 0.61 0.03 0.11

Mean values in a column followed by the same letter are not significantly different at 5% LSD

ns = non significant

straight fertilizer (SF)(114 kg N ha⁻¹, 114 kg P₂O₅ ha⁻¹, 222 kg K₂O ha⁻¹), ½ straight fertilizer (57 kg N ha⁻¹, 57 kg P₂O₅ ha⁻¹, 111 kg K₂O ha⁻¹) and compost (54t ha⁻¹), ½ straight fertilizer and biocompost (54 t ha⁻¹), ⅓ straight fertilizer (38 kg N ha⁻¹, 38 kg P₂O₅ ha⁻¹, 74 kg K₂O ha⁻¹) and compost (54t ha⁻¹), ⅓ straight fertilizer and biocompost (54 t ha⁻¹) and compound fertilizer (CF) (56 kg N ha⁻¹, 56 kg P₂O₅ ha⁻¹, 56 kg K₂O ha⁻¹)

**3.4 The uptake of N, P, K by tomato plants as influenced by the integrated use of compost and inorganic fertilizer**

The N P K uptake by tomato plant as influenced by combined use of compost and inorganic fertilizers are showed in Table 4. The results showed that the uptake of N P K by tomato plant was affected by integrated use of compost and inorganic sources. The N P K uptake of 0.49, 0.12, 0.40 was the highest with the application of ½ dose of straight fertilizer and biocompost. The lowest N P K uptake of 0.21, 0.06, 0.12 was found in compound fertilizer treated plants. The application of compost and inorganic fertilizers increased the nutrient availability and soil microbial activity which resulted in more uptake of nutrient ultimately enhanced the growth of tomato crop. Manoj et al. reported that the highest uptake of N, P and K was found in the application of inorganic fertilizers and organic fertilizer [34].

**Table 4. The uptake of N, P, K by tomato plants as influenced by the integrated use of compost and inorganic fertilizers**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N (g/plant)</th>
<th>P (g/plant)</th>
<th>K (g/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>0.33</td>
<td>0.10</td>
<td>0.22</td>
</tr>
<tr>
<td>½ SF + compost</td>
<td>0.35</td>
<td>0.11</td>
<td>0.31</td>
</tr>
<tr>
<td>½ SF + biocompost</td>
<td>0.49</td>
<td>0.12</td>
<td>0.40</td>
</tr>
<tr>
<td>⅓ SF + compost</td>
<td>0.20</td>
<td>0.07</td>
<td>0.29</td>
</tr>
<tr>
<td>⅓ SF + biocompost</td>
<td>0.27</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td>CF</td>
<td>0.21</td>
<td>0.06</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**3.5 Population density of Trichoderma spp. before growing and harvested soil of tomato as influenced by the integrated use of compost and inorganic fertilizer**

Population density of Trichoderma spp. as affected by combined use of compost and inorganic fertilizers are showed in Table 5. The addition of compost and chemical fertilizers affected population density of Trichoderma spp. in harvested soil. The
results indicated that all treatments caused increase in population density of *Trichoderma* spp. when compared with the soil before growing. The total propagules count of *Trichoderma* spp. in harvested soil of treated with compost and inorganic fertilizers treatments were greater than straight fertilizers and compound fertilizer application. Among the treatments, the highest population density was obtained with application of $\frac{1}{2}$ dose of straight fertilizer and biocompost. The lowest population density of *Trichoderma* spp. was obtained in compound fertilizer alone. Increase in population density of *Trichoderma* spp. might be due to increase in the nutrient content of the soil. Mohaedy et al. reported that population density of *Trichoderma* spp. was increased in rhizosphere soil of mandarin trees by biocompost which was made from agricultural wastes [35].

Table 5. Population density of *Trichoderma* spp. before growing and harvested soil of tomato as influenced by the integrated use of compost and inorganic fertilizers

<table>
<thead>
<tr>
<th>Treatment</th>
<th><em>Trichoderma</em> spp. (cfu/gm of soil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>$1.00 \times 10^7$</td>
</tr>
<tr>
<td>SF</td>
<td>$1.25 \times 10^7$</td>
</tr>
<tr>
<td>$\frac{1}{2}$ SF+compost</td>
<td>$1.50 \times 10^8$</td>
</tr>
<tr>
<td>$\frac{1}{2}$ SF+biocompost</td>
<td>$2.35 \times 10^8$</td>
</tr>
<tr>
<td>$\frac{1}{3}$ SF+compost</td>
<td>$1.25 \times 10^8$</td>
</tr>
<tr>
<td>$\frac{1}{3}$ SF+biocompost</td>
<td>$1.40 \times 10^8$</td>
</tr>
<tr>
<td>CF</td>
<td>$1.00 \times 10^7$</td>
</tr>
</tbody>
</table>

cfu – colony forming unit

4. Conclusion

Among the treatments, $\frac{1}{2}$ dose of straight fertilizer and biocompost treated plants gave the positive effects in plant growth character such as shoot and root fresh weight, shoot dry weight. However, yield of tomato was not significantly different from the plants treated with compound fertilizer and full dose of straight fertilizer. That means, yield of tomato as affected by the integrated use of compost and inorganic fertilizer can be compared to the yield of plants treated with the only application of inorganic fertilizers such as compound and straight fertilizer. Moreover, N P K uptake and population density of *Trichoderma* spp. of harvested soil were increased when the combination of $\frac{1}{2}$ dose of straight fertilizer and biocompost was used. Integrated use of organic and inorganic fertilizers can reduce the use of chemical fertilizers. Therefore, combined application of compost and inorganic fertilizers would help to maintain the long term soil productivity for sustainable crop production and support environmental friendly.

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References


[18] F. M. P. Viana, R. F. Kobory, W. Bettiol and S. C. Athayde, Control of damping-off in bean plant caused by *Sclerotinia sclerotiorum* by the incorporation of organic matter in the


Abstract— Myanmar stood as the largest sesame seed producer in Asia and second largest global producer in 2017. Sesame is mainly grown in central dry zone of Myanmar and Magway Region occupied the largest sesame sown area for many years. Only less than 15% of total sesame production could reach to export market due to many constraints along sesame supply chain. Traditional production practices and fragmented linkages among stakeholders are major barriers to expand share in world market. Facilitating the production and marketing constraints are getting important along sesame supply chain. Informal contract agreement among sesame farmers and buyers is practicing along with encouraging Good Agricultural Practices in Magway Region. This study will point out production and marketing constraints and performances of sesame supply chain stakeholders under informal contract system and conventional one. Aung Lan Township was purposively selected due to wide sown area of top export sesame variety named Sahmon Nat in Magway Region for this study. By using stratified random sampling procedure, sesame farmers, wholesalers, processors and exporters were individually interviewed with structured questionnaires from November, 2017 to February, 2018. Farm and household characteristics, constraints, marketing activities of supply chain stakeholders were collected and descriptive statistics, cost and return analysis and marketing margin analysis were applied with STATA 14 statistical software. The findings indicated that contract farmers were younger, and less farming experience as compared to non-contract farmers. Education level of wholesalers, processors and exporters were higher than that of farmers. Contract farmers received credit and market information from more diverse sources and more participated in training, meeting and field demonstration which mostly related to sesame production practices in comparison with non-contract farmers. Contract farmers used high dose of farm yard manure, compound fertilizer and fungicide, thus, their production cost per hectare was slightly higher. However, it did not affect their benefit as a result of better sesame yield as compared to non-contract farmers. All stakeholders apart from processors sold raw sesame and there was still lack of advanced technology in quality checking and grading, some of wholesalers used fan air dry or sun dry and only exporters had the capacities to use color sorter and cleaning machine to get better quality sesame. Climate change, labor scarcity and high input cost were major constraints for rain-fed dependent and labor-intensive sesame farmers while low quality sesame due to chemical residue problem, price fluctuation, lack of capital, and advance technology were common constraints for all stakeholders although they received reasonable profits at each nodes of supply chain. All stakeholders should pay attention to not only quality improvement but also overcoming current constraints along supply chain in order to maintain global export share of Myanmar sesame.

Keywords: Sesame, Supply Chain, Contract, Myanmar

I. INTRODUCTION

Agriculture sector remains important role in agrarian Myanmar’s economy. It provides food and employment opportunities for the growing population and also contributes a large part of export earnings. Oilseed crops covered about 16.21% of total crop sown areas which was the third most important crop group in Myanmar agriculture after cereals and pulses during 2017-2018, as illustrated in Fig.1. The most extensive and traditional oilseed crop in Myanmar is sesame which occupied about 48.83% of total oilseed crop areas in 2017-2018 as shown in Fig. 2 [3].
In Myanmar, sesame is economically important for producing edible oil and export. Table 1 indicated that Myanmar was the second largest global sesame producer after Tanzania in 2017. Being as one of the leading sesame producing countries in the world, Myanmar took 34.81% and 13.81% of the total sesame production in Asia and in the world respectively. However, Myanmar reached only 1.29% and 1.86% of global sesame export volume and value in 2016 [2].

Table 1. Harvested area, yield, production and export status of sesame by top seven global sesame producing countries in 2017

<table>
<thead>
<tr>
<th>Country</th>
<th>Harvested area (’000 Ha)</th>
<th>Avg. yield (MT/ Ha)</th>
<th>Production (’000 MT)</th>
<th>Export quantity* (’000 MT)</th>
<th>Export value* (Million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>9,983.17</td>
<td>0.55</td>
<td>5,531.95</td>
<td>1,895.58</td>
<td>2,069.27</td>
</tr>
<tr>
<td>Asia</td>
<td>3,952.06</td>
<td>0.56</td>
<td>2,195.09</td>
<td>460.94</td>
<td>610.41</td>
</tr>
<tr>
<td>Tanzania</td>
<td>750.00</td>
<td>1.07</td>
<td>805.69</td>
<td>133.75</td>
<td>129.57</td>
</tr>
<tr>
<td>Myanmar</td>
<td>1,478.16</td>
<td>0.52</td>
<td>764.32</td>
<td>24.51</td>
<td>38.41</td>
</tr>
<tr>
<td>India</td>
<td>1,800.00</td>
<td>0.42</td>
<td>751.32</td>
<td>325.91</td>
<td>415.20</td>
</tr>
<tr>
<td>Sudan</td>
<td>2,141.34</td>
<td>0.26</td>
<td>550.00</td>
<td>258.54</td>
<td>259.14</td>
</tr>
<tr>
<td>Nigeria</td>
<td>500.00</td>
<td>1.10</td>
<td>550.00</td>
<td>172.84</td>
<td>209.68</td>
</tr>
<tr>
<td>China</td>
<td>260.67</td>
<td>1.40</td>
<td>366.00</td>
<td>26.27</td>
<td>49.21</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>293.65</td>
<td>0.79</td>
<td>231.19</td>
<td>382.05</td>
<td>383.59</td>
</tr>
</tbody>
</table>

Note: Export * data are available for 2016
Source: FAO, 2018

Myanmar cultivates three main types of sesame; (1) white sesame which is roasted and used in snacks and in salads, (2) red sesame which is mainly used for oil extraction, (3) black that is mainly exported to Japan and few in local consumption especially for sesame brittle [3]. Sesame is grown three seasons namely rain-fed or monsoon season, summer or pre-monsoon season and winter or post-monsoon season. In 2017-2018, the sown area of rain-fed or monsoon sesame was accounted for about 1161,387 hectares which was 74.16 percent of the total sesame area [1]. Nearly ninety percent of the sesame are grown in the central dry zone of Myanmar: Magway, Mandalay and Sagaing Regions in 2017-2018. Magway Region stood as the largest sesame sown area in Myanmar which contributed about 520.19 thousand hectares (34%) of the national total area of sesame cultivation [1].

Figure 3 revealed that the sown area of sesame in Myanmar which gradually increased from 1,338 thousand hectares in 2005-2006 to 1,590 thousand hectares in 2017-2018. Yield per hectare of sesame also increased from 0.40 MT per hectare in 2005-2006 to 0.54 MT per hectare in 2017-2018. Consequently, total production also increased because of expansion of area and improved yield. The clear trend of increasing sown area and total sesame production can be seen in 2015-2016 across a decade [4].

Sesame is mostly exported in the form of raw seed, roasted seed, powder and edible oil which is depending upon the international/ foreign market demand. Myanmar sesame seed has been exported yearly to the countries such as China, Japan, Singapore, Taiwan, Denmark, Republic of Korea, Malaysia, Hong Kong and India. The intake of foreign markets depends on the colors of the sesame and among the cultivated strains of “Ordinary black sesame” “White sesame” “Red sesame” “Brown sesame”. Black colored cultivar, “Sahmon Nat” that is mainly cultivated in Aung Lan Township, Magway Region fetched the highest prices in Japanese markets and Japan has mainly imported that kind of sesame from Myanmar. Myanmar sesame export volume was high in 2012-2013 and 2013-2014 then it gradually went down less than 100,000 MT during 2014-2015 and 2015-2016. However, about 120,999.37 MT of sesame could be exported to different destinations and the export value was 147 million US$ in 2017-2018, in Fig. 4 [5].
Nevertheless Myanmar stood as the largest sesame seed producer in Asia and the second largest global producer of sesame in 2017, only less than 15% of total sesame production could reach to export market due to many constraints along the supply chain [2]. Major problems are price uncertainty, unpredictable rainfall, low productivity and quality of sesame, lack of marketing laws and regulations [6]. Traditional production practices and fragmented linkages among stakeholders are major barriers to expand export share in world market. Facilitating the production and marketing constraints along with considering food safety criteria become important role along Myanmar sesame supply chain. Informal contract agreement between sesame farmers and buyers is practicing along with encouraging Good Agricultural Practices in Magway Region where there is under the largest sesame area. Contract farming scheme was launched in Magway Region since 2003 and the contract companies provided sesame seeds, capital, efficient pesticide spraying method and SPS (sanitary and phytosanitary) demonstration to contract farmers and also purchased black sesame seeds which were exported to Toyota Tsusho Food Corporation and Kanematsu Corporation in Tokyo, Japan [6]. Currently, many local wholesalers at Aung Lan Township, Magway Region are providing sesame seeds and credit via informal contract agreements to sesame farmers. However, there is very limited study indicating the status of farmers and other stakeholders along sesame supply chain in comparison with contract agreement and traditional ones. Therefore, this study will point out production and marketing activities including the constraints as well as the performances of sesame supply chain stakeholders under informal contract system and conventional one in order to clearly understand which one is better for supply chain stakeholders.

II. RESEARCH METHODOLOGY

A. Study Area

Aung Lan Township, Magway Region was purposively selected due to practicing informal contract scheme and wide sown area of top export sesame variety named Sahmon Nat.

B. Data Collection and Sampling Method

The earlier reconnaissance survey was conducted in Aung Lan Township during November 2017. Information about contract farming activities, situation of the study area was gathered by means of direct observation and discussion with the field supervisors of Department of Agriculture and some supply chain stakeholders in Aung Lan Township. Thereafter, the study villages and involved stakeholders were noted. This study focused only on contracting with Sahmon Nat variety producers, thus, stakeholders included farmers, wholesalers, food processors and exporters as that variety is not used for edible oil. Finally, different sets of questionnaires for sesame supply chain stakeholders could be improved to fit with real situation.

Stratified random sampling procedure was applied to gather primary data such as farm and household characteristics, socio-economic conditions, production and marketing activities and constraints faced by the different supply chain stakeholders. Sample respondents were individually interviewed with different sets of structured questionnaires during December 2017 and February 2018. Total 102 sesame farmers composed of 60 contract farmers and 42 independent farmers based on their participation into contract scheme during 2017-2018 monsoon sesame cultivation were randomly interviewed in selected five villages. Also, 14 wholesalers and 2 food processors in Aung Lan Township and 5 sesame exporters in Yangon Region were also individually interviewed to cover the whole supply chain. Secondary data such as temperature and rainfall, cropping pattern, crop yield, sesame export volume and value, etc were collected from published and official records of Ministry of Agriculture, Livestock and Irrigation (MOALI), Ministry of Commerce (MoC), Central Statistical Organization (CSO), Food and Agriculture Organization (FAO) and Union...
of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI), etc.

Descriptive statistics, cost and return analysis and marketing margin analysis were applied with the help of STATA 14 statistical software to deliberate the meaningful findings.

III. RESULTS AND DISCUSSIONS

A. Socioeconomic Characteristics of Sample Farmers

There was no significant difference in age and farming experience between contract and non-contract farm household heads in study area, as shown in Table 2. The average age of contract farm household heads was 47.63 years and that of non-contract farm household heads were 49.24 years. The average experiences in farming of contract farmers were 25.25 years while that of non-contract farmers were 26.19 years. Both groups occupied secondary education level, however, non-contract farmers had significant high schooling years which were 6.71 years in comparison with contract farmers which were 5.25 years.

The majority of sample respondents were male and there were no female respondents in contract farmer group. However, only a few respondents which were 7.14% of sample non-contract respondents were female as presented in Fig. 5.

Table 2. Demographic characteristics of sample farm household heads in Aung Lan Township (Unit = Years)

<table>
<thead>
<tr>
<th>Items</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47.63(29 - 72)</td>
<td>49.24(32 - 74)</td>
<td>48.29(29 - 74)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.78**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farming experience</td>
<td>25.25 (5 - 58)</td>
<td>26.19 (2 - 55)</td>
<td>25.64 (2 - 58)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.38**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schooling year</td>
<td>5.25 (2 - 14)</td>
<td>6.71(2 - 14)</td>
<td>5.85 (2 - 14)</td>
</tr>
<tr>
<td>t-test</td>
<td>2.22**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the parentheses represent range. *, ** and ***are significant at 10%, 5%, 1% level and ns is not significant differences respectively.

Figure 5. Gender status of sample respondents in Aung Lan Township

Family size, numbers of different age groups of family members and agricultural labors were not statistically significant differences between contract and non-contract households as shown in Table 3. The average family size of contract and non-contract farm households was composed of about 4 family members ranging from the smallest 2 to the highest 10 persons. The majorities of family members which were 3.08 and 3.57 persons of contract and non-contract farm households respectively were working aged family members (between 15 and 65 years old), in which, 2.28 persons of contract and 2.36 persons of non-contract households involved in agricultural activities. The remaining young (less than 14 years old) and aged (above 65 years old) family members were only a few numbers for both contract and non-contract farm households.

As shown in Table 4, the land holding capacity was also not significant difference between two groups of farmers. Sample farmers owned the cultivated land in average 7.33 hectares ranging from 1.62 to 32.39 hectares.

Table 3. Family size and agricultural labors of sample farm households in Aung Lan Township (Unit = Number)

<table>
<thead>
<tr>
<th>Items</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family size</td>
<td>4.20 (2 - 8)</td>
<td>4.50 (2 - 10)</td>
<td>4.32 (2 - 10)</td>
</tr>
<tr>
<td>t-test 0.94**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member (&lt; 14 years)</td>
<td>0.82 (0 - 3)</td>
<td>0.55 (0 - 2)</td>
<td>0.71 (0 - 3)</td>
</tr>
<tr>
<td>t-test 1.76**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member (15-60 years)</td>
<td>3.08 (1 - 6)</td>
<td>3.57 (1 - 7)</td>
<td>3.28 (1 - 7)</td>
</tr>
<tr>
<td>t-test 1.77**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member (&gt; 65 years)</td>
<td>0.33 (0 - 2)</td>
<td>0.43 (0 - 2)</td>
<td>0.37 (0 - 2)</td>
</tr>
<tr>
<td>t-test 0.70**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural labor</td>
<td>2.28 (1 - 6)</td>
<td>2.36 (1 - 7)</td>
<td>2.31 (1 - 7)</td>
</tr>
<tr>
<td>t-test 0.33**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the parentheses represent range. *, ** and ***are significant at 10%, 5% and 1% level and ns is not significant differences respectively.
Upland type was in majority for sample farmers which were 6.47 hectares and share of lowland and alluvial land types were less than 1 hectare respectively for both groups of farmers in study area.

Table 4. Land holding assets by sample farm households in Aung Lan Township

<table>
<thead>
<tr>
<th>Items</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm size</td>
<td>7.23 (2.02-21.05)</td>
<td>7.47 (1.62-32.39)</td>
<td>7.33 (1.62-32.39)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.20**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>6.93 (2.02-21.05)</td>
<td>7.47 (1.62-32.39)</td>
<td>7.15 (1.62-32.39)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.46**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rent-in</td>
<td>0.30 (0-13.77)</td>
<td>0.00</td>
<td>0.17 (0-13.77)</td>
</tr>
<tr>
<td>t-test</td>
<td>1.27**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowland</td>
<td>0.67 (0-2.83)</td>
<td>0.65</td>
<td>0.66 (0-3.24)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.09**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upland</td>
<td>6.56 (1.21-20.24)</td>
<td>6.76 (0.81-32.39)</td>
<td>6.47 (0.81-32.39)</td>
</tr>
<tr>
<td>t-test</td>
<td>0.16**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alluvial soil</td>
<td>0.00</td>
<td>0.06</td>
<td>0.02 (0-2.43)</td>
</tr>
<tr>
<td>t-test</td>
<td>1.00**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the parentheses represent range. *, ** and ***are significant at 10%, 5% and 1% level and ns is not significant differences respectively.

Table 5 showed the ownership of the farm and livestock assets by sample farm households in study area. Sample farm households seem to have more manual farm assets in comparison with machines. All sample contract and non-contract farm households possessed ploughs, harrows and bullock carts while less than 10% of sample households had farm machineries such as tractors and power tillers. More than 90% of sample households possessed sprayers. Around 26% of sample households owned generators for water pumping while about 17% and 12% of them had mechanized threshers and fodder cutting machines respectively. Very few numbers, about 1% each of sample households had Htaw-lar-gyi (small truck) and inter-cultivators respectively.

In the context of possession livestock by sample farm households, livestock rearing looked like a relatively small scale in the study area. However, nearly 100% of sample farm households owned cattles for farming activities. Less than 10% of sample farm households raised pigs and poultry, as illustrated in Table 5.

B. Source of credit by sample farmers in Aung Lan Township

The sample households received the credit from different sources as shown in Table 6. Some households received credit from only one source while other took from two credit sources and other had three sources. In the context of taking credit from one source, majorities of sample households took season agricultural credit from only Myanmar Agricultural Development Bank (MADB) which were about 38.33% of contract farmers and 45.24% of non-contract farmers, respectively. Moreover, about 13.33% of contract farmers and 2.38% of non-contract farmers took the credit from township wholesaler alone. Less than 2% of sample contract households took credit from agro-input dealers alone while other 2% of them achieved from cooperatives alone and another 2% of sample contract households borrowed from money lender alone.

At the same time, non-contract farm households did not take credit from two different sources such as (MADB & township wholesalers), (MADB & agro-input dealers), and (township wholesalers & cooperatives) as compared to contract farm households. More than 10% of sample farm households acquired credit from two different sources like MADB & cooperatives. About 11.67% of contract farmers received credit from another sources such as MADB & township wholesaler while non-contract farmers did not receive credit from these two sources at the same time. Regarding
taking credits from three sources at the same time, about 5% each of sample contract farm households received credit from three different sources such as (MADB, agro-input dealer & cooperative) and (MADB, township wholesaler & cooperative) respectively. About 16.67% of non-contract farmers took credit from MADB, agro-input dealer and cooperative at the same time. Only few farm households which were 3.33% of contract and 2.38% of non-contract households had never borrowed credit from any credit sources.

Table 6. Source of credit by sample farmers in Aung Lan Township

<table>
<thead>
<tr>
<th>Sources of credit</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access from one source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MADB</td>
<td>23 (38.33)</td>
<td>19 (45.24)</td>
<td>42 (41.18)</td>
</tr>
<tr>
<td>• Township wholesaler</td>
<td>8 (13.33)</td>
<td>1(2.38)</td>
<td>9 (8.82)</td>
</tr>
<tr>
<td>• Agro-input dealer</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td>• Cooperative</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td>• Money lender</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td>Access from two sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MADB and Cooperative</td>
<td>6 (10.00)</td>
<td>9 (21.43)</td>
<td>15 (14.71)</td>
</tr>
<tr>
<td>• MADB and Township wholesalers</td>
<td>7 (11.67)</td>
<td>0.00</td>
<td>7 (6.86)</td>
</tr>
<tr>
<td>• MADB and Money lender</td>
<td>0.00</td>
<td>3 (7.14)</td>
<td>3 (2.94)</td>
</tr>
<tr>
<td>• MADB and Agro-input dealer</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td>• Township wholesaler and Cooperative</td>
<td>2 (3.33)</td>
<td>0.00</td>
<td>2 (1.96)</td>
</tr>
<tr>
<td>Access from three sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MADB, Agro-input dealer and Cooperative</td>
<td>3 (5.00)</td>
<td>7 (16.67)</td>
<td>10 (9.80)</td>
</tr>
<tr>
<td>• MADB, Cooperative and Money lender</td>
<td>2 (3.33)</td>
<td>2 (4.76)</td>
<td>4 (3.92)</td>
</tr>
<tr>
<td>• MADB, Township wholesaler and Cooperative</td>
<td>3 (5.00)</td>
<td>0.00</td>
<td>3 (2.94)</td>
</tr>
<tr>
<td>Nil</td>
<td>2 (3.33)</td>
<td>1 (2.38)</td>
<td>3 (2.94)</td>
</tr>
</tbody>
</table>

C. Access to production practices by sample farmers in Aung Lan Township

Sample farmers in study area received information about sesame production practices from different sources like Department of Agriculture (DoA) and agro-input dealers. Meanwhile, few farmers which were about 6% of total sample did not get production practices from any sources. Majority of both contract and non-contract farmers which were more than 50% of each group respectively got production practices in association with not only DoA but also agro-input dealers, as illustrated in Table 7.

Contract farmers had more involvements in training, meeting and field demonstration as compared to non-contract farmers as shown in Figure 6. About 81.67% and 78.57% of contract and non-contract farmers obtained sesame production practices by attending meetings. More than 50% of contract farmers and about 38% of non-contract farmers participated in training to get production practices while only 1.67% of contract farmers got production practices by exploring demonstration field.

Table 7. Access to production practices by sample farmers in Aung Lan Township

<table>
<thead>
<tr>
<th>Source of production practices</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access from one source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DoA</td>
<td>18 (30.00)</td>
<td>4 (9.52)</td>
<td>22 (21.57)</td>
</tr>
<tr>
<td>• Agro-input dealer</td>
<td>5 (8.33)</td>
<td>8 (19.05)</td>
<td>13 (12.75)</td>
</tr>
<tr>
<td>Access from two sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DoA and Agro-input dealer</td>
<td>33 (55.00)</td>
<td>28 (66.67)</td>
<td>61 (59.80)</td>
</tr>
<tr>
<td>Nil</td>
<td>4 (6.67)</td>
<td>2 (4.76)</td>
<td>6 (5.88)</td>
</tr>
</tbody>
</table>

Figure 6. Type of extension services received for sesame production by sample farmers in study area

D. Access to market information by sample farmers in Aung Lan Township

In the study area, sample farmers had different sources to get access market information as shown in Table 8. About 55%, 8.33%, and 1.67% of contract farmers accepted market information from township wholesaler, neighboring farmer and social media respectively while 28.57% each of non-contract farmers got market information from township wholesaler and neighboring farmer respectively. Moreover, contract farmers jointly received market information from two sources such as township wholesaler and neighboring farmer (30%), township wholesaler and social media (3.33%) while non-contract farmers jointly received from township wholesaler and neighboring farmer (40.48%), neighboring farmer and social media (2.38%). About 1.67% of contract farmers took market information from township wholesaler, neighboring farmer and social media jointly.

<table>
<thead>
<tr>
<th>Source of market information</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access from one source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MADB</td>
<td>18 (30.00)</td>
<td>4 (9.52)</td>
</tr>
<tr>
<td>• Money lender</td>
<td>5 (8.33)</td>
<td>8 (19.05)</td>
</tr>
<tr>
<td>Access from two sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MADB and Money lender</td>
<td>33 (55.00)</td>
<td>28 (66.67)</td>
</tr>
<tr>
<td>• MADB and Township wholesaler</td>
<td>4 (6.67)</td>
<td>2 (4.76)</td>
</tr>
</tbody>
</table>
Table 8. Access to market information by sample farmers in Aung Lan Township

<table>
<thead>
<tr>
<th>Sources</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access from one source</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Township wholesaler</td>
<td>33 (55.00)</td>
<td>12 (28.57)</td>
<td>45 (44.12)</td>
</tr>
<tr>
<td>Neighboring farmer</td>
<td>5 (8.33)</td>
<td>12 (28.57)</td>
<td>17 (16.67)</td>
</tr>
<tr>
<td>Social media</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td><strong>Access from two sources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Township wholesaler and Neighboring farmer</td>
<td>18 (30.00)</td>
<td>17 (40.48)</td>
<td>35 (34.31)</td>
</tr>
<tr>
<td>Township wholesaler and Social media</td>
<td>2 (3.33)</td>
<td>0.00</td>
<td>2 (1.96)</td>
</tr>
<tr>
<td>Neighboring farmer and Social media</td>
<td>0.00</td>
<td>1 (2.38)</td>
<td>1 (0.98)</td>
</tr>
<tr>
<td><strong>Access from three sources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Township wholesaler, Neighboring farmer and Social media</td>
<td>1 (1.67)</td>
<td>0.00</td>
<td>1 (0.98)</td>
</tr>
</tbody>
</table>

E. Utilization of seed, FYM and agrochemicals in monsoon sesame production by sample farmers

As shown in Table 9, compound fertilizer, gypsum, insecticide and fungicide were used by higher percentage of contract farmers as compared to non-contract farmers.

Table 10 described the amount of different inputs used by sample farmers in study area. Contract farmers used 6.09 Kg/ha of seeds which was less than 6.48 Kg/ha for non-contract farmers. Contract farmers applied FYM as more than 2 ton per hectare while non-contract farmers applied less than 2 ton per hectare. Contract farmers used compound fertilizer almost 50 Kg/ha but non-contract farmers used less than 40 Kg/ha for compound. The average rate of urea fertilizer used by contract and non-contract farmers were 21.98 Kg/ha and 29.29 Kg/ha respectively. The average rate of 19.90 Kg/ha and 16.47 Kg/ha of gypsum was applied by contract and non-contract farmers respectively. Average amount of fungicide was 0.09 Kg/ha for contract and 0.02 Kg/ha for non-contract farmers respectively. As overall, contract farmers utilized high dose of farm yard manure (FYM), compound fertilizer, gypsum and fungicide in comparison with non-contract farmers. The usage of urea fertilizer and foliar fertilizer of non-contract farmers were a little higher than that of contract farmers in study area.

F. Cost and return analysis of monsoon sesame production by sample farmers

Cost and return analysis can compare the profitability of the contract and non-contract farmers. Fig. 7 illustrated that effective yield and price of contract and non-contract farmers for monsoon sesame production in 2017. Effective yield were 261.03 Kg/ha and 237.04 Kg/ha and effective price were 1,643.33 MMK/kg and 1,630.90 MMK/kg received by sample contract and non-contract farmers respectively. Thus, contract farmers received the higher effective yield and price as compared to non-contract farmers in study area.

Table 10. Number and percentage of sample farmers using different inputs for monsoon sesame production

<table>
<thead>
<tr>
<th>Items</th>
<th>Contract farmers (N=60)</th>
<th>Non-contract farmers (N=42)</th>
<th>Total (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>60 (100.00)</td>
<td>42 (100.00)</td>
<td></td>
</tr>
<tr>
<td>FYM</td>
<td>36 (60.00)</td>
<td>25 (59.52)</td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>31 (51.67)</td>
<td>25 (59.52)</td>
<td></td>
</tr>
<tr>
<td>Compound</td>
<td>51 (85.00)</td>
<td>29 (69.05)</td>
<td></td>
</tr>
<tr>
<td>Gypsum</td>
<td>34 (56.67)</td>
<td>18 (42.86)</td>
<td></td>
</tr>
<tr>
<td>Insecticide</td>
<td>48 (80.00)</td>
<td>33 (78.57)</td>
<td></td>
</tr>
<tr>
<td>Fungicide</td>
<td>25 (41.67)</td>
<td>8 (19.05)</td>
<td></td>
</tr>
<tr>
<td>Herbicide</td>
<td>15 (25.00)</td>
<td>11 (26.19)</td>
<td></td>
</tr>
<tr>
<td>Foliar</td>
<td>40 (66.67)</td>
<td>32 (76.19)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the parentheses represent range.
Fig. 8 presented cost of monsoon sesame production by sample farmers in the study area. Total material cost included the cost of seed, FYM and other agro-inputs used in monsoon sesame production. Opportunity cost of family labor was also counted by referring the wage rate for hired labors. Interest on paid hired labor cost and material cash cost was also included. Total variable cost or total production cost of monsoon sesame per hectare was then calculated by combining total material costs, family and hired labor costs, and total interests on cash costs. By deducting the opportunity cost of family labor and own input cost, total variable cash cost was derived.

Contract farmers used high dose of agro-inputs such as FYM, compound fertilizer, gypsum and fungicide, thus, total material cost was slightly higher in contract farmers which was 75,736 MMK/ha as compared to that of non-contract farmers which was 71,932 MMK/ha. Total family labor cost was higher in non-contract farmers which was 49,576 MMK/ha while contract farmers spent 47,527 MMK/ha for family labor as opportunity cost. The hired labor cost for contract and non-contract farmers were 159,319 MMK/ha and 154,360 MMK/ha respectively. Total variable cost per hectare of monsoon sesame was 301,371 MMK for contract farmers and 293,307 MMK for non-contract farmers. It was due to higher cost on some inputs and hired labor, thus, total variable cost was higher in contract farmers as compared to non-contract farmers. Consequently, total variable cash cost per hectare of monsoon sesame was also higher for contract farmers, as in Fig 8.

Total gross benefits, return above variable cost and variable cash cost per hectare of monsoon sesame production were illustrated for contract and non-contract farmers in Fig 9. Total gross benefit was by multiplying effective yield and price received by both contract and non-contract farmers respectively. Total gross benefit was about 428,958 MMK/ha for contract farmers while that for non-contract farmers was 386,589 MMK/ha. Return above variable cost (RAVC) for contract and non-contract farmers were 127,588 MMK/ha and 93,282 MMK/ha respectively. In addition, return above variable cash cost (RAVCC) were 201,410 MMK/ha for contract farmers and 168,844 MMK/ha for non-contract farmers in the study area. Due to higher effective yield and price received by contract farmers as compared to non-contract farmers, they achieved higher gross benefit, returns above variable cost and variable cash costs, although they paid higher production cost.

As a consequence of better returns by contract farmers, the return per unit of cash expended and return per unit of invested capital were also higher for them as compared to those of non-contract farmers as illustrated in Fig. 10. Return per unit of cash expenses was 1.89 for contract farmers while that of non-contact farmers was 1.78. Return per unit of invested capital or benefit-cost ratio were 1.42 and 1.32 for contract and non-contract farmers respectively.

Figure 8. Costs of monsoon sesame production per hectare by sample farmers

Figure 9. Returns of monsoon sesame production per hectare by sample farmers

Figure 10. Return per unit of cash and capital invested in monsoon sesame production by sample farmers
The break-even yield and price received by sample farmers were presented in Fig. 11. The break-even yield was the yield which can cover the total variable cost at the current sesame price and break-even price was the price which can cover the total variable cost at the current yield of sesame production. The break-even yield of contract and non-contract farmers were 183.39 Kg/ha and 179.84 Kg/ha respectively. It indicated that contract and non-contract farmers can cover their total monsoon sesame production cost when they started to achieve above yield at the current monsoon sesame price. Similarly, contract and non-contract farmers can get benefit over their total production cost when they started to get sesame price 115.4.54 MMK/kg and 1237.37 MMK/kg at the current yield. The results revealed that break-even yield of contract farmers was a little bit more than non-contract farmers but break-even price of contract farmers was lower than non-contract farmers in order to cover their production cost for monsoon sesame per hectare in the study area.

Figure 11. Break-even yield and price of monsoon sesame production by sample farmers

G. General characteristics of township wholesalers, food processors and exporters

General characteristics of the stakeholders such as township wholesalers, food processors and exporters were described in Table 11. The average age of township wholesalers was around 45.14 years old ranging from the youngest 32 to the oldest 64 years old. Average age of food processors was about 60 years old which range from 52 to 69 years old while that of exporters was about 54 years old within the youngest 40 years to the oldest 65 years old.

The township wholesalers had business experiences of 19.36 years on average while food processor experienced in their snack business for about 16 years and exporters had about 15 years of experiences on sesame export.

Half of township wholesalers and all exporters were graduate while one food processor had high school level and another food processor had only secondary education level.

Table 11. Age, experience and education level of township wholesalers, food processors and exporters

<table>
<thead>
<tr>
<th>Items</th>
<th>Wholesalers (N=14)</th>
<th>Processors (N=2)</th>
<th>Exporters (N=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. age (year)</td>
<td>45.14</td>
<td>60.50</td>
<td>54.00</td>
</tr>
<tr>
<td>(32 - 64)</td>
<td>(52 - 69)</td>
<td>(40 - 65)</td>
<td></td>
</tr>
<tr>
<td>Avg. experience (year)</td>
<td>19.36</td>
<td>15.50</td>
<td>15.00</td>
</tr>
<tr>
<td>(5 - 40)</td>
<td>(2 - 29)</td>
<td>(12 - 18)</td>
<td></td>
</tr>
<tr>
<td>Avg. education level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Primary level</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>(71.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Secondary level</td>
<td>1</td>
<td>1</td>
<td>0.00</td>
</tr>
<tr>
<td>(71.4)</td>
<td>(50.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- High school level</td>
<td>5</td>
<td>1</td>
<td>0.00</td>
</tr>
<tr>
<td>(35.71)</td>
<td>(50.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Graduate level</td>
<td>7</td>
<td>0.00</td>
<td>5</td>
</tr>
<tr>
<td>(50.00)</td>
<td>(100.00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The values in the parentheses represent range and percentage.

H. Marketing activities of farmers, township wholesalers, food processors and exporters

Marketing activities including purchasing, selling, grading, weighting, and transportation activities by sample farmers, township wholesalers, food processors and exporters were illustrated in Table 12.

About 98% of sample contract farmers directly sold sesame seed to connected wholesaler while the remaining of them and all non-contract farmers sold to normal wholesalers in open market. Majority of sample farmers sold raw sesame seed immediately after harvest and only a few of sample farmers sold out within one month by using cash down system. None of sample farmers used grading system and their weighting measurement in selling was 1basket = 15 viss. Most of farmers used light truck in transporting their sesame to wholesalers in Aung Lan and Paylo.

Sample wholesalers bought raw sesame seed directly from farmers not only in Aung Lan but also in Sinpaungwe Township, Magway Region. Most of wholesalers sold immediately after purchase while only some of wholesalers sold within one month. Majority of wholesalers sold out again to connected stakeholders by both cash down and credit system (for a week) and a few wholesalers used only cash down system. All wholesalers applied visual grading to check quality of sesame based on their business experiences. Majority of wholesalers used fan air drying and only a few of wholesalers used sun
drying method to get dry and purified sesame seed. There were no technical tests or instruments to determine seed dryness and purity in marketing activities at the stage of wholesaling in local market. Sample wholesalers used to sell by putting 45 viss (3 baskets) into 1 bag of sesame seed to exporters. Their domestic market destination was within Aung Lan and to Mandalay, Yangon and Magway by 6 or 12 wheel trucks.

Food processors purchased sesame seed from wholesalers in Pakokku and Aung Lan in cash down system. They employed both cash down payment and credit when selling snack. They sold the value-added product which is sesame brittle immediately after processed to both connected stakeholders and open market not only in Aung Lan but also to Yangon, Mandalay, Nyaung U, and Ayeyarwady Region by transporting with express buses.

Cash down and advanced payments were used by exporters via commission agents with 0.05% fee in purchasing sesame. Exporters graded sesame quality based on personal experiences and then they used color sorter and cleaning machine compulsorily to export good quality seed fitting with international standards: FFA = 2, chemical residue = 0.005, moisture content = 7-8% and color = 5-10%. Before selling product, they took one to four months to prepare for exportation. They sold out the raw sesame product to connected stakeholders by both cash down system and credit system (for a week). The weighting system in purchasing was (1 bag = 45viss), although; kilogram/ton in selling system (19 Ton = 1 container). They exported raw sesame to Japan, Taiwan by ship and China by 12 wheel truck.

Table 12. Marketing activities of farmers, wholesalers, food processors and exporters

<table>
<thead>
<tr>
<th>Items</th>
<th>Sample farmers</th>
<th>Wholesalers</th>
<th>Food processors</th>
<th>Exporters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of purchasing</td>
<td>CF</td>
<td>NCF</td>
<td>CF</td>
<td>NCF</td>
</tr>
<tr>
<td>Type of selling</td>
<td>Only cash down</td>
<td>Cash down and credit (for a week)</td>
<td>Cash down and credit</td>
<td>Cash down and credit</td>
</tr>
<tr>
<td>Product selling form</td>
<td>Raw seed</td>
<td>Raw seed</td>
<td>Sesame brittle</td>
<td>Raw seed</td>
</tr>
<tr>
<td>Product selling to</td>
<td>C* &amp; O** (CF)</td>
<td>O** (NCF)</td>
<td>Connected stakeholder</td>
<td>Connected stakeholder &amp; open market</td>
</tr>
<tr>
<td>Product selling time</td>
<td>Immediately after harvest/within one month</td>
<td>Immediately after purchase/within one month</td>
<td>Immediately after process</td>
<td>Within one to four months</td>
</tr>
</tbody>
</table>

Note: C* means connected stakeholders and O** means open markets.

1. Marketing margin analysis of sesame wholesalers, food processors and exporters

Table 13 mentioned the marketing costs and profit and margins of market participants. According to the result, the net profit received by wholesalers, food processors and exporters were 102,151 MMK per ton, 82,698 MMK per ton and 116,881 MMK per ton respectively. Total marketing costs of township wholesalers, food processors and exporters were 16,094 MMK per ton, 937,925 MMK per ton and 200,235 MMK per ton respectively. The marketing margins of township wholesalers, food processors and exporters were 118,244 MMK per ton, 1,020,623 MMK per ton and 317,116 MMK per ton respectively in this study.

Table 13. Marketing cost, margin and profit of wholesalers, food processors and exporters (MMK/ton)

<table>
<thead>
<tr>
<th>Items</th>
<th>Wholesalers</th>
<th>Food processors</th>
<th>Exporters</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Purchase price</td>
<td>1,685,095</td>
<td>1,735,402</td>
<td>1,818,884</td>
</tr>
<tr>
<td>(2) Selling price</td>
<td>1,803,339</td>
<td>2,756,025</td>
<td>2,136,000</td>
</tr>
<tr>
<td>(3) Marketing margin (2-1)</td>
<td>118,244</td>
<td>1,020,623</td>
<td>317,116</td>
</tr>
<tr>
<td>(4) Marketing cost</td>
<td>16,093</td>
<td>937,925</td>
<td>200,235</td>
</tr>
<tr>
<td>- Packing cost</td>
<td>3,240</td>
<td>32,664</td>
<td>6,125</td>
</tr>
<tr>
<td>- Transportation cost</td>
<td>0.00</td>
<td>122,490</td>
<td>33,872</td>
</tr>
<tr>
<td>- Labor cost</td>
<td>5,390</td>
<td>331,744</td>
<td>8,125</td>
</tr>
<tr>
<td>- Processing cost</td>
<td>6,725</td>
<td>448,905</td>
<td>80,051</td>
</tr>
<tr>
<td>- Other fees</td>
<td>738</td>
<td>2,122</td>
<td>72,062</td>
</tr>
<tr>
<td>(5) Profit (3-4)</td>
<td>102,151</td>
<td>82,698</td>
<td>116,881</td>
</tr>
</tbody>
</table>

J. Constraints of different stakeholders in sesame production and marketing

The sample farmers in Aung Lan Township faced a number of constraints that limit their productivity and marketing in monsoon sesame production during 2017 as shown in Fig. 12. Among these problems, all sample respondents answered that they suffered climate change as a
major constraint in the study area because erratic rainfall and unfavorable temperature during of monsoon season which reduced sesame yield. Moreover, it was obvious that the most common constraints faced by sample respondents in the study area were labor scarcity, unstable price, high input cost, lack of capital, incidence of disease and pest, lack of extension service, high transportation cost and lack of improved varieties. These major problems affected farmers to reduce yield and low income.

Fig. 12. Constraints in monsoon sesame production and marketing by sample farmers in study area

Fig. 13 presented the constraints of wholesalers in the study area. The majority of wholesalers felt price fluctuation which was major problem for them in sesame market. The price of sesame was mainly dependent on not only export market demand and production amount but also available of sesame by major producing countries such as, India, China and Africa. Wholesalers mentioned that there were difficulties to get quality sesame and faced up to extreme weather. Both lack of capital and seed impurity were also mentioned as the important constraints. Moreover, lack of information and lack of improved storage facilities were responded as other constraints by wholesalers. They also mentioned that high tax rate in marketing, chemical residue problem and labor scarcity as their constraints.

Fig. 13. Constraints of township wholesalers in monsoon sesame marketing in study area

Constraints expressed by food processors were mentioned as shown in Fig. 14. The major constraints of sample food processors were lack of capital followed by lack of skillful labors, low quality of sesame and credit system in selling the process.

Fig. 14. Constraints of food processors in monsoon sesame processing and marketing in study area

Myanmar is one of the major sesame export countries in the world and there are a lot of potential demands. Fig. 15 presented some constraints of exporters in sesame marketing. Sample exporters faced low quality of sesame, lack of improved varieties, lack of advanced technology, problem of chemical residue, price fluctuation, extreme weather and lack of SPS (Sanitary and phytosanitary) testing laboratory. In addition, sample exporters faced high tax rate, lack of storage facilities, lack of dryer, color sorter and cleaning machine.

Figure 12. Constraints in monsoon sesame production and marketing by sample farmers in study area

Figure 13. Constraints of township wholesalers in monsoon sesame marketing in study area

Figure 14. Constraints of food processors in monsoon sesame processing and marketing in study area

Figure 15. Constraints of exporters in sesame marketing in study area
IV. CONCLUSIONS AND RECOMMENDATIONS

Contract farmers were younger, less schooling years and less farming experience compared to non-contract farmers. Majority of sample respondents were male. Most of farm households had more working age family members and more than half of the family members worked in agriculture. Upland farm size is the largest share in total farm area by sample farmers. Minority of sample farm households had tractor and power tiller on the other hand majority of farm household had plough, harrow, bullock cart and cattle.

According to result, most of contract and non-contract farmers received the credit from MADB alone, and contract farmers had more credit sources in comparison with non-contract farmers such as township wholesaler and cooperative. Majority of sample farmers acquired production practices mainly from both DoA and agro-input dealer through extension agents. Majority of contract farmers have more access of extension services from training, meeting and field demonstration as compared to non-contract farmers. Regarding market information, contract farmers mostly received from township wholesalers while non-contract farmers got from both township wholesalers and farmers to farmers.

With respect to input used in monsoon sesame production of sample farmers in study area, contract farmers used more inputs than non-contract farmers in sesame production because of they could receive credit from more different sources. Production cost of sesame by contract farmers was relatively higher as compared to non-contract farmers due to their higher usage of FYM, compound fertilizers, gypsum and fungicide. However, it did not affect their returns because contract farmers received higher sesame yield in comparison with others.

Education level of other market participants such as wholesalers, food processors and exporters were higher than sample farmers. All stakeholders apart from processors sold raw sesame and there was still lack of advanced technology in quality checking, grading and using international recognized weighting scale. Some of wholesalers had capacities of using fan air dry and some used only sun dry for cleaning seed. Only exporters had the capacity to use color sorter and cleaning machine to get better quality sesame.

Due to unpredictable rainfall and unfavorable temperature during monsoon sesame production season reduced the yield and climate change was the major constraint for sample farmers followed by labor scarcity, unstable price, high input cost and lack of capital, etc. Low quality sesame, price fluctuation, extreme weather, lack of capital, lack of information, and advanced technology were common constraints for all stakeholders although each stakeholder earned reasonable returns or profits at each stage of sesame supply chain.

Overall, performance of contract farmers was better than that of non-contract farmers in study area although contract scheme was not legally arranged between stakeholders. Thus, in order to get better performances of sesame farmers in Myanmar, more effective and comprehensive contract scheme should be practiced based on learning other successful contract crops. All sesame supply chain stakeholders should pay attention to improve quality of sesame in order to get market share in not only domestic but also international market by overcoming current constraints.
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REFERENCES


Plant nitrogen content estimation in rice under different nutrient management practices using sensor technologies

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Abstract—Management of nutrients for rice production is an important contemporary issue in Myanmar. Nitrogen (N) is the most important nutrient for rice plants, and its deficiency occurs almost everywhere unless N is applied as a fertilizer. The nutritional monitoring of crop plants using remote sensing is an important component of precision agriculture. Remote sensing has received increased interest as a non-destructive tool for determining the nutrient status of standing crops. This study investigated to detect rice plant nitrogen content based on crop canopy reflectance information from Green, Red, and Near-Infrared bands of a multi-spectral camera. Two experiments were carried out at the farmers’ field in Letkotegone village, Taunggoo Township and Seinsarpin village, Zayarthiri Township during the summer season of 2019. Experiments were laid out in a randomized complete block (RCB) design with four replications. Five nutrient management practices were used as 1) zero kg N ha⁻¹; 2) Farmer practice at the rate of 50 kg N ha⁻¹; 3) Puddled with urea at the rate of 70 kg N ha⁻¹; 4) Deep placement of urea at the rate of 70 kg N ha⁻¹; 5) three split broadcast at the rate of 70 kg N ha⁻¹. Sinthuka variety was used in this study. The aerial photograph by drone (DJI Phantom 4) with multi-spectral camera was acquired at different growth stages of rice. The acquired images analysis was implemented with Pix4D software to calculate Normalized Difference Vegetation Index (NDVI). The growth and stress indices were evaluated for their relationship to plant chlorophyll content by measuring with chlorophyll meter (SPAD meter) at the time of flying drone. In both experiments, the results showed that NDVI and SPAD values were higher in deep placement of urea than other practices due to maintaining an adequate supply of N availability throughout the growth cycle. The results also indicated that there was a linear relationship between leaf reflectance and SPAD values. It observed that nitrogen responsiveness of rice had performed well at the practice of urea deep placement at all growth stages, which was followed by the three split broadcast application in both experiments. In contrast, zero N application gave a poor value of NDVI and SPAD readings. Therefore, remote sensing technology can provide the crop nutrient status and thereby allow for site-specific applications of fertilizers through effective use of fertilizer in an approach to upgrade the livelihood of farmers in the study areas.

Remote sensor can estimate chlorophyll content and nitrogen status by their reflectance in the visible region of the electromagnetic spectrum [3]. During the vegetative stage, the chlorophyll content increases and hence the absorption of visible light increases and its reflectance decrease [4]. The relative decrease in green (G) reflectance is much less compared to red (R) and blue reflectance, resulting in a green peak during vegetative stage. Chlorophyll content and the green reflectance stabilize when the crop reaches maturity and decreases when the crop goes through senescence. Most of the reported studies on nitrogen status of crops used reflectance based crop indices for extracting crop stress information [5]. Reflectance values at 550
nm and 680 nm [6], and near-infrared reflectance at 800 nm [7] can be used to measure Chlorophyll-a content and hence to estimate the application of nitrogen for the plant. Some researches reported light reflectance at 550 nm had a strong association with chlorophyll meter readings and leaf nitrogen concentration in corn [8]. Red-edge band was also used for measuring Chlorophyll-a content [9] and hence nitrogen concentration in plant. As the Chlorophyll-a content increases the red-edge band moves to longer wavelengths [10]. Amplitude and area are parameters of red-edge band derived from the first derivative of the reflectance curve. These parameters are also greatly associated to plant Chlorophyll-a content [9, 11]. Plant, especially leaves, absorbs visible light but does not absorb near infrared light and reflects it.

At present, many sensors technologies can detect earth and acquire images with various wavebands. These images can be used in a particular study such as vegetation growth condition analysis. By using remote sensing images, many parameters such as normalized difference vegetation index (NDVI) can be measured for the vegetation growth as well as estimating plant nitrogen content. Therefore, this study investigated to detect rice plant nitrogen content based on crop canopy reflectance information from Green, Red, and Near-Infrared (NIR) bands of a multi-spectral camera.

II. MATERIALS AND METHOD

A. Site selection

Two experiments were carried out at the farmers’ field in Letkotegone village (18°59’ N, 96°19’ E), Taungoo Township (designated as experiment I) and Seinzabin village (19°49’ N, 96°15’ E), Zeyarthiri Township (designated as experiment II) during the summer season of 2019. Across the study areas, the lowest daily minimum temperature recorded during the growing season was 23 °C, while the highest recorded daily maximum temperature was 42 °C.

B. Experimental design and treatments

Experiments were laid out in a randomized complete block (RCB) design with four replications. For both experimental field, five nutrient management practices were used as T1) zero kg N ha⁻¹; T2) Farmer practice at the rate of 50 kg N ha⁻¹; T3) Puddled with urea at the rate of 70 kg N ha⁻¹; T4) Deep placement of urea at the rate of 70 kg N ha⁻¹; T5) three split broadcast at the rate of 70 kg N ha⁻¹. Sinthuka rice variety was used in both fields.

C. Data collection with sensor by drone

There are several different remote sensing systems in order to acquire the high resolution image. In this study, a Parrot Sequoia multispectral sensor was used to acquire the color-infrared (CIR) reflectance data from the experimental fields. The aerial imaging system consisted of a high-resolution digital camera, a GPS receiver, a tablet and a DJI Phantom 4. A GPS receiver was integrated to the camera to record the GPS location of the camera when the image was taken. A tablet was used to control the drone with a camera. Images were acquired from the altitude of 30 m above ground level in both experimental fields. After the data were acquired by the images with drone at 40 and 65 days after transplanting, the rest of the processes such as data analysis and information extraction were done in a laboratory.

D. Image analysis

The acquired images analysis was implemented with Pix4D software and ArcGIS 10.2 to calculate the vegetation indices for leaf N estimation as showed in Table (1).

<table>
<thead>
<tr>
<th>Index</th>
<th>Formula</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalized difference vegetation index (NDVI)</td>
<td>(NIR−Red)/(NIR+Red)</td>
<td>[12]</td>
</tr>
<tr>
<td>Green NDVI</td>
<td>(NIR−Green)/(NIR+Green)</td>
<td>[13]</td>
</tr>
<tr>
<td>Normalized Difference Red Edge index (NDRE)</td>
<td>(NIR - Red_edge)/(NIR + Red_edge)</td>
<td>[14]</td>
</tr>
<tr>
<td>Simple ration index (SRI)</td>
<td>NIR/red</td>
<td>[12]</td>
</tr>
</tbody>
</table>

E. Leaf chlorophyll content measurement

Leaf chlorophyll content under different nutrient management was measured with the model 502 Minolta a SPAD chlorophyll meter (Spectrum Technologies, Plainfield, IL) [15] on the day of collection of crop canopy reflectance measurements.

III. RESULTS AND DISCUSSION

A. Chlorophyll content at tillering stage

The images analyses that were acquired from the experimental field of Letkotegone village, Taungoo Township (experiment I) were shown in
Fig. 1. The results of the classified image of the nitrogen management plots taken on 40 DAT showed the low nitrogen plots distinctly separate from the rest. The highest NDVI value was 0.95 (Table 2). The vegetation index values (NDVI, GNDVI, NDRE, and SRI) were higher in the practice of puddled with urea at the rate 70 kg N ha$^{-1}$ with the values of 0.95, 0.79, 0.45 and 39.23, respectively. Deep placement of urea was followed as second NDVI value (0.87) at this stage. In contrast, zero N application gave the lowest index value (0.41) due to sparse vegetation in the plots.

The image calibrations taken on 40 DAT from the experimental field of Seinzabin village, Zeyarthiri Township (experiment II) were shown in Fig. 3. The results showed that the classified image under different nitrogen management found distinct indices among the practices. The highest vegetation index value was 0.93 (Table 4). Similar to the experiment I, the NDVI value (0.93) was higher in the practice of puddled with urea and followed by deep placement of urea (0.89). In contrast, the lowest NDVI value (0.41) was found in zero N application due to stumpy vegetation.

B. Chlorophyll content at panicle initiation stage

At panicle initiation (65 DAT), in experiment I, the highest index values were recorded at the practice of deep placement of urea and followed by the three split broadcast at the rate of 70 kg N ha$^{-1}$ treatment (Fig. 2). The highest vegetation index value was 0.90 (Table 3). In this stage, the practice of puddled with urea treatment was decreased the value than 40 DAT. This might be the decreasing of N availability in the soil.

In experiment II, the results of the classified image of the nitrogen management plots (Fig. 4) were similar to the results of experiment I. The highest vegetation index value was 0.90 (Table 5).

### Table 2. Statistical results for chlorophyll estimation at 40 DAT in experiment I

<table>
<thead>
<tr>
<th>Index</th>
<th>Min</th>
<th>Max</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>-0.39</td>
<td>0.95</td>
<td>0.51 ± 0.27</td>
</tr>
<tr>
<td>Green NDVI</td>
<td>-0.50</td>
<td>0.79</td>
<td>0.34 ± 0.21</td>
</tr>
<tr>
<td>NDRE</td>
<td>-0.19</td>
<td>0.45</td>
<td>0.21 ± 0.11</td>
</tr>
<tr>
<td>SRI</td>
<td>0.44</td>
<td>39.23</td>
<td>5.24 ± 4.64</td>
</tr>
</tbody>
</table>

### Table 3. Statistical results for chlorophyll estimation at 65 DAT in experiment I

<table>
<thead>
<tr>
<th>Index</th>
<th>Min</th>
<th>Max</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>-0.10</td>
<td>0.90</td>
<td>0.50 ± 0.25</td>
</tr>
<tr>
<td>Green NDVI</td>
<td>-0.40</td>
<td>0.76</td>
<td>0.39 ± 0.14</td>
</tr>
<tr>
<td>NDRE</td>
<td>-0.19</td>
<td>0.36</td>
<td>0.10 ± 0.05</td>
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<tr>
<td>SRI</td>
<td>0.81</td>
<td>19.27</td>
<td>4.25 ± 2.93</td>
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</tbody>
</table>

### Table 4. Statistical results for chlorophyll estimation at 40 DAT in experiment II

<table>
<thead>
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<th>Index</th>
<th>Min</th>
<th>Max</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>-0.13</td>
<td>0.93</td>
<td>0.33 ± 0.22</td>
</tr>
<tr>
<td>Green NDVI</td>
<td>-0.31</td>
<td>0.72</td>
<td>0.20 ± 0.18</td>
</tr>
<tr>
<td>NDRE</td>
<td>-0.20</td>
<td>0.54</td>
<td>0.08 ± 0.05</td>
</tr>
<tr>
<td>SRI</td>
<td>0.68</td>
<td>26.03</td>
<td>2.64 ± 1.45</td>
</tr>
</tbody>
</table>

### Table 5. Statistical results used chlorophyll estimation at 65 DAT in experiment II

<table>
<thead>
<tr>
<th>Index</th>
<th>Min</th>
<th>Max</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI</td>
<td>-0.12</td>
<td>0.90</td>
<td>0.47 ± 0.26</td>
</tr>
<tr>
<td>Green NDVI</td>
<td>-0.17</td>
<td>0.73</td>
<td>0.32 ± 0.20</td>
</tr>
<tr>
<td>NDRE</td>
<td>-0.19</td>
<td>0.44</td>
<td>0.09 ± 0.05</td>
</tr>
<tr>
<td>SRI</td>
<td>0.79</td>
<td>18.72</td>
<td>4.12 ± 3.09</td>
</tr>
</tbody>
</table>
Figure 2. Classified image of the nitrogen management practices at 65 DAT in Letkotegone village, Taungoo Township

Figure 3. Classified image of the nitrogen management practices at 40 DAT in Seinzabin village, Zeyarthiri Township

Figure 4. Classified image of the nitrogen management practices at 65 DAT in Seinzabin village, Zeyarthiri Township
C. Chlorophyll content assessment

There were highly associations with the NDVI values and the SPAD readings at 40 and 65 DAT in both experiments (Figure 5 and 6). The lower the NDVI values and SPAD readings indicate the lower nitrogen content in plant. From the results, it would be possible to manage the nitrogen for site-specific application.

IV. CONCLUSION

The estimated leaf chlorophyll content maps showed a visual good agreement with the true color images. The reflectance and SPAD meter reading under different nitrogen practices showed a strong association in this study. The sensor images of this study were indicative of the chlorophyll content and nitrogen availability for rice plant under different nitrogen management practices.

This study has shown that there would have advantages to using drone-based sensor technology to determine plant nitrogen content and to make recommendations for nitrogen applications and management. Even there are some limitations to use drone and difficult to get the satellite image, further study should be done with the remote sensing technology with related advanced software technology.

ACKNOWLEDGMENT

This study was financially supported by the Project “Management of Nutrients for Improved Profitability and Sustainability of Crop Production in Central Myanmar” from Australian Centre for International Agricultural Research (ACIAR) for the field experiment, and technically supported by the Project “JICA-TCP” by JICA (Japan International Cooperation Agency) for Capacity Development of Yezin Agricultural University.

REFERENCES


Evaluation of Some Promising Lines of Rice (*Oryza sativa* L.)

**Under Saline Soil Condition**

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**Abstract**—Field experiments were conducted at Htein Kan Gyi Village, Myittha township, Mandalay Region during 2018 monsoon season to evaluate the rice grain yield and yield components character of some YAU promising lines of rice on different soil salinity levels and to find out the salinity-tolerant rice varieties that are adaptable to the central dry zone of Myanmar. Three field experiments were conducted in the three different salt affected area in this village from June to December 2018. Each experiment was laid out in a randomized complete block (RCB) design with four replications. The lines tested in this study were seven YAU rice promising lines (V\(_1\): YAU-1211-14-1-1; V\(_2\): YAU-1201-90-2-4; V\(_3\): YAU-1211-18-1-1; V\(_4\): YAU-1211-195-1-1; V\(_5\): YAU-1201-26-1-1; V\(_6\): YAU-1201-26-1-3 and V\(_7\): YAU-1211-82-1-1) and three check varieties (Manawthukha (local check); IR-29 (sensitive check); and Pyi Myanmar Sein (tolerance check). These total ten varieties (seven tested promising lines and three check varieties) were evaluated at three different soil salinity level (3.32 dS m\(^{-1}\), 6.0 dS m\(^{-1}\) and 7.64 dS m\(^{-1}\)) under field condition. The results showed that the higher the salinity level, the lower the performance of growth, yield and yield component parameters. Among the seven tested YAU promising rice lines, V\(_3\): YAU-1211-18-1-1, V\(_4\): YAU-1211-195-1-1 and V\(_7\): YAU-1211-82-1-1 performs better than any others tested lines at soil salinity condition. More specifically, V\(_3\): YAU-1211-18-1-1, V\(_4\): YAU-1211-195-1-1 and V\(_7\): YAU-1211-82-1-1 could be grown well at electrical conductivity value of 3.32 and 6.0 dS m\(^{-1}\) while only V\(_3\): YAU-1211-18-1-1 could be grown well at EC 7.64 dS m\(^{-1}\).

**Keywords:** promising rice lines; soil salinity level; tolerance

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**I. INTRODUCTION**

Rice is the most important agricultural crop in the world that grown under extensive irrigation environment. Besides, it is one of the Asia largest food demands and grown crop. It is also the stable food of Myanmar people. The total rice sown area in Myanmar is 7.26 million hectare with the annual production of 25.62 million metric ton and the average yield was 3.36 ton ha\(^{-1}\) in 2017-2018 [1]. Rice is noted as a crop of high-tolerant to submersion but not highly to salinity [2]. Salt affected soil is one of the uncomic abiotic stresses that may cause reducing in plant growth and development, thereby decreasing crop productivity.

In Myanmar, about 3% of the total rice sown area was affected by salinity [3]. The total salt affected areas progressively increase during these years with the total salt affected areas of 119866 ha: Ayeyarwady division 62529 ha, Tanintharyi division 2186 ha, Yangon division 7349 ha, Mandalay division 1780 ha, Mon state 14582 ha, Rakhine state 8097 ha, Bago division 22085 ha, Sagaing division 579 ha and Magwe division 679 ha.

Under low rainfall with high evaporative conditions in arid regions, water moving upward from the shallow water tables evaporates by leaving salts at the soil surface to form salt affected soil [4]. The excessive applications of irrigation water are also an important factor that raised the ground water level sufficiently to increase salt concentration through evaporation. To overcome the salt related problems, there are two approaches. The first one is changing the growing environment that is suitable for the
normal plant growth and the next one is selecting the crops and/or changing genetic architecture of the plant in case it could be grown in such area. Correcting a salt-affected soil involves identifying the kind of dominant salt, chemical treatment that should be given and amount of leaching. Most of the managing practices to reclaim the salt affected soil is time consuming and expensive. Developing salt adaptive plants and better understanding in its mechanism, especially rice may become important factor especially in salt related problem areas since more soil remediation management will become more difficult. So developing new varieties with higher yield potential that is also suitable with across environments, climate and geographic location become an important factor. By fulfilling this requirement, the present investigation was conducted with the following objectives; 1. to evaluate the rice grain yield and yield components character of some YAU promising lines of rice on different soil salinity levels and 2. to find out the salinity-tolerant rice varieties that are adaptable to central dry zone of Myanmar.

I. MATERIALS AND METHOD

Three field experiments under different salinity levels were carried out at Htein Kan Gyi Village, Myittha Township, Mandalay Region on rice (*Oryza sativa* L.) to evaluate the performance of some YAU promising lines of rice. The experimental site was located at 21° 24´ N latitude and 96° 14´ E longitudes with the elevation of 114 meters above sea level. Each salinity level experiment comprised with four replications in the form of randomized complete block design. There were 40 experimental plots comprising 10 varieties and 4 replications in each salinity level. Electrical conductivity (EC) values of level I, level II and level III were 3.32 dS m⁻¹, 6 dS m⁻¹ and 7.64 dS m⁻¹ respectively. The names of varieties were as follow; V₁: YAU-1211-14-1-1, V₂: YAU-1201-90-2-4, V₃: YAU-1211-118-1-1, V₄: YAU - 1211-195-1-1, V₅ : YAU -1201-26-1-1, V₆ : YAU-1201 -26 -1-3, V₇: YAU-1211-82-1-1, V₈: Manawthukha (local check), V₉: IR-29 (sensitive check) and V₁₀: Pyi Myanmar Sein (tolerance check). The whole size of each experimental area was (39 m x 15 m) and each plot size was (3 x 3) m². The distance between plots in each level was 1m. Twenty eight days old seedlings that were sown in dappog method were transplanted at the space of 20cm × 20cm with two hills per plant. The experimental plots were irrigated whenever necessary. Weed control and other managements were done regularly, especially at the early rice growth stages.

Fertilizer application was conducted by applying urea (85 kg N ha⁻¹) in three equal splits at 14, 30 and 55 days after transplanting (DAT) and potassium fertilizer (31 kg K ha⁻¹) in twice at 30 and 55 days after transplanting while triple super phosphate was applied as basal application at the rate of 13 kg P ha⁻¹.

Growth parameters such as plant height, number of tillers hill and tolerance score were recorded from randomly selected 4 hills from each plot at two weeks interval starting from 14 DAT to 56 DAT. Irrigation was done with 10 days interval. Three days before irrigation, apparent electrical conductivity (ECₐ) was recorded by Field Scout direct soil EC meter (model no: 2265FS/2265FSTP) from randomly selected 5 places from each level at different soil depth (5, 10, 20, 30 and 40cm) with two weeks interval starting from 14 DAT to 70 DAT. To convert the ECₑ or saturated media extract (SME) from ECₐ or FS (EC value measured by field scout direct soil EC meter), the following formula was used [5].

\[ \text{SME} = 2.7 \times \text{FS} + 0.8 \]

Grain yield was determined from a central 1m² harvested areas from each plot and was adjusted to 14% moisture content. Five hills were selected as samples to assess the yield component parameters. All the collected data were analyzed using ANOVA with Statistix 8 software. The treatment means were separated by Least Significant Difference (LSD) at 5 % probability level.
TABLE 1. PHYSICOCHEMICAL PROPERTIES OF THE EXPERIMENTAL SOILS

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Salinity Level I</th>
<th>Salinity Level II</th>
<th>Salinity Level III</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Values</td>
<td>Range</td>
<td>Values</td>
</tr>
<tr>
<td>Soil Texture</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sand (%)</td>
<td>21.85</td>
<td>Clay loam</td>
<td>15.3</td>
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<tr>
<td>Silt (%)</td>
<td>43.65</td>
<td></td>
<td>24.1</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>33.2</td>
<td></td>
<td>60.6</td>
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<tr>
<td>Total N (%)</td>
<td>0.14</td>
<td>Low</td>
<td>0.18</td>
</tr>
<tr>
<td>Available P (ppm)</td>
<td>14.42</td>
<td>High</td>
<td>17.36</td>
</tr>
<tr>
<td>Available K⁺ (meq/100g)</td>
<td>25.8</td>
<td>High</td>
<td>25.21</td>
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<tr>
<td>Soil pH</td>
<td>8.29</td>
<td>Moderately alkaline</td>
<td>8.62</td>
</tr>
<tr>
<td>EC (dSm⁻¹)</td>
<td>3.32</td>
<td>6</td>
<td></td>
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<tr>
<td>TDS (ppm)</td>
<td>285</td>
<td>599</td>
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<td>ESP</td>
<td>5.91</td>
<td>24.53</td>
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<tr>
<td>Cation Exchange</td>
<td>52.41</td>
<td>Very high</td>
<td>45.57</td>
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<tr>
<td>Capacity (CEC)</td>
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<tr>
<td>Exchangeable Ca⁺</td>
<td>42.28</td>
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<tr>
<td>Exchangeable Mg⁺</td>
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<td>1.38</td>
<td>2.15</td>
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<tr>
<td>Exchangeable Na⁺</td>
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<td>12.64</td>
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<tr>
<td>Exchangeable K⁺</td>
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<td>0.65</td>
<td>0.95</td>
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<tr>
<td>Exchangeable H⁺</td>
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<td>0</td>
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<tr>
<td>Organic carbon (%)</td>
<td>0.98</td>
<td>Very low</td>
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</tr>
<tr>
<td>Dominant salt</td>
<td>Na₂SO₄</td>
<td>Na₂CO₃</td>
<td>Na₂CO₃</td>
</tr>
<tr>
<td>Classification</td>
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<td>Saline-Sodic Soil</td>
<td>Saline-Sodic Soil</td>
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TABLE 2. QUALITY OF IRRIGATION WATER

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<tr>
<td>EC</td>
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<td>low</td>
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<tr>
<td>TDS</td>
<td>430.72</td>
<td>low</td>
</tr>
<tr>
<td>SAR</td>
<td>1.44</td>
<td>low</td>
</tr>
<tr>
<td>Anions (meq/L)</td>
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</tr>
<tr>
<td>CO₃²⁻</td>
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<td></td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>0.16</td>
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<tr>
<td>Cl⁻</td>
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<td></td>
</tr>
<tr>
<td>SO₄²⁻</td>
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<td></td>
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<tr>
<td>Cations (meq/L)</td>
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<td>Ca²⁺</td>
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<tr>
<td>Mg²⁺</td>
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</tr>
<tr>
<td>K⁺</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Na⁺</td>
<td>1.58</td>
<td></td>
</tr>
<tr>
<td>Dominant salt</td>
<td>CaCO₃</td>
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TABLE 3. IRRI’S STANDARD EVALUATION SYSTEM (SES)

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<th>Score</th>
<th>Observation</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal growth, no leaf symptoms</td>
<td>Highly tolerance</td>
</tr>
<tr>
<td>3</td>
<td>Nearly normal growth, but leaf tips of few leaves whitish and rolled</td>
<td>Tolerant</td>
</tr>
<tr>
<td>5</td>
<td>Growth severely retarded and tillering reduced, most leaves rolled, only a few are elongating</td>
<td>Moderately tolerance</td>
</tr>
<tr>
<td>7</td>
<td>Complete cessation of growth, most leaves dry, some plant dying</td>
<td>Susceptible</td>
</tr>
<tr>
<td>9</td>
<td>Almost all plants dead or dying</td>
<td>Highly susceptible</td>
</tr>
</tbody>
</table>
II. RESULTS AND DISCUSSION

A. Plant height

At all levels, the plant height increased progressively up to 56 DAT (Fig. 1). The result showed significant variation in plant height among the varieties as affected by different salinity levels. Among them, V6, V2 and V7 showed higher performance at 3.32 dS m\(^{-1}\), V7, V6 and V4 at 6 dS m\(^{-1}\) and V7, V2 and V5 at 7.64 dS m\(^{-1}\). In contrast, the lower plant height were observed in V3, V8 and V9 at 3.32 dS m\(^{-1}\), V10, V3 and V9 at 6 dS m\(^{-1}\) and V9, V6 and V8 at 7.64 dS m\(^{-1}\). Tolerance to salinity by each variety in term of plant height varied greatly. V7 produced higher plant height at all level. This might be due to varietal superiority of V7 in terms of plant height than other tested varieties. On the other hand, V6 showed higher plant high at 3.32 and 6 dS m\(^{-1}\) than most of the other tested varieties but its height was unfortunately decreased at 7.64 dS m\(^{-1}\). This indicated the higher sensitivity to salinity of V6 in term of plant height than other tested varieties. All of the tested YAU promising rice lines except V6 get higher plant height even than that of V10 (tolerance check) at 7.64 dSm\(^{-1}\). This might be varietal superiority of YAU promising rice lines. By comparing the different salinity levels, reduction in plant height occurred with increasing salinity. The result indicated that the effect of salinity on plant height was different, which might be due to genetic potentiality of these varieties which tolerate to salinity. Similar result was reported by many researchers who studied the effect of salinity on rice genotypes [6, 7, 8].

B. Number of tillers hill\(^{-1}\)

Number of tillers hill\(^{-1}\) counted at various growth stages from 14 DAT to 56 DAT was continually increased at all salinity level (Fig. 2). At EC value 3.32 dS m\(^{-1}\), numbers of tillers hill\(^{-1}\) were highly significant among tested varieties at all growth stages. In the case of 6 dS m\(^{-1}\), there was not significant at only 14DAT while at 28DAT, 42DAT and 56DAT showed highly significantly at 1% level among different varieties. Tiller numbers of different varieties at 7.64 dS m\(^{-1}\) were not significant at all recorded date except 56 DAT. But at 56 DAT, all three salinity levels (3.32, 6 and 7.64 dS m\(^{-1}\)) were highly significant in tiller numbers hill\(^{-1}\) among different varieties. The top three highest number of tillers hill\(^{-1}\) was found in V8 (local check), V10 (tolerance check) and V4 at 3.32 dS m\(^{-1}\), V5, V8 (local check) and V10 (tolerance check) at 6 dS m\(^{-1}\) while V8 (local check), V10 (tolerance check) and V5 at 7.64 dS m\(^{-1}\). In contrast, the three lowest tiller number was observed in V7, V9 (sensitive check) V8 (local check) and V6 at 6 dS m\(^{-1}\) and V8 at 7.64 dS m\(^{-1}\). V8 and V10 gave higher tiller numbers than other varieties at all salinity level. Although V8 gave the higher number of tiller hill\(^{-1}\) it gave low yield due to lower filled grain % and lower 1000 grain weight. The result form the present study indicated that increasing the salinity level decreased the numbers of tillers hill\(^{-1}\). It was also reported by many authors [9, 10, 11]. One of the studies on the effect of saline irrigation water on rice stated that the number of tillers in different levels of salinity (3.6 to 8.3 dS m\(^{-1}\)) decreased but it was not significant statistically [12].

C. Days to 50% flowering

Comparing the mean performance of flowering date, V9 (sensitive check) and V10 (tolerance check) flowers earlier than YAU improved rice varieties and V8 (local check). Flowering date in all tested varieties ranged from 90 to 105 days at 3.32 dS m\(^{-1}\), 93 to 108 days at 6 dS m\(^{-1}\) and 106 to 124 days at 7.64 dS m\(^{-1}\) respectively. The latest flowering date was observed in V8 and V1 at 3.32 dS m\(^{-1}\), V5 and V8 at 6 dS m\(^{-1}\) and V6 and V8 at 7.64 dS m\(^{-1}\).

By comparing the differences among these three EC levels, 6 dS m\(^{-1}\) needed extra 3 to 7 days and 7.64 dS m\(^{-1}\) needed extra 10 to 22 days to reach 50% flowering compared to 3.32 dS m\(^{-1}\).
One of the studies on the effect of irrigation water on rice stated that salinity delays ripening of rice about one week; weight of 1000 seeds significantly decreases with salinity increase [12]. At salt concentration of 4.13 dS m\(^{-1}\), the plant needed from two to three extra days to achieve the growth stages in relation to control treatment [2].

D. Salt tolerance score

The visual symptoms of salt stress may still be the most appropriate for mass screening [17]. Different degrees of salt injuries (scores 3 to 9) was observed in all varieties under salt stressed condition.

All tested varieties except \( V_7 \) and \( V_9 \) (sensitive check) were tolerant at 3.32 dS m\(^{-1}\) while \( V_7 \) was highly tolerant and \( V_9 \) was moderately tolerant at 70 DAT. In the case of 6 dS m\(^{-1}\), \( V_4 \) was tolerant at all recorded stage. Other varieties except \( V_2 \), \( V_6 \) and \( V_9 \) were moderately tolerant at 70 DAT while \( V_2 \) and \( V_6 \) were sensitive at this stage and \( V_9 \) was highly sensitive. At 14DAT and 28 DAT, \( V_3 \), \( V_4 \) and \( V_5 \) showed moderately tolerance even at 7.64 dS m\(^{-1}\). But the trend was changed at 42 DAT, only \( V_4 \), \( V_7 \) and tolerant check showed moderately tolerant while others become sensitive at 7.64 dS m\(^{-1}\). In the case of 50 DAT and 70 DAT, at 7.64 dS m\(^{-1}\), only tolerance check showed moderately tolerant while all of YAU lines became sensitive. Among these, \( V_6 \) and \( V_9 \) showed highly sensitive.

Salt tolerance varies with according to the growth stages, varietal differences, soil water and aeration [18].By comparing the recorded date, all varieties showed slightly higher tolerance ability at 28 and 42 DAT than any other stage. Most of the YAU promising lines showed very sensitive at 56 and 70 DAT.

At 7.64 dS m\(^{-1}\) \( V_7 \) showed sensitive at early growth stages (14 DAT and 28 DAT) but it was recovered at 42 DAT although it was also sensitive at 56 DAT and 70 DAT. Similar results were reported by other researchers. During germination, rice is very tolerant against salinity but it is very sensitive in seedling and reproductive stages. However it is less sensitive during tillers and seed filling [19]. Rice response to salt stress varies according to the growth stages: rice is sensitive to sat stress at seedling stage, panicle initiation and early booting stages while tolerant at germination, grain filling and grain maturation [20].

E. Yield and Yield component parameters

Most of the yield contributing components measured were progressively reduced at 7.64 dS m\(^{-1}\) when compare to 3.32 dS m\(^{-1}\) by pointing out the higher the salinity level, the lower the performance of growth, yield and yield component parameters. Panicle length, numbers of spikelets per panicle and filled grain percent were highly and negatively affected by salinity while numbers of panicles per hill and 1000 grain weight was least affected. In the case of no of panicles hill\(^{-1}\), the significant reduction was found in level III (7.64 dS m\(^{-1}\)) compare to level I (3.32 dS m\(^{-1}\)) by pointing out the higher the salinity level, the lower the number of panicles hill\(^{-1}\). But the opposite is true at level II (6.0 dS m\(^{-1}\)). Most of the varieties such as \( V_4 \), \( V_5 \), \( V_6 \), \( V_7 \), \( V_8 \) and \( V_9 \) from Level II (6 dSm\(^{-1}\)) produced higher numbers of panicles per hill compared to level I (3.32 dSm\(^{-1}\)). But these produced panicles bare lower spikelet per panicle with lower filled grain %.

At level I (3.32dSm\(^{-1}\)), \( V_3 \) gave the highest yield which was followed by \( V_7 \) and \( V_4 \). The reason why \( V_3 \) gave the highest grain yield was due to the combined effect of highest number of spikelets per panicle, higher filled grain % and higher number of panicles per hill, regardless of its poor tillering capacity.

At level II (6.0 dS m\(^{-1}\)), \( V_4 \) gave the highest grain yield which was followed by \( V_7 \) and \( V_3 \). The reason why \( V_4 \) gave the highest yield may be due to the combine effect of highest number of spikelets per panicle, highest panicle length and higher filled grain percent. When compare to the tolerance check, \( V_3 \), \( V_4 \) and \( V_7 \) produces +21%, +1% and +7%
respectively at 3.32 dS m\(^{-1}\) and +2\%, +15 and +4\% respectively at 6 dS m\(^{-1}\).

However at level III (7.64 dS m\(^{-1}\)), V\(_{10}\) (tolerance check) gave the highest yield. Among the YAU promising lines V\(_{3}\) gave the highest grain yield and it was statistically similar to tolerance check with only – 17\% reduction. The higher yield potential of these varieties is due to the combine effect of higher performance of yield component characters.

With regard to the results of grain yield comparison, it can be clearly seen that yield of each varieties varies depend on the salinity level. The greatest grain yield for all varieties for all varieties belongs to the lowest salinity level (3.32 dS m\(^{-1}\)) and the lowest grain yield for all varieties belongs to the highest salinity level (7.64 dS m\(^{-1}\)) with 10-49 \% reduction at 6.0 dS m\(^{-1}\) and 69-95 \% reduction at 7.64 dS m\(^{-1}\) compared to 3.32 dS m\(^{-1}\). Grattan et al., 2002 [13] also estimate a yield loss of 50\% with an EC of around 7.4 dSm\(^{-1}\). Studies from some researchers [14, 15] showed significant rice yield reductions from a salinity concentration of 3 dS m\(^{-1}\), increasing in a 12\% for every extra EC units. Crops tolerate salinity up to a threshold level but above this, yields decrease approximately linearly with increasing salt concentrations [16].

F. Electrical Conductivity (EC)

Salinity is quantified in terms of the total concentration of such soluble salts, or more practically, in terms of the electrical conductivity of the solution [20]. Electrical conductivity is an easily measured and practical index of the total concentration of ionized solutes in an aqueous sample [21]. The EC data obtained for different soil depths can be seen at Fig. 3. In all three salinity levels, it was found that the lower the soil depth the greater the EC value. All three salinity levels showed a slightly higher EC value at the upper most surface soil (5cm and 10cm) than the adjacent lower layer (20cm). This may be due to the effect of evaporation that favors the salt to goes up to the surface layer. After that it became higher at 30 and 40 cm depth. This may be because of that became higher at 30 and 40 cm depth. This may be because of that after every irrigation; some leachable salts such as Na\(^+\), K\(^+\) are easily leached out by irrigation water to the lower layer of soil.

At all three salinity levels, by comparing the recorded date, 56 DAT gained the greater EC value at all soil depth than any others. This might be the effect of chemical fertilizer; these all levels were feed by nitrogen (urea) and potassium (MOP) fertilizer at 55 DAT. Soil EC levels were influenced by the applications to some extent and chemical fertilizer brought about the highest soil EC level in the each season [22].

IV. CONCLUSION

The response to salinity by each variety varies due to varietal performance. Increasing the salinity caused reducing in plant height and tiller numbers hill\(^{-1}\). Salinity delays the flowering up to one week at 6 dS m\(^{-1}\) while up to three weeks at EC 7.64 dS m\(^{-1}\). Different degrees of salt injuries (scores 3 to 9) and growth retardation was observed in all varieties under salt stressed condition. At 332 dS m\(^{-1}\), all tested varieties showed tolerant symptom. At 6.0 dS m\(^{-1}\), only one variety, V\(_{4}\) tolerate at all recorded date while V\(_{2}\) and V\(_{6}\) were sensitive and the remaining others were moderately tolerant. At highest salinity level none of these YAU improved varieties tolerate. By comparing the growth stages, all varieties showed slightly higher tolerance ability at active tillering stage than recovery stage and panicle initiation stage at all level.

In all three level, it was found that the lower the soil depth the greater the EC value. All three levels showed a slightly higher EC value at the upper most surface soil (5 cm and 10 cm) than the adjacent lower layer (20 cm) due to the effect of evaporation that favors the salt to goes up to the surface layer especially at level capacity situation. After that it became higher at 30 and 40 cm depth. This may be because of that
after every irrigation; some leachable salts such as Na\(^+\), K\(^+\) are easily leached out by irrigation water to the lower layer of soil. It was also found that soil EC levels was influenced by the application of fertilizers; within 2-3 days after application of fertilizers, EC levels slightly became higher than before. Among the yield component character, panicle length, numbers of spikelets per panicle and filled grain % were severely affected thereby causing significant reduction in final grain yield. Number of panicle per hills was the least affected by increasing salinity by bearing the lower number of spikelet panicle\(^1\).

Response of each variety in term of yield varies according to different salinity level; the greatest grain yield for all varieties belong to the lowest salinity level whereas the lowest for all varieties obtained from the highest salinity level. According to the results it can be concluded the higher the salinity levels lower the performance of growth, yield and yield components parameters. It is revealed from the current investigation that among the seven YAU promising rice lines, V\(_3\), V\(_4\) and V\(_7\) performs better soil salinity condition. More specifically, V3, V4 and V7 could be grown well at 3.32dSm\(^{-1}\) and 6dSm\(^{-1}\) while only V\(_3\) could be grown well at 7.64dSm\(^{-1}\).

**ACKNOWLEDGMENTS**

We would like to gratefully acknowledge to Rector and Pro-rectors of Yezin Agricultural University for their permission to conduct this research and Japan International Cooperation Agency, Technical Cooperation Project (JICA TCP) for the financial and technical supporting to this research. Moreover, we would also like to thank to the farmers in Htein Kan Gyi Village for their keenly participation.

**TABLE 4. Tolerance levels of seven YAU promising lines and three check varieties as affected by different salinity levels: 3.32 dS m\(^{-1}\), 6.0 dS m\(^{-1}\) and 7.64 dS m\(^{-1}\)**

<table>
<thead>
<tr>
<th>Varieties</th>
<th>14 DAT</th>
<th>28 DAT</th>
<th>42 DAT</th>
<th>56 DAT</th>
<th>70 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>V(_1)</td>
<td>T</td>
<td>MT</td>
<td>MT</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_2)</td>
<td>MT</td>
<td>MT</td>
<td>S</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_3)</td>
<td>T</td>
<td>MT</td>
<td>MT</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_4)</td>
<td>T</td>
<td>MT</td>
<td>MT</td>
<td>HT</td>
<td>T</td>
</tr>
<tr>
<td>V(_5)</td>
<td>T</td>
<td>MT</td>
<td>HT</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_6)</td>
<td>MT</td>
<td>S</td>
<td>S</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_7)</td>
<td>MT</td>
<td>S</td>
<td>S</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_8)</td>
<td>MT</td>
<td>MT</td>
<td>S</td>
<td>T</td>
<td>MT</td>
</tr>
<tr>
<td>V(_9)</td>
<td>MT</td>
<td>S</td>
<td>S</td>
<td>MT</td>
<td>S</td>
</tr>
<tr>
<td>V(_10)</td>
<td>T</td>
<td>T</td>
<td>MT</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

82
Fig. 1. Mean value of plant height of YAU promising rice lines and Check rice varieties A) 3.32 dS m⁻¹, B) 6 dS m⁻¹ and C) 7.64 dS m⁻¹

Fig. 2. Mean value of number of tillers hill⁻¹ YAU promising rice lines and Check rice varieties A) 3.32 dS m⁻¹, B) 6 dS m⁻¹ and C) 7.64 dS m⁻¹

Fig. 3. Mean EC values at different soil depths A) 3.32 dS m⁻¹, B) 6 dS m⁻¹ and C) 7.64 dS m⁻¹
TABLE 5. Yield and yield components of seven YAU promising rice lines and three check varieties as affected by different salinity levels: 3.32 dS m\(^{-1}\), 6 dS m\(^{-1}\) and 7.64 dS m\(^{-1}\)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>filled grain %</th>
<th>1000 grain wt (gm)</th>
<th>no of spikelets panicle(^{-1})</th>
<th>Yield (t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.32 dSm(^{-1})</td>
<td>6.0 dSm(^{-1})</td>
<td>7.64 dSm(^{-1})</td>
<td>3.32 dSm(^{-1})</td>
</tr>
<tr>
<td>V(_1)</td>
<td>85.4 bc</td>
<td>75.4 abc</td>
<td>49.2 ab</td>
<td>28.6 ab</td>
</tr>
<tr>
<td>V(_2)</td>
<td>84.4 bc</td>
<td>75.0bcde</td>
<td>44.1 bc</td>
<td>25.1 c</td>
</tr>
<tr>
<td>V(_3)</td>
<td>86.8 b</td>
<td>74.8 bcde</td>
<td>45.8 ab</td>
<td>28.2 ab</td>
</tr>
<tr>
<td>V(_4)</td>
<td>86.1 b</td>
<td>76.5 abc</td>
<td>46.5 ab</td>
<td>21.5 d</td>
</tr>
<tr>
<td>V(_5)</td>
<td>85.5 bc</td>
<td>76.4 abc</td>
<td>44 bc</td>
<td>29.3 a</td>
</tr>
<tr>
<td>V(_6)</td>
<td>78.5 d</td>
<td>68.3 de</td>
<td>32.2 d</td>
<td>28.1 ab</td>
</tr>
<tr>
<td>V(_7)</td>
<td>85.6 bc</td>
<td>82.1 a</td>
<td>52.6 a</td>
<td>27.7 b</td>
</tr>
<tr>
<td>V(_8)</td>
<td>80.9 ed</td>
<td>62.2 e</td>
<td>37.3 cd</td>
<td>20.1 e</td>
</tr>
<tr>
<td>V(_9)</td>
<td>83.4 bc</td>
<td>70.1 cd</td>
<td>36.9 cd</td>
<td>17.8 f</td>
</tr>
</tbody>
</table>

Means followed by the same letter in each column are not significantly different by LSD at 5% level.
ns = no significant, * = significant at 5% level, ** = significant at 1% level

TABLE 5, Yield and yield components of seven YAU promising rice lines and three check varieties as affected by different salinity levels: 3.32 dS m\(^{-1}\), 6 dS m\(^{-1}\) and 7.64 dS m\(^{-1}\) (continued)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>no of panicle hill(^{-1})</th>
<th>panicle length (cm)</th>
<th>Yield (t ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.32dSm(^{-1})</td>
<td>6dSm(^{-1})</td>
<td>7.64dSm(^{-1})</td>
</tr>
<tr>
<td>V(_1)</td>
<td>14.8 cd</td>
<td>13.0 de</td>
<td>12.3 cdee</td>
</tr>
<tr>
<td>V(_2)</td>
<td>13.8 de</td>
<td>12.5 e</td>
<td>12.8 bcde</td>
</tr>
<tr>
<td>V(_3)</td>
<td>17.8 a</td>
<td>16.3 bc</td>
<td>15.3 ab</td>
</tr>
<tr>
<td>V(_4)</td>
<td>13.0 de</td>
<td>15.5 bcd</td>
<td>10.8 def</td>
</tr>
<tr>
<td>V(_5)</td>
<td>13.5 de</td>
<td>17.3 ab</td>
<td>11.5 def</td>
</tr>
<tr>
<td>V(_6)</td>
<td>12.3 e</td>
<td>14.5 cde</td>
<td>10.5 ef</td>
</tr>
<tr>
<td>V(_7)</td>
<td>13.3 de</td>
<td>16.5 bc</td>
<td>13.5 abcd</td>
</tr>
<tr>
<td>V(_8)</td>
<td>16.5 bc</td>
<td>19.5 a</td>
<td>15.8 a</td>
</tr>
<tr>
<td>V(_9)</td>
<td>12.8 de</td>
<td>14.0 cde</td>
<td>9.3 f</td>
</tr>
<tr>
<td>V(_10)</td>
<td>19.5 a</td>
<td>19.3 a</td>
<td>14.8 abc</td>
</tr>
</tbody>
</table>

Means followed by the same letter in each column are not significantly different by LSD at 5% level.
ns = no significant, * = significant at 5% level, ** = significant at 1% level

<table>
<thead>
<tr>
<th>LSD_{0.05}</th>
<th>1.91</th>
<th>1.82</th>
<th>2.21</th>
<th>1.28</th>
<th>1.23</th>
<th>0.58</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&gt;F</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>CV (%)</td>
<td>11.45</td>
<td>10.89</td>
<td>15.06</td>
<td>5.63</td>
<td>6.1</td>
<td>9.04</td>
</tr>
</tbody>
</table>
REFERENCES


Effect of Biochar with Inorganic Conditioners on Rice Productivity in Salt-Affected Soils

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Abstract— Increasing the food requirements due to the increasing trend of population, upcoming climate change and increasing soil salinity, the reclamation of salt-affected soil is becoming an important one to increase cultivable area and improve crop yield. Salt-affected soil, sodic and saline-sodic soils possess poor physical properties and fertility problems that adversely affect the growth and yield of most crops. In order to evaluate the effects of biochar (rice husk biochar), calcium chloride and gypsum as individual and combined applications on rice productivity and the reclamation potential of salt-affected soils, two field experiments were conducted at sodic soils in Ta Kaw and saline- sodic soil in Oke Pho village, Waw Township, Bago Region during the rainy season of 2018. Experiment was laid out in a randomized complete block (RCB) design with four replications. Six treatments were used as T\textsubscript{0} - control; T\textsubscript{1} - biochar (20 t ha\textsuperscript{-1}); T\textsubscript{2} - calcium chloride (50% soil gypsum requirement, SGR); T\textsubscript{3} - gypsum (50% SGR); T\textsubscript{4} - biochar (10 t ha\textsuperscript{-1}) + calcium chloride (25% SGR); T\textsubscript{5} - biochar (10 t ha\textsuperscript{-1}) + gypsum (25% SGR). Twenty eight days old Sin Thu Kha rice seedlings were transplanted with spacing of 15 cm x 20 cm. Soil pH, electrical conductivity (EC), bulk density, grain yield and yield components were measured at harvest. Data collected were analyzed statistically using statistic 8. According to the study, the results showed that the highest grain yield and yield components were observed in the combination of biochar (10 t ha\textsuperscript{-1}) and calcium chloride (25% SGR) treatment, but it was not significantly different from the combination of biochar (10 t ha\textsuperscript{-1}) and gypsum (25% SGR) treatment, biochar (20 t ha\textsuperscript{-1}) treatment, and calcium chloride (50% SGR) in both sodic and saline-sodic soils. The rice yield from gypsum (50% SGR) application was not different when compared to control. The lowest soil bulk density and electrical conductivity were observed in biochar (20 t ha\textsuperscript{-1}) application in both soils. The highest soil bulk density, electrical conductivity and lowest pH value were observed in gypsum (50% SGR) application. This study suggested that biochar and calcium chloride combination, biochar and gypsum combination, calcium chloride and biochar alone were efficient on rice yield and soil properties in both sodic and saline-sodic soils. It can be concluded that combined applications of biochar and inorganic conditioners were more effective and rice husk biochar (agricultural waste) would be used effectively for rice production in salt-affected soil.

Key words: Salt-affected soil, biochar, soil conditioners, soil gypsum requirement, rice yield

I. INTRODUCTION

Increasing the food requirements due to the increasing the population, upcoming climate change and increasing soil salinity, the reclamation of salt-affected soil is becoming an important one to increase cultivable area and improve crop yield [1, 2, 3]. Primary salinization occurs naturally in sea salt water flooded areas in which salt is a part of the soil composition. Men made salinization, secondary salinization, occurs when soils that had a low concentration of salt become more and more saline because of irrigation with salted water and poor drainage [4]. Salinity is a major environmental stress that affects nearly 7% of total land area of the world. Around the world, more than 800 million hectares of land are affected by salinity [5] with an annual increase of ∼1–2% [6]. Increasing soil salinity, soils high in soluble salts, and sodicity, soils high in exchangeable sodium are land degradation problems worldwide, and are predicted to more importance in the future. Myanmar has a considerable extent of inland salinity in central Myanmar and coastal salinity in coastal regions. A total of 0.6 million ha of saline-alkaline soils was recorded in Myanmar in 2012 [7] and around 3% of the country’s rice is affected by salinity [8]. The estuary areas of Sittaung river are included in the salt-affected soils by tidal flooding during wet season (June to October) and upward or lateral movement of saline ground water during dry season (November to May).

Salinity adversely affects plant growth and metabolism. High salinity retards plant growth by causing osmotic imbalances and specific ion toxicities. Sodium (Na\textsuperscript{+}) is the dominant cation in salt-affected soils which creates physiological disturbance of crop [9, 10]. The removal of Na\textsuperscript{+} from the soil colloid followed by leaching of the replaced Na\textsuperscript{+} out of the root zone is one of the reclamation procedures of salt affected soils [11]. There are many methods to improve salt-affected land, for example, water leaching, chemical remediation and phytoremediation [9, 12, 13, 14]. The soluble source of calcium (Ca\textsuperscript{2+}) is essential for reclamation of salt-affected soils, which is useful in removing injurious Na\textsuperscript{+} from the exchange complex. Gypsum, calcite, calcium chloride and other chemical agents provide Ca\textsuperscript{2+} to replace exchangeable Na\textsuperscript{+} and they are effective for saline soil amelioration [15].
The application of organic matter conditioners is one method which can both ameliorate and increase the fertility of saline soils [16]. Salt-affected soils generally manifest poor structural stability due to low organic matter content. [17] said that the structural stability of soil can be improved by the addition of organic materials. But the decomposition rate of organic matter are high and the benefits are often short-lived [18].

Biochar likes the charcoal obtained by the pyrolysis of biomass, i.e., by incomplete thermal decomposition of organic material under low oxygen conditions at relatively low temperatures (< 700 °C). Biochar is produced for the use of a soil amendment [19]. Due to its degradation rate is very low, biochar is a more stable material than the common organic conditioners and lasting as several hundred years for complete decomposition. Thus, its ability on the chemical, physical and biological properties of the soil may extend over a long period of time [20]. Since biochar possesses high surface area and surface charge density [21], it increases the ability of soils to retain nutrients and moisture and it reduces the leaching of nutrients and agricultural chemicals [22, 23, 24]. The combined application of organic and inorganic amendments increases their effectiveness for improving soil properties [25]. Gypsum (100% soil gypsum requirement, SGR) and combination of CaCl2 (50% SGR) and biogas slurry (10 tons per hectare, t·ha⁻¹) are equally effective strategies for reclaiming sodic soil [26]. The highest grain yield of rice was obtained with the combination of 50% rice straw and 50% gypsum treatment and the combination of 50% cowdung and 50% gypsum treatment in salt-affected area in Bangladesh [27]. To achieve the maintenance and improvement of soil physicochemical properties and the better crop yields, it is needed to proper choice of soil amendments and/or combination in the salt-affected soils. On this review, this study was carried out to evaluate the effects of biochar (rice husk biochar), calcium chloride and gypsum as individual and combined applications on rice productivity and the reclamation effects on salt-affected soils.

II. MATERIALS AND METHODS

The field experiments were conducted at farmer’s fields; (1) sodic soils in Ta Kaw village (17° 29′ 56.5ʺ N 96° 48′ 30.8ʺ E) and (2) saline-sodic soil in Oke Pho village (17° 31′ 08.1ʺ N 96° 51′ 51.0ʺ E), Waw Township, Bago Region, during the rainy season of 2018 (June to October). The main characteristics of the experimental site are shown in Table 1. Six treatments were included as T₀- control; T₁- biochar (20 t ha⁻¹); T₂ - calcium chloride, CaCl₂ (50% SGR); T₃- gypsum (50% SGR); T₄- combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR); T₅- combination of biochar (10 t ha⁻¹) and gypsum (25% SGR). Both field experiments were arranged in randomized complete block design with four replications. Each plot size of 25 m² (5 m × 5 m) was separated 1 m between plots with double bands. According to treatments plan, CaCl₂ and gypsum were applied on soil surface and followed by puddling one month before transplanting and were leached out. Biochar was applied 15 days before transplanting. There was no addition of any conditioners in control plots. Rice seedlings with the age of 28 days old were transplanted three plants per hill at 15 cm between plants and 20 cm inter row spacing. The rice variety used in these experiments was Sin Thu Kha (135 days). At the harvesting time, plants from one square meter area in the center of each plot were cut to measure grain yield and biomass yield per square meter. Eight plant samples were selected from the harvested plants to measure plant height, number of panicles per hill, panicle length, number of grains per panicle, and thousand grains weights. Harvest index was calculated by

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ta Kaw Sodic soil</th>
<th>Oke Pho Saline-sodic soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (soil:water = 1:5)</td>
<td>8.68</td>
<td>6.49</td>
</tr>
<tr>
<td>ECₑ (dS m⁻¹) in 0-10 cm depth</td>
<td>1.23</td>
<td>7.30</td>
</tr>
<tr>
<td>ECₑ (dS m⁻¹) in 10-20 cm depth</td>
<td>1.77</td>
<td>5.94</td>
</tr>
<tr>
<td>Cation exchange capacity (CEC, cmol, kg⁻¹)</td>
<td>9.30</td>
<td>27.30</td>
</tr>
<tr>
<td>Clay %</td>
<td>32.80</td>
<td>16.80</td>
</tr>
<tr>
<td>Silt %</td>
<td>33.00</td>
<td>48.00</td>
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<tr>
<td>Sand %</td>
<td>34.20</td>
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</tr>
<tr>
<td>Texture</td>
<td>Clay loam</td>
<td>Loam</td>
</tr>
<tr>
<td>Exchangeable Sodium Percentage (ESP %)</td>
<td>58 %</td>
<td>29 %</td>
</tr>
<tr>
<td>Soil gypsum requirement, (SGR, t ha⁻¹)</td>
<td>9.52</td>
<td>12.65</td>
</tr>
</tbody>
</table>
using the formula; Harvest index = Grain yield/Biomass yield. Grain:straw ratio was calculated as the ratio of grains dry weight and straw dry weight. Soil samples were collected separately after harvest. Soil samples were dried, powdered and sieved through 2 mm sieve for analysis of pH and EC. The pH of soil samples was measured in soil:deionized water (1:5) suspension with the help of pH meter. EC was measured in soil: deionized water (1:5) suspension and apparent EC by the EC meter. Bulk density was also measured. The data collected was statistically analyzed the analysis of variance (ANOVA) technique, while the least significance difference (LSD) test was used to compare the differences among treatment means.

III. RESULTS

A. Effect on yield components of rice

In sodic soil, all yield components, except 1000 grains weight, of rice grown in amendment treated soils were significantly higher than that of control soil (Table- 2) The tallest plant height (109.7 cm) was observed in biochar (20 t ha\(^{-1}\)) which was followed by CaCl\(_2\) (50% SGR) and the combination of biochar (10 t ha\(^{-1}\)) and CaCl\(_2\) (25% SGR). The highest number of panicles per hill was obtained by the combination of biochar (10 t ha\(^{-1}\)) and gypsum (25% SGR) which was followed by biochar (20 t ha\(^{-1}\)). The longest panicle length (23.52 cm) and maximum number of grains per panicle (181.63) were recorded in the combination of biochar (10 t ha\(^{-1}\)) and CaCl\(_2\) (25% SGR). They were statistically similar with CaCl\(_2\) (50% SGR) treatment. The highest 1000 grains weight (19.48 g) was found in the combination of biochar (10 t ha\(^{-1}\)) and CaCl\(_2\) (25% SGR) and the lowest was observed in gypsum (50% SGR) treatment. In saline-sodic soil, number of panicles per hill, panicle length, number of grains per panicle of rice grown in amendment treated soils were significantly higher than that of control (Table - 3). The tallest plant height (104.38 cm) and number of panicles per hill (7.40) were observed in the combination of biochar (10 t ha\(^{-1}\)) and CaCl\(_2\) (25% SGR) which was followed by the combination of biochar (10 t ha\(^{-1}\)) and gypsum (25% SGR). The longest panicle length (24.25 cm) and the maximum number of grains per panicle (194.57) were recorded in biochar (20 t ha\(^{-1}\)) treatment. The maximum 1000 grains weight (19.48 g) was found in the combination of biochar (10 t ha\(^{-1}\)) and gypsum (25% SGR).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of panicles hill(^{-1})</th>
<th>Panicle length (cm)</th>
<th>No. of grains panicle(^{-1})</th>
<th>1000 grains weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>85.7 b</td>
<td>4.05</td>
<td>20.30 c</td>
<td>120.15 b</td>
<td>19.38</td>
</tr>
<tr>
<td>Biochar (20 t ha(^{-1}))</td>
<td>109.78 a</td>
<td>5.15</td>
<td>22.22 b</td>
<td>153.35 a</td>
<td>19.22</td>
</tr>
<tr>
<td>CaCl(_2) (50% SGR)</td>
<td>108.93 a</td>
<td>4.95</td>
<td>23.41 a</td>
<td>169.10 a</td>
<td>19.32</td>
</tr>
<tr>
<td>Gypsum (50% SGR)</td>
<td>98.03 ab</td>
<td>5.00</td>
<td>22.94 ab</td>
<td>161.57 a</td>
<td>19.10</td>
</tr>
<tr>
<td>Biochar (10 t ha(^{-1}))+ CaCl(_2) (25%SGR)</td>
<td>107.90 a</td>
<td>5.05</td>
<td>23.52 a</td>
<td>181.63 a</td>
<td>19.48</td>
</tr>
<tr>
<td>Biochar (10 t ha(^{-1}))+ Gypsum (25%SGR)</td>
<td>104.28 a</td>
<td>5.20</td>
<td>22.55 ab</td>
<td>163.18 a</td>
<td>19.24</td>
</tr>
</tbody>
</table>

LSD 0.05: 15.99 1.18 1.01 32.58 1.02
Pr>F: 0.043 0.358 0.0001 0.010 0.98
CV%: 10.36 15.94 2.98 14.26 5.51

Means in a column showed same letter are not significantly different at p < 0.05. LSD: least significant difference.
### TABLE 3: EFFECT OF BIOCHAR AND INORGANIC CONDITIONERS ON PLANT HEIGHT, NUMBER OF PANICLES PER HILL, PANICLE LENGTH, NUMBER OF GRAINS PER PANICLE AND 1000 GRAINS WEIGHT OF RICE IN SALINE- SODIC SOIL (OKE PHO)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of panicles hill⁻¹</th>
<th>Panicle length (cm)</th>
<th>No. of grains panicle⁻¹</th>
<th>1000 grains weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>92.85</td>
<td>5.08 b</td>
<td>22.96 b</td>
<td>149.88 b</td>
<td>17.30</td>
</tr>
<tr>
<td>Biochar (20 t ha⁻¹)</td>
<td>99.25</td>
<td>5.80 b</td>
<td>24.25 a</td>
<td>194.57 a</td>
<td>17.37</td>
</tr>
<tr>
<td>CaCl₂ (50% SGR)</td>
<td>96.38</td>
<td>5.12 b</td>
<td>24.08 a</td>
<td>162.57 b</td>
<td>17.78</td>
</tr>
<tr>
<td>Gypsum (50% SGR)</td>
<td>90.97</td>
<td>5.52 b</td>
<td>22.71 b</td>
<td>142.67 b</td>
<td>17.72</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + CaCl₂ (25% SGR)</td>
<td>104.38</td>
<td>7.40 a</td>
<td>22.64 b</td>
<td>159.55 b</td>
<td>17.56</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + Gypsum (25% SGR)</td>
<td>101.03</td>
<td>7.28 a</td>
<td>22.57 b</td>
<td>156.57 b</td>
<td>17.95</td>
</tr>
</tbody>
</table>

LSD 0.05 11.38 1.21 0.90 22.56 0.68  
Pr>F 0.124 0.002 0.002 0.004 0.312  
CV% 7.75 13.36 2.58 9.30 2.56

Means in a column showed same letter are not significantly different at p < 0.05. LSD: least significant difference

#### B. Effect on biomass yield of rice

Biomass yields were significantly affected by different treatments (Table 4) in both experiments. In sodic soil, the highest straw yield (6.57 t ha⁻¹) was recorded in CaCl₂ (50% SGR) treatment that was statistically similar to the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR). These treatments were not significantly different with the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR) and the treatment of biochar (20 t ha⁻¹) alone. In contrast, the lowest straw yield (2.65 t ha⁻¹) was found in the control. In saline-sodic soil, the highest straw yield (13.63 t ha⁻¹) was noted with the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR) treatment that was statistically similar to the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR). The lowest biomass yield (8.68 t ha⁻¹) was found in gypsum (50% SGR) alone in saline-sodic soil.

#### C. Effect on Grain yield of rice

The results showed that different treatments had significant effect on the grain yield of rice (Table 4). In sodic soil, the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) gave maximum grain yield (3.67 t ha⁻¹) among the treatments. However, it was not significant different with CaCl₂ (50% SGR) alone, biochar (20 t ha⁻¹) alone and combination of biochar (10 t ha⁻¹) and gypsum (25% SGR). Gypsum (50% SGR) produced the gain yield (2.34 t ha⁻¹), which was not statistically significant with control. The minimum grain yield (1.58 t ha⁻¹) was recorded in control where no amendment was used.

In saline-sodic soil, the maximum grain yield (5.18 t ha⁻¹) was recorded in treatment using the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR), but it was statistically similar with the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR) and CaCl₂ (50% SGR) alone. The mean grain yield (3.49 t ha⁻¹) of gypsum (50% SGR) treatment was slightly lower than control (4.36 t ha⁻¹). In both salt-affected soils, the application of biochar in combination with inorganic conditioners showed a positive effect on the grain yield of rice.
TABLE 4: EFFECT OF BIOCHAR AND INORGANIC CONDITIONERS ON GRAIN YIELD AND BIOMASS YIELD OF RICE IN SODIC SOIL AND SALINE-SODIC SOIL, RAINING SEASON 2018

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Sodic soil (Ta Kaw)</th>
<th>Saline-sodic soil (Oke Pho)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain yield (t ha⁻¹)</td>
<td>Biomass yield (t ha⁻¹)</td>
</tr>
<tr>
<td>Control</td>
<td>1.58 b</td>
<td>2.65 c</td>
</tr>
<tr>
<td>Biochar (20 t ha⁻¹)</td>
<td>3.35 a</td>
<td>5.63 ab</td>
</tr>
<tr>
<td>CaCl₂ (50% SGR)</td>
<td>3.66 a</td>
<td>6.57 a</td>
</tr>
<tr>
<td>Gypsum (50% SGR)</td>
<td>2.34 b</td>
<td>3.60 bc</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + CaCl₂ (25% SGR)</td>
<td>3.67 a</td>
<td>6.47 a</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + Gypsum (25% SGR)</td>
<td>3.43 a</td>
<td>6.05 ab</td>
</tr>
<tr>
<td>LSD₀.₀₅</td>
<td>0.92</td>
<td>2.64</td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>0.001</td>
<td>0.027</td>
</tr>
<tr>
<td>CV%</td>
<td>20.37</td>
<td>33.00</td>
</tr>
</tbody>
</table>

Means in a column showed same letter are not significantly different at p < 0.05. LSD: least significant difference

TABLE 5: THE EFFECT OF BIOCHAR AND INORGANIC CONDITIONERS ON GRAIN: STRAW RATIO AND HARVEST INDEX AND PERCENT OF YIELD INCREASE OF RICE IN SODIC SOIL AND SALINE-SODIC SOIL, RAINING SEASON 2018

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Sodic soil (Ta Kaw)</th>
<th>Saline-sodic soil (Oke Pho)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain: Straw</td>
<td>Harvest Index</td>
</tr>
<tr>
<td>Control</td>
<td>0.71</td>
<td>0.40</td>
</tr>
<tr>
<td>Biochar (20 t ha⁻¹)</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>CaCl₂ (50% SGR)</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>Gypsum (50% SGR)</td>
<td>0.72</td>
<td>0.41</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + CaCl₂ (25% SGR)</td>
<td>0.57</td>
<td>0.36</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + Gypsum (25% SGR)</td>
<td>0.60</td>
<td>0.37</td>
</tr>
<tr>
<td>LSD₀.₀₅</td>
<td>0.26</td>
<td>0.10</td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>0.770</td>
<td>0.902</td>
</tr>
<tr>
<td>CV%</td>
<td>26.62</td>
<td>17.36</td>
</tr>
</tbody>
</table>

Means in a column showed same letter are not significantly different at p < 0.05. LSD: least significant difference

D. Effect on Grain: straw ratio and harvest index of rice

There were not significantly differences in grain: straw ratio and harvest index in both salt-affected soils (Table 5). Gypsum (50% SGR) treatment was recorded the maximum grain: straw ratio (0.72) and harvest index (0.41) and the minimum grain: straw ratio (0.57) and harvest index (0.36) were observed in the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) in sodic soil. In saline-sodic soil, the highest grain: straw ratio (0.76) and harvest index (0.43) were found in the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) and the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR) was the minimum. The highest percent of yield increased from control were observed in the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) in both experiments.
TABLE 6: EFFECTS OF BIOCHAR AND INORGANIC CODITIONERS ON pH, ECₑ AND BULK DENSITY IN UPPER 10 CM DEPTH OF SODIC AND SALINE-SODIC SOIL AT HARVEST

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Sodic soil (Ta Kaw)</th>
<th>Saline-sodic soil (Oke Pho)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH</td>
<td>ECₑ (dS m⁻¹)</td>
</tr>
<tr>
<td>Control</td>
<td>5.52 a</td>
<td>0.19 b</td>
</tr>
<tr>
<td>Biochar (20 t ha⁻¹)</td>
<td>5.44 ab</td>
<td>0.09 b</td>
</tr>
<tr>
<td>Calcium chloride (50% SGR)</td>
<td>4.96 bc</td>
<td>0.22 b</td>
</tr>
<tr>
<td>Gypsum (50% SGR)</td>
<td>4.60 c</td>
<td>1.90 a</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + CaCl₂ (25% SGR)</td>
<td>5.40 ab</td>
<td>0.16 b</td>
</tr>
<tr>
<td>Biochar (10 t ha⁻¹) + Gypsum (25% SGR)</td>
<td>4.98 bc</td>
<td>0.61 b</td>
</tr>
<tr>
<td>LSD₀.₀₅</td>
<td>0.52</td>
<td>0.77</td>
</tr>
<tr>
<td>Pr&gt;F</td>
<td>0.012</td>
<td>0.001</td>
</tr>
<tr>
<td>CV%</td>
<td>6.68</td>
<td>68.04</td>
</tr>
</tbody>
</table>

Means in a column showed same letter are not significantly different at p < 0.05. LSD: least significant difference

E. Effect on Soil properties at harvest

Applications of biochar amendments improve some of the physical properties of salt-affected soil (Table 6). The highest pH was observed with control in sodic soil and the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) in saline-sodic soil. The lowest pH was found with the treatment of gypsum (50% SGR) in sodic soil and the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR) in saline-sodic soil. The ECₑ was significantly different in both soils. The highest ECₑ (1.9 and 4.332 dS m⁻¹) were observed in gypsum (50% SGR) treatment in both experiments and the lowest ECₑ (0.086 dS m⁻¹) was recorded with biochar (20 t ha⁻¹) treatment in sodic soil and (1.121 dS m⁻¹) with the combination of biochar (10 t ha⁻¹) and CaCl₂ (25% SGR) in saline-sodic soil. In both salt-affected soil, the highest bulk densities (1.34 g cm⁻³ and 1.2 g cm⁻³) were observed in the control treatments and the lowest bulk densities (1.22 g cm⁻³ and 1.10 g cm⁻³) were found in biochar (20 t ha⁻¹) treated soil. The bulk density of the soil treated with gypsum (50% SGR) was 1.36 g cm⁻³ in sodic soil and 1.24 g cm⁻³ in saline-sodic soil. They are slightly higher than that of control.

F. Soil electrical conductivity (ECₑ) during rice growing period

Soil ECₑ of all treatments were measured monthly interval during rice growing period. In sodic soil, the variation of soil ECₑ during rice growing period were not significantly different between treatments in both 10 cm and 20 cm soil depth (Fig: 1 and 2). Gypsum (50% SGR) showed the highest ECₑ and the lowest ECₑ was found in biochar (20 t ha⁻¹) treatment in both soil depths. ECₑ of each treatment was not different with soil depth. The addition of inorganic conditioners showed the increasing in ECₑ just after application and then decreasing with time during rice growing period. It might be due to abruptly increase in chemical ion concentrations of soil by addition of inorganic conditioners. In saline-sodic soil, ECₑ all treatments, except the combination of biochar (10 t ha⁻¹) and gypsum (25% SGR), trend to increase in 10 cm soil depth but decrease in 20 cm soil depth during rice growing period (fig: 3 and 4). The higher ECₑ was observed in lower (20 cm) than that of upper (10 cm) soil depth. It was due to the accumulation of salt in lower soil layer by leaching.
III. DISCUSSION

Poor and inconsistent stands, stunted growth and reducing yield of crop are caused by the excessive concentrations of soluble salts and/or exchangeable sodium (Na⁺) on cation exchange sites in salt-affected soils [28]. Thus, there is a need to replace excessive amounts of Na⁺ from the cation exchange sites with cations such as Ca²⁺ and then leach with good-quality water to remove Na⁺ from the soil profile for reclamation of saline-sodic and sodic soils. To replace excessive Na⁺ from saline-sodic and sodic soils, gypsum is widely used as a source of Ca²⁺ [29, 30]. However, the solubility of gypsum in water is the lowest when soil temperature below 40°C [32], Solubility of CaCl₂ in water is higher than gypsum [32] and both the chemical behave similarly in calcareous soil [33]. Many researchers said that biochar application is efficient for salt-affected soils by increasing soil organic carbon and nutrients content, increasing CEC and surface area, stabilization of soil structure, improving physical properties by balancing water content and air porosity, increasing retention of polyvalent cations, and replacement of Na⁺ from exchange sites by providing Ca²⁺ in soil solution [34, 35, 36, 37].

Based on the results, the combination of biochar and CaCl₂ treatment followed by CaCl₂ alone gave the highest grain yield of rice in sodic soil. In saline-sodic soil, biochar combined with CaCl₂ or gypsum showed the highest grain and straw yield. The application of biochar alone also showed the positive effect on the grain yield and yield components of rice. These results showed that these soil conditioners have the ameliorative effect of soil salinity and sodicity and improving effects of soil physical properties by replacing and leaching of Na⁺ from root zone Thus crop might be benefited by the improving physical properties of soil leading to more growth and yield in these treatments [38, 39, 40].

In this study, the treatment of gypsum alone was not effective in rice yield. The highest ECₑ was observed in gypsum (50% SGR)
treatments in both soils. It may be due to relatively insolubility of gypsum and it has lowest solubility in water below 40º C [31]. Gypsum seems to be accumulated in surface layer of treated soil and ion concentration also high and ECₑ might be high in gypsum alone treated plots. So, gypsum may be less efficient in removal of salt from the top soil than CaCl₂. The lowest ECₑ was found in biochar (20 t ha⁻¹) in sodic soil and the combined application of biochar and CaCl₂ also showed lowest ECₑ in saline-sodic soil. It might be due to improving hydraulic conductivity and salts were leached down more effectively [32, 41]. In addition, some researches concern with biochar stated that biochar amendments reduced ECₑ and salinity stress. This might be due to several reasons. One of the reasons may be the capacity of biochar to retain salt such as Na⁺ on its surface or the physical entrapment of salt in fine pores of biochar. Moreover, it can reduce the evaporation by reducing the upward movement of saline water thereby decreasing salt contents in surface soil [42, 43, 44, 45].

The lowest bulk densities observed in biochar (20 t ha⁻¹) application in both soils in this experiment because of biochar is a highly porous material. Some researches stated that biochar application improves total porosity, water holding capacity and bulk density of salt-affected soils [46, 47, 48]. Moreover, the bulk density of the biochar-amended soils is likely to be reduced due to high porosity of the biochars, and decreasing in bulk density of amended soils up to 24% was observed compared to control soils [49, 50, 51, 52]. Gypsum (50% SGR) treatment showed the lowest pH (4.6) in sodic soil. It might be probably due to the accumulation of sulphate containing materials, decomposition of organic matter and subsequent formation of carbonic acid [53].

IV. CONCLUSION

The results of this research show that the combination of biochar with calcium chloride or gypsum and the application of biochar alone and calcium chloride alone were effective strategies for increasing rice yield and improving the properties of the salt-affected soils in the estuary area of Sittaung river. Biochar from rice residues with inorganic conditioners can be beneficial in rice-based systems but that actual effects on soil fertility, grain yield, and soil physical properties will depend on site-specific conditions. Long-term studies in field trials are needed to more understand biochar effects and it combination with inorganic conditioners and to investigate their behavior in soils.

ACKNOWLEDGMENT

The authors would like to thank the Myanmar AWBA group, Yezin Agricultural University and local farmers from Waw Township, Bago Region.

REFERENCES


In Vitro Antagonistic Effect of Different Trichoderma Isolates on Growth of Rhizoctonia bataticola (Taub.) Butler

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Abstract — Charcoal rot caused by Rhizoctonia bataticola is one of the most devastating disease of mungbean. Mungbean [Vigna radiata (L.) Wilczek] is an important pulse crop around the world. This pathogen seriously caused charcoal rot disease in mungbean cultivated areas of Nay Pyi Taw Territories under dry and hot condition. Trichoderma are one of soil borne fungi and are capable of parasitizing many plant pathogenic fungi.

Thirty-four indigenous Trichoderma isolates collected from healthy mungbean growing fields and two commercial Trichoderma spp. were studied. Generally, in morpho-logical characters, colony appearance of 12 isolates was white, radiate and less fluffy. Another 12 isolates were whitish green, 1-3 ringed and appressed. Colonies of the left 12 isolates were whitish green, ringed, fluffy and abundantly formed aerial hyphae. Phialides of studied Trichoderma isolates were ampulliform to lageniform. The hyphae of all Trichoderma isolates were septate and branched at right angle to primary hyphae but the younger hyphae were branched in a cute angle. Conidia were globose, sub-globose, oval, ellipsoidal, ellipsoidal with apiculate at one end, and ovate. All isolates formed chlamydospores within 10 days after incubation (DAI). They were intercalary to terminal, globose, sub-globose, ellipsoidal, and oval in shape. Most colonies produced sweet coconut-like smell but some had moldy odor. Clear zone formations were observed in some isolates. Some isolates showed pigment diffusion, pustule and moldy odor. Clear zone formations were observed in some isolates.

As the evidence of mycoparasitism, coiling around, overgrowth and penetration of host hyphae by Trichoderma isolates were observed. Only 4 isolates (P-3, P-13, P-17 and T-3) showed below 50% inhibition at 7 days after inoculation (DAI). The left 32 isolates were capable to inhibit the growth of pathogen by over 60% inhibition at 14-DAI. Three isolates viz., Z-6, P-10 and P-12 with inhibition of 81.88 %, 81.25 %, and 80.31 % respectively were the most effective against mycelial growth of the tested pathogen. Inhibition percent of two commercial Trichoderma spp. were lower than studied indigenous Trichoderma isolates.

Key words - Antagonistic; Rhizoctonia bataticola; indigenous Trichoderma; biocontrol efficacy; mycoparasitism

I. INTRODUCTION

Charcoal rot caused by Rhizoctonia bataticola is an economically important disease of many crops particularly in regions with warm and dry weather conditions of the growing season [1, 2]. This fungus generally attacks the fibrovascular system of the roots, and blocks the transport of water and nutrients to the upper parts of plant. As a consequence, it causes progressive wilting, loss of vigor, premature dying, and reduction in yield [3]. The charcoal rot disease caused by R. bataticola is a major limiting factor in the mungbean production [4]. It seriously infects mungbean in India under dry and hot conditions [5]. It causes damping off, seedling blight, collar rot, stem rot, charcoal rot, and root rot in various economically important crops under stressed environmental conditions [6, 7]. There was also 60-100% yield loss of mungbean by charcoal rot disease around the world [7, 8, 9, 10]. Mungbean is susceptible to R. bataticola at various growth stages [11]. All parts of plant (roots, stems, branches, petioles, leaves, pods and seeds) are attacked. Infected roots show necrotic lesions and small dark spots at the basal stem of mungbean plants [12]. The pathogen may inhibit seed germination at pre-emergence stage, and if heavily infected, plants died prematurely. Charcoal rot is difficult to control because of soil borne nature of causal agent, R. bataticola. It invades the roots of a host at an early stage within 1–2 weeks after planting, but the symptoms appear mostly in mature plants [13].

Chemical control of charcoal rot is useful for only short time-effect and its long-time effectiveness is not approached. They polluted the environment. They have harmful side effects on human beings and animals [10]. Many introductions of biocontrol agents in the laboratory, glass house and field have been achieved some notable successes in disease control. Nowadays, it is essential to develop an effective, safe and healthy way to control charcoal rot disease. Among the biocontrol agents, Trichoderma spp. are effective in inhibiting plant pathogens [14, 15, 16, 17]. Many soil-borne pathogens including R. bataticola are successfully controlled by Trichoderma spp. [18]. Trichoderma spp. are very wide spread in nature with high population densities in soils and plant litters. They are quickly growing fungus. They are also easy to culture, and able to produce the large amounts of conidia with long life time [19]. Trichoderma inhabits in nearly all agricultural soils [20] and forest soil but they are very common in diverse habitats [21]. It also improves plant growth and increases resistance against plant pathogens [22]. Trichoderma species control pathogens not only in indirect way by producing several groups of antibiotics that inhibit the growth of the pathogen but also in direct methods showing antagonism against the pathogen by mycoparasitism. Trichoderma harzianum gives maximum inhibition of mycelia growth of all pathogenic fungi. Trichoderma viride controlled the emergent death of mungbean caused by R. bataticola [23].

Although there is some information on the antagonistic effect of Trichoderma spp., investigation of higher inhibitory effect of indigenous isolates on charcoal rot disease of mungbean in Myanmar is still needed. Therefore, present study aimed to isolate indigenous Trichoderma and to evaluate the antagonistic effect of it on growth of R. bataticola in vitro.
II. MATERIALS AND METHODS

A. Isolation and identification of Trichoderma isolates

This study was carried out at the Department of Plant Pathology, Yezin Agricultural University (YAU) from June to September 2017.

1) Collection of soil sample

Soil samples were collected from three different healthy mungbean growing fields of Tat kone, Pyinmana and Zay Yar Thiri Townships during June to July 2017. Firstly, 3cm of the top soil was removed and 5 subsamples (200g each) were then taken randomly at a depth of 20 cm from around the rhizosphere of healthy mungbean plants for each site. All subsamples from one site were combined to get one composite sample representing the location. And then, made air dried for one week at room temperature (28-30°C).

2) Isolation of Trichoderma isolates from the soil by serial dilution method

Serial dilution method given by Anil Kumar et al. [24] was used for the isolation of Trichoderma spp. Each soil suspension was serially diluted to obtain dilution factor of 10⁻², 10⁻³, 10⁻⁴. From each of the dilutions, 0.1mL of the suspension was taken with the help of a micropipette and spread into the plates containing Martin's media [25]. The plates were incubated at room temperature for one week. By visual observation, each green conidia forming fungal colony (considered as Trichoderma spp.) was taken by sterilized needle and cultured on Potato Dextrose Agar (PDA) media. The cultures were incubated at room temperature for 3 to 5 days.

3) Identification of different Trichoderma isolates

Commercial species of Trichoderma harzianum (T.h) and Trichoderma viride (T.v) were used to compare their biocontrol efficacy with indigenous Trichoderma isolates against the growth of R. bataticola in vitro. T.h and T.v were obtained from Plant Pathology, Research Section, Department of Agricultural Research (DAR), Nay Pyi Taw. From each pure culture of respective Trichoderma isolates, 5 mm mycelial disc was taken by cork borer and put onto PDA media and incubated at room temperature for 14 days. The plates were incubated at room temperature and studied their morphological characteristics and growth rates. Colony morphology was characterized according to morphological key described by Hagn et al. [20]. Presence of pigments, green conidia, odor, and colony appearance were also examined according to Samuels et al. [26]. The identified Pyinmana Trichoderma isolates, Zay Yar Thiri isolates and Tat kone isolates, two commercial species of Trichoderma harzianum and T. viride were named as P-1, P-2, P-3, ... P-21, Z-1, Z-2, Z-3, ... Z-6, T-1, T-2, T-3, ... T-7, T.h and T.v. respectively. After identification, pure cultures of each isolates were stored at 4°C for further study.

4) Experimental design and data collection

The experiment was laid out in Completely Randomized Design (CRD) with five replications. Data on the colony morphological characteristics such as mycelia growth rate (mm day⁻¹), colony morphology, shape and size of conidia, phialide shape, and color of colony were observed at 3 to 5 days after incubation (DAI), and characteristics of chlamydospore were observed at 7-14 DAI.

B. Efficacy of Trichoderma isolates on mycelial growth of R. bataticola in vitro

1) Tested isolate of Rhizoctonia bataticola

Among the three isolates from previous varietal resistant test, the most virulent one of R. bataticola namely Pyinmana isolate was used in this study.

2) Mode of mycoparasitism

Hyphal interactions between Trichoderma isolates and R. bataticola were studied using slide culture method described by Anil Kumar et al. [24] at 3 to 5 days after inoculation (DAI). A clean sterilized glass slide was placed in 9 cm diameter petri dish containing sterilized filter paper. A small amount of autoclaved melted PDA was spread over the slide to make a thin film on the glass slide. Then, 5mm mycelial discs of three days old pathogen and four days old of each Trichoderma isolates were placed (separately) on the opposite sides of the slide at 3cm apart from each other on the PDA surface. A few mL of double sterilized distilled water was added to prevent drying, and incubated the slides at room temperature for 3-5 days. After incubation period, mode of hyphal interaction was examined under the microscope.

3) Biocontrol efficacy of different Trichoderma isolates

Antagonistic effect of different Trichoderma isolates was studied using dual culture technique described by Asran-Amal et al. [27] with a few modifications. Antagonistic effect of biocontrol agent was determined by rating scale of percent inhibition according to Khan et al. [28]. Fifteen mL of sterilized melted PDA was plated in petri dishes and solidified. The pathogen and Trichoderma isolates were separately grown on PDA media for one week at room temperature (28-30°C). Each 5 mm mycelial disc of 3 days old culture of R. bataticola and 4 days old culture of Trichoderma isolates were separately placed on each opposite site of the petri dish containing PDA media at equidistance (7 cm apart from each other). The petri dishes with 5 mm mycelial disc of pathogen inoculated at one end and sterilized PDA media at the other site served as control. The plates were incubated at room temperature for 14 days.

4) Experimental design and data collection

A completely randomized design (CRD) with 4 replications was used and observed at 24 hours’ intervals until 14 DAI. Radial growth of pathogen was measured at 7 DAI and 14 DAI. Daily data recording was also carried out until the mycelium of R. bataticola grew on the entire surface of control plate. Percent inhibition of mycelial growth of the pathogen was calculated by the following formula given by Asran Amal et al. [27].

98
I (%) = \frac{C - T}{C} \times 100

Where,
I = Per cent inhibition in growth of test pathogen
C = Radial growth of pathogen (cm) in control
T = Radial growth of pathogen (cm) in the presence of *Trichoderma* isolates

III. RESULTS AND DISCUSSION

**A. Identification of Trichoderma isolates and colony morphology**

Thirty-four indigenous *Trichoderma* isolates were identified. The morphological characters of all the studied *Trichoderma* isolates including two commercial species were more or less similar to each other. Colonies of P-1, P-2, P-3, P-4, P-5, P-7, P-12, P-13, P-14, P-15, P-17 and T.v were white, ringed and radiate, less fluffy with high pustule production (Fig. 1., P-5). Some of indigenous isolates produced pustules and yellow pigments which were diffused into PDA media (Fig.1, P-1). Colonies of P-6, P-8, P-9, P-10, P-11, P-16, P-18, P-21, T-1, Z-3, Z-4 and T.v formed 1-3 concentric rings, whitish green with green conidial sporulation, and appressed growth, yellow pigment production with some isolates (Fig. 2., Z-5, T-1) and the left P-19, P-20, T-2, T-3, T-4, T-5, T-6, T-7, Z-1, Z-2, Z-5 and Z-6 were whitish green colonies, green sporulation, ringed and highly fluffy with aerial hyphae formation. Some colonies of reversed view were yellow or orange in color.

The above findings of colony morphological characteristics were agreed with the findings of Samuels et al. [25] who reported that some species of *Trichoderma* were ringed (1 to 3 rings), white or green sporulation, radiate colony patterns and produced pustules. Rex [29] and Hui [30] also reported that some species of *Trichoderma* produced yellow pigments which were diffused into the medium and reversed colony in petri dish showed pale, tan, orange and yellow in color. Samuels et al. [25] and Gams [31] also mentioned that some *Trichoderma* spp. produced yellow pigments which diffused into the media and their smell were like coconut odor or moldy smell.

1) **Hyphal type and width**

All the hyphae of tested *Trichoderma* isolates were septate, and branched at right angle to primary hypha and younger hyphae mostly branched in acute angle (Fig. 3.). The widths of hyphae were ranged from 2.04 μm to 8.23 μm. The largest hyphal width was observed in T-2, T-4, P-6 and Z-2 with 8.23 μm, 6.99 μm, 6.84 μm and 6.53 μm respectively, and Z-2, T.h and T.v isolates were with the minimum hyphal width by 2.91 μm, 2.70 μm, and 2.70 μm respectively.

2) **Shape, color and dimension of conidia**

Conidia are green, globose to sub-globose, ovate, oval, ellipsoidal, and ellipsoidal with one apiculate end (Fig. 4.). Recent findings in conidial characters were agreed with the findings of Samuels et al. [25] who reported that the conidia of *Trichoderma* spp. are green globose to sub-globose, oval, ovate, ellipsoidal, and ellipsoidal with one apiculate end.

Size of conidia were ranged from (3.07 x 2.28) ≥ (4.39 x 7.85) μm, (2.04 x 1.95 ≥ 8.12) x (8.75) μm and (2.52 x 2.27 ≥ 4.14 x 3.80) μm in the terms of length and width in Pyinmana isolate, Tatkone isolate and Zay Yar Thiri isolate respectively.

3) **Shape of phialide**

Phialides of studied *Trichoderma* isolates were lageniform except in Z-3, Z-5, P-4 and P-21 in which, they were ampulliform. Most of conidiophores were branched types (Fig. 5.).

4) **Chlamydospore**

All the studied *Trichoderma* isolates produced chlamydospores within 7 to 10 DAI. They were globose, sub-globose, nearly ellipsoidal or oval in shape and intercalary or terminal in position (Fig. 6.).

5) **Colony growth rate**

All the studied *Trichoderma* isolates had nearly the same growth rate except P-1, P-2, P-3, P-4, P-19, P-20, T-1, T-3, T-6, T-7, Z-1, Z-6 and T.h isolates which were grew faster than other isolates at 28°C on PDA (Fig. 7.). All studied colonies grew full in petri dish within 3 to 4 DAI. According to Samuels et al. [25], these isolates were designated as rapid growing fungi. Morphological variability has also been reported by many workers in terms of growth rate, colony color, odor, shape and size.
of conidia and phialide, hyphal type, shape and position of chlamydsospore among different isolates of Trichoderma spp. from different habitats and hosts [32] which agreed with the findings of recent study.

B. Antagonistic effect of different Trichoderma isolates on mycelial growth of R. bataticola in vitro

1) Mood of mycoparasitism

The first contact between Trichoderma isolate and R. bataticola occurred after 3 to 5 DAI, and then growths of pathogens were inhibited. The hyphae of P-6, P-10, P-12, P-19, T-4, T-5, T-6, Z-2 and Z-3 coiled around the hyphae of pathogen (Fig. 8.). The hyphae of P-3, P-11, P-15 and P-18 penetrated the host tissues (Fig. 9.). The hyphae of the left 23 isolates overgrew on the colony of pathogen (Fig. 10.). Similar results that the penetration of Trichoderma spp. into the host tissues and formation of haustoria-like structure were reported by Yedidia et al. [33, 34, 35]. Monteiro et al. [17] reported that Trichoderma spp. were capable of overgrowing and degrading mycelia of Rhizoctonia solani and R. bataticola and formed appressoria-like structures which penetrate the host tissues.

Monteiro et al. [17] also found that within 7 DAI, the mycelium of antagonists attacked parasites by penetrating them. Similar results of both coiling and penetration of pathogen hyphae by Trichoderma spp. were also reported by Yedidia et al. [33]; Benitez et al. [34]; Harman et al. [35]; Almeida [36], Howell [37] and Eteberian et al. [38].

2) Biocontrol efficacy of Trichoderma isolates

All the tested Trichoderma isolates including two commercial species highly suppressed mycelial growth of R. bataticola (Fig. 12 to 14) by above 61% inhibition when compared to the control at 14 DAI (TABLE I). In recent study, inhibition percent of Trichoderma harzianum and Trichoderma viride were lower than indigenous isolates by 64.69 % and 69.69 % respectively. Choudhary [39] observed that Trichoderma viride, Trichoderma harzianum, and Aspergillus versicolor were effective in inhibiting the growth of R. bataticola to an extent of 61 to 65% in dual culture. Among the studied Trichoderma isolates, P-10, P-12 and Z-6 suppressed the growth of R. bataticola by the highest inhibition of 81.25%, 80.31% and 81.88 % respectively at 14 DAI. These results were in agreement with the observation of Kumari et al. [3] and Choudhary [39] who reported that strains of Trichoderma inhibited mycelial growth of R. bataticola by above 50% under in vitro condition. This antagonistic effect might be due to antibiotic, nutrient competition, and cell wall degrading enzymes [40].

It was also noted that the inhibition percent of P-14, P-15, P-18, P-20 and T-6 were decreased at 14 DAI (TABLE I) showing that inhibition percent of some antagonists became decrease with the time. This might be due to defense mechanism of R. bataticola and resistance of it. Vu Tien Khang et al. [41] reported that some fungi became resistant to the metabolites produced by antagonists decreasing the efficacy of biocontrol agents. It was suggested that these isolates are not very good biocontrol agents because after some time, their biological control ability become reduced. P-1, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12, P-14, P-15, P-19, P-20, T-1, T-2 and Z-3 isolates inhibited the mycelial growth of R. bataticola prior to mycelial contact. It might be due to the production of diffusible antimicrobial compounds, such as lytic enzymes or water-soluble metabolites by Trichoderma isolates [42]. The inhibition zones between the colony of pathogen and antagonist were occurred in P-2, P-4, P-5, P-10, P-12, P-14, P-15, P-18, P-20, T-3, T-7, Z-2, Z-6, T.v and T.h as clear zone (Fig. 11.). The rests of the studied
Fig. 7 Average radial growth rate (mm/day) of 36 *Trichoderma* isolates on PDA media
Trichoderma isolates showed their antagonistic activities by overwhelming on the colony of the tested pathogens. According to Pal et al. [43], the inhibition zone produced indicates antibiotic production and is regarded as an important criterion for the selection of potent antagonists. Jackson et al. [44] and Crawford et al. [45] also reported that the presence and size of the inhibition zone have been used as evidence of the production of antibiotics by Trichoderma strains.

In recent study, almost all biocontrol agents grown on PDA plates showed confluent growth on colony of the tested pathogen within 3 to 4 days because of their higher growth rates and their effective inhibitory ability. There were slight variations of antagonistic effect among the isolates. Most of indigenous Trichoderma isolates showed strong antagonistic activities on mycelial growth of pathogen at 14 DAI. Similar results were previously reported by Yedidia et al. [33]; Benitez et al. [34] and Harman [35]; Eteberian et al. [38] who found that indigenous Trichoderma spp. strongly suppressed the mycelial growth of R. bataticola by over 60% of inhibition in vitro. Indigenous Trichoderma isolates viz., P-6 and T-6 showed the lowest inhibitory effect on the pathogen.
**Table 1.** Inhibition percent of 36 *Trichoderma* isolates against the growth of *R. bataticola*

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Inhibition (%)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>7 DAI*</td>
</tr>
<tr>
<td>P-1</td>
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</tr>
<tr>
<td>P-2</td>
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<td>P-18</td>
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</tr>
<tr>
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<td>58.33</td>
</tr>
<tr>
<td>P-20</td>
<td>74.84</td>
</tr>
<tr>
<td>T.h</td>
<td>66.72</td>
</tr>
<tr>
<td>T.v</td>
<td>64.69</td>
</tr>
<tr>
<td>Z-1</td>
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<td>68.44</td>
</tr>
<tr>
<td>T.h</td>
<td>54.25</td>
</tr>
<tr>
<td>T.v</td>
<td>66.72</td>
</tr>
</tbody>
</table>

* Values of means in the same column followed by the same letter are not significantly different at P < 0.05 as determined by LSD.

Total of 34 *Trichoderma* isolates were isolated from 15 soil samples of three different healthy mungbean growing fields within Nay Pyi Taw Territories. *Trichoderma* isolates having similar colony morphology may probably belong to the same species. In recent study, the encircling, penetration and overgrowth of host tissues by mycelium of antagonists were observed. All the studied *Trichoderma* isolates strongly suppressed mycelial growth of *R. bataticola* within 14 DAI. The two indigenous biocontrol agents, viz., P-6 and T-6 decreased their biocontrol efficacy within two weeks after inoculation. The highest biocontrol efficacy tested pathogen by 61.25% efficacy each at 14 DAI when compared to the two commercial *Trichoderma* species. The performance of antagonists could be influenced by various factors such as the relative humidity, temperature, structure of the soil and other uncontrolled, adverse environmental conditions [7].

**IV. CONCLUSION**

Fig. 14. Antagonistic effects of T.h and T.v against the growth of pathogen on PDA media at 7DAI

Table 1. Inhibition percent of 36 *Trichoderma* isolates against the growth of *R. bataticola*
percents were observed by four indigenous *Trichoderma* isolates, viz. P-10, P-12, Z-2 and Z-6.

Indigenous *Trichoderma* isolates at species level should be identified. On the basis of present study, indigenous *Trichoderma* isolates might be used in management of mungbean charcoal rot disease. It might also be useful for sustainable disease management programs to save environmental risk.

**ACKNOWLEDGMENT**

Thanks are due to Dr. Myint Oo (Retrd.), Rector, University of Forestry and Environmental Science, Yezin for his permission to do this research and Pro-rectors for their encouragement and helps during the research work. I give my hearty thanks to Dr. Tin Aye Aye Naing, Professor of Plant Pathology, Yezin Agricultural University for supervising me in the field of plant pathology. I also thank Daw Yi Yi Mon, Lecturer, Plant Pathology, Yezin Agricultural University for her close guide and advice in during the research.

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Effects of Urea Molasses Mineral Blocks on the Nutrient Intake, Digestibility and Nitrogen Retention of Goats

1Aung Aung, 1Htun Myint, 1Nang Kham Hline, 1MyoThet Naung, 1May Myat Chal Aung, 1MyoZin Aung, 1Myo Zin Aung, 1Wint Thida Aung, 1Ei Thanda Aung, 1Wai Phyo Aung, 1Zin Mar Aung, 1Yan Myo Aung and 1Wai Yan Aung

1Department of Physiology and Biochemistry, University of Veterinary Science, Yezin
Corresponding author: Aung Aung, Emial: aung.aaung@gmail.com

Abstract—A total of nine male goats with age ranging from 4 to 6 months and live weight ranging from 10kg to 12kg (5-6 months of age) were used in this experiment to evaluate the effect of urea molasses mineral blocks supplementation on the nutrient intake, digestibility and nitrogen retention of goats. The goats were divided into three groups. There were three replicates per group in completely randomized design (CRD). The experimental diets were isonitrogenously formulated at the level of crude protein, 13.00% of total diet. The experimental diets were control diet (rice straw + groundnut meal + rice bran), diet – 1 (rice straw + groundnut meal + rice bran + UMB) and diet – 2 (rice straw + groundnut meal + rice bran + UMMB). In the results, the nutrient intakes (DM, OM, CP, NDF and ADF) of goats fed experimental diets were not significantly different from each other. The nutrient digestibility (DM, OM, CP, NDF and ADF) and nitrogen retention of goats fed experimental diets did not differ from each other although tendency to increase was observed in the goats fed UMB and UMMB supplemented diets. It could be concluded that the UMB and UMMB can be incorporated in goat ration without adverse effect on digestibility of goat.

Key words: digestibility, goats, molasses, mineral, nitrogen

I. INTRODUCTION

Livestock animals in Myanmar are predominantly reared in mixed crop-livestock farming systems. The present national herds of sheep and goats were approximately 76lekh goats were mainly grazed on natural grassland around the whole year. Goat farming also provides additional income to peri-urban farmers particularly in the central region of Myanmar. Frequently, both the quality and quantity of feed is low especially during the dry season. Among the many problems faced by goat farmers, scarcity and high price of feed ingredients is considered to be the major constraint.

During the dry season, when good quality forage becomes scarce, farmers have to use alternative feeds, such as agricultural crop residues. The animals suffer from malnutrition due to insufficient supply of minerals, of nitrogen in particular [1]. Livestock production in developing countries is largely dependent on fibrous feeds - mainly crop residues and low quality pasture - that are deficient in nitrogen, minerals and vitamins. The rice straw plays a vital role. Compared with other straws, rice straw is low in nutritional quality, palatability and digestibility, so upgrading of straw prior to feeding becomes necessary [2].

Efficiency of livestock production is not satisfactory because digestibility of straw is low and lacks protein. Many farmers in rural and peri-urban areas usually offer their ruminant animals only limited concentrate supplementation. As protein supplements such as oil cakes are only availability at a very high price in developing countries, if available at all, this has led to the use of non-protein-nitrogen sources, such as urea, to compensate for the nitrogen deficiency in fibrous feeds, thus enhancing their digestibility, intake and nutrient availability through optimization of rumen fermentation [3]. Livestock production in many tropical environments is constrained by low feed availability and quality during the prolonged dry season [4] [Leng and Preston, 1984]. There is thus the need to search for and utilize other alternative low cost feeds for ruminants at such critical periods [5]. Therefore the research workers tried to reduce the cost of production by replacing UMMB for concentrates.

Urea molasses block lick was originally practiced in Australia [6]. He found that hay intake improved in supplementation of urea molasses mineral block licks being to goats along with low quality native pasture hay. UMMB is usually made of molasses, urea, cement or lime, bran, eventually protein rich by-products, salt and water which are mixed and processed into the form of a solid and compact block. The block should be well accepted by livestock and provide essential nutrients such as protein, minerals and energy which are usually deficient in most forages and crop residues. Some researches indicated that UMMB supplementation resulted in a substantial improvement of productive, reproductive and economic performance of both local and crossbred dairy cows in different livestock production systems [7].

It was also discussed that the molasses will provide a range of minerals (except phosphorus, P) and a complete mixture of vitamins, and will made blocks appetizing for animals [8]. The fibrous components containing UMMB are high in P, trace minerals and a range of vitamins, they absorb moisture from the molasses and give structure to the blocks. Cement or quicklime is used as binding agent. Cement constitute up to 1.5% of the totally daily intake of dry matter...
without negative effect when using over long periods of time [9]. Salt provides much of the macrominerals (sodium, potassium, calcium and phosphorus) requirements of the microbes as well as those of the host animals. Multinutrient blocks, therefore, provide the nutrient requirements of both the microbes and the host animal [10]. In other report it was recommended that 70-150 gm UMMB per day can be fed to goat [11]. On average, an animal licks 500-700 gm UMMB per day, but some animals may lick as much as 1.25 kg/day without any adverse effect on their health[12]. Thus, supplementation of UMMB for both protein and energy sources become essential in large and small ruminants to the world.

It was also concluded that continuous supplementation of solidified feed block increased the intake and digestibility of roughage based diet [13]. The same results were also found by[14]. Hosamani et al. Hosamani et al.(1998)[14] stated that digestibility of dry matter, organic matter, crude protein, neutral detergent fiber and acid detergent fiber were increased and the animal could maintain body weight in feeding of UMMB and on the wheat straw diet in buffaloes. In the same study, they also reported that higher plane of nutrition did not have any positive effect on intake of wheat straw and UMMB.

Supplementation with urea blocks and cottonseed meal to wheat straw increased feed intake and digestibility of dry matter and live weight of lambs. With a basal diet of straw without any supplementary concentrate, the increase of straw consumption due to molasses urea block is between 25 and 30 percent. When some high protein concentrate is also given with basal diet, the increase of straw consumption is less and varies between 5 to 10 percent. This study indicated that combination of the block with by-pass protein increased feed intake and production by more than the combination of urea and protein (Sudana and Leng, 1984). (16)

The study carried out in lactating buffaloes in India (13) has also reported that urea molasses block may be used as supplement to a fibrous diet particularly to reduce the amount of concentrate needed to maintain milk yield (Kunju, 1986) (17). Garcia and Restrepo (1995) (18) recommended that 70 to 150g UMMB per day can be fed to goat. The ability of UMMB to upgrade animal productivity id associated with an increased efficiency of utilization of the available forage through improved rumen condition (Leng, 1997) (18). Thus, supplementation of UMM blocks for both protein and energy sources become essential in large and small ruminants throughout the world.

Although researches on UMMB supplementation in roughage base diets in ruminant have been conducted, the differences in ingredients and proportion of ingredients as well as protein level in the UMMB supplemented diet might change the intake and digestibilities of ruminant. Therefore, this study was carried out to determine the effects of UMMB supplementation in the roughage base diet on the nutrient intake, digestibility of nutrients and nitrogen retention of goats.

II. MATERIAL AND METHODS

The rice straws, the groundnut meal and rice bran used in the experiment were collected from Yeizin area, ZayarThiri Township, Nay Pyi Taw. The minerals were purchased from the Academy Chemical Shop, Yangon.

A. Preparation of urea molasses blocks and urea molasses mineral blocks

Urea molasses mineral blocks in this study were prepared by the manual machine. The composition of ingredients used in urea molasses blocks and urea molasses mineral blocks were shown in the Table (1) and Table (2). All solid components of ingredients were well homogenized with the liquid mixture composed of dissolved molasses, urea and salt. The obtained homogenous mixture was molded in molding machine and blocks were air-dried until they are sufficiently hard.

<p>| TABLE 1 INGREDIENT COMPOSITIONS OF UREA MOLASSES MINERAL BLOCKS (UMMB) |</p>
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<thead>
<tr>
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<tr>
<td>2</td>
<td>Urea</td>
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</tr>
<tr>
<td>3</td>
<td>Rice polish</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>Calcium hydroxide</td>
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<tr>
<td>6</td>
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<td>7</td>
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<td>Diammonium phosphate</td>
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<p>| TABLE 2 INGREDIENT COMPOSITIONS OF UREA MOLASSES BLOCKS (UMB) |</p>
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<th>Amounts (%)</th>
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<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Groundnut cake</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Cement</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Salt</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Urea</td>
<td>6</td>
</tr>
</tbody>
</table>

B. Feeding trial

Experimental animals and their management

Nine local male goats (Htein San breed) with body weight ranging from 10 to 13 kg and similar age (5-6 months old) were used allocated in three group into a
CRD design. Each treatment consisted of three replicates. During the period of feeding trial, the selected animals were kept in individual cage (Figure 1 and 2). Feeding was done twice a day at 8:00 am and 4:00 pm and the animals were free access to water. Before experimental period, animals were administered with Ivermectin to remove the external and internal parasites. The experimental diets were isonitrogenously formulated at the level of 15% CP of total diet.

Experimental feedstuffs and diets

Experimental feedstuffs and diets used in experiment were:

Feedstuffs

Feedstuffs used in experiment were rice straw and ground nut meal and two types of nutrient blocks.

<table>
<thead>
<tr>
<th>Description</th>
<th>DM</th>
<th>OM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS</td>
<td>93.79</td>
<td>82.21</td>
<td>4.78</td>
<td>65.22</td>
<td>42.32</td>
</tr>
<tr>
<td>RB</td>
<td>92.26</td>
<td>89.22</td>
<td>13.86</td>
<td>27.87</td>
<td>10.49</td>
</tr>
<tr>
<td>GM</td>
<td>92.78</td>
<td>93.86</td>
<td>45.02</td>
<td>25.08</td>
<td>12.55</td>
</tr>
<tr>
<td>UMB</td>
<td>88.79</td>
<td>76.52</td>
<td>33.00</td>
<td>16.65</td>
<td>7.19</td>
</tr>
<tr>
<td>UMMB</td>
<td>80.59</td>
<td>77.38</td>
<td>17.21</td>
<td>11.99</td>
<td>4.96</td>
</tr>
<tr>
<td>CD</td>
<td>93.05</td>
<td>78.91</td>
<td>11.37</td>
<td>58.07</td>
<td>30.86</td>
</tr>
<tr>
<td>D-1</td>
<td>86.27</td>
<td>80.54</td>
<td>10.64</td>
<td>49.76</td>
<td>28.04</td>
</tr>
<tr>
<td>D-2</td>
<td>93.03</td>
<td>84.90</td>
<td>11.36</td>
<td>55.98</td>
<td>30.97</td>
</tr>
</tbody>
</table>

Experimental diets

Rice straw + Groundnut meal + Rice Bran (Control diet) (CD)
Rice straw + Rice bran +UMB (D1)
Rice straw + Groundnut meal + Rice bran +UMMB (D2)

During the feeding trial, all of the feedstuffs were weighed and sampled before feeding. The collection period was the last 5 day of feeding trial. Feeding trial period was lasted for 30 days. During collection period, feedstuffs offered samples and refused (orts) samples were collected for chemical analysis. The orts were weighed and sampled before morning feeding and then removed (Figure 3). Faeces voided and urine outputs were recorded daily during the collection period. The faeces voided from each buck were also weighed and 10% was collected for sample. Faecal samples were sprayed with 5ml of 10% formalin to prevent the putrefaction and dried under the sunlight until constant weight was obtained. Each volume of urine was also measured. Ten ml of 15% H2SO4 was added into bucket for trapping ammonia and then 10% of urine was collected for sample and stored in a deep freezer until the chemical analysis was done.

C. Measurements

Nutrient intakes (DMI, OMI, CPI, NDFI and ADFI) digestibility (DMD, OMD, CPD, NDFD and ADFD) and nitrogen retentions of goats responded to respective experimental diets were measured.

D. Statistical analysis

Data for nutrient intakes, digestibility and nitrogen retentions were subjected to analyze with ANOVA using SAS (2002). The significant differences between treatment means were compared by Duncan’s Multiple Range Test (DMRT).

III. RESULTS

The result of the detailed chemical compositions of experimental feedstuffs and diets were shown in Table 3. The chemical composition of rice straw was 93.79% DM, 82.21% OM, 4.78% CP, 65.22% NDF and 42.32% ADF. The nutritive values of rice bran were 92.26% DM, 89.22% OM, 13.86% CP, 27.87% NDF and 10.49% ADF. The amount of DM, OM, CP, NDF and ADF of groundnut cake were 92.78%, 93.86%, 45.02%, 25.08% and 12.55%, respectively. The nutrient contents of UMB were 88.79% DM, 76.52% OM, 33.00% CP, 16.65% NDF and 7.19% ADF. The UMMB with mineral were 80.59% DM, 77.38% OM, 17.21% CP, 11.99% NDF and 4.96% ADF. The amount of DM, OM, CP, NDF and ADF of control diet (CD) were 93.05, 78.91, 11.37, 58.07, and 30.86%, respectively. The contents of Diet-1 (D-1) were 86.27% DM, 80.54% OM, 10.64% CP, 49.76% NDF and 28.04% ADF. The Diet-2 (D-2) consisted of 93.03% DM, 84.90% OM, 11.36% CP, 55.98% NDF and 30.97% ADF.

A. Nutrient intake

The daily nutrient intakes (g/kg BW/day) of goats offered experimental diets are shown in Table 4. The nutrient intakes [dry matter intake (DMI), organic matter intake (OMI), neutral detergent fibre intake (NDFI) and acid detergent fibre (ADFI)] of all experimental diets fed on heifer were not significantly different (P>0.05) from each other.

<table>
<thead>
<tr>
<th>Description</th>
<th>DMI</th>
<th>OMI</th>
<th>CPI</th>
<th>NDF</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD</td>
<td>497.76</td>
<td>415.74</td>
<td>80.4</td>
<td>325.56</td>
<td>150.24</td>
</tr>
<tr>
<td>D-1</td>
<td>388.04</td>
<td>379.62</td>
<td>65.47</td>
<td>281.61</td>
<td>110.02</td>
</tr>
<tr>
<td>D-2</td>
<td>658.61</td>
<td>611.98</td>
<td>99.11</td>
<td>428.22</td>
<td>202.44</td>
</tr>
<tr>
<td>SEM</td>
<td>75.56</td>
<td>67.58</td>
<td>9.08</td>
<td>47.97</td>
<td>25.54</td>
</tr>
</tbody>
</table>
Digestibility of nutrients

The digestibilities of nutrients are shown in Table 5. All the digestibilities of nutrients [dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD), neutral detergent fibre digestibility (NDFD) and acid detergent fibre digestibility (ADFD)] were not significantly different (p>0.05) from each other.

<table>
<thead>
<tr>
<th>Description</th>
<th>DMD</th>
<th>OMD</th>
<th>CPD</th>
<th>NDFD</th>
<th>ADFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD</td>
<td>59.24</td>
<td>63.37</td>
<td>80.70</td>
<td>67.18</td>
<td>56.94</td>
</tr>
<tr>
<td>D-1</td>
<td>48.87</td>
<td>64.95</td>
<td>80.97</td>
<td>72.39</td>
<td>57.71</td>
</tr>
<tr>
<td>D-2</td>
<td>55.52</td>
<td>78.05</td>
<td>82.49</td>
<td>82.81</td>
<td>73.77</td>
</tr>
<tr>
<td>SEM</td>
<td>3.61</td>
<td>5.59</td>
<td>2.24</td>
<td>5.38</td>
<td>6.99</td>
</tr>
<tr>
<td>P Values</td>
<td>0.56</td>
<td>0.57</td>
<td>0.95</td>
<td>0.55</td>
<td>0.61</td>
</tr>
</tbody>
</table>

DMD: dry matter digestibility, OMD: organic matter digestibility, CPD: crude protein digestibility, ADFD: acid detergent fibre digestibility, NDFD: neutral detergent fibre digestibility

Nitrogen utilization

Nitrogen utilizations of goats fed on experimental diets are shown in Table 6. In which, nitrogen intake, feces nitrogen content, urine nitrogen content and nitrogen retention of all experimental group were not significantly different (p>0.05) from each other.

Table 6. NITROGEN UTILIZATIONS OF GOATS FED ON EXPERIMENTAL DIETS

<table>
<thead>
<tr>
<th>Description</th>
<th>Experiment diets</th>
<th>SEM</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N- intake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD</td>
<td>10.40</td>
<td>0.14</td>
<td>1.99</td>
</tr>
<tr>
<td>D-1</td>
<td>12.86</td>
<td>0.10</td>
<td>3.04</td>
</tr>
<tr>
<td>D-2</td>
<td>15.86</td>
<td>0.11</td>
<td>2.56</td>
</tr>
<tr>
<td>Urine N</td>
<td>1.82</td>
<td>0.04</td>
<td>2.63</td>
</tr>
<tr>
<td>Faecal N</td>
<td>1.28</td>
<td>0.07</td>
<td>1.87</td>
</tr>
<tr>
<td>N retention</td>
<td>2.63</td>
<td>0.55</td>
<td>0.87</td>
</tr>
</tbody>
</table>

IV. DISCUSSIONS

The nutrient digestibility (DM, OM, CP, NDF and ADF) of goats fed experimental diets did not differ from each other although increase in tendency of digestibility was observed in the goats fed UMB and UMMB supplemented diets. The result was agreed with the other report [35] in which the UMBM supplementation did not improve the digestibility of goat.

The results in the current study were not in agreement with other reports. Supplementation of UMMB in the ration of ruminant animal improves the digestion and utilization of nutrients as reported by various investigators. UMMB lick is effective in increasing nutrient digestibility of high quality roughages through improved ruminal fiber digestion.
bicarbonate treated straw and hay prepared from wild and nitrogen utilization of rice straw, ammonium UMB licks supplementation [40].

Based on these observations, it can be safely concluded that the control diet and UMB and UMMB supplemented diets were the same level of crude protein. However, the control diets used in other researches were negative control diet (rougudge only) which might differ in CP contents compared to UMBM supplemented diet. In the current experiment, the control diet and UMB and UMMB supplemented diets were the same level of crude protein. Based on these observations, it can be safely concluded that supplementation with UMMB licks could increase the digestibility of basal diets only based on low quality forages.

V. Conclusions

In the current study, the nutrient intakes of goats fed experimental diets were not significantly different from each other. The nutrient digestibility and nitrogen retention of all experimental group were not significantly different (p>0.05) from each other although the goats fed the diets containing UMB and UMMB has the tendency to be higher than others.

Acknowledgement

The authors would like to express their thanks to the staff from the Department of Physiology and Biochemistry for their help in conducting this research works. It is also thankful to the organizers of this conference for giving the chance to express our experience.

References


M.V.Sc. Thesis submitted to the Department of Physiology and Biochemistry, University of Veterinary Science, Yezin, 2013.


Abstract— Rubber is one of the major industrial crops in Myanmar and total planting area has about 0.65 million hectares. The sector employs about 400,000 workers, mainly in the plantation or upstream sector linked to rubber planting and production. Rubber industry also has huge market demand of natural rubber from neighboring countries. Currently, rubber prices had been fluctuated and rubber farmers are facing low market price. Hence, rubber farmers think that natural rubber (NR) prices will decline to a level that renders the NR production becomes unprofitable and need to change alternative crops. The study aimed to point out rubber production’s profitability to answer the question for alternative crops substitution. The study was also designated to point out major constraints to provide some recommendations for more profitable business. The study areas, five Townships were selected from Mon State, Tanintharyi and Bago Regions, major traditional rubber plantation areas in Myanmar. Therefore, this study would revealed important economic parameters such as break-even yield, operating ratio based on variable cost of rubber production system in Myanmar.

Keywords- Break-even price, Current rubber market price, Myanmar, Natural rubber (NR), Operating ratio

I. INTRODUCTION

A. History of World Natural Rubber Industry and Natural Rubber Industry in Myanmar

The discovery of vulcanization of natural rubber led to a blossoming of natural rubber (NR) industries. It was fueled by Sir Henry Wickham, an Englishman, transported 70,000 NR seedlings from the Amazon Basin to the Royal Botanic Gardens at Kew in 1876. Among them, only 2,397 germinated and 1,900 germinated seedlings were shipped to Ceylon and Singapore (22 seedlings). These seedlings formed the nucleus of the NR industries in South-East Asia, including Myanmar, which accounts for around (75%) of all cultivated NR trees.

The NR demand take-off was precipitated by prevention of transmission of human immunodeficiency virus (HIV) and hepatitis B with the increase in the use of NR latex gloves [1]. Therefore, NR consumption is projected to grow by two percent per year through 2025. Table 1 indicated the world consumption and production of NR and synthesis rubber (SR).

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural Rubber Production (‘000 MT)</th>
<th>Synthetic Rubber Production (‘000 MT)</th>
<th>Total Rubber (‘000 MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>9,850</td>
<td>12,700</td>
<td>22,550</td>
</tr>
<tr>
<td>2007</td>
<td>10,057</td>
<td>13,829</td>
<td>22,886</td>
</tr>
<tr>
<td>2008</td>
<td>10,098</td>
<td>12,285</td>
<td>22,383</td>
</tr>
<tr>
<td>2009</td>
<td>9,723</td>
<td>11,488</td>
<td>21,211</td>
</tr>
<tr>
<td>2010</td>
<td>10,403</td>
<td>13,277</td>
<td>23,680</td>
</tr>
<tr>
<td>2011</td>
<td>11,239</td>
<td>14,091</td>
<td>25,330</td>
</tr>
<tr>
<td>2012</td>
<td>11,658</td>
<td>14,042</td>
<td>25,700</td>
</tr>
<tr>
<td>2013</td>
<td>12,281</td>
<td>14,184</td>
<td>26,465</td>
</tr>
<tr>
<td>2014</td>
<td>12,142</td>
<td>14,071</td>
<td>26,213</td>
</tr>
<tr>
<td>2015</td>
<td>12,271</td>
<td>14,507</td>
<td>26,778</td>
</tr>
<tr>
<td>2016</td>
<td>12,451</td>
<td>14,831</td>
<td>27,282</td>
</tr>
</tbody>
</table>

Source: Natural Rubber Statistic 2017

In the future, World NR demand will be accelerated again as a result of increasing demand in lower and middle income countries and sustained demand of China, India, the United States, and Japan, the four largest importers of NR. With movement away from rubber production in Malaysia and limited scope for rubber expansion in Indonesia and other
countries, Myanmar could become an important NR exporter [2].

In Myanmar, agriculture sector is pivotal for any attempt to increase income, alleviate wide spread poverty and upgrade living standard of Myanmar people. Among several crop productions in the country, rubber production is one of the central of the economic development. It was because the sector employs between 350,000 and 400,000 workers, mainly in the plantation or upstream sector linked to planting and production of raw NR makes their living from their plantation [3].

Additionally, Myanmar’s geographic position and climate make potential driver for growth and development of rubber plantation. In particular, Myanmar becomes a large exporter of nature rubber (NR) among the NR producing countries. Table 2 showed the ten important countries that exported the highest dollar value worth of NR during 2017.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Major exporting countries</th>
<th>Exported value (US$ million)</th>
<th>(%) of World Exported Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thailand</td>
<td>4,600</td>
<td>34.5</td>
</tr>
<tr>
<td>2.</td>
<td>Indonesia</td>
<td>4000</td>
<td>29.9</td>
</tr>
<tr>
<td>3.</td>
<td>Vietnam</td>
<td>987.3</td>
<td>7.5</td>
</tr>
<tr>
<td>4.</td>
<td>Malaysia</td>
<td>936.5</td>
<td>7.1</td>
</tr>
<tr>
<td>5.</td>
<td>Ivory Coast</td>
<td>752.6</td>
<td>5.7</td>
</tr>
<tr>
<td>6.</td>
<td>Myanmar</td>
<td>280</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Belgium</td>
<td>202</td>
<td>1.5</td>
</tr>
<tr>
<td>8.</td>
<td>Laos</td>
<td>168.3</td>
<td>1.3</td>
</tr>
<tr>
<td>9.</td>
<td>Guatemala</td>
<td>152.7</td>
<td>1.2</td>
</tr>
<tr>
<td>10.</td>
<td>Liberia</td>
<td>127.2</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Other countries’</td>
<td>1,146.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13,333</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: The World Factbook 2018

B. Statement of the Problem

Myanmar had huge market as high demand of NR by neighboring such as China utilized (37%) of world nature for their industrialization and India for (9%) and South East Asian countries for (17%) [4]. Accordingly, the rubber plantation area, tapping area and yield per acre had been increased dramatically. Fig. 1 showed in rubber planting area, tapping area and production in Myanmar from 1988 to 2018.

However, rubber prices had been fluctuated in real terms and the nominal price level. Fig. 2 indicated that the fluctuation of world rubber price from 1988 to 2018. Often, there was estimated that NR prices decline to a level that renders the NR was unprofitable for rubber farmer. If this estimation is correct, NR producers need to switch for other profitable alternatives crops. In spite of this, the estimations were pronounced without surveying and economic analyzing of the rubber industry.

To date it has become necessary for NR producer to clarify the current scenario of profitability of rubber production and key predicaments of profitability. The results of research paper could also be provided break-even price, break-even yield and operating ratio based on total variable cost and appropriate recommendations for more profitable rubber industry.
C. Objectives of the Study

1) To clarify the current scenario of profitability and key predicaments of profitability by cost and benefit analysis of rubber production.
2) To find out main constraints of rubber farmer for production system.
3) To provide appropriate recommendation for more profitability of rubber production.

II. LITERATURE REVIEW

Concept of Cost and Benefit Analysis Model

Most of the perennial crops required different approaches for performing the economic analysis. The components of cost of production and the annual maintenance cost are considerable higher and it would take years to get realized by the growers. Hence, while performing the economic analysis in perennial crops, it needs to be added the maintenance cost of before tapping period [5].

However, smallholder rubber farmers seldom maintain records of inputs and outputs and hence compilation of data for economic analysis of these crops is a tedious task. Generally, in the absence of farm records, neither the farmer nor the research personnel would be able to identify the precise age of the perennial crop. Hence, the methodology for constructing lifetime matrix of data lacks field level application.

Similarly, Sudha and Reddy (1987), Nallathambi et.al (1988), Latha Bastine and Abdul Razak (1991) [6, 7, 8] were also augured that it was restricted for their estimation of cost of cultivation in the bearing phase of the perennial crop. Taking into account the above lacuna, the present study was formulated with an aim to perform the economic analysis based on variable cost and benefit of rubber production.

2014-2015, it were contributed (31%) of the rubber sown area and (49%) of the rubber tapping areas in Myanmar. In Mon State, the secondary data from Department of Agriculture (DOA) presented (29%) planting area were found in Thaton District and (71%) in Mawlamyine District in the State.

2) Tanintharyi Region

Tanintharyi Region was also selected as the one of a major rubber producing area in Myanmar, contributed about (20%) of total rubber farmers in Myanmar [10]. Like Mon State, there is also having the various types of rubber markets and different farm sizes of rubber farmers were found. According to secondary data from DOA, in Tanintharyi Region, about (40%) of rubber plantation areas were observed in Dawei District. It were about (42%) in Myeik and (18%) in Kawthoung Districts.

3) Bago Region

Bago Region was also selected as the study area of focus due to one of considerable rubber planting and producing area. The selected survey area, Shwegyin Township, was most rubber planting area in Bago region. It had historical background of rubber plantation since the beginning of British Colonial Rule in Myanmar by the established the Sit-Taung Valley rubber estate in 1905.

The study areas, Mon State, Tanintharyi and Bago Regions are traditionally rubber planting areas and large contributed to country rubber planting area as well as rubber production. Therefore, the survey results could be more validated and represented for rubber production’s profitability scenario in Myanmar.

B. Survey Area Selection Criteria and Selected of Study Areas

The following key selection criteria were setting up for effective engagement of survey in Mon State and Tanintharyi and Bago Regions.

1) A primary criterion was the areas should have large amount of total planting areas and also rubber tapping areas.
2) A second criterion for selection was assessment on high ratio of total tapping area in total planting area.
However, the area occupied only small amount of total planting area and relatively large tapping area should not be considered in selection.

3) Reasons of security and mobility were also important consideration in selection.

C. Sampling Method and Data Collection

1) Proportionate Stratified Random Sampling

Proportional sampling is a method of sampling in which the researcher divides a finite population into subpopulations or strata and then applies random sampling techniques to each subpopulation of rubber farmers. In this approach, each stratum has the same sampling fraction [11].

Proportionate stratified random sampling formula:

\[ n_h = \left( \frac{N_h}{N} \right) \times n \]  
(1)

\[ n_h = \text{Sample size for } h^{th} \text{ stratum} \]

\[ N_h = \text{Population size for } h^{th} \text{ stratum} \]

\[ N = \text{Size of entire population} \]

\[ n = \text{Size of entire sample} \]

(Source: Salkind 2010)

The precise calculation of the average rubber production cost for different farms sizes are most important and primary data should be collected by proportionate stratified random sampling method for more accurate represented.

2) Classification of Rubber Farmers Based on Farm Size

The classification of rubber farmers based on farm sizes was different with rubber producing countries depending on their references. Most countries classified rubber farmers for (2) types as smallholder and large holder or estate [12]. In Myanmar, classification of rubber farmers has been recently approved by DOA.

<table>
<thead>
<tr>
<th>Types</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholder</td>
<td>Less than 8.5 ha</td>
</tr>
<tr>
<td>Middle holder</td>
<td>Above 8.5 ha - 20.25 ha</td>
</tr>
<tr>
<td>Large holder (Estate)</td>
<td>Above 20.25 ha</td>
</tr>
</tbody>
</table>

According to the survey area criteria, sampling methods and classification, following five townships were chosen with respective sample size (Table 3) for survey areas.

Most of the data used in this study were primary data, but secondary data was also used as supporting validity of the study. Primary data involved almost the cost of production, processing, marketing in rubber production system. Primary data set were collected by face-to-face interview to different rubber farmers according to their farm sizes with semi-structural questionnaire.

Secondary data were time series data of rubber production, planting area and average yield data were mainly collected from DOA and some official websites. Table 4 presented the total number of farmers and their planting areas according to farm sizes in study areas.

<table>
<thead>
<tr>
<th>Types/ Townships</th>
<th>Kyai-kto</th>
<th>Mudo n</th>
<th>Dawei</th>
<th>Myeik</th>
<th>Shwe-gyin</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholder</td>
<td>10</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>55</td>
</tr>
<tr>
<td>Middle holder</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Large holder</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Types/ Townships</th>
<th>Types of Rubber Farmer</th>
<th>No. of Farmer (No.)</th>
<th>Household Head (%)</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kyai-kto</td>
<td>Smallholder</td>
<td>838</td>
<td>64.71</td>
<td>1,268</td>
</tr>
<tr>
<td></td>
<td>Middle holder</td>
<td>290</td>
<td>22.39</td>
<td>1,383</td>
</tr>
<tr>
<td></td>
<td>Large holder</td>
<td>167</td>
<td>12.89</td>
<td>3,335</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,295</td>
<td>99.99</td>
<td>5,986</td>
</tr>
<tr>
<td>Mudon</td>
<td>Smallholder</td>
<td>10,316</td>
<td>98.38</td>
<td>7,865</td>
</tr>
<tr>
<td></td>
<td>Middle holder</td>
<td>155</td>
<td>1.48</td>
<td>627</td>
</tr>
<tr>
<td></td>
<td>Large holder</td>
<td>15</td>
<td>0.14</td>
<td>1,339</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>10,486</td>
<td>99.99</td>
<td>9,831</td>
</tr>
<tr>
<td>Mon State</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>11,781</td>
<td>15,817</td>
<td></td>
</tr>
<tr>
<td>Dawei</td>
<td>Smallholder</td>
<td>1,904</td>
<td>83.50</td>
<td>1,534</td>
</tr>
<tr>
<td></td>
<td>Middle holder</td>
<td>353</td>
<td>15.48</td>
<td>687</td>
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<tr>
<td></td>
<td>Large holder</td>
<td>23</td>
<td>1.01</td>
<td>736</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2,280</td>
<td>99.99</td>
<td>2,957</td>
</tr>
<tr>
<td>Myeik</td>
<td>Smallholder</td>
<td>2,490</td>
<td>85.82</td>
<td>2,154</td>
</tr>
<tr>
<td></td>
<td>Middle holder</td>
<td>329</td>
<td>11.31</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Large holder</td>
<td>89</td>
<td>3.06</td>
<td>2,407</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2,908</td>
<td>99.99</td>
<td>6,061</td>
</tr>
<tr>
<td>Tanintharyl Region</td>
<td></td>
<td>5,188</td>
<td>9,018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5,188</td>
<td>9,018</td>
<td></td>
</tr>
<tr>
<td>Shwegyin</td>
<td>Smallholder</td>
<td>568</td>
<td>59.10</td>
<td>875</td>
</tr>
<tr>
<td></td>
<td>Middle holder</td>
<td>308</td>
<td>32.04</td>
<td>946</td>
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<tr>
<td></td>
<td>Large holder</td>
<td>85</td>
<td>8.84</td>
<td>341</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>961</td>
<td>99.98</td>
<td>2,162</td>
</tr>
<tr>
<td>Bago Region</td>
<td></td>
<td>961</td>
<td>2162</td>
<td></td>
</tr>
</tbody>
</table>

Source: DOA 2018
D. Method of Analysis (Cost and benefit analysis model)

1) Cost structure

a) Cost of production per one unit of output \( (C_1) \)

The cost of production per one unit of rubber (Kg) included all variables cost incurred cost of fertilizer, equipment, labour cost for tapping and labour for maintaining, etc. Opportunity costs for family labour were computed by using most common payment type and wages in respective study areas.

b) Cost of processing per one unit of output \( (C_2) \)

The cost of processing per one unit of rubber (Kg) comprised all variable costs of materials and labour for processing activities. If tapping labour cost included for processing activities, labour cost for processing would not be considered.

c) Cost of marketing per one unit of output \( (C_3) \)

Marketing costs could be different based on distance from market, transportation facilities, number of alternative buyers and forms of rubber. Costs of marketing include cost of transportation, loading-unloading, grading, re-baling, and painting etc.

2) Break-even price or operational cost of rubber production system

The total operational cost of the rubber production system is summed of the cost of production, processing and marketing per one unit of output. It is equal to the break-even price based on the total variable cost. Therefore, based on variable cost, break-even point occurs where total operational cost of one unit of output is equal current market price.

\[
\text{Break-even price or total operational cost per one unit} = C_1 + C_2 + \frac{C_3}{C_1} \tag{2}
\]

\[C_1 = \text{Cost of production per one unit of output}\]
\[C_2 = \text{Cost of processing per one unit of output}\]

3) Market price

The rubber market price is different with form of rubber, market demand, type of acid use, presence of alternatives buyers, selling practice and others influenced factors. Hence, price received by respondents during the study period are used instead of reported average price collected by local wholesalers.

4) Break-even yield of rubber production system

The break-even yield is the yield that necessary to cover and prevent a firm from operating at loss [13]. The break-even yield is computed by divided total variable cost of the production system per unit area (ha) by current market price.

\[
\text{Break-even yield} = \frac{\text{Total variable cost of production system of unit area}}{\text{Current rubber market price}} \tag{3}
\]

The total cost of production system of unit area was computed by sum of the total cost of production, processing and marketing per unit area. In rubber industry, cost of production is based on the unit area but the cost of processing and marketing are based on the unit of output. However, it was simple to transform based on unit of output to unit of area by multiplied or divided by yield of the unit area.

5) Operating ratio

The objective of research study was effort to clarify the current scenario of profitability in rubber production consequence of world rubber price crush. The cost and benefit analysis was emphasized only on the turnover of rubber farmers as they are key stakeholders of rubber industry.

To analysis cost and benefit of the rubber production, the operating ratio is used as the parameter of representation of revenue and expense categories based on variable cost. It is presented as a ratio or a percentage value. Operating ratios totaling less than (100%) denote an operating surplus. Those totaling more than (100%) denote an operating deficit.
The Asia Development Bank, ADB (2011) defined operating ratio as operating costs as a percentage of total revenue [14]. To clarify, operating ratio in rubber production is a ratio that shows the efficiency of rubber production by comparing operating expenses to net sales (revenue) that is mainly depended on the world rubber price.

Meaning, the smaller the operating ratio, the greater the margin, the rubber production sector has to make a profit. Conversely, the greater the operating ratio is, the lower the margin to generate profit for rubber farmer. The formula for calculating operating ratio is therefore: [14, 15].

\[
\text{Operation ratio} = \frac{C_1 + C_2 + C_3}{P} \times 100
\]

Operating ratio provides information about the conditions of the rubber production sector. The research findings would be important as it reflects further continuity of rubber production sector.

IV. RESULT AND DISCUSSION

In present study, samples comprised of 75 rubber farmers from different study areas, Kyaikto and Mudon Townships for Mon State, Dawei and Myeik Townships for Tanintharyi Region and Shwegyin Township for Bago Region. The socio-economic characteristics and productive characteristics of sample farmers for each State and Region was presented in Table 5 and 6 by using SPSS software statistic 22.

A. Socio-economic Characteristics of Sample Farmers

The results from Table 5 showed that the average age of household heads in all study areas was 53.14 years with the oldest 80 years and the youngest 32 years old. Average ages for specific area were 55.03 years for Mon State, 53.33 years for Tanintharyi and 49.06 years for Bago Region. Average rubber experience for study areas was 18.98 years. For Mon State, it was 24.03 years, 16.06 years for Tanintharyi Region and 14.73 years for Bago Region. In all study areas, the educational level of household heads was 9.92 schooling years and highest education was M.B.B.S. degree and lowest education level was grade two.

However, there was not much significantly different education level between study areas as 9.70 average schooling years for Mon State, 9.66 years for Tanintharyi Region and 9.92 years for Bago Region. As results from Table 5, average family size for all study areas was 4.76 persons per family. It was also not much different between Mon State and Tanintharyi Region as 4.73 persons per family and 4.66 persons for Tanintharyi Region. But slightly higher in Bago region, it was about average 5.00 persons for family size.

The average family labour used and hired labour used in study areas were about (21%) and (78%) respectively. However, it was significantly different in Mon State with other study areas. Highest family labour used and lowest hired labour was observed in Mon State as (35%) and (65%) respectively. The other study areas Tanintharyi and Bago Regions had low family labour used as (12%) and (13%). Accordingly, these areas were highly depended on hired labour for rubber production about (88%) and (86%) respectively.

\[
\begin{array}{|c|c|c|c|c|}
\hline
\text{Mean values} & \text{Unit} & \text{Mon (N=30)} & \text{Tanintharyi (N=30)} & \text{Bago (N=15)} \\
\hline
\text{Age of household heads} & \text{Year} & 55.03 & 53.33 & 49.06 & 53.14 \\
& \text{(36 - 80)} & (32 - 70) & (34 - 67) & (32 - 80) \\
\hline
\text{Rubber experience} & \text{Year} & 24.03 & 16.06 & 14.73 & 18.98 \\
& \text{(4 - 50)} & (4 - 46) & (7 - 29) & (4 - 50) \\
\hline
\text{Schooling year} & \text{Year} & 9.70 & 9.66 & 10.86 & 9.92 \\
& \text{(3 - 15)} & (4 - 15) & (3 - 18) & (3 - 18) \\
\hline
\text{Family size} & \text{No.} & 4.73 & 4.66 & 5.00 & 4.76 \\
& \text{(3 - 8)} & (3 - 7) & (3 - 9) & (3 - 9) \\
\hline
\end{array}
\]


<table>
<thead>
<tr>
<th>Labour use</th>
<th>%</th>
<th>(0 - 100)</th>
<th>(0 - 100)</th>
<th>(0 - 100)</th>
<th>(0 - 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>35.00</td>
<td>(0 - 100)</td>
<td>12.00</td>
<td>13.33</td>
<td>21.46</td>
</tr>
<tr>
<td>Hired</td>
<td>65.00</td>
<td>(0 - 100)</td>
<td>88.00</td>
<td>86.66</td>
<td>78.33</td>
</tr>
</tbody>
</table>

(Note: Table in the parentheses represents the range value)

B. Productive Characteristics of Sample Farmers

Average percentage of tapping area per total areas and maintaining areas per total areas in the study areas were about (82%) and (18%) (Table 6). There were not much different percentage for tapping and maintaining areas between study areas.

One of the important parameters of rubber production, plant population per unit areas, was observed highest in Bago Region, it was 506 plants per hectare. For Mon State and Tanintharyi Region, there were 481 and 445 plants per hectare respectively.

The location of rubber farms far from town was considerable characteristic for rubber production. Table 6 indicated the average distance to town from rubber farm for study areas was 17.79 km. Among the study areas, the Taninthary Region had highest distance from town for 30.03 km and 10.16 km in Mon State and 7.66 km for Shwegyin Township.

Table 6 also presented average percentage of rubber tapping areas according to age of rubber tree and classified as three categories- between 7-10 years, above 10-20 years and above 20 years. The average percentage of tapping areas in the study areas according to above categories were about (40%), (42%) and (19%) respectively. The areas between 7-10 years were highest in Taninthary Region and it was about (60%), lowest for Mon State about (23%) and (33%) for Bago Region. However, most productive age, area above 10-20 years was highest in Bago Region about (63%) and about (42%) for Mon State and (33%) for Taninthary Region. Average percentage of low productive age, above 20 years, was about (34%) in study areas of Mon State, about (11%) for Bago Region and (8%) for Taninthary Region respectively.

Average amount of fertilizer used for rubber production was 153 Kg per hectare for study areas. Highest fertilizer application was observed in Mon State (198 Kg/ ha) and 111 Kg/ ha and 150 Kg/ ha for Taninthary and Bago Regions respectively.

Therefore, as the results presented in Table 5 and 6, within the study areas were not much different in socio-economics and productive parameters because each area had the advantages and disadvantages.

C. Break-even price or operational cost for rubber production system

In case of break-even price or the operational cost of rubber production system, Table 7 presented average operational cost of rubber production system was 861 MMK/ Kg for study areas. According to the observed cost structure, cost of production was the largest amount (803 MMK/ Kg) and it took about (93%) of the total operational cost. Among the study areas, the highest operational cost was observed in Taninthary Region (910 MMK/ Kg). For Mon
State and Bago Region were (846 MMK/ Kg) and (789 MMK/ Kg) respectively.

In case of processing cost, Bago Region had highest processing cost (81 MMK/ Kg) because most farmers produced high quality rubber smoke sheets. The lowest processing cost was observed 23 MMK/ Kg for Tanintharyi Region as most farmers sell filed latex directly to processing factories. For Mon State, it was about 35 MMK/ Kg as most farmers produced different quality of sun dry rubber.

One of the operational costs, marketing cost was lowest in Mon State (9 MMK/ Kg) because of efficient marketing channel and adequate transportation in the study areas. For Tanintharyi and Bago Regions, it were about 24 MMK/ Kg and 23 MMK/ Kg as these regions had inadequate transportation and poor marketing channel.

**TABLE 7. BREAK-EVEN PRICE OR OPERATIONAL COST OF RUBBER PRODUCTION SYSTEM (MMK/ Kg)**

<table>
<thead>
<tr>
<th>Items</th>
<th>Mon (N=30)</th>
<th>Tanintharyi (N=30)</th>
<th>Bago (N=15)</th>
<th>Total (N=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of production (C₁)</td>
<td>802</td>
<td>863</td>
<td>685</td>
<td>803</td>
</tr>
<tr>
<td>1) Cost of fertilizer</td>
<td>96</td>
<td>107</td>
<td>65</td>
<td>95</td>
</tr>
<tr>
<td>2) Cost of production equipment</td>
<td>44</td>
<td>55</td>
<td>29</td>
<td>45</td>
</tr>
<tr>
<td>3) Cost of tapping</td>
<td>618</td>
<td>598</td>
<td>539</td>
<td>594</td>
</tr>
<tr>
<td>4) Cost of maintaining</td>
<td>44</td>
<td>103</td>
<td>52</td>
<td>69</td>
</tr>
<tr>
<td>Cost of processing (C₂)</td>
<td>35</td>
<td>23</td>
<td>81</td>
<td>41</td>
</tr>
<tr>
<td>Cost of marketing (C₃)</td>
<td>9</td>
<td>24</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Total operational cost (Break-even price)</td>
<td>846</td>
<td>910</td>
<td>789</td>
<td>861</td>
</tr>
</tbody>
</table>

**D. Break-even yield and estimated yield of the study areas**

The break-even yield of the study areas was about (535 Kg/ ha/ season) and it was also analyzed separately between the study areas in order to compare the break-even yield. According to observed data in Table 8, the highest break-even yield was found in Mon State about (597 Kg/ ha/ season). The lowest break-even yield was observed in Bago Region about (488 Kg / ha/ season) and moderate at Tanintharyi Region about (505 Kg/ ha/ season).

**TABLE 8. BREAK-EVEN YIELD OF THE STUDY AREAS**

<table>
<thead>
<tr>
<th>Particular</th>
<th>Unit</th>
<th>Mon (N=30)</th>
<th>Tanintharyi (N=30)</th>
<th>Bago (N=15)</th>
<th>Total (N=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak season</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping days per month</td>
<td>day</td>
<td>22.06</td>
<td>21.16</td>
<td>14.60</td>
<td>20.21</td>
</tr>
<tr>
<td>Tapping months per season</td>
<td>month</td>
<td>3.50</td>
<td>2.26</td>
<td>2.43</td>
<td>2.79</td>
</tr>
<tr>
<td>Tapping days per season</td>
<td>day</td>
<td>77.11</td>
<td>47.66</td>
<td>35.56</td>
<td>57.02</td>
</tr>
<tr>
<td>Yield per day</td>
<td>Kg/ ha/day</td>
<td>9.32</td>
<td>9.85</td>
<td>15.17</td>
<td>10.70</td>
</tr>
<tr>
<td>Yield per ha per season</td>
<td>Kg/ ha/season</td>
<td>689.74</td>
<td>466.38</td>
<td>529.32</td>
<td>568.31</td>
</tr>
<tr>
<td>Hard season</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapping days per month</td>
<td>day</td>
<td>22.06</td>
<td>21.60</td>
<td>14.33</td>
<td>20.33</td>
</tr>
<tr>
<td>Tapping months per season</td>
<td>month</td>
<td>3.53</td>
<td>3.66</td>
<td>3.90</td>
<td>3.66</td>
</tr>
<tr>
<td>Tapping days per season</td>
<td>day</td>
<td>78.23</td>
<td>78.61</td>
<td>55.66</td>
<td>73.87</td>
</tr>
<tr>
<td>Yield per day</td>
<td>Kg/ ha/day</td>
<td>5.54</td>
<td>5.78</td>
<td>9.11</td>
<td>6.35</td>
</tr>
<tr>
<td>Yield per ha per season</td>
<td>Kg/ ha/season</td>
<td>420.13</td>
<td>440.06</td>
<td>503.31</td>
<td>444.74</td>
</tr>
<tr>
<td>Estimated yield</td>
<td>Kg/ ha/season</td>
<td>1,109.87</td>
<td>906.44</td>
<td>1,032.63</td>
<td>1,013.05</td>
</tr>
</tbody>
</table>

However, estimated yield of study areas in Table 9 indicated about 1,013 Kg/ ha/ season and it was nearly double of break-even yield (Kg/ ha/season). The lowest estimated yield was observed in Tanintharyi Region about (906 kg/ ha/ season). The other study areas, Mon State and Bago Region had not much different estimated yield and it was about (1,109 and 1,032 Kg/ ha/ season) respectively.

**TABLE 9. ESTIMATED YIELD OF RUBBER IN THE STUDY AREAS**

By comparing break-even yield and estimated yield in the study areas, the break-even yield was significantly lower than the estimated yield of sample farmers. However, if rubber farmers received better yield than estimated, it will be more profitable for rubber farmers and high competitive for rubber production.
E. Operating Ratio

Table 10 presented the results of the operating ratio of the rubber production system and it was about (55%) for all study areas. It means the operational cost for rubber production is about 55 MMK to obtain revenue of 100 MMK and current profit would be 45%. Therefore, rubber plantation systems of the study areas are still tolerate to world price crush and profitable and efficient.

Among the study areas, the lowest operating ratio was found in Bago Region (49%) and it indicated that area was most profitable area for rubber production among the study areas. The operating ratio for Mon State was about (55%) and Tanintharyi Region for about (59%).

<table>
<thead>
<tr>
<th>TABLE 10. OPERATIONAL RATIO BASED ON VARIABLE COST OF RUBBER PRODUCTION SYSTEM IN STUDY AREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particular</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Total operational cost</td>
</tr>
<tr>
<td>Current market price</td>
</tr>
<tr>
<td>Operating ratio</td>
</tr>
</tbody>
</table>

V. CONCLUSION

The analysis on the profitability and efficient of rubber industry in the study areas bring out that rubber plantation system is tolerated to world price crush and still profitable and efficient. Alternatively, to be more profitable rubber production system, it is required to reduce the cost of production system and to promote yield per unit area.

The major cost of production system was cost of production and it contributed about (93%). In production cost, the most considerable cost were the tapping labour cost, it was about (74%). Other costs were the fertilizer cost (12%), cost of equipment (6 %) and labour cost for maintaining (9 %).

(1) To reduce production cost, the present study revealed that the tapping labour cost is most appropriate cost to be reduced. It was because tapping labour cost could be differenced depending on tapping system. In case of tapping system, proper tapping system, alternative day tapping (S₂ D₂), make lower tapping days per season and reduced the wages for payment. Result from survey in Bago Region, proper tapping system, S₂ D₂, could not be different in yield with other tapping systems from Mon State and Taninthary Region. Therefore, proper tapping systems should be used for lower tapping labour cost and also to overcome labour scarcity.

(2) In the case of processing, the study pointed out that there were chance to exclude the total variable processing cost by selling latex and cup lump directly to processing factories. It could be reduced about (5%) of total variable cost. However, there were limited latex and cup lump markets and trust between buyer and seller were vital challenges in most study areas. This scenario was revealed that the requirement for establishment of rubber processing factories in different parts of rubber planting areas.

(3) For the marketing sector, there was not much cost for reduction in marketing activities as mainly depends on bargaining power between buyer and seller. Hence, the effort should be initiated to improve the marketing efficiency to reduce marketing cost and receive better premium price.

Finally, the major findings of the research paper were summarized by evaluating operational ratio as indicator of profitability and efficiency of the rubber production system that lead the rubber crop was still economically viable. It was also provided the recommendation for continuity of rubber production instead of changing alternative crops in current situation.

The study was also revealed that the total operational cost or average break-even price. If the market price will lower than the break-even price, the government intervention in rubber sector will be critically needed. However, as nature of perennial crops and to develop the rubber sector, the intervention would be
considered for long term strategic plan which will protect rubber farmers’ livelihood.

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REFERENCES

Evaluation of Green Manure Effects on Tomato and Mustard Crops

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¹, ² Yezin Agricultural University (Magway Campus)

Abstract — Gliricidia and leadtree belong to the family Fabaceae. It has a very fast growth rate and young trees reach a height of more than 20 ft in two to three years. It is used for forage production but spreads like a weed in some places. These green leaves can be used as green manure (organic manure) in vegetable crop production as clean as the environment to maintain biodiversity [3][4]. Therefore, the experiment was conducted to evaluate the effects of green manure on vegetable crops with the use of tomato and mustard as indicator plants in Yezin Agricultural University, Magway Campus during August 2017 - 2018 academic year. There was significant observation in vegetative stage of tested vegetables (mustard and tomato) with the application of green manure as organic fertilizer. In the effect of green manure on leave number and plant height was higher than control. The green manure application should be used as soil amendment organic fertilizer in growing of vegetable crops to increase yield as well as quality. According to this result, it can be concluded that the application of green manure can increase agricultural productivity, improve soil structure, increases the water holding capacity and promotes biological transformation such as N-mineralization. Furthermore, it can reduce the use of chemical fertilizer and pesticide as well as it served as organic food production for food safety. Therefore, the application of green manure can promote the environmental conservation and produce the safety food for consumers in the world.

Keywords: Green manure, gliciridia, leadtree, tomato, mustard, organic fertilizer

I. INTRODUCTION

Amongst many kinds of vegetable such as tomato, mustard have significant role on supplying nutritive values to human daily diets. These crops could thrive on well in most tropical and sub-tropical areas where fresh edible fruits provide supplementary vitamins such as vitamin C, A, B-complex, iron and calcium. Nevertheless, vegetable growers in all region of the country have come across with many problem using insecticide and herbicide which affected export quality standard demanded by customers. Furthermore, the problem on disease and in particular poor soil fertility are also having an important role in producing crop yields [1]. Recently, there have been a number of workers who pointed out that organic agriculture had its significant role on sustainable agriculture, since most tropical soil contain small amount of organic matter and soil deterioration could be most rapid due to high leaching rate of soil nutrients caused mostly by rainfalls [2]. Moreover, decomposition rate of soil organic matter is most rapid due to high environmental temperature. One way to improve soil condition is to add green manure to the soil. Organic fertilizers have been proposed as one solution to relieve environmental pressure and be a carbon-neutral alternative to liquid fossil fertilizers [1]. Organic matter improves soil structure, increases the water holding capacity and promotes biological transformation such as N-mineralization.
There have been many kinds of organic fertilizers such as manure, sewage sludge, stalks, compost, biogas residues, and biogas slurry and so on. Gliricidia can tolerate a wide range of soil types, both alkaline and acidic, but prefers free drainage. It is also more tolerant of acid and low fertile soils than leucaena [4]. Therefore, this investigation focused on the use of two types of green leaves like gliciridia (Gliciridia sepium) and leadtree (Leucaena leucocephala) to the soil and to evaluate the effects on vegetable crops of tomato and mustard.

II. MATERIALS AND METHODS

This experiment was carried out at the Field of Magway campus, Yezin Agricultural University (Magway) during August 2017 - 2018 academic year. Two vegetable crops, tomato and mustard were used as tested crops with 3 replications in treatments of (i) gliricidia leaves (27 ton ha⁻¹), (ii) lead tree leaves (27 ton ha⁻¹) and (iii) control (none of green manure). The area of each bed was 10m² (10m length x 1m width) and spacing between each bed was 0.0254m. The seedlings of 3 weeks old mustard and tomato were transplanted on well prepared bed used in drip irrigation. For data collection, number of leave, plant height (cm), total number of flower, and total number of fruit, total fruit weight (g), and weight per fruit (g) were collected. The average 5 samples of plants were recorded as measured data. For number of leave, data were measured 7 days interval at 30 days after transplanting. In plant height (cm), counted at 45 days after transplanting. The flower numbers recorded 5 days interval at 45 days after transplanting. Total fruit number produced per plant and fruit weight (g) were recorded at harvesting time. Data were generated by using the GEN STAT (version 9) statistical methods.

III. OBSERVATIONS (RESULTS)

All data can observe differences in visually in both vegetable crops (tomato and mustard) though were no significant differences in statistically. Mean data were taken by randomly selected 5 sample of tested plants.

(a). Effects of green manure on tomato crop

In tomato, yield and yield component characters were recorded in average 5 plants at 7 days interval.

<table>
<thead>
<tr>
<th>Character</th>
<th>Glicidia</th>
<th>Leadtree</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>leaf no.</td>
<td>21.2</td>
<td>21.8</td>
<td>17.2</td>
</tr>
<tr>
<td>flower no.</td>
<td>18</td>
<td>20</td>
<td>17.1</td>
</tr>
<tr>
<td>fruit no.</td>
<td>19</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>plt ht(cm)</td>
<td>119.3</td>
<td>134.9</td>
<td>101</td>
</tr>
<tr>
<td>fruit wt(g)</td>
<td>38.2</td>
<td>39.2</td>
<td>36</td>
</tr>
<tr>
<td>total fruit wt(g)</td>
<td>701</td>
<td>738</td>
<td>555</td>
</tr>
</tbody>
</table>

Table (1) showed the responses of tomato affected by green manure application. All tested characters were observed better in green manure application compared to control.

In Fig. 1, an average leave numbers were observed 23 in lead tree, 22 in gliciridia leave treatment and 17 in control. The use of green manure as organic fertilizer showed more number of leaves (5-6 leaves) than control (no application). The
more number of leaves can affect for more photosynthesis for crop yield. Therefore, application of green manure gave better result in vegetable crop production.

Fig. 1. Effect of green manure on leave number of tomato plant

Fig. 2. Effect of green manure on plant height of tomato plant

Fig. 3. Effect of green manure on flower number of tomato plant

Fig. 4. Effect of green manure on total fruit number of tomato plant
For fruit weight (g), average weight was recorded at harvesting time (105 days old). Weight per fruit was 34-40g in control, 43g in lead tree treatment and 41g in gliciridia treatment. Total fruit weight was 480-630g in control, 738g in lead tree and 701g in gliciridia leaf treatment. Therefore, green manure application gave higher yield compared to control about the range of 16-135g in tomato crop (Fig 5).

In the character of yield per acre (viss), it was found that 2565-3370 viss/ac [10328 – 13568 kg/ha] in control, 3946 viss/ac [15887 kg/ha] in lead tree treatment and 3747 viss/ac [15086 kg/ha]. Therefore, yield of vegetable crops was significantly increased 1181-1380 viss/ac [4758-5558 kg/ha] by the use of green manure as organic fertilizer. So, the green manure can make more productivity as well as safety food to consumers in our environment.

(b). Effect of green manure on mustard crop

In mustard crop, some agronomic characters were taken in average 5 sample plants from each treatment.

Plant height (cm) character was observed in Fig. 6. The average values of plants were recorded at 24 days after transplanting. Plant height was recorded 21cm in control, 28 cm in lead tree and 27cm in gliciridia treatment. There was difference between control and treatments vary from 6 - 7cm in size. This variation mean vegetative growth of crop vigor can see clearly in mustard crop. So green manure application gave more effective the mustard crop.

Fig. 7 shows number of leaves on mustard vegetable, average value of plants were recorded 7 days interval at 17 days after transplanting. It was found that 22-24 in control, 28 in lead tree and 25 in gliciridia leaves treatment. The more number of leaves mean the more vigor of plant in mustard. Therefore, leave number in green manure treatments were more productive effect compared to control (without treatment) [5-6 leaves].
In Fig. 8, weight per plant (g), average value of mustard plant was recorded at harvesting stage (35 days after transplanting). Weight per plant was observed 334 g in leadtree, 300 g gliciridia treatment and 199-258 g in control (range 76-135 g) respectively. The weight/plant in vegetable crops means yield of production. Therefore, application of green manure treatments gave higher yield compared to control.

In yield per acre (viss) for tomato crop, it was found that 1063-1383 viss/ac (or) 4282 – 5569 kg/ha in control, 1789 viss/ac (or) 7204 kg/ha in lead tree treatment and 1603 viss/ac (or) 6455 kg/ha. Furthermore, yield of mustard crop was observably higher in green manure application compared to control.

IV. CONCLUSION AND DISCUSSION

The application of green manure used as organic fertilizer can mainly increase plant height, leaves number, number of nodes and internodes, early flowering, flower number, and fruit number of tomato crop. Moreover, use of green manure can improve reduction of flower defoliation, larger fruit size for high yield. According to this result, tomato and mustard crops used green manure application were shown shorter duration and higher yield compared to control. Among the lead tree and gliciridia treatment, crop response of tested in lead tree was higher than gliciridia treatment because lead tree leaves were more quickly decomposable than gliciridia leaf [3]. Otherwise, nutrient like phosphorous needed for plant growth was higher in lead tree than gliciridia leaf [5]. Therefore, the application of green manure can increase yield per acre and quickly produce the safety food to the consumers. Any green leave which are easily available from our surrounding can be used as organic fertilizers in vegetable crop production. On the other hand, green leave are slowly decompose because of low nitrogen content. Therefore, green leave can be mixed with animal’s residue to quickly decompose and to get organic fertilizer with high nutrient [3]. Based on this experiment, it can be suggested that application of green leaves as organic fertilizer can increase nutrient uptake of plant, soil conservation, protection of pest and disease, reduction in use of chemical fertilizer and insecticide, environmental conservation and
production of safety food for consumers. The organic agriculture can cure human diseases as well as reduce the environmental pollution in humanbeing.

ACKNOWLEDGEMENT

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1) ဦးဇော်သန်း (ဘာသာပြန်). ၂၀၁၇, စိုက်ပျိုးရေးတွင် အရေးပါသည့် သဘာဝမ ြေဩဇာလွယ်ကူစွာ ပြုလုပ်သုံးစွဲနည်းများစာမျက်နှာ ၅၇-၅၈.


Study on antimicrobial resistance pattern of *Escherichia coli* isolated from layer farms within Pyin Oo Lwin Township

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**Abstract**- Antimicrobial resistance is a global problem in both human and veterinary medicine, and varieties of factors have been identified as the cause of bacteria resistance. A cross-sectional study was carried out to examine antimicrobial resistance of *Escherichia coli* isolated from layer farms within Pyin Oo Lwin Township and to identify its associated factors. Questionnaire data for farm management and antimicrobial usage was taken during sampling. A total of 100 pooled cloacal swab samples were collected and isolation and identification of *E. coli* was performed. Among 100 samples, *E. coli* was isolated from 95 samples (95%). Antimicrobial susceptibility was performed for 11 antimicrobials by agar disc diffusion method. This study showed a higher percentage of multidrug resistance (MDR) in the selected layer farms. Therefore, the occurrence of MDR *E. coli* isolates highlighted the possible threat to humans and the importance of prudent antimicrobial usage and need to regulation.

**Keywords**- Antimicrobial; resistance; layer; *Escherichia coli*; Pyin Oo Lwin

I. INTRODUCTION

Poultry is a major fast growing source of food in the world [1]. Along with the development of poultry farms, the occurrences of disease and antimicrobial usage have been increased. However, antimicrobials can also have a marked effect on commensal microflora resulting in either an increase in the antimicrobial resistance of these bacteria or replacement of the bacterial populations by more resistant bacteria [2]. *Escherichia coli*, as part of the intestinal microbiota, is one of the most important and common bacterial agents responsible for different intestinal or extra-intestinal infections in human and animal populations [3]. It is also one of the most important etiological agents causing diseases in poultry which leads to significant economic losses related to high mortality, poor weight gain of infected chicken and poor carcass quality [4]. Multidrug resistant, nonpathogenic *E. coli* found in the intestine is probably an important reservoir of resistance genes [5]. Emergence of multidrug resistant *E. coli* in food animals including chicken arise due to the improper use of antibiotics, thereby reducing the clinical efficacy to antibiotics commonly used in human and veterinary medicine [6]. Therefore, the present study was conducted to describe antimicrobial resistance pattern of *E. coli* isolates from layer farms within Pyin Oo Lwin Township and to identify its associated factors of AMR.

II. MATERIALS AND METHODS

A. Sample collection

A total of 100 pooled cloacal swab samples were collected from 4 different age groups, 1-3 months, 4-5 months, 6 months-1 year and over 1 year old of layers between April and August, 2018. In each farm unit, the cloacal swab samples were collected from five different birds and pooled and kept in a labeled plastic bag. Questionnaire data for farm management and antimicrobial usage was taken during sampling.

B. Isolation and identification of *E. coli*

Each pooled sample was streaked on MacConkey agar and incubated at 37°C for 24 hrs. After incubation, suspected pink colonies on MacConkey agar were subcultured into nutrient
agar and incubated at 37°C for 24 hrs. And then, a pure single colony from nutrient agar was picked up and oxidase test, spot indole test and gram’s staining were performed to identify E. coli. For confirmation of E. coli, an API identification test kit was used.

C. Antimicrobial susceptibility test

The antimicrobial susceptibility test was performed by using agar disc diffusion method according to Clinical and Laboratory Standards Institute (2012) [7]. Eleven antimicrobials such as ampicillin, amoxicillin/clavulanic acid, cephalothin, cefoxitin, ceftiofur, colistin, enrofloxacin, gentamycin, neomycin, tetracycline and sulfamethoxazole/trimethoprim were tested. E. coli ATCC 25922 was used as a quality control strain. The zone diameter breakpoints for the antimicrobials were determined by CLSI (2012 and 2013) [8]. The antimicrobial resistance levels, multidrug resistant (MDR) and not-MDR were determined based on the European Food Safety Authority (2015) [9] and intentional standard definition antimicrobial categories.

D. Statistical analysis

Data files of questionnaires and laboratory results were entered into Microsoft Excel Sheet. Fisher’s Exact test was used to identify the association between the hypothesized factors and antimicrobial resistance of E. coli in layer farms by using SPSS version 20 at p<0.05 level of significance.

III. RESULT

Overall occurrence of E. coli isolates from layer farms within Pyin Oo Lwin Township was 95% (95/100). Among 95 isolates, only one isolate was susceptible to all antimicrobials tested. A total of 94 isolates were extremely high resistant to tetracycline (TE) (86.17%), very high resistant to sulfamethoxazole/trimethoprim (SXT) (62.76%) and ampicillin (AMP) (57.44%), high resistant to enrofloxacin (ENR) (47.87%), colistin (CT) (41.48%), amoxicillin/clavulanic acid (AMC) (32.79%), neomycin (N) (28.72%), cephalothin (KF) (25.53%) and gentamycin (CN) (24.46%), moderate level resistant to ceftiofur (EFT) (17.02%) and low level resistant to cefoxitin (FOX) (6.38%). Antimicrobial Resistance, Intermediate and Susceptibility of E. coli isolates to each antimicrobial are shown in Fig. 1.

Resistance of 94 E. coli isolates to the number of antimicrobial tested ranged from one to nine (Fig. 2) and showed 72 different antibiotypes. Among them, the most predominant antibiotype was TE (6.38%) and followed by AMP AMC ENR TE SXT (4.26%) and CT TE (3.19%).

The occurrence of multidrug resistance (MDR) was 79.79% and not-MDR was 20.21%. Description of questionnaire data for layer farms in study area was shown in Table 1 and antimicrobials commonly used in layer farms of study area were shown in Table 2. For the identification of factors associated with antimicrobials resistance, Fisher’s Exact test was used based on 95 farms from where E. coli could be isolated. There were no association between hypothesized factors and antimicrobial resistance. (Table3).
Table 1. Description of questionnaire data for layer farms in study area (n=100)

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors</th>
<th>No. of farm</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rearing of other animals in the farm (eg. Dog, cat, cow, pig)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>2</td>
<td>Duration of farm establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 years</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>&lt;5 years</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Cleanliness of farm’s environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Use of antimicrobials</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>97</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Purpose of antimicrobials usage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Prevention</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Choice of antimicrobials used</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vet prescription</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Experience</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>7</td>
<td>Kind of antimicrobials used</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;3</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>&lt;3</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>8</td>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-3 months</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>4-5 months</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>6 months -1 year</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Over 1 year</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 2. Antimicrobials commonly used in 97 layer farms of study area

<table>
<thead>
<tr>
<th>No.</th>
<th>Antimicrobials class</th>
<th>Name of antimicrobials used</th>
<th>No. of farm using antimicrobials</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Penicillin</td>
<td>Amoxicillin</td>
<td>10</td>
<td>10.30</td>
</tr>
<tr>
<td>2</td>
<td>Aminoglycosides</td>
<td>Neomycin</td>
<td>26</td>
<td>26.80</td>
</tr>
<tr>
<td>3</td>
<td>Tetracycline</td>
<td>Doxycycline, Oxytetracycline, Chlorotetracycline</td>
<td>52</td>
<td>53.60</td>
</tr>
<tr>
<td>4</td>
<td>Macrolide</td>
<td>Tylosin, Erythromycin, Tilmicosin</td>
<td>46</td>
<td>47.42</td>
</tr>
<tr>
<td>5</td>
<td>Fluoroquinolones</td>
<td>Enrofloxacin, Norfloxacin, Levofloxacin, Ciprofloxacin</td>
<td>36</td>
<td>37.11</td>
</tr>
<tr>
<td>6</td>
<td>Sulphur compounds</td>
<td>Sulfamethoxazole/ trimetoprim</td>
<td>36</td>
<td>37.11</td>
</tr>
<tr>
<td>7</td>
<td>Polymycin</td>
<td>Colistin</td>
<td>42</td>
<td>43.29</td>
</tr>
</tbody>
</table>
Table 3. Analysis of factors associated with antimicrobial resistance (n=95)

<table>
<thead>
<tr>
<th>No.</th>
<th>Factors</th>
<th>Resistance</th>
<th>Susceptible</th>
<th>p value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Antimicrobials usage</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>90</td>
<td>2</td>
<td>0.093</td>
<td>0.992-1.054</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Existence of Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 years</td>
<td>89</td>
<td>2</td>
<td>0.122</td>
<td>0.996-1.073</td>
</tr>
<tr>
<td></td>
<td>&lt;5 years</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>No of antimicrobials used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;3</td>
<td>35</td>
<td>1</td>
<td></td>
<td>0.027-3.512</td>
</tr>
<tr>
<td></td>
<td>&lt;3</td>
<td>57</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Purpose of antimicrobials used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>78</td>
<td>2</td>
<td>0.073</td>
<td>1.082-1.286</td>
</tr>
<tr>
<td></td>
<td>prevention</td>
<td>14</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rearing of other animals (eg. Dog, cat, cow, pig)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>39</td>
<td>1</td>
<td></td>
<td>1.457-2.068</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>53</td>
<td>2</td>
<td></td>
<td></td>
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</table>

CI-confidence interval
One category of all factors was found to be negative. The value one was added to all categories of those factors and recalculated in SPSS software in order to get p value.

IV. DISCUSSION

Widespread use of antimicrobials has benefits for poultry production but contributes to the increasing concern about drug-resistance bacteria [10]. *E. coli* can play a role in transmission of mobile resistance genes. Exchange of resistance genes occurs between pathogens and non-pathogens, even between Gram-positive and Gram-negative organisms [11]. Occurrence of *E. coli* isolates in layer farms of Pyin Oo Lwin was observed 95% in the present study. This occurrence was higher than those reported in other parts of Myanmar and other countries. The occurrence of *E. coli* in broiler and layer farms was 60.67% in Mubin and Nyaung Done Township [12] and 64.86% in Nay Pyi Taw [13]. In other regions of the world, the occurrence of *E. coli* in poultry was 39% in Thailand, 58% in Bangladesh, 30.5% in West Indies and 15% in Abeokuta [14], [15], [16], [17]. This variation of *E. coli* occurrence may be due to differences in collecting methods of samples, isolation and identification method of samples and hygiene practice in the study area. Present study showed that *E. coli* isolates were extremely high resistant (86.17%) to tetracycline. This finding was higher than those observed 58.5% in Grenada [18], (52%) in Bangladesh [15], 52% in Malaysia [19] and 30% in Spain [20]. Tetracycline is a broad-spectrum antibiotic with bacteriostatic activity which is widely used in the prevention and treatment of poultry disease. However, the long-term application of tetracycline leads to selection of drug resistance. So, extremely high tetracycline resistance of *E. coli* isolates might be due to cross-resistance of tetracycline group antimicrobials in this study. In the present investigation, *E. coli* isolates were very high resistant (62.76%) to sulfamethoxazole/trimethoprim. There were higher resistance rate in this study than 25.27% reported by Honey Wai [12] and 39% reported by Abbasi [21]. Use of sulfur compounds for preventive and therapeutic purposes in the study area might be the cause of being resistance. The current study demonstrated that *E. coli* isolates were very high resistant to ampicillin (57.44%). Other studies in Korea [22], Southwest Nigeria [23], Grenada [16] and Bangladesh [15] have also shown very high resistance of *E. coli* to ampicillin. This might be due to use of other penicillin group antimicrobials in the study farms and the presence of resistance organisms around the farm environment. *E. coli* isolates exhibited high resistance to enrofloxacin (47.87%), colistin (41.48%), amoxicillin/clavulanic acid (32.79%), neomycin (28.72%), cephalothin (25.53%) and gentamycin (24.46%). Regular use of antibiotics in avian industries for therapeutic or preventive purposes mainly leads to selection of resistant clones and afterward, for intra- and inter-spread of these clones by fecal contamination [21]. The occurrence of *E. coli* isolates resistant to such antimicrobial might depend on the presence of resistance gene around the environment of poultry farms in the study area and using antimicrobials. In this study, resistance rate to ceftiofur (17.02%) and cefoxitin (6.38%) was low. Resistance genes and determinants from these bacteria can be transferred to other bacterial species, even taxonomically and genetically distant ones [24]. The present study exhibited 79.79% multidrug resistance among *E. coli* isolates from layer farms. Similar findings have been reported in Vietnam and Morocco [25], [26]. Other studies in Bangalore, Iran, Bangladesh and Malaysia reported 100% multidrug resistance among *E. coli* isolates from poultry [27], [15], [19]. The use of combinations of antimicrobials may also result in the selection of MDR bacterial strains [28]. In this study, the high occurrence of multidrug resistance might depend on use of drug with experience, use of drug combinations and years of farms establishment. OIE (World Organization for animal health) list of veterinary critically importance antimicrobial agents are penicillin, cephalosporin (third and fourth generation), aminoglycoside, macrolides, amphenicols, quinolones (second generation), tetracycline and sulfonamides. Amaechi reported that data on drug usage is essential for development of antimicrobial resistance [29]. According to questionnaire data, 97 layer farms from Pyin Oo Lwin Township were commonly used 7 classes of antimicrobial. The most commonly used antimicrobial class was tetracycline group (53.6%) and followed by macrolide (47.42%),...
polymycin (43.29%) Tetracycline as antibiotic growth promoters for example chlortetracycline, tetracycline, doxycycline and oxytetracycline have been played major role in feed additives [30] and it is also the cheapest classes of antimicrobial available [31]. So, such group of antimicrobials was widely used for the purpose of disease control and growth promoting in the study area. In the study farm, farmers were using tylosin and tilmicosin for prevention and treatment of respiratory infection in layers. Colistin, an antibiotic belonging to the polymyxin group possesses activity mainly against gram-negative bacteria [32]. Thus, in layer farms of Pyin Oo Lwin township, farmers were using colistin for treatment and prevention of enteritis. To sum up, it could be suggested that usage of antimicrobial in farm is clearly connect with antimicrobial resistance.

V. CONCLUSIONS

Multidrug resistance of E. coli isolates were observed in layer farms of study area. It can be noticed that widespread antimicrobial usage and environmental factors such as soil, water, feed, manure, litter and farms’ equipment play an important role in the dissemination of resistance elements and antimicrobial resistant organism. To control antimicrobial resistance, it is necessary to take control measures, especially biosecurity management on reducing horizontal transmission of resistance bacteria in the farm environment and prudent use of antimicrobial agent in the study farms.

ACKNOWLEDGMENT

I would like to thank to veterinarians from Pyin Oo Lwin Township for participating in the sample collection on the layer farms. I am also thankful to all staffs from the Department of Pharmacology and Parasitology, University of Veterinary Science, Yezin, Nay Pyi Taw for providing laboratory support.

REFERENCES


Effect of the Different Extender and Cryoprotectants of the Cryopreservation of *Cirrhusmrigala* (Hamilton, 1822) Spermatozoa

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Abstract - Cryopreservation is one of the widely accepted and useful methods for preservation of gametes especially for spermatozoa. The present study was conducted to compare the post-thaw motility and viability of *Cirrhusmrigala* sperms using different extenders and cryoprotectants. The rip male brooders were obtained from the Thetyetkone fishery station, Mandalay during the spawning season. Laboratory works were performed in Livestock Breeding Improvement Section (Upper Myanmar), Livestock Breeding and Veterinary Department. Four extenders: egg-yolk citrate, glucose egg-yolk, 0.9% NaCl and glucose solution and two cryoprotectants: Dimethyl sulfoxide (DMSO) and Glycerol were used for this experiment. Diluents were prepared by mixing the 5% concentration of cryoprotectants with 90% extenders (% volume/volume). Milt and cryodiluents were mixed with a ratio of 1:4 for all extenders. The mixture of milt and cryodiluents were kept at 4°C for 30 minutes as an equilibration period, and then observed the motility and viability of the sperm. The mixture of milt and cryodiluents were filled in the straw. Afterwards, it was put inside the liquid nitrogen tank (-100 ± 2°C) for 10 minutes to be frozen. The straw must be placed at 2 cm above the surface of the liquid nitrogen. The frozen straws were thawed in 29°C water bath for 10-15 seconds. In order to check the motility and viability of cryopreserved sperm. The motility and viability of sperm in egg-yolk citrate, glucose egg-yolk and 0.9% NaCl with both cryoprotectants were significantly better performance (p< 0.001) than that of glucose solution at the equilibrium period. In post-thaw period, both of the egg-yolk citrate and 0.9% NaCl with DMSO showed significantly higher (p<0.001) than that of others. From previous results, the two diluents: egg-yolk citrate and 0.9% NaCl, and cryoprotectant DMSO were selected to continue next experiments. Four different concentration of DMSO cryoprotectant (5%, 10%, 15% and 20%) were mixed with three different dilution ratio of two extender (egg-yolk citrate and 0.9% NaCl) (1:4, 1:7, and 1:10), and checked the motility of the cryopreserved sperm in post-thaw period. From this experiments, the egg-yolk citrate (1:7) showed significantly higher post-thaw motility (p<0.001) in DMSO (5%) cryoprotectant. Also the 0.9% NaCl diluents (1:4) showed the higher post-thaw motility (p<0.001) with DMSO (10%) cryoprotectant. The result of this study is hoped to some shed light on for long-term conservation of not only genetic materials of *Cirrhusmrigala* but also other fish species of economic important and those imposed by threats.

Keywords - Cryopreservation, *Cirrhusmrigala*, Cryoprotectants, Milt, Post-thaw motility

I. INTRODUCTION

The world’s population is continually growly with a consequently increased demand for fresh and safe sources of animal protein. Fish & fishery products are good quality protein sources and essential for daily need in Myanmar. Myanmar has hills, valleys and rivers with a tropic monsoon climate, and has
impressive fisheries. In order to maintain the aquatic ecosystem stability many conservation strategies have been developed to overcome the crisis [1]. Cryopreservation protocol of Cirrhinus mrigala required a few basic parameters. Cryopreservation technique is required in all endangered and endemic species of vertebrates because many species are facing extinction worldwide due to rapidly lessening and disappearing habitats. In Myanmar, conservation of fish genetic resources has not yet been done by cryopreservation technique. In the present study cryopreservation technique was conducted on the milt of freshwater fish species C. mrigala.

Myanmar people, generally, prefer freshwater to marine fish. In freshwater fish, C. mrigala is an important species due to it relatively better taste and higher market price. A commercially important aquaculture fish, required of seed is meeting up through by the induced breeding techniques in fishery station. Therefore, the species are severely being threatened by unprogressive hybridization. In addition unplanned hybridization, inbreeding depression and genetic drifts have been the causes of deteriorating quality of this species. In this regard cryopreservation is the simplest and most inexpensive methods of preserve genomes that can be used to maintain future with alternative conservation.

Cryopreservation of fish spermatozoa is relatively new technique compared to livestock semen preservation that is now applied in horse, cow, pig and poultry to upgrade the native stock. Since 1970, there have been many of publications those are demonstrating the feasibility of cryopreserving fish spermatozoa. The technical capacity to cryopreserve fish, aquatic invertebrate gametes and embryos has expanded rapidly in recent years, driven primarily by the aquaculture industry. The majority of publication and protocols related to three groups of fish such as salmon, tilapia and carp of aquacultures important[2]. Now more than 200 species have been tested for sperm cryopreservation[2].

Nowadays the local cattle breed straw produce and distribute from LBVD in Myanmar. Until now, probably very little effort has been made on the cryopreservation of fish gametes in Myanmar. Different extenders and cryoprotectants used for the cryopreservation of Pangasiushypophthalmus (Sauvage, 1878) were reported by Myint Wai, 2007 and KyawNaingOo, 2011 in Myanmar[3],[4]. Cryopreservation of fish spermatozoa and oocytes can have a profound effect on aquaculture by allowing the maintenance of a large gene pool for genetic manipulations and increasing the fish production by timely supply of quality fish seed. Moreover, it might decrease the aquaculture cost by reducing the facilities needed and long period of storage of gametes without changing native character. Therefore, the most useful method were attained long storage period without changing property of gametes is ultrafreezing or cryopreservation.

As much effort has been taken place in fishery researches, mostly emphasizing on the improvement of fish production such as nutrition, breeding techniques, rearing methods, taxonomy and reproduction. A very little effort was exerted to maintain the genetic resources of fish and other aquatic animals. In view of filling the gap that the present study was conducted to observe the viability of spermatozoa among the different cryoprotectants and to investigate the viability of spermatozoa following cryopreservation and thawing in C. mrigala species.

II. MATERIALS AND METHODS

A. Rearing of Brood Stock

The ripe male brooders were procured from the Thetyetkone fishery station, Patheingyi Township, Mandalay Region during the breeding season by gill net. Cirrhinus mrigalawas obtained from Thetyetkone fishery station. Male brooders were selected for maturity age of 2-3 years
with pinkish and pointed vascular papilla. The current study, mature males was kept in the pond and water temperature was maintained 27°C to 29°C in rainy season at the pond. The identification of male ripe brooder is easy in those species where sexual dimorphism exist. The experiments of cryopreserve milt were carried out in Livestock Breeding Improvement Section (Upper Myanmar), Livestock Breeding and Veterinary Department.

B. Cryodilutents

Dilution of sperm was done by adding cryodiluent to the milt sample at specific ratio. Cryodilutents consists of extenders and cryoprotectants. The extender is a solution that contains organic and inorganic chemicals which increase the efficacy of cryopreservation of sperm. Cryoprotectants are mixed with extender to protect the cell from damage during cooling and freezing. Four extenders are egg-yolk citrate, glucose egg-yolk, 0.9% NaCl and Glucose solutions. Two cryoprotectants are DMSO (Dimethyl sulfoxide) and glycerol. The chemical constitutions of these extenders are given in Table 1.

Table 1. Chemical constitution of different extender used for sperm cryopreservation of Cirrhinus mrigala

<table>
<thead>
<tr>
<th>Composition</th>
<th>Extender I</th>
<th>Extender II</th>
<th>Extender III</th>
<th>Extender IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaCl (g/100ml)</td>
<td>0.4</td>
<td>0.75</td>
<td>0.9</td>
<td>0.75</td>
</tr>
<tr>
<td>KCl (g/100ml)</td>
<td></td>
<td></td>
<td></td>
<td>0.04</td>
</tr>
<tr>
<td>NaHCO₃ (g/100ml)</td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Sodium citrate (g/100ml)</td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Glucose (g/100ml)</td>
<td>0.1</td>
<td>5.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg-yolk (ml)</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All chemicals were diluted in distilled water to a final volume of 100ml.
Source: 1,2,3Sarder et al. (2009), 4,5Stein H and Bayrle (1978)

C. Experimental Design

In my present study was used the four extenders for appropriate the cryopreservation of spermatozoa Cirrhinus mrigala species. These extenders were mixed to determine the assessment of cryoprotectants concentration in the diluents, two cryoprotectants (DMSO and Glycerol) at four different concentrations such as (5%, 10%, 15% and 20%). Eight different diluents were generated from each extender. Four extenders and two cryoprotectants concentration was estimated the dilution ratio between milt and cryodiluents at three different ratios 1:4, 1:7 and 1:10. Twelve combinations were obtained for each extender. The post-thaw motility of the sperm at these experiments was assessed and motility was recorded.

D. Semen Collection

Mature male (1.5 to 3 kg) with desired phenotypic characteristics were selected and induced by injecting hormone extract to get sufficient amount of milt. The collected milt were always preformed from oozing male ripe brooders by stripping method, these collected semen must be free from contamination, such as water, mucus, blood and gut waste. The brooder wipe with soft cotton cloth. The collected semen was put directly in to the clean, sterilized and dry 15 ml plastic tube by stripping the brooder. The semen samples were maintained at 0-4°C in ice chest until analyzed for semen quality and used for cryopreservation [5].

E. Color and pH

The colour of the semen of C. marigla fish species were checked from contamination in milt. The pH of milt was measured by litmus paper.

F. Motility of Sperm

The motility of sperm was checked under microscope by Makler Counting Chamber after collection [5]. Sperm concentration apparatus
wererequired microscope, Makler counting chamber, pipette and 0.6% NaCl solution. The number and motile sperm cells were estimated, diluting (0.5:100) μl previously the sperm in a saline physiological solution (0.6% NaCl) and subsequently individual spermatooza were counted at ×20 magnification and ×10 eyepiece.

The motility evaluation was done within 3-5 minutes by counting all motile sperm within 9 or 16 squares. Motile sperm in the same area were counted and estimated the grade of motility from 0 to 4 according of the percentages of motile sperm and calculated the average (Makler, 1978) Table 2.

Table 2. The grade of motility from 0 to 4 according of the percentages of motile sperm

<table>
<thead>
<tr>
<th>Grade</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0% to &lt;1%</td>
</tr>
<tr>
<td>1</td>
<td>1% to &lt;25%</td>
</tr>
<tr>
<td>2</td>
<td>25% to &lt;50%</td>
</tr>
<tr>
<td>3</td>
<td>50% to &lt;75%</td>
</tr>
<tr>
<td>4</td>
<td>75% to 100%</td>
</tr>
</tbody>
</table>

Source: Agarwal, 2016

G. Percentage of Live and Dead Sperm Cells

The live and dead spermatozoa were determined in nigrosin-eosin stained smear method. The stain was an isotonic mixture containing eosin and nigrosin. The eosin having the property live sperm are not stained but dead ones are stained pink against a blue background[7].

H. Preparation of Milt for Cooling

One part of collected milt sample was diluted with 4 parts. Cryodiluents were prepared by mixing 5% cryoprotectant with 95% extender (%v/v). The mixing of milt and cryodiluted was kept of 4°C for 30 mins as an equilibration period. In the cooling chamber, the diluted semen was aspirated into 0.25μl French medium straw (IMV Techniologies) sealed with polyvinyl alcohol (PVA) powder. French medium straws (0.25μl) were placed from 4°C to -4°C at the rate of 4°C min⁻¹ in the cooling chamber.

Cryopreservation process was conducted in a Styrofoam box containing liquid nitrogen (-196°C). Straw filled with diluted milt were placed at a 2 cm above the surface of liquid nitrogen. The liquid nitrogen vapour 2 cm above the liquid nitrogen surface in -100±2°C. The straws were allowed to be frozen for 10 min[6].

The frozen straws were transfer in the goblet placed in the canister and plunged into the liquid nitrogen for long-term storage. The straws were stored in the liquid nitrogen by keeping the sealed side at upper side.

I. Thawing

Straws were retrieved from the liquid nitrogen canister using tweeze and thawed rapidly into 29°C water bath for 10-15 sec. The percentage of motile sperm and live spermatozoa were activated post-thawed motility. The sample check for 3 straws placed on the glass slide using microscope for ensure of cryopreserved semen quality.

J. Statistical Analysis

Data of the experiments were presented as percentage of motile cells. The effects of different extenders and cryoprotectants on post-thawed motility of sperm, dilution ratio and cryoprotectant concentrations were statistically analyzed with one way analysis of variance (ANOVA) using SAS software and the differences between treatment means were compared using Duncan’s Multiple Range Test (DMRT).
III. RESULTS

Table 3. Body weight and fresh sperm features of *Cirrhinus mrigala*

<table>
<thead>
<tr>
<th>Number of fish</th>
<th>Fish weight (kg)</th>
<th>Sperm volume (ml)</th>
<th>Sperm concentration (million/ml)</th>
<th>Sperm motility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1.3 – 2.7</td>
<td>3 - 7.5</td>
<td>100 - 450</td>
<td>98%</td>
</tr>
</tbody>
</table>

Fresh sperm of the 12 males used in this study showed 98.8% motility rate (Table 3). The fresh sperm pH value was 8 with creamy white color and the sperm were collected sperm samples without any contaminant materials for preservation trials. Motility of sperm was tested for all the experimental variants during post-thaw period.

A. Assessment of Equilibrium and Post-Thaw Motility of Cryopreserved Sperm among Using for 4 Cryodilutents

Four extenders and two cryoprotectants were used in this study. Among the four extenders, DMSO mixed with extender I showed best result (p<0.001) and the followed by extender III compared to those of other in equilibration motility (Table 4). The extender IV was not satisfactory in equilibration motility. The equilibrium motility of sperm was observed not significant results in extenders I, II, III and IV with glycerol cryoprotectant. After storage of three successive days, among the four extenders, DMSO mixed with extender I showed best result (p<0.001) and their followed by extender III compare to those of other in post-thaw motility (Table 4). Extender I, II, III and IV were given the worst results with Glycerol cryoprotectants and in many cases the some sample became clotted.

Table 4. Effect of study extender and cryoprotectants on the equilibration and post-thaw motility of sperm *Cirrhinus mrigala*

<table>
<thead>
<tr>
<th>Extenders</th>
<th>Cryoprotectants</th>
<th>Equilibration motility</th>
<th>Post-thaw motility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extender I</td>
<td>DMSO</td>
<td>85a</td>
<td>75a</td>
</tr>
<tr>
<td></td>
<td>Glycerol</td>
<td>65d</td>
<td>8d</td>
</tr>
<tr>
<td>Extender II</td>
<td>DMSO</td>
<td>70b</td>
<td>25b</td>
</tr>
<tr>
<td></td>
<td>Glycerol</td>
<td>65d</td>
<td>0b</td>
</tr>
<tr>
<td>Extender III</td>
<td>DMSO</td>
<td>75b</td>
<td>75b</td>
</tr>
<tr>
<td></td>
<td>Glycerol</td>
<td>65d</td>
<td>0b</td>
</tr>
<tr>
<td>Extender IV</td>
<td>DMSO</td>
<td>25c</td>
<td>0c</td>
</tr>
<tr>
<td></td>
<td>Glycerol</td>
<td>65d</td>
<td>0c</td>
</tr>
</tbody>
</table>

* a, b, c, d and e Means with different superscript in each column differed significantly (p<0.001)

B. Assessment of Post-Thaw Motility of Cryopreserved Sperm among Using for Cryodiluent Ratios and Cryoprotectant Concentration

From previous results, the two diluents: egg-yolk citrate and 0.9% NaCl, and DMSO cryoprotectant were selected to continue next experiments. Four different concentration of DMSO cryoprotectant (5%, 10%, 15% and 20%) mix with three different dilution ratio of two extender (egg-yolk citrate and 0.9% NaCl) (1:4, 1:7, and 1:10), and checked the motility of the cryopreserved sperm in post-thaw period. From this experiments, the egg-yolk citrate (1:7) showed significantly higher post-thaw motility (p<0.001) in DMSO (5%) cryoprotectant. Also the 0.9% NaCl diluents (1:4) showed the highest post-thaw motility (p<0.001) with DMSO (10%) cryoprotectant (Table 5).
Table 5. Effect of the study of milk and diluted ration and cryoprotectant concentration on the post-thaw motility of sperm Cirrhinus mrigala

<table>
<thead>
<tr>
<th>Component + Extender</th>
<th>Dilution</th>
<th>Cryoprotectant concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Extender I + DMSO</td>
<td>1:4</td>
<td>75°</td>
</tr>
<tr>
<td></td>
<td>1:7</td>
<td>75°</td>
</tr>
<tr>
<td></td>
<td>1:10</td>
<td>75°</td>
</tr>
<tr>
<td>Extender III + DMSO</td>
<td>1:4</td>
<td>75°</td>
</tr>
<tr>
<td></td>
<td>1:7</td>
<td>71°</td>
</tr>
<tr>
<td></td>
<td>1:10</td>
<td>6°</td>
</tr>
</tbody>
</table>

*a, b, c* Means with different superscript in each column differed significantly (p<0.001)

IV. DISCUSSION

Four extender and two cryoprotectants (DMSO and glycerol) were used in the current study. The choice of extenders was made from previous studies of (Sarder et al., 2009) on Indian major carps and Stein H and Bayrle (1978) on some freshwater teleosts [8][9]. The extenders might have an optimal osmolality to balance the osmotic pressure of spermatozoa [10]. In the present study DMSO with extender I and extender III was executed excellent post-thaw motility. This statement is agreement with the present findings.

In the current study, extender I (egg-yolk citrate) use as extender it acts an extracellular cryoprotectant. Egg yolk citrate improves post-thaw motility because the low density lipoprotein fraction (LDL) associates with cell membranes and provides protection against injury during the cryopreservation process[11]. In the current study was in agreement with that of the above authors. Extender III (0.9%NaCl) was occurred during post-thaw that extends the active life of the sperm cells by increasing the osmotic pressure on them [12]. The author reported that extender 0.9% NaCl generally gave the 38% of equilibrium and post-thaw motility of cryopreservation sperm C. cirrhosus[9]. In the present findings disagreement the statements of the above authors and present results showed species specific efficiency of extender.

Cryoprotectants are essential for the preservation of animal cell at low temperature and the choice of cryoprotectants often depends on the ability of permeation through cell membrane[10]. In the present study were selected the low molecular weight molecules as cryoprotectants. DMSO has been considered as act as common and effective cryoprotectants for cryopreservation of fish sperm. DMSO cryoprotectant was the best post-thaw motility of sperm in common carp species [13]. DMSO cryoprotectant penetrates rapidly into the cellular membrane and brings a quick balance in between the intra and extracellular fluid concentration[10]. Glycerol, on the other hand, exhibited worst performances in both equilibration and post-thaw motility and in most cases it produced a big clot. It might be happened due to its slow penetration into the cell membrane [14].

DMSO and glycerol have been used at concentrations of 5% and 20% in cryopreservation of marine fish sperm but DMSO was superior to glycerol for sperm of yellow fin sea-bream, black grouper, barramundi and turbot[10]. In the present study revealed that DMSO was recommended for high post-thaw motility of cryopreservation spermatozoa. In some indications that the Glycerol was first used extender for the mammalian sperm cryopreservation but it was the lower post-thaw motility on sperm in several fish species.

Semen-diluents ration is very important factor for cryopreservation. Semen diluents is essential and the extent of dilution often depends on the constituents of the extending media, concentration of the spermatozoa in gonad, the sperm physiology of the species and on the freezing protocols[10]. Egg-yolk citrate (1:4) and urea egg-yolk (1:4) and Alsever’s solution (1:9)
were the highest post-thaw motility in *Cirrhinus crirrhosus*, *Laeborohina* and *Cyprinus carpio* respectively [10]. The present findings of best post-thaw motility was 1:7 dilution ration on cryodiluted because this constituents was the best extending media for milt of *Cirrhinus mrigala* species. In addition, extender III with the different concentration of DMSO was findings 1:4 dilution ratio the best post-thaw motility. The author reported the best results were achieved from egg-yolk citrate and 0.9% NaCl with different cryoprotectants at the rations of 1:20, 1:7 and 1:4 respectively [9]. These results proved that confirmed the statements of the above authors in the present findings.

**V. CONCLUSION**

In conclusion, in the current study corroborated previous reports on species-specific requirements for cryoprotectants and extenders in *Cirrhinus mrigala*. Four extenders were tested reliable for storage of the spermatozoa of *C. mrigala*. In this study is rather effective was favorable in DMSO and Glycerol compared with the post-thaw motility of cryopreserved sperm. DMSO with extender I and III were showed the highest post-thaw motility percentage compared with that of diluted ratio and cryoprotectants concentration. In addition, the straw which revealed high motility was stored in the liquid nitrogen for future investigation on survival and development of larvae.

**ACKNOWLEDGMENT**

Authors are thankful to all teacher and all staff members in Department of Anatomy (UVS), staff members who are working at Theyetkone Fishery Station and laboratory facilities for conducting this research work at LBVD (Livestock Breeding Improvement Section), Mandalay.

**REFERENCE**


Abstract—This feeding experiment was carried out to determine comparison on performance between cattle fed on locally available forage and introduced forage in central dry zone area of Myanmar during the period of February to May, 2017. The experimental diets were D-1 (50% sorghum stover + 30% groundnut straw + 20% pigeon pea residues), D-2 (50% Mombasa grass + 30% groundnut straw + 20% pigeon pea residues) and D-3 (70% Mombasa grass + 30% groundnut straw). In this experiment, the dry matter (DM) content of D-1 was significantly higher (p<0.05) than those of D-2 and D-3. The organic matter (OM) contents of D-1 and D-2 were significantly higher (p<0.05) than that of D-3. Among the experimental diets, the relatively similar crude protein (CP) and fibre contents were found in D-1 and D-2, however, the lower CP content and higher fibre content were observed in D-3. However, dry matter intake (DMI), organic matter intake (OMI), neutral detergent fibre intake (NDFI) and acid detergent fibre intake (ADFI) of all diets were not significantly different (p>0.05) from each other. The highest crude protein intakes (CPI) were observed in cattle fed on D-1 (50% sorghum stover + 30% groundnut straw + 20% pigeon pea residues) and D-2 (50% Mombasa grass + 30% groundnut straw + 20% pigeon pea residues) in comparison with the animal fed on D-3 (70% Mombasa grass + 30% groundnut straw). The CP contents of D-1 and D-2 were significantly higher (p<0.05) than D-3 which resulted the increased CPI than D-3. The digestibilities of nutrients were not significantly (p>0.05) different from each other except acid detergent fibre digestibility (ADFD). The ADFD of D-2 was significantly lower (p<0.05) than those of D-1 and D-2. The digestible crude protein intake (DCPI) of D-2 was higher than those of D-1 and D-3. The highest live weight gain (kg/day) was found in the animal fed D-2 diet and was significantly higher (p<0.05) than live weight gain of the animal fed D-1 and D-3. In conclusion, feeding 50% Mombasa grass based diet to cattle was more beneficial effect on growth performance compared to 50% sorghum stover based diet and D-3 (70% Mombasa grass + 30% groundnut straw). Key words: Sorghum and Mombasa grass based diets, nutrient composition, local cattle, Animal performance

I. INTRODUCTION

Central dry zone (CDZ) is one of the most important agricultural production areas in Myanmar, because it has the highest ruminant density, particularly cattle, sheep and goats. Draught cattle are used predominantly for crop production and transport, while the cows and their offsprings are providing valuable income for farmers. Almost more than half of the livestock population of Myanmar is inhabited in CDZ [1]. The scarcity and fluctuating quantity and quality of the year-round supply of conventional feed, especially in dry season, is limiting the ruminant production in this area as a major constraint. Animal nutrition systems in the dry zone area utilize a wide range of feedstuffs; mainly the crop residues and agro industrial by-products and forages such as natural grasses, legumes, trees and shrubs. Those feeds are usually fibrous and devoid of most essential nutrients including proteins, energy, vitamins and minerals which are required for increased rumen microbial fermentation and improved performance of the host animal [2].

In Myanmar including central dry zone, crop residues such as rice straw, wheat straw, sorghum stover, maize stover, groundnut straw, pigeon pea residue and black gram and green gram residues are widely used as ruminant feed because of mass production. However, these
residues are often the only livestock feed available in smallholder mixed crop and livestock system [3].

In Myanmar, many researchers reported that the crude protein content of sorghum stover was 3.00-5.00% and neutral detergent fibre (NDF) content was 72-83 % [4], [5] and [6]. Moreover, crop residues such straw and stover contained high indigestible fibre due to increased lignifications of cellulose [7]. Inadequate nutrition in ruminant animal has often been associated with heavy economic losses to the farmers because of animal weight and condition losses, reduced reproductive capacity and increased mortality rate [2]. Therefore, some researchers introduced forage interventions to address the feed constraints through planting of fast-growing perennials grasses for feeding in the early wet season and planting of tree legumes for feeding in the late dry season [1]. Australia Center for International Agricultural Research (ACIAR) project also introduced some exotic forage including Mombasa grass in 2014. Mombasa guinea grass (Panicum maximum cv. Mombasa) was introduced to Thailand in 2007. Mombasa grass was also tolerance to drought and high sowing rate in CDZ of Myanmar [8].

Dry matter (DM) yield of Mombasa was 28-40% more DM than Tanzania grass [9]. In Myanmar, the DM yields of Panicum maximum cv. Mombasa was 0.72t/ha without irrigation and fertilizer [8]. Moreover, DM yield of Mombasa grass was 10.11t/ha and 12.01t/ha with irrigation and fertilizer [10] and [11]. However, the crude protein (CP) content and fibre content of Mombasa grass was varies depend on the plant maturation stage. The cumulative in vitro gas production of 50% and 70% Mombasa grass based feed mixtures were significantly (p<0.05) were higher than that of 50% sorghum stover based feed mixture indicating that the higher digestibility was observed in Mombasa grass based feed mixtures compared to sorghum stover based feed mixture [6]. However, there is still need to determine the effects of Mombasa based feed mixtures and sorghum stover based feed mixture on growth performance, nutrient intake and digestibility in local indigenous cattle. The object of this study is to evaluate the performance of cattle fed on the diets containing locally available feed and introduced forage.

II. MATERIALS AND METHODS

This study was conducted from February, 2017 to May, 2017, at Ya Thar village in Myingyan Township, Mandalay Region.

A. Experimental animals, their management and experimental design

Twelve female cattle (about 18 months of age) with the range of body weight between 125 kg to 200 kg were used in this experiment. During the period of feeding trial, the experimental animals were weighed and they were randomly divided and allocated into four groups with three replications in a completely randomized design (CRD). The animals were treated with Ivermetin to be free from parasites prior to the experiment. Each animal was kept in individual compartment. The animals were offered the diets containing sorghum stover base diet (CP 7.13% of total diet) and Mombasa based diets (CP 7.24% and 5.95% of total diet) ad libitum. The feeding was done twice a day at 8:00 am and at 4:00 pm. Water was given free access.

B. Experimental diets and experimental period

Three different diets having relatively similar crude protein contents used in this experiment were as follows:
D-1: SS50%+ GNS30%+ PPR20%
D-2: MG50%+ GNS30%+ PPR20%
D-3: MG70%+ GNS30%

SS: Sorghum stover
GNS: Groundnut residue
PPR: Pigeon pea residue
MG: Mombasa grass

Experimental feedstuffs used in this experiment were collected from Myingyan Township. There was still limitation concerned with collection of Mombasa grass to get adequate amount for feeding trial. One of the reasons was that Mombasa grass was not particularly planted for feeding trial in this study. However, in this study area, ACIAR project started to introduce Mombasa grass to the farmers. Some interesting farmers planted
Mombasa grass to use for their animals in study area. Moreover, one of innovative farmers planted Mombasa grass for the purpose of seed production. Mombasa grass for feeding trial was collected from Mombasa seed production farm. Therefore, it was not convenience to cut and store the Mombasa grass at young stage for feeding trial. Therefore, Mombasa grass used for feeding trial was mature and low crude protein content.

The experimental period lasted for three months. The first 14 days was used for adaptation period and digestion trial was made at the last consecutive 5 days of the experimental period.

C. Measurements

During the feeding trial, all of the feedstuffs offered and refused were weighed and sampled before feeding for chemical analysis to calculate feed intake. Moreover, the animals were weighed every week before morning feeding.

During collection period, the samples of feedstuffs offered and refused (orts) were weighed and sampled before morning feeding for chemical analysis to calculate nutrient intake and digestibility of nutrients. Collection of faeces voided by each animal was made for five consecutive days for. Faeces voided were recorded daily during the collection period. The faeces voided from each animal were weighed and 10% of total weight was collected for sample. Faecal samples were added with 5 ml of 10% formalin and dried under the sunlight until constant weight was obtained. All samples for diets and faeces were ground and stored for chemical analysis.

D. Live weight gain of the experimental animals

During the feeding experiment, the body weights of experimental animals were measured weekly before feeding in the morning to correct feed offered and to calculate daily weight gain. The live weight gain of experimental animal was measured by using cattle commercial weighing scale (Centra Digital Weighing Scale Company, Myanmar) with two load bars to get live weight gain. There was a wooden floor over the two

E. Chemical analysis

The determination of nutrient compositions of feedstuffs and experimental feed mixtures used in this experiment and faecal samples was carried out at the Department of Physiology and Biochemistry, Yezin, Nay Pyi Taw. Samples of feedstuffs, experimental feed mixtures and faeces were analyzed for dry matter (DM) and organic matter (OM) by the method described by Association of Analytical Chemists [12]. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were analyzed according to the method of Goering and [13]. All feedstuffs and experimental feed mixtures were analyzed for nitrogen (N) by using Kjeldahl method (Fross 2020 digester and Foss 2100 Kjeltect distillation unit) and crude protein (CP) was calculated as $6.25 \times N$ [12].

F. Statistical analysis

The data will be subjected to the statistical analysis of variance (ANOVA) using SAS (version 9.0) software (SAS, 2002) [14] for completely randomized design (CRD) and the significance of differences between treatments means will be compared by the Duncan’s Multiple Range Test (DMRT).

II. RESULTS

A. Chemical composition of the experimental feedstuffs and diets

Chemical compositions of experimental diets are shown in Table 1. DM content of D-1 was significantly higher ($p<0.05$) than D-2 and D-3. OM contents of D-1 and D-2 were significantly higher ($p<0.05$) than D-3. Among the experimental diets, the relatively similar CP and fibre contents were found in D-1 and D-2, however, the lower CP and higher fibre content was observed in D-3.
### TABLE 1 CHEMICAL COMPOSITIONS (%) OF EXPERIMENTAL DIETS

<table>
<thead>
<tr>
<th>Diet</th>
<th>DM</th>
<th>OM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>90.26a</td>
<td>91.60a</td>
<td>7.13a</td>
<td>60.78b</td>
<td>52.97b</td>
</tr>
<tr>
<td>D-2</td>
<td>91.69b</td>
<td>91.32a</td>
<td>7.24a</td>
<td>61.93b</td>
<td>53.27b</td>
</tr>
<tr>
<td>D-3</td>
<td>91.30b</td>
<td>90.77b</td>
<td>5.95b</td>
<td>66.07b</td>
<td>56.19a</td>
</tr>
</tbody>
</table>

a, b; Mean value with different superscripts with the same row are significantly different (p<0.05)

### B. Nutrient intake

The daily nutrient intakes (metabolic size per body weight) of female cattle offered experimental diets are presented in Table 2. The nutrient intakes [dry matter intake (DMI), organic matter intake (OMI), neutral detergent fibre intake (NDFI) and acid detergent fibre (ADFI)] of all experimental diets fed to female cattle were not significantly different (P>0.05) from each other. The crude protein intake (CPI) of female cattle fed on D-1 and D-2 were significantly higher (P<0.05) than crude protein intake (CPI) of female cattle fed on D-3.

### TABLE 2 NUTRIENT INTAKES OF HEIFER OFFERED EXPERIMENTAL DIETS (g/kg BW<sup>0.75</sup>)

<table>
<thead>
<tr>
<th>Nutrient intake</th>
<th>D-1</th>
<th>D-2</th>
<th>D-3</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI</td>
<td>70.61</td>
<td>76.28</td>
<td>68.55</td>
<td>0.4001</td>
</tr>
<tr>
<td>OMI</td>
<td>65.07</td>
<td>69.70</td>
<td>62.24</td>
<td>0.3817</td>
</tr>
<tr>
<td>CPI</td>
<td>5.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.006</td>
</tr>
<tr>
<td>NDFI</td>
<td>43.41</td>
<td>50.59</td>
<td>49.04</td>
<td>0.1792</td>
</tr>
<tr>
<td>ADFI</td>
<td>37.97</td>
<td>40.68</td>
<td>38.65</td>
<td>0.6385</td>
</tr>
</tbody>
</table>

DMM: dry matter intake, OMI: organic matter intake, NDFI: neutral detergent fibre intake and ADFI: acid detergent fibre intake

a, b; Mean value with different superscripts with the same row are significantly different (p<0.05)

### C. Digestibility of nutrients and nutritive values

The digestibilities of nutrients are shown in Table 3. Although all the digestibilities of nutrients [dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD) and neutral detergent fibre digestibility (NDFD)] were not significantly different (P>0.05) from each other, acid detergent fibre digestibility (ADFD) of D-3 was significantly higher (p<0.05) than D-2.

### TABLE 3 DIGESTIBILITY OF NUTRIENTS

<table>
<thead>
<tr>
<th>Digestibility (%)</th>
<th>Experimental diets</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMD</td>
<td>60.49</td>
<td>51.43</td>
</tr>
<tr>
<td>OMD</td>
<td>56.47</td>
<td>44.34</td>
</tr>
<tr>
<td>CPD</td>
<td>48.27</td>
<td>57.90</td>
</tr>
<tr>
<td>NDFD</td>
<td>48.79</td>
<td>42.99</td>
</tr>
<tr>
<td>ADFD</td>
<td>42.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>37.69&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

DMD: dry matter digestibility, OMD: organic matter digestibility, CPD: crude protein digestibility, NDFD: neutral detergent fibre digestibility and ADFD: acid detergent fibre digestibility

a, b; Mean value with different superscripts with the same row are significantly different (p<0.05)

### D. Digestible nutrient intake

The digestible nutrient intakes (g/kg BW<sup>0.75</sup>) of female cattle fed on experimental diets were expressed in Table 4. Most of digestible nutrient intakes were not significantly different (p>0.05) among the heifer fed on the experimental diets except digestible crude protein intake (DCPI). The DCPI of female cattle fed on D-2 was significantly higher (p<0.05) than D-1 and D-3.

### TABLE 4 DIGESTIBLE NUTRIENT INTAKES (G/KG BW<sup>0.75</sup>) OF HEIFER FED ON EXPERIMENTAL DIETS

<table>
<thead>
<tr>
<th>Digestible nutrient intake (%)</th>
<th>Experimental diets</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDMI</td>
<td>42.30</td>
<td>39.26</td>
</tr>
<tr>
<td>DOMI</td>
<td>36.95</td>
<td>31.15</td>
</tr>
<tr>
<td>DCPI</td>
<td>2.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.21&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>DNDFI</td>
<td>21.14</td>
<td>21.89</td>
</tr>
<tr>
<td>DADFI</td>
<td>16.19</td>
<td>15.44</td>
</tr>
</tbody>
</table>

DDMI: digestible dry matter intake, DOMI: digestible organic matter intake, DNFIDigestible neutral detergent fibre intake and DADFI: digestible acid detergent fibre intake

a, b; Mean value with different superscripts with the same row are significantly different (p<0.05)

### E. Live weight gain of the experimental animals

The live weight gain (kg/day) of female cattle in experimental periods is expressed in Table 5. Among the groups, live weight gain of female cattle from D-2 was significantly higher than those of D-1 and D-3.
TABLE 5 LIVE WEIGHT GAIN OF THE EXPERIMENTAL ANIMALS

<table>
<thead>
<tr>
<th>Experimental diet</th>
<th>Initial live weight</th>
<th>Final live weight</th>
<th>Average Live weight gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>157.40</td>
<td>163.40</td>
<td>0.07^b</td>
</tr>
<tr>
<td>D-2</td>
<td>145.13</td>
<td>160.50</td>
<td>0.17^a</td>
</tr>
<tr>
<td>D-3</td>
<td>147.00</td>
<td>154.75</td>
<td>0.09^b</td>
</tr>
<tr>
<td>p value</td>
<td></td>
<td></td>
<td>0.0122</td>
</tr>
</tbody>
</table>

^a, b; Men value with different superscripts with the same row are significantly different (p<0.05)

IV. DISCUSSION

In the results of present study, DMI, OMI, NDFI and ADFI content of all diets were not significantly different from each other, however, the numerical variations were observed. The lowest DMI was observed in D-3 while the D-1 showed the highest DMI. This might be due to the nutrient composition of diets. This finding was agreed with Sein Maung Maung et al. (2009) [15] and Yadanar Lwin (2012) [16] who described that DMI, OMI, CPI and fibre intakes of ruminant fed on untreated and urea-treated crop residues were not significantly different. The variation in DMI intakes were influenced by many factors. The kind of forages and amount of supplementation forage variables affect intake by domestic range ruminants [17]. Possible reason for reduction of DM intake may be increased moisture in the diet. The diet contained NDF which fibre is food fraction that best correlates with DM intake by ruminants [18].

The excess of insoluble neutral detergent fibre (iNDF) concentration (over 15%) in the diet could decrease the DMI of cattle [19]. Formulating a diet to a specific level of NDF without reference to the iNDF could markedly affect the resulting intake, digestibility and metabolisable energy (ME) content of the diet. It is concluded that nutritional models need to be modified to accept directly determined iNDF [20]. Therefore, the observation of lower DMI in D-3 compared to D-2 and D-1 might be the higher content of iNDF in D-3.

The higher crude protein intakes were observed in female cattle fed on D-1 and D-2 comparison with the animal fed on D-3. The possible reasons might be the higher CP contents in the D-1 and D-2 diets. The intake might be influenced by the decrease in crude protein content of the rations as the proportion of roughage in the diet increased [21]. The level of protein in the diet, below approximately 7% crude protein affects voluntary intake by ruminants [22]. They found that the concept of a positive correlation between intake and digestibility of a food was valid only when protein intake was at least 4g digestible crude protein/kg W^{0.75} per day.

In the current study, the digestibilities of all experimental diets were not different from each other. The possible reason is that the apparent total tract digestibilities of DM, OM, CP, and NDF were not improved by supplementation of carbohydrate-rich food in the rumen [23]. The dietary synchronization index (SI) did not influence the apparent total tract digestibilities of DM, CP, NDF, or ADF, although SI significantly influenced rumen fermentation characteristics and microbial protein synthesis [24].

In the results, the highest ADFD was found in D-3 and followed by D-1. If the diets contained higher ADF fibre for ruminant, animal feeding digestibility was decreased because such fibre are well known to ferment hardly in compare with easily digestible fibre. This result is in agreement with the report by researcher, Heidary and Kafilzadhe who found that NDF and ADF content had negative correlation with fermentation parameters for microbe’s proliferation [25].

In the current data regarding digestible nutrient intake, all digestible nutrient intakes were not different except for digestible CP intake. The digestible CP intake of D-2 was higher than those of D-1 and D-3 but D-1 and D-3 were not significantly different. That might be due to higher CP digestibility as well as higher RDN/OMDR ratio in D-2 compared to D-1 and D3. Reduction in dry matter intake in the digestion of protein and fibre is an adverse effect often associated with tannins [26] and [27]. Reduced DM digestion, which is associated with tannin concentrations in sorghum silage has been observed in vitro [28] and in vivo [29].
The highest live weight gain found in D-2 (0.17 kg/day) was the result of higher digestible crude protein intake, major sources for synthesis of body protein. The animal performance is the product of nutrient concentrations such as intake, digestibility, and metabolic efficiency of absorbed nutrients [30]. The highest weight gain of this study (0.17 kg/day) is lower than those of the report of Dahlanuddin et al. (2014), who found that the growth rate of female Bali cattle (between 12 and 18 month of age) was 0.33 kg/day [31]. The daily live weight gains of bulls (2-3 years old) fed on rice straw supplemented with heat treated sesame cake and untreated sesame cake were 0.64 and 0.61 kg/day, respectively [32]. Moreover, The daily live weight gains of bulls were 0.32 kg/day with the supplementation of sugar cane bagasse, rice bran and sesame cake in rice straw based diet which are sparing urea and molasses, 15 and 100g per kg [33]. The breed of experimental animal in these two studies was the same, Zebu, however difference in sex. The variation in weight gain of female cattle between this study and other studies might be due to the sex difference. The growth rate of male Bali cattle (between 12 and 18 month of age) was faster than the growth rate of female Bali cattle [31].

Regarding the age of forage used in this experiment, it was maturation (7 months of age) which lead to decrease protein content and increase fibre content. The DM intake of forage declines with increasing ADF and NDF contents of the forage, and digestibility also declines with increasing lignin content of the forage [34]. The major factor which could enhance intake of forages by cattle is lower cell wall content [35]. The digestibility of a feed is affected by plant parts (leaves are more digestible than stems), age of the forage (young forages are more digestible than old forages), and species (some grasses and legumes are more digestible than others). The more mature and fibrous forage, the longer it takes to be digested and the less an animal will consume [36], thereby might achieving the slowly growth rates.

V. CONCLUSIONS

The highest daily live weight gain was observed in female cattle fed on diet containing Mombasa 50%, in compare with weight gains of cattle offered diets containing sorghum stover 50% and Mombasa 70%. It was clear that Mombasa, even in higher age (7 months), has the better nutrient quality than sorghum stover. However, the consideration should be taken on the use of Mombasa with younger age (about 1.5 - 2 months) instead of using older forage because of the higher fibre content and lower crude protein content in old aged Mombasa.

ACKNOWLEDGEMENTS

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Adoption Constraints for Soil Conservation Practices in Kyaukpadaung and Chaung U Townships, Dry Zone Region of Myanmar

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ABSTRACT-Soil degradation problems in central dry zone (CDZ) of Myanmar are getting worse. If no proper soil conservation practices are practiced and enough measures are taken out the farmers have to leave their land. The problems are to be solved urgently and the farmers are very much in need for help. Vast majority of farmers in central dry zone of Myanmar are facing land degradation related poor productivity problems. Major causes of soil degradation are water erosion in the slopes, continuous mono-cropping patterns for long term, converting Yar land into low land by pump irrigation projects, use of underground water for long time, and wind erosion in the study area. Furthermore, the salinization and/or alkalinization problems occur because of scarce rain and high evaporation. The study aims to understanding the constraints for adoption of soil conservation practices in the study area and to find out the constraints for adoption of soil conservation management.

65 respondents from Kain were, Kyauk Tagar, Medee and Kataw villages were selected in Kyaukpadaung Township and 40 respondents from Taw Kyuang Gyi, Than Pin Kan, New Khway and Khin Mon village were selected in Chaung U Township for the study. About 29 percent of land were observed as degraded land. Water erosion shared 49 percent of total land degradation and which is followed by 18.3 percent of manmade problems or malpractices in farming, 15.1 percent of wind erosion, and 14 percent of salinity problem because of high temperature and scare rain. Among soil conservation practices, contouring and construction of stone wall were the most costly practices but the cost can be spread over several years that if is worth investing. Crop loss due to land degradation were estimated and it is assumed as the benefit of soil conservation, which means if the soil conservation practices are adopted the farmer will achieve the average yield from their farm. Amount of crop loss per acre ranges from 44-67 \% in Kyaukpadaung Township and 29-70 \% in Chaung U Township. The most binding constraints for adoption of soil conservation practices was not enough capital (65\%) and followed by technological limitation problem by 16\%. Therefore, the government should consider the aid or subsidy program for soil conservation and should strengthen knowledge extension program on soil conservation.

INTRODUCTION

If current rates of land degradation continue all of the world's top soil would be gone within 60 years and generating three centimeters of top soil will take 1,000 years, a senior UN official said on December 5, 2014 according to the Reuters News. Soil degradation problems in central dry zone (CDZ) of Myanmar are getting worse. If no proper soil conservation practices are practiced and enough measures are taken out the farmers have to leave their land. The problems are to be solved urgently and the farmers are very much in need to be helped. Vast majority of farmers in central dry zone of Myanmar are facing land degradation related poor productivity problems.

Top soils are being removed by wind and water because the soil type in CDZ is mostly sandy. The prominent soil type in the dry zone area is sandy or sandy loam and soil fertility is depleted because of wind and water erosion. If the land has some degree of slope it worsens the problem. Furthermore, the salinization and/or alkalinization problems occur because of scarce rain, high temperature and high evaporation. This phenomenon is also unavoidable because we are living now in global warming scenario. The amount of evaporated water is much more than the amount of rain water that the salinization problems emerge. Whereas many soil problems are occurred naturally, there are some man-made soil problems in CDZ as well.

There are two types of land in the central dry zone: upland (Yar Myae) and low land (Le Myae). The land degradation problems are observed in both types of land. The cropping pattern in Kyak Mauk Taung Dam irrigated area in Kyaukpadaung Township (Rice-Rice pattern). Farmers grow rice in the monsoon and after harvesting monsoon rice they grow summer rice. They do not practice any crop rotation and continuously grow rice for many years and soil are under the submerge condition for most of the time that the soil structure is heavily destroyed. The problem is so severe that only manual labor is possible to till the land.

Another soil problem in Chaung U Township occurred when farmers change their land from upland to lowland to grow rice. There was electric water pumping project from Chindwin River in the area more than 10 years ago. However, the irrigation canals are not concrete canals and the fields are irrigated by the earth canals. In upland of the central dry zone, the soils are originally more or less alkaline. When the land was changed from up land to low land, the salts melt down in the water and
moved along the irrigation water. The salts accumulated in some fields and make the fields alkalization problem. The affected areas of land become larger from year to year.

The other soil problem in Chanung U Township was occurred by irrigating the land with underground water. It is in Khin Mon village and there is no extra source of water except from underground water so that they grow crops by pumping water from underground. The quality of water is never tested and many areas of land became harden and some lands have been left uncultivated for several years. The problem has to be named technically.

There are several soil conservation practices recommended by the land use division of Department of Agriculture (DOA) and the department of agricultural research (DAR). They are zero tillage or minimum tillage to conserve the soil, crop rotation, growing cover crop, crop residue management, water conservation, contour farming, systematic utilization of chemicals and inorganic fertilizers and other agro chemicals, and improved nutrient cycling and so on. Some farmer practice zero tillage for the second crop if it is chickpea. Otherwise, no zero tillage is practiced. In this case, they practice zero tillage not for soil conservation but for to rush for next crop and to catch the soil moisture. There are many advantages of practicing zero tillage. The farmer can save machine or animal power to till the soil at least.

No-till is a conservation practice that leaves the crop residue undisturbed from harvest through planting except for narrow strips that cause minimal soil disturbance. Crop residues are materials left in the field after the crop has been harvested. These residues include stalks and stubble (stems), leaves and seed pods. Good management of field residues can increase efficiency of irrigation and control of erosion. No-till can be used for almost any crop in almost any soil and can save producers labor and energy cost. It’s a sound investment for the environment and the farm. The soil conservation practices such as zero tillage, crop rotation, and residue management with no or low cost. Natural vegetation along the contour line does not add extra cost to farmers but it conserves the soil as well. But they just need to be made aware by the farmers. Aside from those, other practices such as making contour bund, growing wind breaks, and water conservation need some amount of investment. The common treatment for acidic soil is to add lime to the field and for alkaline soil is to add gypsum to the field. Applying animal manure and crop residues improve the soil structure better and add some level of organic matter to the soil. Above mentioned practices were asked to the farmers by structured questionnaire.

The Dry Zone covers approximately 8,718,898 Hectare (13 percent of the country's total land area) and is situated in Magway, Mandalay and the lower Sagaing Division. CDZ was identified by based on mean annual precipitation rates and which covers 13 districts and 57 townships. The current population of the Dry Zone is roughly 11.5 million, some 27 percent of the country's total population. Annual precipitation in the Dry Zone is on average less than 30 inches (750 mm). Temperature ranges from a minimum of 12 C to a maximum of 44 C during the warmest period of the year (March-April).

The Dry Zone soil types are characterized by clay, sandy loam and sandy soils (including gravel). The soils clearly vary with topography. According to soil survey data, all soil series have low fertility and declining amount of organic matter levels. Potassium levels are considerably low. Nitrogen is required for all non-legume crops on all soil types. This suggests the low organic matter level in the soil. Available soil moisture holding capacity of the soils of the Dry Zone is low and with the high level of evapotranspiration, constitutes a major constraint to crop growth during periods of inadequate rainfall (June and July). Management practices that conserve soil moisture or increase the water holding capacity of the soils are being practiced to help take advantage of the full growing season.

Soil erosion is a serious problem and the soil has almost completely removed by water and wind erosion in some places. Soil erosion is particularly severe in the upland areas of Kyaukpaung and Chaung U largely as a result of the high intensity of rainfall and surface runoff in slopes, ranging from 5-15%. The erodibility of the soil in slopes is relatively very high. In Chaung U the most severe erosion occurs in the upland areas. Hard pan formation is common to all upland areas. But the soil erosion in Kyaukpaung township can be observed both in low land and upland.

1.2 Objectives of the Research
General Objective
The research generally aims to understanding the constraints for adoption of soil conservation practices in the study area.

Specific Objectives
The study specifically aims –
1) To measure the degree of land degradation problems at farmer’s level.
2) To explore the extent of soil conservation practices currently being practiced by the farmers,
3) To identify the constraints for decision making of soil conservation practices adoption,
4) To know the level of investment they did for the soil conservation and
5) To compute the costs and benefits for different soil conservation methods for policy recommendation.
2. Study Area
2.1 Kyaukpadaung Township

Kyaukpadaung Township is 1954.2 km² wide and population residing there were 261,908 as of March, 2014. Of which 83.7 percent resides in rural area. Kyaukpadaung Township is the southwestern most township in Myingyan District and bordering with Taungtha, Mahlaing, Meiktila, Natmauk, Yenangyaung, Chauk, and Nyaung-U Township. Rural population relies more on agriculture and cropping systems are such as mix cropping, intercropping, and relay cropping. Oil seed crops such as sesame and peanut are grown as a mono crop occupying vast majority of cropping area. Rice is grown where the places with access to irrigation water. The study sites were in Kyauk Tagar, Medee, Kadaw and Kaing village. The villages were selected based on the severity of land degradation problem. Those villages have significant land degradation problems than any other areas in the township.

2.2 Chaung U Township

Chaung-U is located in Monywa District, Sagaing Division. It is situated in 231.46 feet (70.55 m) above sea level at north latitude 22° 45' and east longitude 95° 8' to 95° 25'. It is 493.63 km² wide and population size in 2014 was 105,955. Of which 79.3 percent dwell in the rural area. The Monywa–Mandalay highway road passes it, so the communication is good, quick and easy. Neighboring townships are: Myinmu, Myaung, Salingyi, and Monywa. The Chindwin River is in the west of the township and which is six miles away from the town. Since there are much farmlands all over the township and rice, pulses, wheat, sesame, niger, sunflower, chili, onion, garlic, cotton, and some minor crops were grown.

The unique soil degradation problem in Chaung U township arises from excessive utilization of underground water for long time. Khin Mon village is well-known for that problem. And there is Chindwin river pumping project to convert land from upland (Yar land) to lowland (Le land) in order to expand rice growing area. Water is pumped from the river and irrigated to the fields by using earth cannels. Gradually, some of the fields are facing cumulative problem of soil. The white layer of salt was observed and many rice hills went died during their vegetative stage.

3. Research Methodology

3.1 Research Questions

The study asked the following research questions:
1) What soil conservation practices are being adopted by the farmers and what is extent of adoption?
2) What are the most binding constraints for adoption of potentially successful approaches, and to improve the options for conserving the land?
3) What are the sources of knowledge on these conservation practices and what investments are needed by the farmers to adopt these conservation practices?
4) What supports would they need to adopt or increase coverage of the practice?

3.2 Conceptual Framework
3.3 Measured Variables

The demographic characters of the respondent farmers, the detail land ownership and the history of the soil problems were collected. All kinds of crops grown on their land, crop yields, prices, and non-farm source of income were obtained. The nutrient status of the soil in general, the adopted soil conservation practices, involvement of men and women in decision making for adopting the soil conservation practices, the adopted duration, the source of information obtained, the constraints for adoption were collected. Furthermore, the constraints for soil conservation practices were asked to the respondents.

3.4 Data Collection Method

The survey used both primary and secondary data. The study areas were selected from the central dry zone of Myanmar where the soil erosion problems are significant. Among the problem soil areas, Kyaukpadaung and Chaung U townships were chosen because they have different problems of soil such as nature-made soil problems and man-made soil problems.

Pilot survey was conducted in Kyaukpadaung Township from March 1 to 2, 2015. Main survey was conducted in both Townships from April 7 to 10, 2015. All possible soil conservation practices based on literature review were included in the questionnaire and screened based on the information which were gathered during pilot survey. Then the sample farmers were asked by conducting one on one interview. Purposive random sampling method was used for choosing the sample. The list of farmers who has soil problem was obtained from the respective township office of Department of Agriculture (DOA) and then sample size was determined. In Kyaukpadaung Township, there are 299 farmers who are facing soil problems and the area of problem soil was 243.2 acres. In Chaung U Township there are 140 soil problem facing farmers owning 386 acres were reported by the respective DOA offices. Therefore, 65 respondents from Kyaukpadaung Township and 40 from Chaung U Township, totally 105 respondents were interviewed by using pre-tested questionnaires. The required secondary data were obtained from the respective Township offices of the Department of Agriculture (DOA).

4. Results and Discussions

4.1 Demographic Facts about the Respondents

Average age of household heads varied from 32 to 81 years in Kyaukpadaung (KPG) township, and from 27 to 76 years in Chaung U (CHU) township. Average age of household heads was about 51 years old for both townships. Average education level of sample farmers in KPG was 7 years, in CHU was 6 years and for all sample farmers was 6.4 years, which was found to be statistically significant. Average number of plots was 6.1 for all sample farmers. The average share of problem soil is 29.2 percent of their total land holding. Similarly, 41.7 percent of their land plots were having soil problems which resulted in poor productivity. It was not a small and negligible portion of their own land. Almost half of their land was in problem which resulted in poor productivity and poor income.

4.2 Land Information

Table 4.2 presents the information about land ownership and problem soil information of sample respondents. Average own land size of sample farmers in KPG was 8.5 acres, in CHU was 16.3 acres and for all sample farmers was 11.4 acres, which was found to be statistically significant. Average number of plots was 6.1 for all sample farmers. The average share of problem soil is 29.2 percent of their total land holding. Similarly, 41.7 percent of their land plots were having soil problems which resulted in poor productivity. It was not a small and negligible portion of their own land. Almost half of their land was in problem which resulted in poor productivity and poor income.

4.3 Reasons for Land Degradation

There are several reasons for land degradation. The study, however, has chosen six types of land degradation based on pilot survey and local information. They were water erosion, wind erosion, continuous monocropping, drought and extreme temperature, continuous practice of same cropping pattern for a long time, and other problems. The unique soil problem in Kyaukpadaung township is the damage of soil structure because of practicing rice-rice cropping pattern for a long time. The many areas of land in Kyaukpadaung township has a slope that it becomes causal factor for water erosion. Majority farmers in KPG township cultivate land long before the growing season. They practice repeated tillage cultivation that soil becomes fine particles which were easily flown away as the wind blows. For this reason, their soil becomes more and more sandy than before but the...
farmers do not notice this practice as the reason of soil degradation.

The unique problem in Chaung U township is because of pump irrigation from the river and from underground water. Although the Chindwin River is one of the four major rivers in Myanmar and the quality of water itself is good enough to use as irrigation water, the quality of underground water was never tested. There has been an agricultural policy for converting upland area to become lowland area to expand rice growing area since 1988 or the time of State Law and Order Restoration Council (SLORC). The government encouraged to convert many areas of land to become rice land that there was an electric river water pumping project in Chaung U Township. The government supported with pumping facilities there, but it did not provide the concrete irrigation canal. That is why farmers have to use earth canal to irrigate the river water into their fields. Chaung U is one of the Townships in central dry zone area of Myanmar and the soil pH is relatively higher than the lower part of Myanmar. The metal ions are cumulated in top soil layer because they come along with evaporation from soil. When the water was irrigated along the earth canal they dissolved in the water and flowed into the rice field. The salts were accumulated in the field gradually and finally the land was destroyed. The other man-made problem in Chaung U Township was because of using underground water for agriculture. The underground water irrigated area became very hard in texture and it looks like a hard pan that the land is not possible for cultivation anymore.

Table 4.3 presented the case of land degradation in the study areas. Man-made factor or mal-practice in cultivation was the biggest causal factor in Kyaukpadaung Township which shared 31.3 percent of total problem soil area. Then, it was followed by the weather phenomenon of extreme temperature and scarce rainfall degraded the land by 30.3 percent. The third most causal factor for land degradation was water erosion since many area of the land has slope. If continuous monocropping system and practicing of single cropping pattern together resulted 11.8 percent of causal factors for land degradation in Kyaukpadaung Township. They practiced monocropping system for a long time. Respondent farmers notice the problem in their soil for about three or four decades and claimed that they noticed the problem become serious during last decade.

In Chaung U Township, water erosion was the most frequently observed factor for soil erosion with 63.33 percent of total problem soil, which was followed by wind erosion with 19.81 percent and man-made erosion of irrigation water problem stood at third place with 11.52 percent. Respondents claimed 5.34 percent of their problem soil was because of high temperature.

For all respondents in both townships, water erosion was the most serious problem with 48.7 percent and followed by man-made problems (18.3 percent), wind erosion (15.1 percent), high temperature (13.9 percent) and continuous monocropping (4.2 percent).

Table 4.3. The causes of land degradation in Kyaukpadaung and Chaung U Township

<table>
<thead>
<tr>
<th></th>
<th>Kyaukpadaung (N=60)</th>
<th>Chaung U (N=42)</th>
<th>All Respondents (N=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total area of problem soil (ha)</td>
<td>% of total problem soil</td>
<td>Total area of problem soil (ha)</td>
</tr>
<tr>
<td>1. Drought and high temperature (20)</td>
<td>70.5</td>
<td>11.3</td>
<td>24.0</td>
</tr>
<tr>
<td>2. Water erosion area (N=20)</td>
<td>67.5</td>
<td>20.5</td>
<td>124.9</td>
</tr>
<tr>
<td>3. Wind erosion area (N=11)</td>
<td>14.3</td>
<td>8.5</td>
<td>89.0</td>
</tr>
<tr>
<td>4. Continuous monocropping (N=25)</td>
<td>21.0</td>
<td>9.0</td>
<td>6.0</td>
</tr>
<tr>
<td>5. Continuous single cropping pattern (N=30)</td>
<td>6.6</td>
<td>2.8</td>
<td>0.0</td>
</tr>
<tr>
<td>6. Other problems (N=44)</td>
<td>71.0</td>
<td>11.5</td>
<td>51.8</td>
</tr>
</tbody>
</table>

Note: (N) = Number of samples.

4.4 Severity of Soil Erosion Problems
Severity of soil erosion problems varies from farmer to farmer and from place to place. The severity was measured by given the score from 1 to 5. If the problem is very severe and it hurts the farm family economically the score of 5 was given. Then, the score 4 for severe, 3 for noticeable stage, 2 for a little bit of problem, and 1 for no problem in the particular type of soil erosion. The collected information regarding the severity of soil erosion severity was organized in Table 4.4. According to the severity of respondents practicing the drought and high temperature was the most frequent causal factor for the soil degradation and claimed by 77 respondents and followed by the continuous monocropping system (50 respondents), water erosion (47 respondents), wind erosion (40 respondents), continuous single cropping pattern (32 respondents), other problems (29 respondents).

The severity of soil problem caused by drought and high temperature was claimed to be very severe by 27 respondents from both townships, where 20 from Kyaukpadaung Township (KPG) and 7 from Chaung U Township (CHU). 18 respondents from KPG claimed the high temperature was very severe cause to soil erosion and 11 from CHU claimed so. Continuous mono-cropping was claimed to be the second most causal factor for soil erosion. 7 respondents claimed that it was very severe in KPG and same number of respondents said it was the same as in KPG. Water erosion and wind erosion were the third and fourth most causal factors for soil erosion. Severity of water erosion was claimed by 31.9 percent of respondents from both township to be very severe and 34 percent of respondents said it was severe. 12 respondents from KPG and 19 respondents from CHU claimed it was more than noticeable. Wind erosion was claimed to be very severe by 22.9 percent of respondents from both townships and severe by 30 percent of respondents from both townships. 10 respondents from KPG claimed the wind erosion was more than noticeable and 11 respondents from CHU said the same as in KPG. Continuous single cropping pattern was the fifth most causal factor for soil erosion. 25 percent of respondents claimed to be very severe and 21.9 percent was claimed to be severe in both townships. The other problems such as irrigation water management problems was claimed by
severe by 13 farmers in KPG and 11 farmers in CHU. Severity degree were by the perception of farmers only. If they feel the causal factor was the worst in their condition they scored it 5.

Table 4.4. The severity of soil erosion problem in Kyaukpadaung and Chaung U Townships

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Soil Problem</th>
<th>Very Severe</th>
<th>Severe</th>
<th>Noticeable</th>
<th>A little</th>
<th>No problem</th>
<th>No of problem answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Drought and high temperature</td>
<td>27 (35.1)</td>
<td>29 (37.7)</td>
<td>13 (16.9)</td>
<td>8 (10.3)</td>
<td>5</td>
<td>77 (100)</td>
</tr>
<tr>
<td>1.2</td>
<td>Kyaukpadaung</td>
<td>20</td>
<td>18</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>52</td>
</tr>
<tr>
<td>1.3</td>
<td>Chaung U</td>
<td>7</td>
<td>11</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>2.1</td>
<td>Water erosion</td>
<td>15</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>58</td>
<td>47 (100)</td>
</tr>
<tr>
<td>2.2</td>
<td>Kyaukpadaung</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>42</td>
<td>23</td>
</tr>
<tr>
<td>2.3</td>
<td>Chaung U</td>
<td>8</td>
<td>11</td>
<td>3</td>
<td>2</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>3.1</td>
<td>Wind Erosion</td>
<td>9 (22.5)</td>
<td>12 (30)</td>
<td>11 (27.5)</td>
<td>8 (20.0)</td>
<td>65</td>
<td>40 (100)</td>
</tr>
<tr>
<td>3.2</td>
<td>Kyaukpadaung</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>3.3</td>
<td>Chaung U</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>49</td>
<td>18</td>
</tr>
<tr>
<td>4.1</td>
<td>Continuous mono-cropping</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>26</td>
<td>72</td>
<td>50 (100)</td>
</tr>
<tr>
<td>4.2</td>
<td>Kyaukpadaung</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>14</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>4.3</td>
<td>Chaung U</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>12</td>
<td>40</td>
<td>22</td>
</tr>
<tr>
<td>5.1</td>
<td>Continuous single cropping pattern</td>
<td>8 (25.0)</td>
<td>7 (21.9)</td>
<td>7 (21.9)</td>
<td>10</td>
<td>73</td>
<td>32 (100)</td>
</tr>
<tr>
<td>5.2</td>
<td>Kyaukpadaung</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>49</td>
<td>22</td>
</tr>
<tr>
<td>5.3</td>
<td>Chaung U</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>42</td>
<td>10</td>
</tr>
<tr>
<td>6.1</td>
<td>Other problems</td>
<td>16</td>
<td>11</td>
<td>2</td>
<td>0</td>
<td>76</td>
<td>29 (100)</td>
</tr>
<tr>
<td>6.2</td>
<td>Kyaukpadaung</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>6.3</td>
<td>Chaung U</td>
<td>5</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>66</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: The numbers in parenthesis are percentage.

4.5 Adoption of soil conservation practice

Among six reasons for the soil degradation, the first three reasons presented in the Table 4.4 such as drought, water erosion and wind erosion are natural factors and there is no particular conservation practice for extreme weather such as drought. However, for the water and wind erosion, the soil can be conserved by building of stone walls, making contour bunds, growing the wind breaks, and growing natural vegetation along the contours. Minimum tillage is a conservation method for wind erosion. The other three causal factors were man-made factors for soil degradation. The respondents in the study area do not change crop or cropping pattern for a long time. Many farmers in Kyaukpadaung Township grow rice-rice cropping pattern for about 40 decades. This problem can be solved by changing crops and cropping pattern, applying residue back to the field, applying recommended amount of organic manure to the field, applying lime or gypsum to the field based on the severity of soil problem, and including pulses in the cropping system. Furthermore, the managed irrigation is also one of the conservation methods.

Table 4.5 presented the adoption of soil conservation practices by the respondents. It was found that majority of farmers do not know the proper conservation method for their soil problem. The method they most practice is applying farmyard manure (FYM) and gypsum to the field. Only 8.2 percent and 7.4 percent of respondents who have water erosion problem fully practiced the contour bund and stone wall construction. 14.4 percent and 11.6 percent of them partially practiced contouring and stone wall construction as soil conservation practices. Around 25 percent of respondents know the soil conservation method but they did not practice. And, more than 50 percent of respondents did not know they should practice contour farming or stone wall construction for soil conservation. 68.4 percent of respondents did not know the minimum tillage cultural practice as a soil conservation method and 22.1 percent of them know the method but they did not practice. 37.5 percent of respondents did not know the leaving the fallow land as a soil conservation practice and 30.2 percent of them knew it but they did not practice. Similarly, 52.2 percent of respondents did not know the
managed irrigation as a soil conservation method and 23.3 percent of them knew it but they did not practice. Growing natural vegetation along the contour bunds was fully practiced by 25.6 percent of respondents, 24.4 percent of them practiced partially, and 36.5 percent of them did not know it as a soil conservation method. The soil conservation practice the farmers do most is application of farmyard manure or composts or gypsum to their fields to improve the soil texture and soil pH and 60.3 percent of farmers fully practice and 30.8 percent of them practice it partially as a soil conservation method. One third of respondents did the residue management properly, but another one third did not practice although they know the technology. Intercropping with pulses was fully practiced by 23 percent and partially practiced by 30.6 percent.

According to the results extension education for the farmers is found to be extremely in need. Many of them are practicing wrong method for treating their soil. The land resource is scarce and expensive they would like to develop their land but they just don’t know how. Many of them know it from somewhere else, but they do not have enough capital to adopt the conservation method. Investment in soil conservation is a long-term investment that the farmers’ interest and willingness are very important to conserve their land.

### 4.6 Costs of Soil Conservation Practices

Average sample farmer fully practiced 1.7 soil conservation methods and partially practiced 1.7 soil conservation methods. Totally there are ten methods of soil conservation methods considered in the study and they are contouring, construction of stone wall, growing wind breaks, apply residue back to the field, intercropping with pulses, managed irrigation, natural vegetation, applying FYM or Gypsum, fallowing and cultivation soil with minimum tillage. The cost of soil erosion practices per acre in Kyaukpaung and Chaung U Townships were presented in Table 4.6.

The values were average costs for each practice and the numbers of farmers who practice particular soil conservation practice were shown in the parenthesis. The costs were decomposed into labor cost, machinery cost and material cost. Labor cost was classified into family labor, and hired labor. Based on computation in Table 4.6, building of stone wall was found to be the most expensive practice and average cost of which was 312,714 Ks. per acre that only 7 respondents could practice among all 105 respondents. Which was followed by making contour bunds (average cost per acre was Ks. 91,909) and applying FYM and gypsum (average cost per acre was Ks. 81,581) which was practiced most among all respondent farmers. Seventy nine respondents out of 105 were practiced this method for soil conservation because apply farmyard manure to the land is traditional way of soil conservation. Although many of farmers could not follow the recommended rate of FYM and gypsum, it was found that majority of farmers practice this as a traditional way of soil conservation method.

Applying crop residues back to the field also helps the land to enrich the organic matters. Only 5 respondents claimed that they put back the crop residues to their fields and many of them need crop residues to use as animal feed. Rice straw and pulses plant parts are being used as animal fodder in Myanmar that it has opportunity costs to practice this method as a soil conservation method. Availability of animal feed is very limited especially in the dry zone region. Managed irrigation practice and growing windbreaks were practiced by 6 respondents each as soil conservation practice.
irrigation costed Ks. 29,750 per acre and growing wind breaks costed Ks. 27,400 per acre. Growing vegetation along the contour line was practiced by 10 respondents and it costed Ks. 24,950 per acre.

Among ten soil conservation practices considered in the study, only seven of them have costs and the other conservation practices such as leaving fallow and minimum tillage practices have no extra cost. Although there is no extra cost, leaving the land fallow may have the opportunity cost. Similarly, growing pulses in intercropping system also did not add any extra cost. It just has to bare the cultivation costs. Therefore, no observation of extra cost for those soil conservation practices. Among seven conservation practices depicted in Table 4.6 contouring and construction of stone wall and growing wind breaks could be used for a long term that their costs may spread over years. Then, the cost of conservation would be very low.

Table 4.6. The cost of soil conservation practices per acre in Kyaukpaduang and Chaung U

<table>
<thead>
<tr>
<th>Family labor cost</th>
<th>Hired labor cost</th>
<th>Total Labor Cost</th>
<th>Machine/animal-power cost</th>
<th>Material cost</th>
<th>Total Non-labor</th>
<th>Total Conservation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)=1+2</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)=4+5</td>
<td>(7)=3+6</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>2,500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6,000</td>
</tr>
<tr>
<td>Max</td>
<td>120,000</td>
<td>180,000</td>
<td>216,000</td>
<td>220,000</td>
<td>320,000</td>
<td>536,000</td>
</tr>
<tr>
<td>Aver</td>
<td>14,864</td>
<td>30,364</td>
<td>50,318</td>
<td>26,727</td>
<td>41,591</td>
<td>91,909</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>4,000</td>
<td>0</td>
<td>18,000</td>
<td>46,000</td>
<td>74,000</td>
</tr>
<tr>
<td>Max</td>
<td>28,000</td>
<td>210,000</td>
<td>231,000</td>
<td>320,000</td>
<td>533,000</td>
<td>746,000</td>
</tr>
<tr>
<td>Aver</td>
<td>4,571</td>
<td>69,286</td>
<td>72,457</td>
<td>177,571</td>
<td>238,429</td>
<td>312,714</td>
</tr>
<tr>
<td>Min</td>
<td>2,000</td>
<td>0</td>
<td>2,000</td>
<td>0</td>
<td>0</td>
<td>4,500</td>
</tr>
<tr>
<td>Max</td>
<td>24,000</td>
<td>15,000</td>
<td>39,000</td>
<td>10,000</td>
<td>52,000</td>
<td>101,000</td>
</tr>
<tr>
<td>Aver</td>
<td>7,600</td>
<td>4,200</td>
<td>12,300</td>
<td>2,500</td>
<td>15,100</td>
<td>27,400</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>6,000</td>
<td>0</td>
<td>0</td>
<td>10,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Max</td>
<td>9,000</td>
<td>28,000</td>
<td>37,000</td>
<td>10,000</td>
<td>40,000</td>
<td>56,000</td>
</tr>
<tr>
<td>Aver</td>
<td>4,400</td>
<td>10,200</td>
<td>14,600</td>
<td>5,000</td>
<td>16,000</td>
<td>39,600</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>4,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4,000</td>
</tr>
<tr>
<td>Max</td>
<td>12,000</td>
<td>120,000</td>
<td>132,000</td>
<td>12,000</td>
<td>12,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Aver</td>
<td>3,000</td>
<td>23,583</td>
<td>27,417</td>
<td>2,333</td>
<td>2,333</td>
<td>29,750</td>
</tr>
<tr>
<td>Min</td>
<td>7,000</td>
<td>24,000</td>
<td>31,000</td>
<td>5,000</td>
<td>72,000</td>
<td>84,000</td>
</tr>
<tr>
<td>Max</td>
<td>29,500</td>
<td>3,800</td>
<td>33,300</td>
<td>3,800</td>
<td>11,100</td>
<td>24,950</td>
</tr>
<tr>
<td>Aver</td>
<td>4,327</td>
<td>9,880</td>
<td>14,001</td>
<td>9,451</td>
<td>56,077</td>
<td>66,780</td>
</tr>
</tbody>
</table>

1= Contouring, 2= Construction of stone wall, 3= Growing wind breaks, 4= Apply residue back to the field, 8= Managed irrigation, 9= Natural vegetation, 10= Applying FYM or Gypsum

4.7 Benefits of Soil Conservation

Almost 30 percent of land was reported as degraded land so that the crop productivity on the degraded land was much lower than that of in the land of normal soil condition (Table 4.7). Various crops have been grown on degraded land and they were such as rice, sunflower, corn, pigeon pea, sesame, blackgram and groundnut in Kyaukpaduang Township and chickpea, cotton, rice, pigeon pea, sesame, greengram and groundnut in Chaung U Township. Average crop yield before the soil has degraded and average crop yield with current soil degradation problem were presented in Table 4.7. Crop losses due to soil degradation ranged from 44-67 percent of the crops and average crop productivity loss percent was 57. Percentage of crop productivity losses ranged from 44 percent in sunflower to 67 percent in pigeon pea and black gram in Kyaukpaduang Township. Crop productivity loss after land degradation in Chaung U Township ranged from 29 percent in groundnut to 70 percent in corn in Chaung U township and average crop productivity loss was 52 percent.
The value of crop loss was assumed to be the benefit for soil conservation for the farmers if and only if they fully conserve their land. It is assumed that farmer would gain their yield potential when their soil is conserved. If the farmer adopts soil conservation practice he would not encounter in crop loss problem. He will harvest at least on average yield for the crop he grew. Therefore, average values for crop losses were estimated for each crop and presented in Table 4.7. The benefits ranged from 42,750-540,000 Ks. per acre in Kyaukpadaung Township and 59,500-413,000 Ks. per acre in Chaung U Township. The average benefits for soil conservation in Kyaukpadaung Township was 278,993 Ks. per acre and in Chaung U Township was 185,715 Ks. per acre.

Table 4.7. Crops grown and crop losses due to soil degradation in Kyaukpadaung and Chaung U townships.

<table>
<thead>
<tr>
<th>Name of crop</th>
<th>N</th>
<th>Yield (Bsk/Ac)</th>
<th>Crop loss in percentage</th>
<th>Price of crop per unit (Ks./Bsk)</th>
<th>Crop loss in value (Ks./Acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before soil problem</td>
<td>Current yield</td>
<td>Crop loss in volume</td>
<td></td>
</tr>
<tr>
<td>KPG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>38</td>
<td>67</td>
<td>35</td>
<td>32</td>
<td>47.76</td>
</tr>
<tr>
<td>Sunflower</td>
<td>6</td>
<td>33.3</td>
<td>18.6</td>
<td>14.6</td>
<td>43.84</td>
</tr>
<tr>
<td>Corn</td>
<td>5</td>
<td>12</td>
<td>4.5</td>
<td>7.5</td>
<td>62.50</td>
</tr>
<tr>
<td>Pigeon pea</td>
<td>5</td>
<td>30</td>
<td>10</td>
<td>20</td>
<td>66.67</td>
</tr>
<tr>
<td>Sesame</td>
<td>5</td>
<td>12.2</td>
<td>4.8</td>
<td>7.4</td>
<td>60.66</td>
</tr>
<tr>
<td>Black gram</td>
<td>3</td>
<td>30</td>
<td>10</td>
<td>20</td>
<td>66.67</td>
</tr>
<tr>
<td>Groundnut</td>
<td>3</td>
<td>120</td>
<td>60</td>
<td>60</td>
<td>50.00</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>57.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| CHU          |    |                 |              |                     |                                |                             |
| Rice         | 12 | 84             | 42.8         | 41.2               | 53.3                        | 4,600                       | 189,520                     |
| Cotton       | 11 | 150            | 65           | 85                 | 56.67                       | 700                         | 59,500                      |
| Pigeon pea   | 11 | 25             | 14           | 11                 | 44.00                       | 24,400                      | 268,400                     |
| Corn         | 5  | 35             | 10.6         | 24.4               | 69.71                       | 7,000                       | 170,800                     |
| Sesame       | 5  | 18.6           | 6.8          | 11.8               | 63.44                       | 35,000                      | 413,000                     |
| Green gram   | 2  | 8              | 5            | 3                  | 37.50                       | 27,000                      | 81,000                      |
| Groundnut    | 2  | 70             | 50           | 20                 | 28.57                       | 9,000                       | 180,000                     |
| Chickpea     | 2  | 14.5           | 9.5          | 9.5                | 65.52                       | 13,000                      | 123,500                     |
| Average      |    | 52.00          |              |                    |                            | 185,715                     |

4.8 Constraints for Adoption of Soil Conservation Practices

Constraints for adoption of soil conservation practices were asked by an open ended question. The answers were organized into six categories. Majority respondents replied that the limited capital was the most binding constraints for practicing soil conservation practice. 59 respondents or 65 percent of respondents has limit in investment capital. 15.4 percent of the respondents said that they would like to know the systematic conservation method. They thought they need training for conserving their land. Small amount of percentage said they needed to care for the working animal, needed crop residues as animal feeds, labor scarcity, etc. Some soil conservation practices such as managed irrigation cannot be done by individual and it needed to be done by groups of farmers that they mentioned that they need to form water users’ association. Although the farmers mentioned that the capital is the most binding constraints for adoption of soil conservation, they also did not know much about the systematic conservation of soil according to the specific problem.

Among 105 respondent farmers about 25 percent of respondents did not get the relevant information for soil conservation technologies and only 75 percent or 80 of them responded the question about the source of information regarding the soil conservation practices. The results were presented in Table 4.8. About 37.5 percent of respondent acquired the relevant information from the extension agents who were assigned by the Department of Agriculture of the respective township. The second mostly used source of information came from co-farmers. Farmers usually exchange the relevant information among them. But, the problem was they copied each other’s practice without diagnosing their own soil problem. Sometimes, the cause of problem was totally different but they treatment they took was the same resulting ineffective use of resources. That kind of phenomenon was observed several times that it is highly suggested for very urgent need of training and proper and effective extension service. Several numbers of NGOs were also involving in poverty reduction programs in central dry zone that 11.25 percent of respondents claimed that they
got the soil conservation technologies and support from NGOs. 6.25 percent of people heard the soil conservation techniques through the radio talk shows. Although the schooling years of respondents were found to be as primary education level, they were rich in indigenous knowledge (IK) that 5 percent of farmers said they followed the traditional customs for agriculture as a soil conservation practice and 17.5 percent of respondents used their intuition and IK for the soil conservation (Figure 5).

5. Conclusion and Policy Recommendation

5.1 Conclusion

Soil loss is not only a problem for the farmer, with the loss of organic matter and fertility; it is also an environmental problem. Soil erosion is a natural process occurring on every landscape [12]. Land degradation problem is very significant and an inevitable one especially in the dry zone region of Myanmar. The study has been conducted with the aim of understanding the constraints for adoption of soil conservation practices, measuring the severity of the land degradation problems, exploring current soil conservation practices being practiced by the farmers, and estimating the costs and benefits for the different conservation methods. About 30 percent of their own land was with land degradation problems and crop losses ranged from 44-66 percent in Kyaukpadaung Township and 29-70 percent in Chaung U Township. Majority of respondent farmers claimed that the lack of working capital was the most binding constraint for adopting or practicing soil conservation methods. The second complaint was lack of technology regarding soil conservation. Although average respondent farmer has middle school education they were rich in indigenous knowledge (IK) regarding soil conservation that some respondents used their IK for soil conservation.

The causal factor, which happened most to the soil degradation problem in the study area was water erosion. There are slope on the land and no contour bundles or no natural vegetation along the contour lines worsened the problem. Then, wind erosion followed the water erosion. The traditional cultural practice of land cultivation in central dry zone is cultivating the land into fine particles so that they were blown away when the wind blew. Consequently, the land became more sandy. The other significant problem in Kyaukpadaung Township was deformation of soil structure because of successive practice of rice-rice cropping patterns for more than 40 years. Under the same cropping pattern, especially rice-rice cropping pattern, for a long time put the soil under anaerobic condition for long time, which made soil microbial activities difficult. Finally it resulted in destruction of soil structure. In the land with the soil structure destruction problem, the land was prepared by man only. No tractor or no working animal could enter the plot otherwise they would drown in the soil. The cost and benefit analysis of soil conservation method was conducted in order to roughly estimate the net benefit of soil conservation in the short-term. The results convinced that there would be positive net benefit by conserving the land.

5.2 Policy Recommendations

The farmers were eager to learn their soil problem systematically. The survey group could explain a little bit of the causal factors of land degradation and general measures for conserving their land, and found that their interests were very high. However, the purpose of the survey team was to conduct the survey that there was not enough time to explain very well about the soil problems in detail. Although there are costly land conservation methods such as construction of stone walls, and contour bunds construction, there are many less costly conservation techniques such as zero tillage, fallowing, intercropping, etc., that the majority farmers need to know the simple ways of soil conservation methods. The survey team just got exposure to sample farmers only and there are many other famers who have soil problems and they might want to know about the soil conservation techniques. The study, therefore, strongly suggest to conduct the farmers training programs regarding the soil conservation in the soil problem area urgently.

The other thing was the farmers do not know their soil problems exactly. It would be great if the diagnosis research was conducted for identifying their soil. Then, the treatment measures would be very effective. Then, precision agriculture would be introduced for more efficient utilization of resources. Conservation agriculture is highly recommended for the improvement of degraded soil in order to obtain at least the average productivity from a unit of land.
6. References:


Diseases of Groundnut in Nay Pyi Taw Area and Effect of Different Fungicides on Cercospora Leaf Spots

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Abstract— In Myanmar, groundnut is the second most important oilseed crop next to sesame. A considerable amount of groundnut yield is lost every year due to several diseases. The study aimed to investigate the diseases of groundnut in Nay Pyi Taw area and to study the effect of different fungicides on Cercospora leaf spot diseases of groundnut. Samples with prominent disease symptoms were collected from Yezin and Tatkon area and disease identification was done. The fungal structures of the causal agents were also measured and recorded. Five fungal diseases, including early leaf spot, late leaf spot, rust, anthracnose and Sclerotium stem rot diseases were found as common groundnut diseases. The experiment was conducted to determine effect of different fungicides on Cercospora leaf spot diseases in the research field of the Department of Plant Pathology, Yezin Agricultural University from June to September, 2018. Five fungicides, Benomyl, Carbendazim, Chlorothalonil, Mancozeb and Thiophanate Methyl which are easily available in the market and widely used by farmers were selected. Nu-008002 variety that is highly susceptible to these diseases was used as test variety. The treatments were laid out in Randomized Complete Block design (RCB) with ten replications. Sterilized water was applied in untreated control. All tested fungicides reduced the disease incidence as compared to untreated control. The lowest disease incidence percent, 41% was observed on Benomyl treated plants compared to untreated control. The lowest disease incidence as the effective fungicides to suppress Cercospora leaf spot diseases.

Keywords. Cercospora leaf spots, Fungicide, Groundnut diseases, Identification

I. INTRODUCTION

Groundnut (Arachis hypogaea L.) is an important oil, food, and feed legume crop which is grown in over 100 countries in the world with the total grown area of 24 million hectares and a total production of 38 million tons in 2010 [1]. Approximately 80% of the world groundnut crop is produced in developing countries where the yields are usually very low [2].

In Myanmar, groundnut is regarded as an important oilseed crop next to sesame. It is mainly grown as monsoon crop in the upper Myanmar and late-monsoon season crop in lower Myanmar. Major groundnut growing areas in Myanmar are Magway, Mandalay, Sagaing, Bago and Ayeyarwady Regions [3]. In Myanmar, groundnut is grown about 1,035,000 hectares with the yield of 1.6 t/ha [4]. The yield is still low when compared to neighboring countries as 3.36 t/ha and 1.75 t/ha in China and Thailand respectively [5].

Diseases are one of the major constraints in groundnut production throughout the world. Several diseases caused by fungi, bacteria, nematodes, viruses and mycoplasma have been reported. Common fungal diseases of groundnut include early leaf spot (Cercospora arachidicola), late leaf spot (Phaeoisariopsis personata), rust (Puccinia arachidis), web blotch (Phoma arachidicola), Phyllosticta leaf spot (Phyllosticta arachidis), pepper spot and leaf scorch (Leptosphaerulina crassiasca), anthracnose (Colletotrichum spp.), etc. [2]. Despite the importance of the diseases, systematic study on symptoms and causal agents of groundnut diseases is still limited in Myanmar.

Among several fungal diseases, early leaf spot and late leaf spot diseases caused by Cercospora arachidicola and Phaeoisariopsis personata, respectively, are usually considered to be the most severe diseases of groundnut worldwide [6]. Cercospora leaf spot diseases infect groundnut crop directly and indirectly. They cause defoliation and as a consequence, photosynthesis process is disrupted and plants produce pods lesser and inferior in quality [7]. Yield losses due to these diseases range from 10 - 50 % [8].

The effective disease management is essential to increase the groundnut production in Myanmar. Chemicals have been used for the control of Cercospora leaf spots for a long time and varying degrees of success have been recorded [9]. Effective and long-term control of Cercospora leaf spots can be achieved by applying recommended fungicides at the right time intervals. Chemical fungicides should be sprayed to achieve optimal yields in most years [10]. Use of systemic fungicides can reduce Cercospora leaf spot diseases and increase yield and haulm quality [11]. However, chemical control of Cercospora leaf spots of groundnut is not widely practiced due to high costs of chemicals and farmers’ unawareness to chemicals in Myanmar. This study was, thus, carried out with two main objectives.

1. To study systematically on the symptoms and causal organisms of common fungal diseases of groundnut in Nay Pyi Taw Council Area

2. To evaluate the most effective fungicide to control leaf spot diseases of groundnut

II. MATERIALS AND METHODS

A. Sample Collection and Identification of Diseases

The diseased samples with prominent symptoms were collected from the groundnut fields in Yezin and Tatkon
areas from July to August 2018. The disease diagnosis was conducted by using microscope with digital camera at the Department of Plant Pathology, Yezin Agricultural University. Firstly, the collected disease samples were put in the paper bags, labeled carefully and brought to the laboratory. Morphology of the causal agents and host-parasite relationships were studied. Very thin pieces of the typical lesions were cut by using razor blades and put in the water drop on the glass slide. Then, it was covered with a cover slip and examined under the microscopes. Measurements of conidia, conidiophores, black setae and acervuli were done for 10 numbers of each fungal structure by using the microscope with camera under high power magnification.

B. Study on Effect of Different Fungicides on Cercospora Leaf Spots

The experiment was conducted in the research field of Plant Pathology at Yezin Agricultural University from June to September, 2018.

1) Test variety: The groundnut variety (NU-008002) having a vegetative cycle of 100 days was used as a susceptible variety to check the efficacy of different fungicides on leaf spot diseases.

2) Test fungicides and fungicide application: Five fungicides including Benomyl, Carbendazim, Chlorothalonil, Mancozeb and Thiophanate Methyl with recommend doses were sprayed. Spraying was started at 34 days after sowing (DAS) when the crop showed the first visible symptoms with 14 days interval for four times (34,48,62,76 DAS). Water was used in untreated control.

3) Experimental design and data recording: The experiment was laid out in Randomized Complete Block (RCB) design having ten replicates with a plot size of 3 m² being separated for 0.9 m between each plot. The plants were sown at the spacing of 45 cm × 10 cm. Each plot consisted of 7 rows and 30 plants in each row.

Eight plants were selected randomly from each plot for data collection. Data were collected at 95 days after sowing. Disease incidence % was calculated by the following equation [12]. After harvest, seed yield was also recorded from a central row of each subplot and transformed to kilogram per hectare.

\[
\text{Disease incidence (\%)} = \left( \frac{\text{Number of infected leaves}}{\text{Total number of leaves}} \right) \times 100
\]

4) Statistical Analysis: The data were statistically analyzed by using Statistix software (version 8) and means were separated by least significant difference (LSD) at 5% level.

III. RESULTS AND DISCUSSION

A. Study on Fungal Diseases of Groundnut in Nay Pyi Taw Area

A total of five different diseases were identified from groundnut fields of Nay Pyi Taw Council Area based on the symptoms and causal organisms of collected disease specimens. Early leaf spot, late leaf spot, groundnut rust, anthracnose and Sclerotium stem rot were found as common fungal diseases in the groundnut cultivated areas.

1) Early leaf spot disease: Symptoms start as pin-point chlorotic lesions. As the disease advances, they become sub-circular, dark brown lesions which are surrounded by a prominent yellow halo on the upper surface of leaflets where most sporulation occurs (Fig. 1). The color of lesions is lighter on the lower leaflet surface than that on the upper surface. Under severe condition, the affected leaflets become necrotic and drop off.

From the sporulated old lesions of disease samples, fungal structures such as conidiophores and conidia were observed under the microscope. Conidiophores are un-branched, arranged in dense bundle with five to many in numbers, 45-73 x 2.9-5.3 μm, with mostly one geniculation (Fig. 2a). Conidia are cylindrical to obclavate, wider at the base, often curved, almost colorless to pale olive in color, 3-12 septate, 70.6 x 5.3μm in size (Fig. 2b). According to the morphology of the causal agent, it can be identified as *Cercospora arachidicola*.

From the detailed systematic study of symptoms and the causal agent, the disease can be diagnosed as early leaf spot of groundnut.
2) **Late leaf spot of groundnut:** The initial symptoms are similar to those of early leaf spots. Mature lesions are more circular and smaller than early leaf spots. Since the sporulation occurs on the lower leaflet surface, the lesions on that surface are darker than those on the upper surface and they show slightly rough appearance (Fig. 2b). Chlorotic halo is not prominent as in early leaf spot. Under favorable condition, affected leaflets become chlorotic, then necrotic, and lesions often coalesce, resulting in premature senescence and shedding of the leaflets as in early leaf spot. Oval to elongate lesions are formed on petioles, stems (Fig. 3c and d), stipules, and pegs. Late leaf spot usually occurs at the same time with rust disease.

Detailed study on fungal structures was conducted from the sporulated old lesions. Diagnosis under microscope with high magnification showed that the characteristics of the causal organism were similar to those of *Phaeoisariopsis personata*. Numerous conidiophores are produced from dense stroma, light to olive brown, 42 - 102.8 x 6.8 – 8.3 µm, smooth wall with 1-3 geniculations (Fig. 4a). Conidia are light brown, cylindrical to obclavate, usually straight or slightly curved, hemispherical apex, with a conspicuous hilum at base, 1-9 septa (mostly 3-4), not constricted, 59.7 - 65.6 x 8.7 – 9.7 µm in size. Base on the characteristics of symptoms and causal agent, the disease can be regarded as late leaf spot.

3) **Groundnut rust:** Yellow to orange colored pustules are found in singly or in group on lower leaflet surface (Fig. 5). Later, they rupture to expose masses of reddish brown urediospores. Under severe condition, the pustules coalesce and the leaves become dry up. As in early and late leaf spots, defoliation is not observed in rust disease. The disease usually occurs at the same time with late leaf spot.

Uredia are nearly 350 µm in average, round ellipsoid or oblong in shape; ruptured epidemic conspicuous (Fig. 6a). Urediospores are circular to obovoid, 16-22 x 28-31 µm in size, thick wall, olive brown to brown colored, finely echinulate (Fig. 6b). Telia are not observed. According to these features, the causal organism can be named as *Puccinia arachidis*. The description of symptoms and causal organism confirmed the disease as rust.
4) *Anthracnose*: Dark brown, V-shaped (wedge-shaped) lesions are found on the leaflet tips (Fig. 7). The lesions are similar to those caused by *Leptosphaerulina crassiasca*. If lesions occur on the leaflet borders, it will lead to marginal blight. A yellow halo is occurred around the lesions. The concentric rings of minute black dots formed by the acervuli of causal agent are found on lesions.

Acervulus with numerous black setae and conidia are found by diagnosis of symptoms under microscope. Black setae are 22 x 134 µm long (Fig. 8). The conidia are colorless, one-celled, falcate or lunar shaped, 19.6-26 x 3-5 µm in size (Fig. 8). Based on these characters, the pathogen was identified as *Colletotrichum* sp. which is responsible as causal agent of anthracnose disease.

5) *Sclerotium stem rot*: Wilted plants could be easily seen among the healthy ones in the field (Fig. 9a). The bases of wilted plants discolor and cover with white mat of mycelia. Round, white to light brown sclerotia are observed on the discolored area. The roots of affected plants become dry and decay (Fig. 9b). Based on these characters, the disease was identified as Sclerotium stem rot.

![Figure 7. Symptoms of anthracnose of groundnut on the upper leaflet surface](image7)

![Figure 8. Acervulus and conidia of *Colletotrichum* sp.](image8)

![Figure 9. a) Wilted groundnut plant infected by Sclerotium stem rot disease b) Symptoms of Sclerotium stem rot disease of groundnut](image9)
Five fungicides were tested for their efficacy on Cercospora leaf spots and crop yield of groundnut. The fungicides, Benomyl and Carbendazim were found as effective fungicides to control leaf spot diseases compared with the tested ones. Disease incidence ranged from 41% in Benomyl-treated plot and 66% in control. It was found that all fungicide-treated plots showed significantly lower disease incidence than untreated plots. The highest disease incidence, 66% was observed in fungicide-un-treated plot which was followed by Chlorothalonil, Mancozeb and Thiophanate methyl treated plots with the disease incidence of 62%, 56%, and 52%, respectively. The lowest disease incidence percent, 41% was observed in Benomyl-treated plot which was not significantly differed from Carbendazim treated plot with the incidence of 45%.

When seed yield was compared, there was a significant difference in seed yield between fungicide-treated plots and control (Table 1). It was noted that the highest seed yield, 836.67 kg/ha was obtained from the fungicide, Carbendazim, but not significantly different from those of other tested fungicides. All the tested fungicides gave higher yield than control, however, the yields produced by Chlorothalonil, Mancozeb and Thiophanate Methyl-treated plots were found as 723.33 kg/ha, 760.00 kg/ha and 686.67 kg/ha, respectively, and were not significantly different from that of control, 596.67 kg/ha.

In this study, the negative relationship between disease incidence and seed yield was recorded and it showed that the disease affected the yield potential of the groundnut. Yield reduction in groundnut as a result of Cercospora leaf spots disease has been reported in many cases [13], [14], [15]. The result of the present study revealed that Benomyl and Carbendazim notably decreased disease incidence with increasing crop yield. Similar findings were described by many researchers. Using Benomyl alone or Benomyl combined with Thiram greatly reduced disease incidence and seed yield was recorded and it showed that the disease affected the yield potential of the groundnut. The effects of different fungicides on Cercospora leaf spot disease of groundnut were evaluated. It was discovered that, the untreated control recorded higher disease incidence and lower crop yield than fungicide-treated plots. Conversely, all the tested fungicides gave lower disease incidence. However, only two fungicides, Benomyl and Carbendazim resulted in statistically higher yield than control. Application of these two fungicides resulted in lower disease incidence with corresponding higher yields that were statistically similar. Therefore, both Benomyl and Carbendazim were recommended to use in the groundnut production.

<table>
<thead>
<tr>
<th>Fungicides</th>
<th>Disease Incidence</th>
<th>Seed yield (Kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benomyl</td>
<td>41 a</td>
<td>770 a</td>
</tr>
<tr>
<td>Carbendazim</td>
<td>46 a</td>
<td>837 a</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>62 b</td>
<td>723 ab</td>
</tr>
<tr>
<td>Mancozeb</td>
<td>56 b</td>
<td>760 ab</td>
</tr>
<tr>
<td>Thiophanate Methyl</td>
<td>52 b</td>
<td>687 ab</td>
</tr>
<tr>
<td>Control</td>
<td>66 c</td>
<td>597 b</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>10.06</td>
<td>164.95</td>
</tr>
<tr>
<td>P≤F</td>
<td>&lt;.001</td>
<td>0.096</td>
</tr>
<tr>
<td>CV (%)</td>
<td>12.0</td>
<td>25.24</td>
</tr>
</tbody>
</table>

Groundnut is susceptible to several diseases caused by fungi, bacteria, nematode, virus and mycoplasma-like organisms. Five diseases mentioned above were common ones which were found in every groundnut field in Nay Pyi Taw Council Area. Occurrence of diseases changes depending on the weather condition and the variety grown. In this study, anthracnose disease was found as one of the major diseases although it was not found in the recent years. Therefore, regular field scouting and reporting of new diseases is very important in order to apply effective control measures. The effects of different fungicides on Cercospora leaf spot disease of groundnut were evaluated. It was discovered that, the untreated control recorded higher disease incidence and lower crop yield than fungicide-treated plots. Conversely, all the tested fungicides gave lower disease incidence. However, only two fungicides, Benomyl and Carbendazim resulted in statistically higher yield than control. Application of these two fungicides resulted in lower disease incidence with corresponding higher yields that were statistically similar. Therefore, both Benomyl and Carbendazim were recommended to use in the groundnut production.

**REFERENCES**


Evaluation on the Efficacy of Vaccination Programmes Against Infectious Bursal Disease Virus Based on Specific Antibody Response in Commercial Broilers

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I. INTRODUCTION

Infectious bursal disease (IBD) is acute, highly contagious viral infection of young chickens and has worldwide geographical distribution [1, 2]. It was first recognized as a specific disease by Cosgrove in 1962 [3] and continues to be an important threat to the poultry industry throughout the world [4]. The disease is caused by Infectious bursal disease virus (IBDV), which is a member of the genus Avibirnavirus of the family Birnaviridae [2, 5, 6]. The major economic impact of the disease is high mortality and poor growth performance in chickens. The virus causes immunosuppression. The infected chickens recovered from the acute disease are more susceptible to infections of other pathogens and fail to respond to vaccines. The control of IBD is mainly through the proper vaccination schedules with the maintenance of good hygienic conditions at the farm [7, 8]. The virus is very resistant to a variety of disinfectants and is very stable in environment. Therefore, vaccination becomes the principal control measure of IBDV infection in chickens [1].

Broiler flocks in many countries are vaccinated against IBD at least once during their growing period [6, 9]. Since maternal antibody (MAb) interferes with stimulation of an active immune response, the efficacy of a vaccination programme in the field was influenced by the presence of maternal antibodies [10]. Several IBDV vaccine types are commercially available [11]. In case of using live vaccines to control IBD, neutralization of vaccine viruses by maternal neutralizing antibodies is considered to be one factor causing vaccination failure. To overcome this problem, relatively virulent strains of vaccine viruses with higher residual pathogenicity (e.g. intermediate strains, intermediate plus strain) have been introduced [12]. Intermediate plus (hot) and intermediate strains break through maternal antibody titers of 1:500 and 1:250, respectively [1]. The better
protection with more virulent strain of IBDV is due to more antigenic stimulation based on higher and longer replication in lymphoid tissues [13].

In Myanmar, broiler (Meat-type chickens) production is one of the major components of livestock production and broiler meat is an essential source of protein. IBD is one of the main factors constraining the broiler production [14, 15, 16] and the disease is mainly controlled by vaccination in Myanmar. In many countries including Myanmar, commercially available live IBDV vaccines containing intermediate and intermediate plus strains are widely used in commercial chickens to get better protection against circulating very virulent IBDV. However, occasional field outbreaks are still commonly reported in the vaccinated flocks. It may probably due to improper timing of IBDV vaccination and inappropriate use of IBDV vaccine type. Despite outbreaks of IBD have been reported in Myanmar, not much is known about efficacy of available vaccines and vaccination. Therefore, the objective of this study was to evaluate the efficacy of three vaccination programmes with commercially available IBDV vaccines based on specific antibody responses to IBDV in commercial broilers.

II. MATERIALS AND METHODS

A. Experimental chickens

One-day old 150 broiler chicks (Indian River) were used in this study. Feed and water were provided ad libitum during the experimental period. The experiment was performed in the animal facility following animal welfare standard of board of postgraduate supervisory committee of University of Veterinary Science, Yezin, Myanmar.

B. The Vaccines

Commercially available IBDV vaccines, Intermediate type (CH/80, Hipra, Spain) and Intermediate-Plus type (GM97, Hipra, Spain), were used in this study.

![Table 1. IBDV Vaccination Programmes for the three groups of commercial broilers](image)

<table>
<thead>
<tr>
<th>Age of Broilers</th>
<th>Group-1</th>
<th>Group-2</th>
<th>Group-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 14</td>
<td>IBD GM97 Hipra Oral Drop</td>
<td>-</td>
<td>IBD CH/80 Hipra Oral Drop</td>
</tr>
<tr>
<td>Day 21</td>
<td>-</td>
<td>IBD GM97 Hipra Oral Drop</td>
<td>IBD GM97 Hipra, Oral Drop</td>
</tr>
</tbody>
</table>

C. Experimental design

The experiment with complete randomized design was conducted in University of Veterinary Science. One-day old 150 chicks were equally divided into 3 groups (50 chicks per group). Each group consists of 2 replicate pens with 25 chicks. Ten blood samples from each group (5 blood samples from each replicate) were collected at 1-day old for detection of MAb to IBDV. Broilers from Group-1 were vaccinated against IBDV by oral drop with live Intermediate plus type IBDV vaccine (IBD GM97, Hipra, Spain) at 14-day old. Broilers from Group-2 were vaccinated against IBDV by oral drop with live Intermediate plus type IBDV vaccine (IBD GM97, Hipra, Spain) at 21-day old. Broilers from Group-3 were vaccinated against IBDV by oral drop administration with Intermediate type live IBDV vaccine (IBD CH/80, Hipra, Spain) at 14-day old and followed by Intermediate Plus type Live IBDV vaccine (IBD GM97, Hipra, Spain) at 21-day old (Table 1). Eight blood samples from each group (4 blood samples from each replicate) were collected at 1st, 2nd, and 3rd-week of age and 10 blood samples from each group (5 blood samples from each replicate) were collected at the 4th, 5th, 6th, and 7th-week of age. Serum samples were stored at -20°C until tested. The experimental birds were also weighed weekly until 42-day old. Weekly feed consumptions of three groups of broilers were also recorded until 6th-week old. Feed conversion ratio (FCR) and broiler performance index at the 6th-week of age were calculated using the following formulas [17]. Mortality rate was also recorded throughout the experiment.

\[
\text{Feed Conversion Ratio} = \frac{\text{Total feed consumed by the broilers in weight}}{\text{Total weight gain of the broilers}}
\]
Broiler Performance Index = \[
\frac{\text{Body weight (Kg)} \times \text{Live ability \%} \times 100}{\text{Age (Day)} \times \text{Feed/Gain (FCR)}}
\]

D. Serological test

Specific antibody responses to IBDV were detected by commercially available Enzyme-linked Immunosorbent Assay (ELISA) Kit (BioChek, Netherland). All kit components were allowed at room temperature (22-28°C) before use. Each test sample was diluted as 1:500. IBD coated plate was removed from sealed bag and recorded location of samples on template. Firstly, 100µl of diluted serum samples were added into each well of the plate. This was followed by 100µl of undiluted negative control into wells A1 and B1, 100µl of undiluted positive control into wells C1 and D1. The plate was covered with sticker and incubated at room temperature for 30 minutes. After incubation, the contents of wells were aspirated and washed 4 times with wash buffer (350µl per well). Goat anti-chicken conjugate (100µl) was dispensed into each well. The plate was incubated at room temperature for 30 minutes, followed by washing each well with 350µl of distilled water 4 times. Tetramethylbenzidine (TMB) solution (100µl) was dispensed into each well. The plate was then incubated at room temperature or 15 minutes. Finally, 100µl of stop solution was dispensed into each well to stop the reaction. The absorbance values were measured and recorded at 405nm. The IBDV-specific titres of the samples were calculated according to the manufacturer’s recommendation. Interpretation of samples to positive ratio was calculated according to the manufacturer’s recommendations. Samples with a sample to positive ratio (S/P) of 0.2 or greater contain anti-IBDV antibodies and are considered as positive.

Calculation of the S/P ratio

Calculation of S/P ratio was followed by the following formula according to the manufacturer’s recommendation.

\[
S/P = \frac{\text{Mean of test sample} - \text{Mean of negative control}}{\text{Mean of positive control} - \text{Mean of negative control}}
\]

Calculation of antibody titre

Calculation of IBDV-specific antibody titre was followed by the following formula according to the manufacturer’s recommendation.

\[
\log_{10} \text{Titre} = 1.1 \times (\log_{10} S/P) + 3.361
\]

\[
\text{Antilog} = \text{Titre}
\]

Interpretation of the results

According to manufacturer’s recommendations, the cut-off value of titres is determined as described in Table 2.

Table 2. Interpretation of the results

<table>
<thead>
<tr>
<th>S/P value</th>
<th>Titre range</th>
<th>Antibody status</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.199 or less</td>
<td>390 or less</td>
<td>Negative</td>
</tr>
<tr>
<td>0.200 or greater</td>
<td>391 or greater</td>
<td>Positive</td>
</tr>
</tbody>
</table>

E. Statistical analysis

Level and uniformity of specific antibody responses and growth performance parameters were compared by one-way analysis of variance (ANOVA) test, followed by Duncan's Multiple Range Test (DMRT) was used to determine the statistically significant differences in mean values between the experimental groups. Sero-conversion pattern to IBDV was analyzed by Chi Square test. Statistical software SPSS 16 was used and p<0.05 is determined as significant.

III. RESULTS

A. Maternal antibody level and specific antibody responses to IBDV

The maternal antibodies (MAb) and IBDV-specific antibody responses in chickens from three groups of commercial broilers were shown in Figure 1 and Figure 2, respectively. The mean MAb of chickens in all groups were not significantly different (p>0.05) at 1st and 2nd-week of age. There were no significant difference (p>0.05) in IBDV specific antibody titres among three groups at the 3rd-week of age. However, IBDV-specific antibody level of Group-1 and Group-2 were significantly higher (p<0.05) than that of Group-3 at the 4th and 5th-week of age. IBDV-specific antibody titres among
three groups were not significantly different (p>0.05) at the 6th and 7th-week of age.

Table 3. Coefficient of variation of the antibody responses in the three groups of broilers

<table>
<thead>
<tr>
<th>Age of Chickens (Week)</th>
<th>CV% of Antibody response</th>
<th>Sig. Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-1</td>
<td>Group-2</td>
<td>Group-3</td>
</tr>
<tr>
<td>1</td>
<td>45.19a</td>
<td>30.70a</td>
</tr>
<tr>
<td>2</td>
<td>64.29a</td>
<td>50.51a</td>
</tr>
<tr>
<td>3</td>
<td>93.71a</td>
<td>86.97a</td>
</tr>
<tr>
<td>4</td>
<td>32.78a</td>
<td>61.32a</td>
</tr>
<tr>
<td>5</td>
<td>16.42a</td>
<td>19.02a</td>
</tr>
<tr>
<td>6</td>
<td>11.31a</td>
<td>23.25a</td>
</tr>
<tr>
<td>7</td>
<td>14.41a</td>
<td>10.31a</td>
</tr>
</tbody>
</table>

a, b The mean with the different superscripts are significant different at (p<0.05).
NS= Not significant

C. Sero-conversion patterns of IBDV-antibody responses

Cut off value (IBDV-specific ELISA antibody titre 391) was followed to determine sero-positivity in broilers according to the manufacturer’s recommendation. Sero-conversion patterns of IBDV-antibody responses in the three groups of broilers were shown in Table 4. No significant differences (p>0.05) in sero-conversion patterns of broilers from the three groups were observed at any experimental time points.

Table 4. Sero-conversion patterns of IBDV-antibody responses in the three groups of broilers

<table>
<thead>
<tr>
<th>Age of chickens (week)</th>
<th>No. of positive/No. of tested</th>
<th>Significant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group-1</td>
<td>Group-2</td>
</tr>
<tr>
<td>1</td>
<td>8/8</td>
<td>8/8</td>
</tr>
<tr>
<td>2</td>
<td>8/8</td>
<td>8/8</td>
</tr>
<tr>
<td>3</td>
<td>8/8</td>
<td>8/8</td>
</tr>
<tr>
<td>4</td>
<td>10/10</td>
<td>10/10</td>
</tr>
<tr>
<td>5</td>
<td>10/10</td>
<td>10/10</td>
</tr>
<tr>
<td>6</td>
<td>10/10</td>
<td>10/10</td>
</tr>
<tr>
<td>7</td>
<td>10/10</td>
<td>10/10</td>
</tr>
</tbody>
</table>

NS= Not significant

B. Uniformity of IBDV antibody responses

The Coefficient of variation % (CV%) of antibody titres represents uniformity of antibody responses in the three groups of broilers. The CV% of the antibody responses in the three groups of broilers were shown in Table 3. The lower CV% indicates the more uniform antibody response to IBDV in broilers [18]. The CV% of antibody response of broilers from Group-1 and Group-2 were significantly better (p<0.05) than that of broilers from Group 3 at the 5th-week of age. It indicates uniform antibody responses to IBDV in Group-1 and Group-2 are significantly better (p<0.05) than that of Group-3 at 5th week of age.
D. Growth performance of three groups of broilers

Growth performance of broilers from three groups were evaluated by livability rate (%), live weight (Kg), CV% of live weight, feed conversion ratio (FCR) and performance index. According to the data analysis, there were no significant differences (p>0.05) in livability rate (%), live weight (Kg), CV% of the live weight, FCR and performance indices among three groups of broilers (Table 5).

Table 5. Growth performance of three groups of broilers at 42-day of age

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group-1</th>
<th>Group-2</th>
<th>Group-3</th>
<th>Sig. Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livability rate %</td>
<td>96</td>
<td>98</td>
<td>96</td>
<td>NS</td>
</tr>
<tr>
<td>Live weight (Kg)</td>
<td>2.77</td>
<td>2.75</td>
<td>2.79</td>
<td>NS</td>
</tr>
<tr>
<td>CV % of live weight</td>
<td>13.18</td>
<td>13.18</td>
<td>10.40</td>
<td>NS</td>
</tr>
<tr>
<td>FCR</td>
<td>1.64</td>
<td>1.62</td>
<td>1.62</td>
<td>NS</td>
</tr>
<tr>
<td>Performance Index</td>
<td>386.06</td>
<td>396.09</td>
<td>393.65</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS= Not significant, CV% = Coefficient of variation % of live weight of broilers at 42-day old.

IV. DISCUSSIONS

It has been indicated that there was strong interference between maternally derived antibody and initial vaccination of IBDV. Therefore, the efficacy of a vaccination programme in the field was largely determined by the presence of maternal antibodies [10]. Kreager (1988) recommended to initially vaccination with intermediate strains at 18-20 days of age for chicks with maternally derived antibody [19]. However, Palya (1991) suggested to vaccinate at one to two weeks of age for chicks with low level of maternal antibodies and at three to four weeks of age for chicks with high level of maternal antibodies [20]. But, Jenson (1992) advised to vaccinate at one day of age for the flock with low level of maternal antibody and at 8-12 day of age for the flock with high level of maternal antibody [21]. Therefore, Fantay et al., (2015) suggested that chicks should not be vaccinated against IBDV without determining the maternal antibody levels [22]. In the present study, mean MAb to IBDV in the experimental chickens at 1-day old was 9537±635. Based on relatively high level of maternal antibody to IBDV, broilers from group 1 and 2 were vaccinated with live Intermediate plus type IBDV vaccine at 14 days and 21-day of age, respectively. For group 3, broilers were initially vaccinated with live intermediate type at 14 days old and booster vaccination with live intermediate plus at 21-day of age.

The maternally derived antibody response of broilers from three groups at 1, 7 and 14-day of age before vaccination are presented in Fig. 3. High and uniform MAb titres (ELISA titre: >9000) were detected in 1-day old broilers from all experimental groups and steadily decline pattern in the mean MAb titres were found from 1-day old age to 14-day of age. There was no significant difference in the level of MAb to IBDV among three groups at 1, 7 and 14-day-old (p>0.05). These data indicated that the parent stocks of the commercial broilers, used in this experiment, have also high and uniform antibody level to IBDV. It has been demonstrated that the level of MAb in the progeny was directly related to the level of antibody in the breeder at the time of lay, and the level of MAb in progeny was equivalent to that of dam [23, 24].

In this study, broilers from Group 1 and Group 3 were vaccinated with live IBD intermediate plus type and intermediate type, respectively, at 14-day of age. IBDV-specific antibody titres among three groups were no significant differences (p>0.05) at the 3rd-week of age. However, IBDV-specific antibody level of Group-1 and Group-2 were significantly higher (p<0.05) than that of Group-3 at the 4th and 5th-week of age. The number of seroconverted birds was numerically higher in Group 1 and 2 than that of Group 3 at 21 and 28-day of age. Significantly higher (p<0.05) antibody titres and numerically higher seropositive chickens were induced by single vaccination with intermediate plus type vaccine as compared to double vaccination with intermediate type and followed by intermediate plus type vaccines in broilers. This finding can be explainable that relatively virulent virus strain induces higher level of antibody response due to more antigenic stimulation. In general,
Intermediate plus strain virus are relatively more virulent than Intermediate strain virus.

In addition, the CV% of antibody response of broilers from Group-1 and Group-2 were significantly better (p<0.05) than that of broilers from Group 3 at the 5th-week of age. It indicates uniformity of antibody responses to IBDV in Group-1 and Group-2 were significantly better (p<0.05) than that of Group-3 at 5th-week of age. High and uniform ELISA antibody response was found in single vaccinated broilers with intermediate plus type vaccine in comparison with double vaccinated broilers with intermediate type and followed by intermediate plus type vaccines. It may be due to relatively proper timing and type of initial vaccination in the experimental chickens with high level of MAb (>9000 ELISA titres) from Group-1 and Group-2. However, IBDV-specific antibody titres and uniformity of antibody response among three groups were not significantly different (p>0.05) at the 6th and 7th-week of age. It indicates vaccination of broilers with intermediate type vaccine at 14-day old and followed by intermediate plus type vaccines at 21-day old can induce high level of IBDV-specific antibody, although the onset of antibody response is significantly slower (p<0.05) in comparison to vaccination of broilers with intermediate plus type vaccine at 14-day old. It has been suggested by Padmaja et al., (2015) that, the use of either a single dose of intermediate plus vaccine or two doses of intermediate vaccine in broilers for enhanced protection in disease endemic regions with maternal derived antibodies [25].

In the present study, we did not conduct challenge infection with virulent IBDV to the experimental broilers due to the biosafety level of the isolation unit. But, the broilers with IBDV-specific antibody titre of 1:1000 are protected against field virulent IBDV infection [1]. According to our other ongoing research, IBDVs circulating in Myanmar are very virulent Infectious Bursal Disease Virus (vvIBDV) (Unpublished data of Department of Medicine, University of Veterinary Science) and IBD outbreaks in broiler flocks commonly occurs at 28-31 day of age. Therefore, it is very important to have protective level of antibody to IBDV in commercial broilers at this point. Based on the results of the present study, it indicates that the Intermediate Plus type live vaccine stimulates high and uniform levels of IBDV-specific antibody response in the vaccinated broilers at the critical field important point.

Regarding growth performance of broilers from the three groups, there were no significant differences (p>0.05) in livability rate (%), live weight (Kg), CV% of the live weight, feed conversion ratio and broiler performance indices at 42-day of age. It indicates vaccination of broilers with different timing and types of vaccine has no significant effect on growth performance of broilers.

V. CONCLUSION

In conclusion, the data indicates that single vaccination with the Intermediate Plus type IBDV vaccine at 14 or 21-day old induced significantly better and uniform antibody responses (p<0.05) in comparison to double vaccination with Intermediate type and then followed by Intermediate Plus type IBDV vaccine in the vaccinated broilers with high level of MAb. Due to relatively earlier onset of antibody response, single vaccination of broilers with the Intermediate Plus type IBDV vaccine at 14-day old is recommended for better control of IBD in Myanmar when the broilers have high level of maternal antibody.

ACKNOWLEDGMENT

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REFERENCES


Evaluation of duckweed meal (Lemna sp.) as replacement to sesame meal on production performance, carcass characteristics and digestibility of commercial meat ducks

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2Department of Anatomy, University of Veterinary Science, Yezin, Zayarthiri Township, Nay Pyi Taw, Myanmar
3Private Animal Feed Shop, Tatkon Township, Myanmar
*Corresponding author: drhtetlinoo@gmail.com

Abstract—This experiment was conducted to evaluate the effects of duckweed meal (Lemna sp.) as replacement to sesame meal on production performance and carcass characteristics of commercial meat ducks. A randomized complete block design (RCBD) was used with a total of 120 day-old commercial meat ducks which were randomly assigned to four treatment groups with five replicates (6 birds per replicate) into 20 pens. The four treatment diets were diet T1 (15 % sesame meal, SMM and 0 % duckweed meal, DWM), diet T2 (10 % SMM and 5 % DWM), diet T3 (5 % SMM and 10 % DWM) and diet T4 (0 % SMM and 15 % DWM) in both starter (from first day to 14th day) and grower-finisher phases (from day 15th onwards). These four experimental diets were isocaloric and isonitrogenous. Weight gain, feed intake and feed conversion ratios were measured and calculated on weekly basis. On day 49, one bird from each replicate per treatment was randomly sacrificed to determine the carcass yields and relative abdominal fat pad weights. After the feeding trial, the digestibility trial was made to examine the digestive ability of meat ducks to the experimental diets. The significant highest (P < 0.05) body weight was noted with meat ducks fed T3 diet. The T3 diet was significantly narrowest (P < 0.05) feed conversion ratio (FCR) of meat ducks when compared to those of other treatment groups. After eviscerating at day 49, meat ducks fed T3 diet had also higher live weight, carcass weight and whole breast weight than those of other treatment groups. The protein digestibility of birds fed different treatments was almost similar. In digestibility of dry matter (DM), although there were no significant differences between meat ducks fed T1, T2 and T3, lowest digestibility of DM was found in the group fed T4. The lowest digestibility of crude fibre (CF) in T4 was observed the same as those of DM. Conclusively, the use of unconventional aquatic plant protein, DWM, can be safely and partially replaced for SMM in commercial meat duck ration.

Key words—Duckweed; production performance; carcass characteristics; digestibility; commercial meat duck

I. INTRODUCTION

The profit of meat duck farming mainly depends on the economic feeding of balanced ration. From the economic point of view, meat duck should be supplied with cheaper feed to get maximum return with minimum cost of production. The price of feeds, especially protein supplements, has increased considerably, which pushes the cost of inputs higher if the raisers feed their meat duck commercial rations. It is, therefore, a recent trend among the poultry nutritionists to explore the unconventional cheaper ingredients towards reducing feed cost to maximize profit from poultry farming. So, locally produced available unconventional feed resource like duckweed (DW) may reduce feed cost [1].

Duckweed protein has a better array of essential amino acids than most vegetable proteins and more closely resembles animal protein [2]. Lysine content of DW as an animal feed also met the standard recommended by Food and Agriculture Organization (FAO) and it is generally higher than that found in grain [3]. The average crude protein (CP) content for DW

...
is 34.9%, and the range is 20.8 to 45% [4, 5]. In addition to the favorable array of amino acids, the DW plant has a high concentration of pigments and xanthophyll that make this plant a valuable supplement for livestock [6, 7, 8]. This is economically important because of the relatively high cost of the pigment supplement in poultry feed [9]. Compared with most plants, DW leaves have little fibre (5 to 15% in dry matter of cultivated plants) [4].

Several studies have examined the effect of inclusion of DW in poultry diets, primarily as a substitute for protein meals [10, 11, 1]. O’Neill et al. reported that feed intakes and production characteristics were unaffected by including up to 13% duckweed (S. punctata) in the diet of laying hens [10]. Improvements in yolk pigmentation from the addition of DW have also been claimed [10]. Feeding DW containing 38.6% CP to ducks as a replacement for roasted soybeans showed that DW can be totally replaced soybeans as a protein source for a duck fattening system based on broken rice [11]. Ahammad et al. observed that the live-weights of broiler chickens increased linearly for the 3% SMM and 6% DWM inclusion diets whilst a decline was observed for the diet with 9% DWM [1]. These authors concluded that partial replacement of SMM with DWM is possible with increased growth performance of the broiler chickens.

However, in the previous study, DWM was used to replace SMM in the ration of broiler chickens. To the best of our knowledge, studies on production performance and carcass characteristics in utilization and replacement of DWM with SMM in commercial meat ducks diet were scanty. There was no information currently available in Myanmar about the use of duckweed as a protein replacement in the diet of livestock. For the sake of these facts, it is of interest to investigate the optimum usable levels of DWM as partially replacement of a protein supplement instead of SMM in commercial meat duck diets. Therefore this study was designed to evaluate the replacement of SMM with DWM in meat ducks diet with respect to production performance, carcass characteristics and digestibility of commercial meat ducks.

II. MATERIALS AND METHODS

A. Location

The experiment was conducted at the University of Veterinary Science, Yezin, Nay Pyi Taw. The determination of nutrient compositions of feed ingredients, feces for digestibility and muscles (CP, ether extract and EE content of breast and thigh meats) of meat ducks were carried out at the Veterinary Assay Laboratory, Insein, Livestock Breeding and Veterinary Department, Yangon Region.

B. Experimental design, animals and diets

A randomized complete block design (RCBD) was used with a total of 120 day-old commercial meat ducks which were randomly assigned to four treatment groups with five replicates (6 birds per replicate) into 20 pens. The four treatment diets were diet T1 (15% SMM and 0% DWM), diet T2 (10% SMM and 5% DWM), diet T3 (5% SMM and 10% DWM) and diet T4 (0% SMM and 15% DWM) in both starter (from first day to 14th day) (TABLE I) and grower-finisher phases (from day 15th onwards) (TABLE II). These four experimental diets were isocaloric and isonitrogenous. Feed and water were available ad-libitum to the meat duck during the whole experiment. Duckweed used in this experiment was harvested from marshy lands, road side ditches and lying paddy fields located in some areas of Amarapura Township.
C. Measurements

Body weight, feed consumption and feed conversion ratio were recorded and calculated on weekly basis. On day 49, one bird from each pen (4 birds per treatment) was randomly chosen and sacrificed to determine the relative abdominal fat pad weight and carcass yields of meat ducks. Carcass was cut into the main parts (thighs, drumsticks, breasts, wings and back) and weighed. Then, the percentage of each part to individual body weight was calculated. On day 49, two birds from each pen (8 birds per

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>T1 (%)</th>
<th>T2 (%)</th>
<th>T3 (%)</th>
<th>T4 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>43</td>
<td>42.5</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td>Broken rice</td>
<td>10</td>
<td>10</td>
<td>9.5</td>
<td>10</td>
</tr>
<tr>
<td>Rice bran</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>8.5</td>
<td>9</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Duckweed meal</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Sesame meal</td>
<td>15</td>
<td>10</td>
<td>5</td>
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</tr>
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<td>2.5</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
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<td>9.5</td>
<td>10.5</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Dicalcium phosphate (D.C.P)</td>
<td>0.41</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
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<tr>
<td>Lysine</td>
<td>0.03</td>
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<td>0.01</td>
</tr>
<tr>
<td>Methio+cystine</td>
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<td>0.03</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>Premix</td>
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</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Calculated nutrient composition (starter)**

| Metabolisable energy (M.E) (kcal/kg) | 3065 | 3092 | 3090 | 3089 |
| CP %                                | 22.0 | 22.2 | 22.2 | 22.0 |
| Calcium (Ca) %                      | 0.82 | 0.87 | 0.78 | 0.68 |
| ME / CP                             | 139.3| 139.3| 138.7| 140.4|

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>T1 (%)</th>
<th>T2 (%)</th>
<th>T3 (%)</th>
<th>T4 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Broken rice</td>
<td>19</td>
<td>17</td>
<td>17</td>
<td>16</td>
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<td>18</td>
<td>19.5</td>
<td>18.5</td>
<td>19</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>2.5</td>
<td>3.5</td>
<td>3.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Duckweed meal</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Sesame meal</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Fish oil</td>
<td>2</td>
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<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Fish meal</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>D.C.P</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Methio+cystine</td>
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<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
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<td>Premix</td>
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<tr>
<td>Total</td>
<td>100</td>
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<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Calculated nutrient composition (grower-finisher)**

| ME (kcal/kg) | 3074 | 3079 | 3079 | 3084 |
| CP %         | 16.2 | 16.1 | 16.1 | 15.9 |
| Ca %         | 0.65 | 0.58 | 0.58 | 0.43 |
| ME / CP      | 189.8| 191.2| 191.2| 193.9|
treatment) were randomly chosen and sacrificed. The breast and thigh meats were dissected and kept at -20°C until analysis. For CP content, nitrogen was determined by using Kjeldahl method (Foss 2100 Kjeldahl distillation unit) and CP was calculated as 6.25 x N [12]. The muscles were analyzed for EE content by using the 2050 Soxtec Auto extraction unit, Foss Tecator. The general principles were according to AOAC [12].

After the feeding trial, the digestibility trial was made to examine the digestive ability of meat ducks to the experimental diets. Three birds of each treatment group with almost similar body weights were selected. Then, the birds were placed in individual cages. After termination of the feeding trial, the birds were continued to be fed the experimental diet for each treatment group. Feed intake of each bird was recorded every day and, the feces on plastic sheet were collected. The split feathers, dropped feed particles, scale of the bird and other foreign materials were removed carefully from the collected feces. Total fresh feces were collected on seven consecutive days and dried with sun and electric bulb (500W-halogen tube). After completion of the trial, feces samples of each bird were placed in the oven for drying and the dried samples were ground for determination of DM, CP and CF.

D. Statistical analysis

The data were subjected to ANOVA using general linear model procedure of SAS® [13]. The significant differences among treatment means were measured by Ducaan’s Multiple Range Test (DMRT) at $P < 0.05$.

III. RESULTS AND DISCUSSIONS

A. Performances

Regarding to feed consumption, the results from the present study showed that the cumulative feed consumption of meat ducks fed T2 was the highest followed by that of T3 and T4 while that of fed T1 was the lowest (TABLE III). The cumulative feed consumption of meat ducks fed T2 was significantly higher ($P < 0.05$) than that of groups fed T1, T3 and T4 (TABLE IV). Cumulative FCR of meat ducks fed T1, T2 and T4 were not significantly ($P > 0.05$) different with one another. This finding was in line with the finding of Ahammad et al. who reported that FCR of broiler chickens fed on diet with the ratio of SSM to DWM 1:2 (3% SSM + 6% DWM) had superior FCR from 28-42 days of age [1]. However, the result from this study was not agreed with observations by Hamid et al. [15] and Johri and Sharma [16], who established that using *Lemma minor* meal in chick starter or broiler ration found non-significant effects on FCR compared to control. This difference might be due to species difference of duckweed and variation in age or types of birds used for experimentation in addition to other environmental and management practices. Probable reason behind the narrower cumulative FCR in meat ducks fed T3 was a reflection of higher body weight in those particular groups.

In this experiment, the final body weight of meat ducks fed T3 was significantly higher ($P < 0.05$) than that of other groups (TABLE V). The meat ducks fed T3 had the highest body weight and T1 had the lowest body weight. The final body weight of meat ducks fed T2 and T4 were not significantly ($P > 0.05$) different with each other. The final body weight of meat ducks fed T2, T3 and T4 were significantly ($P < 0.05$) higher than that of group fed T1. This finding was similar with the report that highest performance on diets with the ratio of SMM to DWM 1:2 (3% SMM + 6% DWM) indicated that partial replacement of SMM by DWM is possible with increased growth performance of broiler [1]. This study also concurred with observations by Kusina et al. who reported that inclusion of DW in broiler finisher diets at 10% level did not compromise growth performance [17]. In this experiment, the live weight of meat ducks fed T1 was the lowest. Church reported that sesame oil cake having high phytic acid content appears to bind dietary calcium depressing growth and it is also deficient in lysine [18]. Moreover, DW protein had higher concentrations of essential amino acids, lysine and methionine, than most that of the control diet, which demonstrates the high palatability of duckweed [14]. Moreover, some species of the duckweed plant are highly palatable thereby stimulating the birds to eat more [14].

In the current study, the cumulative FCR of meat ducks fed T3 were significantly narrower ($P < 0.05$) than that of groups fed T1, T2 and T4 (TABLE IV). Cumulative FCR of meat ducks fed T1, T2 and T4 were not significantly ($P > 0.05$) different with one another. This finding was in line with the finding of Ahammad et al. who reported that FCR of broiler chickens fed on diet with the ratio of SSM to DWM 1:2 (3% SSM + 6% DWM) had superior FCR from 28-42 days of age [1]. However, the result from this study was not agreed with observations by Hamid et al. [15] and Johri and Sharma [16], who established that using *Lemma minor* meal in chick starter or broiler ration found non-significant effects on FCR compared to control. This difference might be due to species difference of duckweed and variation in age or types of birds used for experimentation in addition to other environmental and management practices. Probable reason behind the narrower cumulative FCR in meat ducks fed T3 was a reflection of higher body weight in those particular groups.
plant proteins [9]. Duckweed species have been proven to be high in amino acids that are required for the growth [19]. The improved final body weight might be ascribed to the relatively high levels of amino acids, especially lysine, methionine and threonine compared to other plant proteins. In addition, duckweed also provides vitamins, especially Vitamin A which is essential for growth and reproduction [4].

### TABLE III. CUMULATIVE FEED CONSUMPTION (G/BIRD) OF MEAT DUCKS (DAY 0 TO 49)

<table>
<thead>
<tr>
<th>Diet</th>
<th>Cumulative feed consumption (Mean ± SEM)</th>
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<tbody>
<tr>
<td>T₁</td>
<td>6582.7 ± 25.18ᵃ</td>
</tr>
<tr>
<td>T₂</td>
<td>7025.8 ± 54.47ᵃ</td>
</tr>
<tr>
<td>T₃</td>
<td>6888.7 ± 22.13ᵇ</td>
</tr>
<tr>
<td>T₄</td>
<td>6874.5 ± 48.04ᵇ</td>
</tr>
</tbody>
</table>

ᵃᵇᵐᵉᵃˢ with different superscript within the same column differ significantly (P > 0.05)

T₁ = SMM 15% and DWM 0%
T₂ = SMM 10% and DWM 5%
T₃ = SMM 5% and DWM 10%
T₄ = SMM 0% and DWM 15%

### B. Carcass characteristics of meat ducks

The CP content of breast and thigh meat of meat ducks fed T₁, T₂, T₃ and T₄ were not significantly (P > 0.05) different one another (TABLE VI). The CP content of thigh observed in the group fed T₃ was numerically higher than that of groups fed T₁, T₂ and T₄. However, the CP content of breast observed in the group fed T₄ was numerically higher than that of groups fed T₁, T₂ and T₃. The data resulted in this study showed that CP contents in thigh and breast meat of meat ducks were not significantly (P > 0.05) different by the partially replacement of SMM to DWM in their diets. This result also concurred with observations by Kusina et al. who reported that inclusion of DW in broiler finisher diets at 10% level did not compromise carcass composition [17]. In this study, meat ducks fed T₂ showed the significantly (P < 0.05) highest EE content in both breast and thigh meats. The result from this study was not agreed with the report that carcasses from birds fed on the 30% duckweed diet had significantly lower (P < 0.05) levels of ether extractable fat than the remaining three groups (0%, 10% and 20%) [17]. This dis-agreement might be due to different in ratios of duckweed used in diets and species difference of birds. Moreover, the DW plant contains fat that favorable fatty acids such as C₂ (11 %), C₃ (3.1 %), C₄ (1.4 %) and C₅ (0.4 %) with SCFA 16.6 % [8]. The relative weight of abdominal fat pad of meat ducks were not significantly (P > 0.05) different with each other. This finding agreed with the results of Kusina et al. who found that incorporating duckweed into broiler finisher diets up to 20 % did not influence abdominal fat yields relative to body weight of broiler chickens [17].
After eviscerating at day 49, meat ducks fed T3 diet was higher live weight, carcass weight and whole breast weight than those of other treatment groups (TABLE VII). Probable reason behind the highest live weight, carcass weight and whole breast weight in meat ducks fed T3 was a reflection of higher final body weight in those particular groups. The weights of the internal organs, such as heart, liver and gizzard and also drumstick, thigh and wing did not differ significantly ($P > 0.05$) between meat ducks fed control diet T1 and those of fed experimental diets. This finding agreed with the report that the weights of the internal organs were not significantly different between ducks fed the control diet and those fed DW diets [14]. Khanum et al. also reported that the treatment effects on the carcass characteristics of DW did not vary significantly ($P > 0.05$) and they concluded that although the replacement of 50% feed by DW reduces performance parameters, the carcass characteristic are not influenced [20].

**TABLE VI. CP AND EE CONTENTS (%) OF THIGH AND BREAST MEATS AND RELATIVE WEIGHT (G) OF ABDOMINAL FAT PAD OF MEAT DUCKS ON DAY 49**

<table>
<thead>
<tr>
<th>Parts of carcass</th>
<th>Diets</th>
<th>CP content (Mean ± SEM)</th>
<th>EE content (Mean ± SEM)</th>
<th>Relative weight of abdominal fat pad (Mean ± SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_1$</td>
<td>$T_2$</td>
<td>$T_3$</td>
<td>$T_4$</td>
</tr>
<tr>
<td>Thigh meat</td>
<td>73.24 ± 2.46$^a$</td>
<td>63.79 ± 0.60$^a$</td>
<td>76.65 ± 6.12$^a$</td>
<td>64.75 ± 2.12$^a$</td>
</tr>
<tr>
<td>Breast meat</td>
<td>74.08 ± 2.53$^a$</td>
<td>74.05 ± 1.11$^a$</td>
<td>74.07 ± 1.79$^a$</td>
<td>79.36 ± 0.18$^a$</td>
</tr>
<tr>
<td>Thigh meat</td>
<td>19.15 ± 0.35$^a$</td>
<td>23.86 ± 0.11$^a$</td>
<td>20.17 ± 0.46$^a$</td>
<td>21.79 ± 0.16$^a$</td>
</tr>
<tr>
<td>Breast meat</td>
<td>14.18 ± 0.15$^a$</td>
<td>16.05 ± 0.18$^a$</td>
<td>17.05 ± 0.30$^a$</td>
<td>15.90 ± 0.18$^a$</td>
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</table>
| **TABLE VII. EFFECTS OF THE DIFFERENT RATIOS OF SMM TO DWM ON CARCASS YIELDS (KG) OF MEAT DUCKS**

| Carcass          | Diets | Live weight (Mean ± SEM) | Carcass weight (Mean ± SEM) | Heart (Mean ± SEM) | Liver (Mean ± SEM) | Gizzard (Mean ± SEM) | Abdominal fat pad weight (Mean ± SEM) | Left stick (Mean ± SEM) | Right stick (Mean ± SEM) | Left thigh (Mean ± SEM) | Right thigh (Mean ± SEM) | Left wing (Mean ± SEM) | Right wing (Mean ± SEM) | Back (Mean ± SEM) | Whole breast weight (Mean ± SEM) |
|------------------|-------|--------------------------|----------------------------|--------------------|-------------------|--------------------|------------------------|-------------------------------|------------------------|------------------------|----------------------|-----------------------|------------------------|------------------------|-----------------|-----------------------------|
|                  | $T_1$ | 2.42 ± 0.07$^{ab}$       | 1.81 ± 0.07$^a$          | 0.01 ± 0.002$^a$   | 0.01 ± 0.001$^a$ | 0.09 ± 0.006$^a$   | 0.02 ± 0.004$^a$       | 0.09 ± 0.005$^a$       | 0.09 ± 0.005$^a$       | 0.17 ± 0.01$^a$ | 0.17 ± 0.01$^a$ | 0.12 ± 0.01$^a$ | 0.12 ± 0.006$^a$ | 0.06 ± 0.01$^a$ | 0.58 ± 0.04$^{ab}$ |
|                  | $T_2$ | 2.41 ± 0.06$^{ab}$       | 1.80 ± 0.06$^a$          | 0.01 ± 0.002$^a$   | 0.03 ± 0.002$^a$ | 0.09 ± 0.004$^a$   | 0.03 ± 0.002$^a$       | 0.09 ± 0.005$^a$       | 0.09 ± 0.002$^a$       | 0.16 ± 0.01$^a$ | 0.17 ± 0.01$^a$ | 0.12 ± 0.01$^a$ | 0.12 ± 0.004$^a$ | 0.06 ± 0.01$^a$ | 0.62 ± 0.03$^a$ |
|                  | $T_3$ | 2.53 ± 0.11$^a$          | 1.90 ± 0.07$^a$          | 0.01 ± 0.002$^a$   | 0.03 ± 0.002$^a$ | 0.09 ± 0.004$^a$   | 0.03 ± 0.004$^a$       | 0.10 ± 0.002$^a$       | 0.10 ± 0.002$^a$       | 0.15 ± 0.01$^a$ | 0.17 ± 0.01$^a$ | 0.12 ± 0.01$^a$ | 0.13 ± 0.005$^a$ | 0.06 ± 0.01$^a$ | 0.65 ± 0.04$^a$ |
|                  | $T_4$ | 2.26 ± 0.10$^b$          | 1.59 ± 0.04$^a$          | 0.01 ± 0.001$^a$   | 0.03 ± 0.004$^a$ | 0.08 ± 0.010$^a$   | 0.03 ± 0.004$^a$       | 0.08 ± 0.005$^a$       | 0.08 ± 0.005$^a$       | 0.14 ± 0.01$^a$ | 0.15 ± 0.01$^a$ | 0.11 ± 0.003$^a$ | 0.11 ± 0.004$^a$ | 0.12 ± 0.07$^a$ | 0.50 ± 0.03$^b$ |

$^a$ means with different superscript within the same column differ significantly ($P < 0.05$)

$T_1$ = SMM 15% and DWM 0%
$T_2$ = SMM 10% and DWM 5%
$T_3$ = SMM 5% and DWM 10%
$T_4$ = SMM 0% and DWM 15%
C. Digestibility trial

In this study, although the digestibility of crude protein (CP) was not significantly (P > 0.05) different one another, digestibility of dry matter (DM) and crude fibre (CF) of meat ducks fed T4 was significantly (P < 0.05) lower than that of groups fed T1, T2 and T3 (TABLE VIII). This finding was in line with the report that the protein efficiency ratios of tilapia that were fed diets containing up to 20 % DW were not significantly different from those of tilapia that were fed the control diet [21]. The result from this study was also in agreement with the observation of Khanum et al. [20]. They reported that fresh DW may be characterized by its high intake and low digestibility of DM and CF.

IV. CONCLUSIONS

Conclusively, it is obvious that the different ratio of SMM to DWM, T3 (SMM 5% and DWM 10%) diet improved body weight and carcass weight and narrowest FCR without any adverse effects on commercial meat ducks. This indicated that unconventional cheaper aquatic DWM could partially replace costly SMM for the formulation of meat duck ration. Further research is recommended for increase inclusion level in the diet and application in other farm animals.

ACKNOWLEDGMENT

Firstly, we would like to express our sincere gratitude to Rector and Pro-Rectors of University of Veterinary Science, Yezin, for allowing us to have the opportunity to take out this research work. Thanks are also due to those who made things run smooth during this study especially to the staff for the Department of Animal Science, University of Veterinary Science.

REFERENCES


II. ARTS

Nation Building through
Quality Research and Innovation

24-25 May, 2019
University of Yangon
Yangon, Myanmar
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myamyawintun7@gmail.com
Mujyd aem fru b u 6 mjzn fzn faynfaaq (csfyn e, ESa  sckdfl) w pav eao vvf o GU avonf x tsqj nefrfr r edwfv t rsn nji ex b nft} [ v b u rf nfu v isbav Mavincef  r P yqe, sny d c] [ b o m u m v Mv f v h j j n m n x sm s GU avonf } v G cm h o shvyf awrincefaev h j j d a c a: a o r b n f r s high yf { GUW csfwG jprsf G jzbn f ariyefsf bd ax b nt n f x b M v h m h jawnincefaev F j k w n d f r p l] o s u f y jn ys h j b y f t (comrades)?} [ m o v} (allies) p o n h awrincef G W G G jyele ex bm avonf t "yj y f zi n b l, c] [ friends} [ l v 0 D a e t x m & csfyn e, f w G s n h a c a: a o j m n f p n f y k a u s o f m ar n y f? t v, y f b e s h awrincef G W G F s y f W H t, c] "khyan' [ b o m u m v kгля в баш tal Яп от р n f b u d f a c a: u m aw G j k w n f x c a: a o m r j n m f p n f w D v e s f? z v r f s f? m r g c f? r n f? l k b n f r f w y s f? r w y s f? u e j u v u f s f? t * y f f x Bertran S. carey ESa H N Tuck y v u c s f s h arj yef s f [ l r n f r s k w m ] [ c] [ b o m a d g r e n } v } [ k u j y n v s c s n f 1900 F e v G v O a s t "yj y s h f w K w p m m } [ s] } o e ] [ b ] 345000 s c s n f v O a s 190000 r e n ("Jin," or "Yen,") r S j r f r h o k l G f [ c] [ j r f r h o W G a e x bm D v O a s 155000 r n t j z p s y m y v v m n f } [ k c e r a e m o n f t o d E d D W G a e x bm y g o n f 1, c] w w r f [ c] k l n n f n r d o w k f & f o m p u m o n f w D v e s r b, a l o w G a e x bm a o m r [ k b v ] v h j j n m n f j z p m n f [ c] [ k c s f w d & f o m r s f k t r s o o o n h t a c c o m r j E G f W L e u f u b b d f w D v e s D w d & f o m r s f b n o p u m e s h [ c] [ k c a: a o m r j k w p c f s s b y/ pr h a s t o m p e f a l m r j z p m g n f 2 (u) c sf] b a n a o j r a b c s f v h s m on f j r f r h o F W G awrincea: a o ESa arjyef c m W G j y e l e c e x b] m o n f j r f r h b d e s f V G J w d u f j r f r m t k b f b n o p u m w f k d u k y r a o m j r f r h e f s f o m w f k d 1 https://en.wikipedia.org/wiki/Tiddim_people

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Alphabetic writing system
Semisyllabic-semiaphabetic writing system
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<td>b = buk^1 (n) Wf</td>
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<td>2</td>
<td>c = ci^2 (n) q m</td>
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1. b = buk^1 (n) Wf
2. c = ci^2 (n) q m
3. d = dim¹ (adj) jyn ho m
4. g = guh³ (n) t ½d
5. h = hong³ (v) zGif honf (wG? pnh yj)
6. K = kap³ (v) i b n f
7. l = lian³ (adj) M b o m
8. m = meh³ (n) [ if
9. n = nih³ (n) ½ * P ef
10. p = pat³ (n) O g n k n f
11. s = sang¹ (n) au s n f
12. t = tui¹ (n) a &
13. v = vuk² (n) Ef
14. z = za¹ (v) M n o n f

An ft u son au w 2v kwJ An fo H lo kwG b o m An fwG t u on o au w (4) wG b n f t o k y n f

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<th>ng</th>
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<tbody>
<tr>
<td>/Kh/</td>
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kh = khua² (n) = sj jr hK
ng = nga¹ sa¹ (n) = i g
ph = phu¹ (v) = t wi fcd dp no n f
th = thei¹ (n) = o zef o D

| jzi h (1) v kl u gi n y n o n f x i fr n pu no H zy kwG / n / An f yg f i f jz y n f f An f t u on o au w h, k, l, m, n, p, t, ng (8) v kwJ n f OP pu n y ls y n b t q k wEf u sa n f t u on au w jzi h OP O pu n y ls y n b t q k w Ef r Ekd m r t f wG y n f |

5' o s o E f o & t u on au w
An fo au w 2v kwG 4v kwJ kl t o hK x mo j z i h p k y n f prn a s t o m p e pOf 18 v kwJ n f aw y n f n f pu no bkJ
An fo E b Ef, gm n f Q t a st wG f m

190
1. a = ha^2 (n)

2. e = khe^3 (n)

3. i = ni^2 (n)

4. o = so^2 (v)

5. u = gu^1 (n)

6. aw = kawm^2 (n)

O'Grad, 1997, 23-24

191
1. ai = pai² (v)  o Go n f
2. ei = pei² (n)  (u mV b f)b D
3. ia = bia³ (v)  Swj Hj n f OwfykJ n f
4. oi = moi² (adj)  i, &G S o n b m
5. ua = gua² (n)  Gyi f
6. iai = hiai¹ (pron)  b ? D o n f
7. uai = khuai² (n)  ysm
8. au = dau² (v)  t & o n a y g h
t & o n a y s b n f  
9. eu = keu² (adj)  ajcra f(rpl)
10. iu = kiu³ (n)  wblwmb pl a x mh
11. awi = nawi¹ (n)  &i n ? Eml
12. ui = ui¹ (n)  acG
13. iau = liau² (v)  'P f M ; a y a q r M h n f 
av s b n f
14. uau = zuau³ (n)  rl a mp u m
(1) o bjy - level
(2) t edb u6 H low falling
(3) t jri wu6 H high rising
(4) t jri bu6 H high falling

| i jzpygn nf |

| 1 = t jri wu6 H /a’/
| 2 = o bjy / a’/
| 3 = t edb u6 H /a’/
| 4 = t jri bu6 H /a’/ | i jzpygn nf |

| 1 = za (v) = M n f
| 2 = za (n) = / / /
| 3 = za (n) = - - - - - = n w p m ? E S m m |
| 4 = a’ za’ za’ - in’ = n m o |

| mäi = rsu En
| mäu = q h b m
| näi = ybn f |

| i jzpygn nf |

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Searching for the most effective method of intensive Myanmar language course

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Abstract—In this paper, a second language teaching method of Myanmar language is presented. This method is called Content-based instruction: a foreign language teaching method that is becoming vastly used around the world. In this approach, teaching a language and teaching content are blended. Features of the approach are discussed and its effectiveness in SEASSI is examined. (SEASSI is the Southeast Asian Studies Summer Institute in USA). Is it the best option for the Intensive Myanmar Language course? Which level of proficiency did the learners reach? These are some of the questions examined in this paper. Moreover, a qualitative study of the application of Content-based instruction within the SEASSI is examined and discussed. Learners and teachers were interviewed about the use of Myanmar language in the classroom and their views about it. The objective of the study is to search for the most effective method of intensive Myanmar language course.

Keywords – content-based instruction, SEASSI, level of proficiency, second language, method.

I. INTRODUCTION

I have got an opportunity to teach Burmese as a second language in Southeast Asian Studies Summer Institute (SEASSI) in 2016 (from 6th June to 5th August) at the University of Wisconsin-Madison. SEASSI was established in 1983 at Ohio University to provide high quality intensive language instruction in at least eight of the major Southeast Asian languages at one location during the summer. It was and remains a unique program that combines institutional, federal, and foundation funding to bring faculty and students together in a single location every summer.

SEASSI is an integral part of a nationwide network of language teaching faculty from the institutions that are members of the SEASSI Network: Arizona State University, Cornell University, Michigan State University, Northern Illinois University, Ohio University, University of California-Berkeley, University of California-Los Angeles, University of Hawaii-Manoa, University of Michigan, University of Notre Dame, University of Washington, and University of Wisconsin-Madison. Representatives from these institutions meet annually to discuss SEASSI and explore ways to improve the program.

SEASSI has been hosted by institutions known for their strong Southeast Asian Studies programs. The first full-scale institute was held at the University of Michigan in the summer of 1984. From 1984 through 1999, SEASSI moved every two years to a different campus. Since 2000, the University of Wisconsin-Madison has been the host of SEASSI. Host institutions and years are summarized below:

- University of Michigan – 1984 ; 1985
- Northern Illinois University – 1986 ; 1987
- University of Hawaii – 1988 ; 1989
- Cornell University – 1990 ; 1991
- University of Washington – 1992 ; 1993
- Arizona State University – 1996 ; 1997
- University of Oregon – 1998 ; 1999

I was responsible for participating in a language pedagogy workshop (June 3–4), the SEASSI teacher orientation (June 6–10) and workshops, preparing appropriate materials and delivering instruction in first-, second-, and third-year language classes, holding office hours, and participating in teacher meetings under the supervision of the Burmese Language Coordinator. Within all languages offered at the institute, SEASSI utilizes team teaching, and combine proficiency-based and communicative methods. Burmese classes at SEASSI may include distance student participants, and instructors are responsible for assuring that quality of instruction offered to SEASSI distance students is as high as for students attending in person (i.e., that distance students are included as full class participants, have access to handouts and other course materials, and have access to the instructor during his/her office hours). Classes are held from 8:00 am to 12:30 pm, Mondays through Fridays. Instruction begins on June 13 and ends on August 5. This is only 160 hours course (4 hours per day for 8 weeks).

II. CONTENT-BASED INSTRUCTION

My personal interest in content-based instruction, CBI, derives from an experience in SEASSI. I had to use this second language teaching method in Burmese language teaching in the 160 hours course. I had to find that all students can begin to acquire Myanmar (Burmese)—not in the traditional way (in a language classroom with a language teacher), but in the subject matter like classroom, through content. Within two months, all students fully understood most of subject matter (Burmese culture, Burmese life, etc.) and at the same time, Burmese language. I would like to introduce CBI here according to Donna Brinton (2003).

“Before proceeding further, let’s examine two important notions, context and content. To comprehend the difference between these, try the following.

First, picture a teacher’s use of the context “Los Angeles vs. San Francisco” in a one-hour lesson on writing paragraphs of comparison and contrast. In this lesson, the teacher might first present ways to organize compare/contrast paragraphs (e.g., block style vs. point by point style), then elicit from students the differences between the two cities and brainstorm with them an organizational plan for the paragraph. Next, picture a five-
week CBI unit centered on the content of urban issues (e.g., crime, traffic, youth culture) in Los Angeles. In this unit, students read articles about urban issues in the city, conduct independent research on one of the subtopics, and discuss and write about their findings. All language instruction (e.g., grammar, vocabulary, and writing) is conducted using the content of urban issues as a point of departure. Thus, students might study the grammar of conditional sentences within the context of urban crime (“If police efforts were more community-based, the inhabitants of that community would not perceive the police as enemies.”)

In the first example, the teacher uses the context of differences between the two cities to illustrate a single teaching point (comparison/contrast). Whereas in the second example, all language activities in the extended five-week unit revolve around the content of urban issues in Los Angeles. This content-rich environment provides optimal conditions for students to acquire language since (1) language is being continually recycled throughout the unit and (2) students are given multiple opportunities to use the new language they acquire as they read, discuss, and write about the topics.

What, then, are the characteristic features of CBI? Quite simply, CBI refers to the teaching of language through exposure to content that is interesting and relevant to learners. This content serves several purposes. First, it provides a rich context for the language classroom, allowing the teacher to present and explain specific language features. Additionally, it provides for what Stephen Krashen (1985) calls comprehensible input-challenging language that is slightly above the current linguistic level of the students which, according to Krashen, provides the foundation for successful language acquisition.

Let’s return to the example of the CBI unit on urban issues mentioned above. In this unit, the content of urban life in Los Angeles has been chosen because of its relevance to the learners’ lives and its potential interest level. The course materials, which consist primarily of readings about various aspects of urban life in the city (e.g., violence, traffic, urban settlement patterns), provide a context for the teacher to use when teaching lessons on issues such as citing sources or achieving paragraph unity. It is important in our definition of CBI to note that the selection of content extends over more than one lesson. In fact, CBI units are often several weeks or more in length. As we will see later in the chapter, the use of sustained content over a period of time effectively differentiates this approach from the previous practice of simply selecting a context for the presentation of new language.”

Donna Brinton (2003) also explained about the background to content-based instruction as follows: “Basing language teaching on content is not a new idea. For probably as long as second languages have been taught, materials developers and teachers have sought interesting content to engage learners’ interest. However, the approach that has come to be known as CBI first appeared in the mid-1980s with the publication of Bernard Mohan’s work, Language and Content. Mohan characterizes his work as an exploration into the ways in which the “learning of language and subject matter... [can] be accomplished” (Mohan, 1986, p. iii). Following closely on the heels of Mohan’s exploratory work are two other early works on CBI by Cantoni-Harvey (1987) and Crandall (1987)—both of which helped to further launch this movement.

In the work I have done with my colleagues Ann Snow and Mari Wesche (Brinton, Snow, and Wesche, 1989), we identify several “prototype” forms of CBI—namely theme-based language instruction, sheltered content instruction, and adjunct instruction. These forms differ in several important respects: (1) the type of population and setting that they serve; (2) the respective degree of focus on language or content; (3) the selection of content; and (4) the degree of coordination with subject matter courses and instructors.

To better understand these three prototype forms, let’s examine the following scenarios:

Scenario 1

**Theme-based language instruction:** Beginning-level English language learners studying English at the fourth grade level work with the theme of friendship. Since the primary aim of this class is language acquisition, the English teacher uses this theme as a point of departure for instruction in reading, listening, speaking, and writing skills (Brinton, 2001a). The thematic content stretches over several weeks of instruction, providing rich input for lessons that are either language-based (i.e., with a focus on vocabulary, pronunciation, and grammar) or skills-based (i.e., with a focus on listening, speaking, writing, or reading). In this environment, students can successfully acquire language.

Scenario 2

**Sheltered content instruction:** English language learners enrolled in a sheltered seventh grade science class improve their English language skills while studying about the big bang theory of the origin of the universe (Brinton and Holten, 1997). The science teacher in this class has received special training in working with second language (L2) learners. Because the students are all still acquiring English as a second or additional language, she modifies her presentation style to help the students comprehend the material. The teacher’s primary goal is for students to understand the content materials (in this case, about the origin of the universe). But she also spends some time helping students with language-related issues (e.g., academic vocabulary, reading skills) that pertain to the science unit they are studying. The exposure to higher-level language (through the content materials) and the explicit focus on language issues by the teacher set the stage for successful language acquisition.

Scenario 3

**Adjunct instruction:** University-level ESL students are enrolled in paired or “adjuncted” English and psychology classes (Brinton, Snow, and Wesche, 1989; in press). Two separate instructors teach the classes—an English language instructor and a psychology instructor. Although the two classes meet and are graded separately, the two instructors meet regularly to coordinate their teaching objectives, and the English language instructor uses the psychology materials as content for the English language course. The instructional goals of these two classes differ since the main goal for the psychology class is for students to understand and learn the subject matter; the main goal
for the English class, on the other hand, is for students to improve their English language skills. Students are able to achieve this goal through their exposure to challenging, yet comprehensible, input in the psychology class and through the language support and systematic language instruction that they receive in the English class. These scenarios are real-life examples of the prototype models my colleagues and I described in our 1989 work. To summarize the differences in these models, let’s return to the differences noted above.

1. Population/setting—The first difference concerns the types of students and settings to which the models are best suited. Since theme-based instruction is the most generally applicable, it is appropriate at virtually any level of language learning and in a wide variety of settings. Sheltered and adjunct instruction, however, are more restricted in their applicability. Sheltered courses are typically found in middle schools and high schools where large populations of learners are receiving subject matter instruction in a language other than their first language. Finally, adjunct courses are typically found in settings where students are studying language as well as subject matter, such as high schools, colleges, and universities.

2. Lesson focus—The second distinction between the models concerns the focus of the lesson itself. As can be seen from the above scenarios, the instructional focus in CBI may be on language (as in theme-based instruction), on content (as in sheltered instruction), or on both (as in adjunct instruction).

3. Selection of content—The third distinction concerns the type of content that is selected. Because most CBI instruction occurs in schools, colleges, and universities, the content of the language class often overlaps with that of students’ subject matter classes. In our ESL courses at my university, for example, we have selected content from a range of required general education courses that students take to graduate from the university.

4. Degree of faculty coordination—A final distinction involves the degree or amount of coordination required between language and content faculty. Adjunct instruction is quite different from the other two models in this respect since it requires the systematic coordination of the language and content instructors. For example, these instructors typically meet before the course (and periodically throughout the course) to discuss curriculum and to coordinate objectives. They may also use this time to discuss the types of assignments they will set for the students. This is not true for sheltered and theme-based instruction, where the instructors do not coordinate in this fashion. These “prototype” models represent early attempts of practitioners to apply CBI principles to various student populations and instructional settings. As such, they are useful for understanding the flexibility of the CBI approach. However, since that time CBI has been applied in virtually all parts of the world, with the result that numerous additional CBI models continue to evolve.

A recent innovation in CBI is sustained-content language teaching (SCLT). SCLT (Pally, 2000; Murphy and Stoller, 2001) involves a focus on a “single content area, or carrier topic ... [along with] a complementary focus on L2 learning and teaching” (Murphy and Stoller, 2001, p. 3). According to Murphy & Stoller, because the use of sustained content simulates the conditions and demands of the subject matter classroom, it allows language learners to more deeply engage the content, in the process acquiring the academic vocabulary and language skills needed for the mainstream. SCLT does not require coordination of the language teacher with a content area expert. Instead, the content serves as a point of departure for language instruction. As such, SCLT most closely resembles theme-based instruction, with the difference that theme-based courses typically cover a variety of topics, whereas in SCLT the content is “sustained,” and students work with only one topic. In theme-based instruction, according to this distinction, a ten-week course might consist of five different topics (e.g., nuclear energy, cloning, volunteerism, leadership, and life expectancy).

III. The nature of Burmese/Myanmar language
Some scholars said that there is no grammar in Burmese/Myanmar language at all. Some scholar said that there is a grammar in Burmese/Myanmar language which scholars cannot find yet. The reasons are as follows.

There are two types of languages all over the world; this is from the grammatical point of view. These are configurational languages and non-configurational languages. The definition of configurational language is as follows:

**configurational languages:** Languages with fairly fixed word-order and hierarchical constituent structure, e.g. English and Hebrew. Such languages are contrasted with non-configurational languages. Both types have received a great deal of attention in government-binding theory as subject to parametric variation. However, the typology is not unequivocally accepted. (Crystal, 100)

The definition of non-configurational languages is as follows:

**non-configurational languages:** Languages with fairly free word-order and seemingly ‘flat’ constituent structure, such as Japanese and the Dravidian and Australian languages; contrasted with configurational languages. Both types have received a great deal of attention in government-binding theory, where non-configurational languages are also known as W* (w-star) languages. (Crystal, 329)

Some scholars used the new term “discourse configurational language” instead of non-configurational languages. The definition of Discourse Configurality is as follows:

“The properties on the basis of which a language is categorized as discourse configurational are, in intuitive terms, the following:

A. The (discourse-) semantic function ‘topic,’ serving to foreground a specific individual that something will be predicated about (not necessarily identical with the grammatical subject), is expressed through a particular structural relation (in other words, it is associated with a particular structural position).

B. The (discourse-) semantic function ‘focus,’ expressing identification, is realized through a particular structural relation (that is, by movement into a particular structural position).”

While these two properties often co-occur, they are independent of each other.
Most of the languages studied in this volume share both, i.e., they are type AB discourse-configuration languages, but, for instance, Aghem is shown (by Horvath) only to have property B (type B discourse-configurationality). There are also languages which only display property A (type A discourse configurationality); the best-known example is Japanese.

Properties A and B are sometimes realized in modified forms. For instance, in Finnish the semantic function of contrast may cut across, and supersede the functions of topic and focus: there is a sentence initial position (in addition to a topic position) that can be occupied by a contrasted element of either topic or focus function.

(KATALIN E'. KISS, 6)

Burmese/Myanmar language can be recognized as a non-configurational language or discourse configurational language according to above definition. Burmese/Myanmar language is a type of Language with fairly free word-order and seemingly ‘flat’ constituent structure, such as Japanese and the Dravidian and Australian languages.

Therefore, the Burmese grammar realized by traditional grammarian in not important for Burmese language learners. The word order of Burmese is determined by discourse factors such as information structure.

IV. BURMESE/MYANMAR LANGUAGE AND CONTENT-BASED INSTRUCTION

Burmese language is a non-configurational language or discourse configurational language. So, to learn grammar is not very important for Burmese language learners. Most of the features of CBI are very appropriate for Burmese language learners. All features of CBI are explained by Donna Brinton (2003) in the sub-title of the “Principles for content-based instruction” as follows.

“1. Base instructional decisions on content rather than language criteria.

Two issues that language course planners or materials designers face at the outset of the planning phase are selection (i.e., which items to include) and sequencing (i.e., how to order these items). In the days of the grammar translation approach, it was thought that certain language items (e.g., simple present tense) were more easily acquired than others. Thus, the decision was made to include these easier items in the beginner course and to sequence them at the beginning. Content-based instruction takes a rather radical departure from this approach since it allows the choice of content to dictate or influence the selection and sequencing of language items. In adjunct instruction, for example, the psychology' professor's introductory lecture on “What is Psychology?” might be coupled with the English instructor’s focus on the language of definition (Brinton, Snow, and Wesche, in press). Similarly, in the sheltered unit about the origins of the universe mentioned above, the focus might be on helping students understand and acquire core academic vocabulary (e.g., “expand” equals “get bigger;” “decrease” equals “get smaller,” etc.).

2. Integrate skills.

Rather than isolate skills in skill-specific classes (e.g., “English Grammar,” “Writing,” “Listening and Speaking”), CBI practitioners use an integrated skills approach to language teaching, covering all four language skills as well as grammar and vocabulary. This reflects what happens in the real world, where interactions involve multiple skills simultaneously. Also, unlike other approaches that dictate a specific skill sequence within each lesson (i.e., starting with listening, then reading, then writing, etc.), there is no set sequence of skills to be taught in CBI. Instead, a lesson may begin with any skill or, alternatively, with a focus on grammar or vocabulary. As we have seen in principle one, it is the content itself that influences the decisions about selection and sequencing.

3. Involve students actively in all phases of the learning process.

Because it falls under the more general rubric of communicative language teaching (CLT), the CBI classroom is learner rather than teacher centered (Littlewood, 1981). In such classrooms, students learn through doing and are actively engaged in the learning process; they do not depend on the teacher to direct all learning or to be the source of all information. Central to CBI is the belief that learning occurs not only through exposure to the teacher’s input, but also through peer input and interactions. Accordingly, students assume active, social roles in the classroom that involve interactive learning, negotiation, information gathering, and the construction of meaning (Lee and VanPatten, 1995). Richards and Rodgers (1985) and Nunan (1989) characterize some possible roles played by students in the communicatively-oriented classroom as follows: recipient/listener, planner, interactor and negotiator, tutor of other learners; and evaluator/monitor of his/her own progress. All these roles are ones assumed by learners in the CBI classroom. In keeping with the multiple roles assumed by learners, the CBI teacher also assumes multiple roles. She may serve as the primary resource for students, particularly where issues of language or culture are concerned. But she also serves as the organizer of tasks, the controller or facilitator of student-centered activities, the prompter of student responses, and the assessor (both formal and informal) of student efforts.

4. Choose content for its relevance to students’ lives, interests, and/or academic goals.

The choice of content in CBI courses ultimately depends on the student and the instructional setting. In many school contexts, content-based language instruction closely parallels school subjects. Thus, in a middle school context, topics may be drawn from social science, history, and/or life science areas that students are studying in their subject matter classes. Similarly, in the college or university setting, students may enroll in linked or adjunct language and content classes, with dual instructors covering the same content from a different perspective and with differing instructional objectives. In other settings, topics may be drawn from students’ occupational needs or be determined by general interest inventories. In fact, this principle is often criticized as a potential weakness of CBI since determining what is of relevance or interest to students is notoriously difficult for both teachers and materials or curriculum developers. However, because the introduction to content in CBI stretches over an extended period of instructional time, teachers have ample opportunity to engage students’ interest and to capitalize on students’ prior knowledge about a given topic. This mandate for the teacher to sell the students on the content...
that has been selected is an important underpinning of CBI teacher training.

5. Select authentic texts and tasks.

A key component of CBI is authenticity—both of the texts used in the classroom and the tasks that learners are asked to perform. To better understand this principle, we need to examine the meaning of authenticity. Hutchinson and Waters define authentic texts as those that are “not originally constructed for language teaching purposes” (1987, p. 159). Thus, an extract from a content area textbook, a cartoon, and the lyrics to a popular song, or a short story would all qualify as authentic texts. However, as Hutchinson and Waters note, bringing an authentic text into the classroom alters its original purpose, which was not to teach language, but rather to inform (in the case of the textbook), entertain (in the case of the cartoon), or perhaps both (in the case of the song or the short story). In other words, the use of an authentic text in a language classroom implies that it has been removed from its original context and that its purpose in the language classroom is quite a different one indeed.

This objection also holds true for task authenticity. Our purpose in interacting with texts in the real world varies greatly according to the content itself, as well as to the circumstances. In the case of a textbook passage, we may read for global understanding and/or specific details; in the case of a popular song, we may listen purely for enjoyment or seek to understand the meaning of the lyrics. Similarly, with a political cartoon or newspaper editorial, we may read to understand the political point of view being expressed and/or to determine the cartoonist’s or author’s bias. In CBI, since the objective is to aim for authenticity of task, the task(s) associated with a given text should mirror those that would take place in the real world.

6. Draw overt attention to language features.

The purpose of CBI is to expose learners to authentic input with the goal of their being able to use language for communicative purposes. Texts form the primary input source in the CBI classroom, with additional input provided by the teacher (through classroom language) and peers (in pair or group work). All of these provide comprehensible input. However, CBI departs from some other approaches to language teaching in its belief that comprehensible input alone will not lead to successful language acquisition (Brinton and Holten, 2001). Instead, it makes use of awareness-raising tasks to draw attention to specific language features found in the authentic texts.” Among these principles, “1. Base instructional decisions on content rather than language criteria”, “2. Integrate skills”, “4. Choose content for its relevance to students’ lives, interests, and/or academic goals”, and “6. Draw overt attention to language features” are very appropriate for Burmese language teaching.

Since content-based instruction is extremely appropriate for Burmese/Myanmar language teaching, other Burmese language instructor and I can teach Burmese language to foreign (university) students at SEASSI (2016) only in the 160 hours. We have used Classroom techniques and tasks such as pair and group work, discussion and debate, role-play, and process writing etc. Donna Brinton (2003) has expressed precious CBI classroom techniques and tasks as follows:

“The techniques and tasks used in the CBI classroom are familiar ones to anyone who practices CLT. These techniques and tasks reflect the principles of CBI since they involve the active participation of learners in the exchange of content or theme-related information. The following is a partial list of techniques and activities commonly found in CBI classrooms.

**Pair and group work** are a hallmark of the communicative classroom. In CBI, they entail the discussion or exchange of information related to the content unit. In pair or group work, the teacher first presents the task, then divides students and sets a time limit for completion of the task. While students work, she circulates to answer questions and makes sure that students are “on task” (i.e., completing the task according to the instructions given). Pair and group work culminate in a reporting stage, with students from each group sharing their ideas or solutions with the rest of the class.

**Information gap** is a form of pair work in which the participants are each given different pieces of information. Using only language (i.e., without looking at their partner’s information), they must communicate to fill in the missing gaps in information.

**Jigsaw** is another variation of information gap. Students are first divided into “expert” groups, with each group given a different piece of information. Once the students in each group have become familiar with their piece of the jigsaw, they are regrouped. Each new group consists of at least one student from each of the previous expert groups. Students then share their expertise to complete the task and report their findings to the rest of the class.

**Graphic organizers** involve the use of visuals that assist in organizing information. They can consist of diagrams, tables, clusters, etc. The teacher may use these graphic organizers to present information or guide student brainstorming. Alternatively, learners may be asked to read or listen for key information and enter this information in the graphic organizer.

**Discussion and debate** involve opportunities for students to express their own opinions about topics, in this case related to the theme of the CBI unit.

**Role-play** entails having students act out a situation. Each participant is given information about the role and the situation. Role-play can involve two or more students. In CBI, the role-play would be connected to the overall unit theme or topic.

**Survey tasks** ask students to conduct a poll of people (either inside or outside the classroom) to determine opinions on a selected topic. These opinions are reported back to others, usually in the form of a chart or table.

**Process writing** is a technique commonly found in CLT. It involves having students write multiple drafts of papers. Each draft receives either comment from the teacher or from a peer. Based on these comments, the student writer revises the draft and submits it to the teacher for evaluation. Often, students do two or three drafts of each paper they submit.

**Problem solving** involves students working in pairs or groups to arrive at a solution to a given problem. In CBI, the context of the problem relates to the theme students have been studying in the content unit.
Sequencing involves students rearranging events or pieces of information into their logical order. This type of task is especially useful in the teaching of reading and listening. Ranking involves students determining an order of listed items based on their perceived importance. Ranking is often done in pairs or groups, with group members being asked to reach consensus on the ordering. A designated reporter then shares the ranking that has been determined with the class as a whole, often providing a rationale for this ranking. Values clarification involves students taking a stand (agreeing or disagreeing) on controversial statements related to a chosen topic. Usually done in pairs or groups, it often involves asking students to come to consensus and then report on their decision and their discussion to the rest of the class members.

The result of the Burmese language learners are as follows:
For Beginner class, Grade A students are 2, Grade AB students are 5, and Grade B student is 1.
For Intermediate class, Grade A students are 2, Grade AB students are 3, Grade B student is 1.
This final result clearly shows that the learners’ levels of language proficiency rise up to B1 according to CEFR system; CEFR is the Common European Framework of Reference for languages: Learning, Teaching, Assessment developed by the Council of Europe. This means that they have achieved higher levels of proficiency.

V. CONCLUSION
In this paper, I presented about the CBI applied for Burmese/Myanmar language teaching at SEASSI. The SEASSI is the worldwide intensive training course of second languages. Only in 8 weeks course (also 160 hours course), the Burmese/Myanmar Language learners can speak, listen, read, and write in their target language. This result shows that the CBI is a most effective method for intensive Myanmar language course. The Myanmar Language learners and instructors were interviewed about the use of Myanmar language in the classroom and their views about the Myanmar language. All of them are very enthusiastic about learning Myanmar language in the whole course.

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Study on Importance of National Language Maintenance for Nation Building

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Abstract— The national language is a prime importance of a country to maintain its national identity and nation building. Myanmar has been established for thousands of years ago and her people live with unique tradition and culture from one generation to another. However the students in Myanmar Higher Educational Society nowadays have become less interest in national language. As a consequence, the new generations in Myanmar pay attention to their tradition and culture less and less. For this reason, this research conducted an assessment on the status of national language and literature quantitatively and qualitatively in Technological University (Maubin).

Keywords: national language, national identity, nation building, educational society.

II. OBJECTIVE AND SCOPE OF RESEARCH

A. Objectives of Research

There are four main objectives for this research:

a) To identify the status of the national language and traditional literature in Myanmar educational society
b) To analyze why new generations become less interested in national language and traditional literature
c) To endeavor to change the attitude of new generations on national language and traditional literature
d) To highlight the importance of self-appreciation of Myanmar’s own traditions and culture for the nation building

B. Scope of Research

The scope of the research mainly includes the questionnaire survey and analysis of these survey data to find out the major reasons why the new generations in Myanmar become less interested in national language and traditional literature and how to solve this problem for proper nation building. The surveying is mainly conducted among the students of Technological University (Maubin) who are regarded as representative of considerable amount of new generations in Myanmar.

C. Methods of Research

This research will be based on quantitative and qualitative analysis, scientific research journals, academic electronic journals, Myanmar articles and surveying data. Empirical approach is definitely used in this research. For quantitative analysis, survey was conducted among the students of Technological University (Maubin). The reason why they are chosen is that they all are very fundamental human resources and most of them are also future engineers of Myanmar. Based on such survey
data, this research highlighted the role of national language and traditional literature, and how much they are important to accelerate Myanmar’s democratic nation-building process.

III. LITERATURE REVIEW

Every respective vernacular language and literature of different countries is very important in promoting culture and traditions. Every year, at least 10 languages disappear of the 6000 currently spoken in the world [1]. The first Myanmar literature: stone-inscription that recorded the donation of prince Rajakumara, during Bagan period was written by four languages: Myanmar, Mon, Pali and Pyuu. It can be seen in Gupawkgyi Pagoda at Bagan.

![Figure 1. (a) Myazedi Inscription, (b) Major Pyu Cities in Myanmar](image)

Among these, one of the distinct ethnic languages, Pyuu has disappeared at present. The loss of the Pyuu language and the Pyuu people occurred at the same time and it is obvious that if the distant language and literature disappear, people who speak and write it die together with it. It can be proved that the maintenance of national identity and language is interdependent of each other and also important for nation building. Preventing language disappearance in a nation is one of the responsibilities of a government in good governance and all citizens in Myanmar.

A. Previous Studies

Some national scholars had been emphasizing the negative attitude of Myanmar people on national language and traditional literature. Firstly, Tha Khin Ko Daw Hmaing, one of the greatest poets who got the Lenin Peace Prize, attempted to promote the role of the national language and traditional literature during the 19th century.

During the British colonial era, most of the highly educated Myanmar people used “Mr.” instead of “U”/u:/ which is the Myanmar naming system for males at the beginning of their names. They thought that if they used Myanmar traditional naming system, they felt very shameful and therefore they always used English naming system. Tha Khin Ko Daw Hmaing tried to solve this problem by using pen name “Mr. Mg Hmaing”, combining “Mr.” that the Myanmar people loved during the colonial period and “Mg Hmaing” that everyone hated so much because it was the name of a very terrible wicked man from a well-known novel at that time. By writing some special articles on the Myanmar tradition and culture under this pen name and the use of “Mr.” gradually disappeared [2]. If not, Myanmar naming system might have been replaced with the English one. It is the one of the remarkable examples of maintenance of national language for the nation building at that time.

In 2003, Mg Khin Min had written about the condition of the national language in Myanmar education society, highlighting that most of the students in Myanmar are not usually careful in learning national language and think that it is not necessary to study. As a result, even though they have received a degree from respective universities, they cannot write national language very well [3]. He mentioned that the status of Myanmar language and literature was moved from royal to labor, there was no Myanmar date in Myanmar newspapers, only English. Moreover, the Myanmar classical literature, Waithandayar Zattawgyi, was taught in English at schools during the British colonization period and we can remember the development of Myanmar and living standard of her people at that time. It is obvious that the teaching of Myanmar literature was seriously bad and its teaching scope was too narrow at that time [4].

One of the Myanmar scholars, Mg Thu Ta pointed out and analyzed that the careless mistakes of Myanmar people in writing the national language by comparing them to the classical literature in 1977 [5].

Another scholar, Norico Iwamoto observed that the role of language in real situation and its function in upgrading nationhood. He discussed that how much language is important for a nation
and started his discussion with his personal statement: the world is constructed by word and then he analyzed the dynamic aspect of language in reality. He examined how language is used to regulate, reconstruct and sometimes manipulate reality and then to control the ideas and behavior of people. He examined the function of specific language in the creation and promotion of nationhood and the advancement of nationalism [6].

The scholars emphasized that creating official language and promoting nation-building cannot be separated for unification. Joshua Fishman warned that mother language maintenance should be ensured for a nation, its tradition and culture. He also emphasized that we are losing all those things that essentially are the way of life, the way of thought, the way of valuing and the human reality. Besides, there is a deep relationship between language and culture and it means that the language stands for that whole culture. He pointed out that the culture is lost by the country when the country lost its language, expressing with language being the soul of the people, the mind of the people and the spirit of the people [7]. Therefore language is important for a nation to have the people with strong spirit and soul.

Stephen Barbour and Cathie Carmichael (2000) pointed out that mutual dependence of language and nation was very essential to creating nation-states, and linguistic homogenization has developed the nationalist ideology [8]. Will Kymlicka and Alan Patten (2003) mentioned that the nation-building and language planning were essential to promote a unification of a nation and the preservation of minority languages is also important for them [9]. Consequently, if there is no national language in a country, there will be no national identity. It is the right thing to create national languages that will be adapted by other language groups within the country. Those scholars highlighted how to establish national language for the nation-building and how much important to preserve national language for national identity.

Myanmar case is different from above cases; In Myanmar, although the Myanmar language has been established as an official one, it is weakened by the lack of respect by her people. In the present days, there are two language conditions: using Myanmar language and ethnical language at the same time especially in the ethnical districts and bordering cities, and using Myanmar language and foreign languages; English, Chinese, Japanese, Thai, and so on in major cities. In these bilingual societies, there can be the situation of language choice and also language shift may happen and consequently it may be language disappear [10].

Presently, in Myanmar, new generations are becoming less interested in national language and literature according to my surveying data. On the other hand, Myanmar endeavors towards a democratic country and also faces many challenges in economics, health, education and ethnic conflicts. In such a period of time, it is essential to preserve the national language and literature, one of the most fundamental and important factors in national identity and national development. Therefore, this research focuses on analyzing the status of national language and literature of Myanmar new generations and how to change and upgrade their attitude of national language and traditional literature in this globalized era.

Additionally, the current status and attitude on national language and literature of Myanmar people is the considerable issue for a land which had been colonized by British and Japanese during 19th and 20th centuries and simultaneously faces many challenges and endeavors towards a democracy country. Thus, the present situation of Myanmar new generations on national language and literature become very weak.

B. Language Homogenization between Ethnic Groups in Myanmar

In Myanmar, there are about 60 million people comprised by 135ethnic groups who have been speaking their mother language and regional dialects. Additionally, Myanmar language is spoken as an official one in public, schools and administration throughout the country. Therefore, the ethnic groups have been speaking Myanmar language as the medium for education, health and social welfare in 1948 Constitution Article 216, 1972 Constitution Article 102 and 152(b), and 2008 Constitution Article (450) [11].

The status of the Myanmar language and literature went from bad to worse as a result of British colonization. Most Myanmar people thought that the English language and literature were the masters’ language and Myanmar language was of slaves’. As a consequence, most of Myanmar believed that if they spoke Myanmar language, if they read Myanmar
literature, if they behaved according to Myanmar traditions and culture, they would be lower class. Therefore, at that time, many Myanmar poems and novels written by Myanmar national poets and novelists such as Tha Khin Kodaw Hmaing, U Latt, Theitpan Maung Wa, Zaw Gyi, Min Thu Wunn, U Pyoe Kyar, Maha Swe, Lal Tipannita U MaungGyi, Thein Phae Myint emphasized that issue in their works; poems, novels and drama. These literatures evoked the national spirit for independence that was gained on January 4th, 1948.

Politically, the Association of Burma (Doe Bama Asi Ayone), established in 1930, created a motto to uplift the Myanmar national spirit at these colonial days as follows:

"Myanmar is Our Nation.  
Myanmar Literature is Our Literature.  
Myanmar Language is Our Language.  
Love Our Nation.  
Appreciate Our Literature.  
Respect Our Language."

Myanmar political parties and Myanmar patriotic poets endeavored to achieve Myanmar independence and most emphasized the need to upgrade the national spirit via literature. It was obvious that neglecting the national language and literature gradually lead to the disappearance of the Myanmar national identity and independence. Upgrading the national language and traditional literature had been one of the fundamental components of Myanmar independence and has been designed to the reinforce Myanmar national spirit during the period of colonial days.

Since the end of the colonized era, Myanmar public was comprised of different ethnic groups, they had only one ultimate goal and they have spoken Myanmar as a common language, an official one which unified different groups into one for Myanmar independence. The Panglong Conference held in February 1947, was an historical meeting that held at Panglong in the Shan States in Myanmar between the Shan, Kachin and Chin ethnic minority leaders and General Aung San. Eventually, there were mutual understanding and trust by using Myanmar language, leading to sign by the Representative of the Executive Council of the Governor of Burma, general Aung San and all Saopas and representatives of the Shan States, the Kachin Hills and the Chin Hills on the 12th February, 1947 according to the interview with Takkathol Sein Tin, the author of the book: Myanmar independence history. In present days, the Myanmar Government and ethnic leaders discuss for nation’s peace by using Myanmar language as well.

Nowadays, in Myanmar community, different ethnic groups believe that the capability of Myanmar language and traditional Myanmar literature is useful and beneficial one for their daily and successful lives. There are many ethnic people who are successful in music and film industry of Myanmar. There are many famous pop stars and film stars, composers such as Sai Hti Saing, Sai Sai Maw, Sai Sai Khan Hlaing, Han Tun, (Shan ethnic group), Htu El Lin, Mi Mi Gal, Lay Lay War, Saw Khuu Sae, Kabyar Bawe Hmuu, Saw Ku Sae (Karen ethnic group), L Khwn Yii, L Lwon War, L Sai Zi, Ray Baga Win (Kachin ethnic group), That Mon Myint, Sone thin Par (Chin ethnic group), Khant Si Thu, Nay Toe, Yadana Mai (Rakkhine ethnic group). The first Myanmar Idol winner is Karen ethnic group and the second winner is Rakkhine. It is believed that Myanmar language is a useful bridge for transmitting ideas and emotion among different ethnic people.

In higher educational society of Myanmar, there are many Ph. D theses about ethnic languages such as Rakkhine, Karen, Mon, Kayah, Phun and also regional dialects like Dawei, Myeik, Inthar written in Myanmar language. These ethnic scholars have been trying to do research of the nature of each language, full of their traditions and culture via Myanmar language. Some of the ethnic people in bordering area are unable to speak Myanmar language, as a result they have no job opportunities in the major cities of Myanmar. It is clear that the ethnic groups have been using Myanmar language as
lingua franca for easy communication across the country.

It is obvious that language homogenization is one of the most fundamental factors for unification of a nation politically and socially. Additionally, the maintenance of national language and the development of a nation is interdependent each other and they can be un-separated.

Unfortunately, the present attitude of Myanmar’s new generations on national language and traditional literature are going back to the past colonial days. On the other hand, there are the Myanmar fragmentations because of ethnic conflicts and thus it is very essential to discuss for peace with a common language to be unifying groups into one via common official language to get mutual understanding and trust.

IV. SURVEY DATA ANALYSIS

A. Attitude of TU (MUB) Students on National Language and Literature

In this democratization period, the attitudes of new generations regarding national language and literature are considerable issue for Myanmar. Thus, the students from Technological University (Mauin) are surveyed as Myanmar new generations to analyze their attitude on national language and literature.

As shown in the Fig. 3, 155 (64%) students out of 241 are less interested in national language and traditional literature. But 206 (85%) students out of 241 agreed that both Myanmar and English languages are necessary to learn engineering subjects. Meanwhile, 148 (61%) students response that it is essential to learn national language and traditional literature in university level.

B. Causes of Less Interest in National Language and Literature

Naturally, everybody wants to have a better life and thus the students have to consider their prospective income after graduation. As a result, they are not interested in national language and traditional literature as they think national language is not supportive for their future.

The Fig. 4 shows that the causes of TU (MUB) students why they have become less interested in learning Myanmar language and literature. The impact of globalization becomes inferior to the interest of them to use IT in English and computer games. As shown in Fig. 4, 137(57%) students out of 241 became less interest in national language and literature because they prefer to use IT in English, 55 (23%) students think that Myanmar language and literature is difficult to learn and 94 (39%) students want to play computer games instead of reading Myanmar literature. One of the causes that Myanmar language and literature is difficult to learn is the most critical issue for the teachers to evaluate their method of teaching and evaluation system.

C. Factors of Learning Myanmar and English Languages

To catch-up the global standard with own ability, human resources with self-appreciation on national language and traditional literature has to be developed. General Aung San, Father of Myanmar Independence, U Thant, Secretary of United Nations and Daw Aung San Su Kyi, the State-Counsellor of Myanmar use both Myanmar and English languages pretty well. They tried to be experts in English and they well studied Myanmar language and never forget the importance of it as well. They are recognized as remarkable leaders by world people and they are the excellent icons for Myanmar politic.
Bilingual is using in university of Myanmar and the students from TU (MUB) were surveyed to understand how and why they are learning both Myanmar and English languages in their classrooms as shown in Fig. 5.

![Factors of learning Myanmar and English languages](image)

**Figure 5. Factors of learning Myanmar and English languages**

As shown in Figure 5, there are three reasons for learning national language and English language. Among 241 students, 206 (85%) students agreed that both languages are important to understand engineering subjects. The 201 (83%) students mentioned Myanmar language is less important to stay in overseas. The 173 students (72%) students believed that learning Myanmar Language will have less job opportunities.

Although 155 students from TU (MUB) have become less interested in Myanmar language and literature, 201 students strongly believe that Myanmar language and literature is important for the country. It is clear that in spite of becoming less interested in national language, they do believe how much Myanmar language is important for Myanmar according to my survey data.

As engineering students like from TU (MUB) are very important and fundamental human resources for Myanmar, their opinion on national language and traditional literature is critical issue for national development. Additionally, they are future intellectuals of Myanmar and therefore the future of Myanmar is in their hands. Thus, it is needed to upgrade their attitude on national language and traditional literature from negative to positive one.

V. CONCLUSION

This research mainly focuses on the attitude of Myanmar new generations, students of Technological University, on national language and traditional literature who are keen human resources for the nation building. Among them, the status of Myanmar language and traditional literature is unrespectable like British colonization era, especially in present educational society. According to my survey data, the following facts are concluded.

1) It is observed that 155 (64%) of total 241 students agree to that the new generation in Myanmar have become less interest in national language.

2) It is confirmed that the fundamental causes of less interest in national language and literature mainly concern with job prospect, using IT in English, computer games and no encourage of their environments.

3) Although Myanmar new generations do not prefer to learn national language and literature, they realize well that it is important for their culture and identity.

It is predicted that if Myanmar government mainly focus on the relation of language and nation-building by enforcing the importance of national language among new generations, Myanmar will attract the interest of other countries, not only for natural resources, but also for the capabilities of her people. Under the leadership of the government and responsible people and state-holders, it is a must to make the new generations realize how and why the maintenance of national language and national identity is important in nation-building.

VI. RECOMMENDATIONS

The national language situation in Myanmar is not good as it was previously described and the following facts are therefore recommended to recover from bad situation.

1) Government policy in education society has to change to bear skillful Myanmar literature teachers with a suitable proportion compared with the English, Mathematics and science teachers in Basic and Higher Education.

2) The teachers especially in basic education have to be trained to be skillful in teaching of national language. At the same time, it is essential to increase the teachers’ salaries to be adequate for living.

3) Government must manage private international schools to venerate national language, Myanmar and traditional literature.
4) The government should create the proper job opportunities for the graduates who specialized in Myanmar language and literature and also Myanmar Studies in administrative sectors.

5) Special talk shows about Myanmar language and literature should often hold not only in university level but also in high school level and junior high school level to understand importance of mother language and national identity.

6) There should be regular symposium or workshop how to improve teaching of national language and how to correlate it international language and culture.

7) The government should create mobile libraries in every district for the whole year to persuade the interest of people and cultivate their reading ability.

8) The government should carry out the special research project how to modify and upgrade national language and literature to maintain national identity and to build a proper nation with sufficient research funds.

9) The ministry of education has to manage the honorable scholars and experts from respective subjects have fully authorized in the curriculum reform of basic education in Myanmar.

At the meantime, however, no one can deny how much Myanmar language is useful in community; they cannot evaluate its usefulness, its prestige and its importance. Before endeavoring to change the attitude of new generations, it is necessary to change the elders’ attitude on Myanmar language and literature first. To be a good citizenship of Myanmar, preserving national language and literature is essential.

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The Comparative study of Akha Proverbs and Myanmar Proverbs

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Abstract—This research paper deals with the comparison of Akha proverbs and Myanmar proverbs. Proverbs have been appeared depending on the thinking, living and talking styles of people in society. Moreover, the habits of communities, visions of environment, social dealings, customs and beliefs controlled the formation of proverbs. This study is based on the Myanmar proverbs published by Myanmar Language Commission, Akha proverbs from Akha Literature Society and the data interviewing with Saya Thuya from Akha Christian Seminary. According to this study, the value of proverbs, their usefulness and distributions in each society can be known. Those proverbs are very similar meanings and nature in some points which can be concluded that Akha society and Myanmar society have been closely related with each other for a long time.

Key Words: Akha Proverbs, Myanmar Proverbs

I. INTRODUCTION

There are several types of ethnic group are living together in Myanmar. Therefore, different types of native languages can be observed in Myanmar. However, due to the similar culture and living style, some of the languages are more or less same attitude meanings and essence in some cases. Proverbs can be found in each language and literature. Proverbs have been appeared depending on the thinking, living and talking styles of people in societies. Moreover, the habits of communities, visions of environment, social dealings, customs and beliefs controlled the formation of proverbs. The aim of this paper is that by the comparative study of proverbs from Akha society and Myanmar society, to know the relations between each society especially for their habits, actions, ideas and culture.

II. METHOD OF STUDY

This research paper deals with the comparison of Akha proverbs and Myanmar proverbs. This study is based on the Myanmar proverbs published by Myanmar Language Commission, Akha proverbs from Akha Literature Society and the current data interviewing with Saya Thuya from Akha Christian Seminary. By interview, some important and most useful Akha proverbs are collected. Then, they are studied with suitable Myanmar proverbs by the comparative study of their nature and essence with each other.

III. A BRIEF HISTORY OF AKHA

The Akha are an indigenous hill tribe who live in small villages at higher elevations in the mountains of Thailand, Myanmar, Laos and Yunan Province in China. As an origin, Akha started living at the central of Asia and then they had moved to Sitsaungpana area since 1860. In Central Asia, there were two majors groups namely "Mari" and "Jabot". They were living along Mekong river ranges region in sub-groups due to the attacking of Mongo. From there, they migrated to the East of China, North of Thailand, West of Laos, North of Vietnam and East of Myanmar. Akha group had been arrived Kyaing Tone area since 1860 and they started to live at "Goodmar kone" area. They came out from Tibeto-Burman group. They were known as Za Nyi in ancient time, but they can be called themselves as Akha which means people migrated far away from native land. Akha people living in different countries are using their different local languages, but, they can communicate with each other. (Personal Communications with Saya Thuya)

IV. GENERAL CHARACTERS OF AKHA

They are living on agriculture works especially for terrace cultivation of Tea plantation. They are wearing colorful threads of cloths made by them-selves. They also are using silver wearing for their ornamental purposes. Both men and women are wearing caps. Different styles of caps indicate even marriage status of Akha tribe. For inheritance, boys should be given favorable by their local rules. There are about 30 different small groups of Akha in Myanmar, they can be known as their leader names, or famous person of their group.

They are normally worshipping their local spirit (nats). If they were sick, they will go to their nats and they will do all the instructions given by their nats. Akha are doing great funeral ceremony for their old age people death and they are also giving great respect to their ancestors. The most important festival of Akha is known as the swing festival.

In a modern time, some Akha are Buddhism and some are Christian. There is no writing style of words in Buddhism, some writing style of Akha words in using christen communities. Akha language had been invented in Myanmar words since 1975, however, it can be found that some difficulties in international communications for Akha Societies. Therefore, using only for Akha language with Myanmar words had been terminated. Akha language which can represent for all Akha groups living in different countries was tried to invent based on among Roman
Catholic and Baptist Christian communities. Up to now, Akha language has been used since 2005. It is an international standard language using computer and e-mail by new generation Akha people.

V. PROVERBS

Proverbs are invented by the people to use among the people for easy communication of their societies with their language. Concerning with the proverbs, the definition of proverbs can be explained as several ways in Myanmar literature as the following:

   "The proverbs are concise form of words which can be used as standard form with effectively knowledge to know more clear writing and talking in society."

2. According to Myanmar encyclopedia (1975)[2]
   "Proverbs can be used comparatively for more effective and active in talking."

3. According to Dr. Hla Pe (1962)[4]
   "Proverbs are most essential words form which can come out from Myanmar learned stories. They can be found as relative words or simile words form between written language and spoken language."

4. According to U Hokewan (2004)[3]
   "Every ethnic group has proverbs and saying. Proverbs are not directly related to academic only; it is directly related to self finding by which human nature and social life nature are included in it."

Therefore, Proverbs are come out from people thinking and their experience to use in writing and speaking in our society. By using these proverbs, the essence of language should be increased in practical ways.

Proverbs and saying are as old as, and almost certainly older than, the written language. Ever since Myanmar was first put into writing perhaps during the early part of the 12th century A.D., they have enriched and embellished the literary as well as the everyday usages. There are many collections of proverbs in Myanmar that people still use, these frequently, whether in formal speech or in daily conversation. (Soe Naing, 2009)[5]

Proverbs can take a implementation not only in culture, custom and thought of a nation but also in literary development (Myanmar Language Commission, 1996)[1]

VI. THE COMPARISON OF AKHA PROVERBS AND MYANMAR PROVERBS

According to Dr. Hla Pe (1962), Proverbs should be appeared from Human Behaviors such as human characters, human manner, human relation, human role and regulations.[4]

(1) Human Characters

Human characters are habitual action for human being in their society. They show the attitude of man, their nature and their interest.

Example (i)

Akha Proverbs

=> သန်ဆားမြင်ားထာပင်ား ြလုပ်ဘူားသူ ုကခကကြုုံ

Myanmar Proverbs

=> မြင်ားြစားတတ်ဝတာွဲ့အုန်ားဝပေါက် က ြ်ားြစားတတ်ဝတာွဲ့ ထုုံားဝပေါက်

Both of them are similar meaning. That means someone who is never doing anything can get great trouble in practical way.

Example (ii)

Akha Proverbs

=> ဆားသန်အေားရက် ြြ န် သန်ဆား

Myanmar Proverbs

=> ကသုယ်ထင်ကုတင်ဝရွှေနန်ား
Those above proverbs show the human nature in living. For example, someone who like one thing is very valuable than the other which is actually not good for common sense. Akha proverbs show that when someone has so hungry, he can eat all things even very bitter leaves, but, when someone has full of stomach he cannot want to eat anymore even tasty food.

(2) Men and Women Proverbs
According to Human nature, men and women are working and living together in society. So, the proverbs which are related to men and women lives are coming out.

Example (i)

Akha Proverbs
=> ဗုံးဖယ်ကသုနုံရုံမြား ရယ်ဖယ်ကသုလက်ေေါးကာ

Myanmar Proverbs
=> ြသန်ားြတသုွဲ့ ဣဝ္နြေဝရွှေဝပားလသုွဲ့ြရ

Those proverbs are showing the nature of women who can do things properly depending on the nature of women-hood.

Example (ii)

Akha Proverbs
=> တစ်ရက်ရှင်ြင်ဝသာ် နုံနက်ဝသရည်ြဝသာက်န ွဲ့

Myanmar Proverbs
=> ရှင်ကသု ဖက်ဝတာွဲ့ ဓဇက်လူကသု ဖက်ဝတာွဲ့ အရက် ဓာားကသု ဖက်ဝတာ် ေေါားမြက်

Those proverbs indicate that the style of human manner especially for heavy drinking practices must be avoided for youth and they have to look after themselves to be a nice gentleman in future.

(4) Age Related Proverbs
Age relations represent the rich of general knowledge and experience in society.

Example (i)

Akha Proverbs
=> ကအသုလ်ားဝဟာင်ားသသ လူအသုဆသုရသုားကာားနှင်ွဲ့ ထုုံားတြ်ားသသ

Myanmar Proverbs
=> ရှာားပင်အသုဝလအနှစ်မပည်ွဲ့ဝလ န ာား ပ သြုသန်လှ  န ာားအသု ပ ေါင်က  ျိုး

Those proverbs say the old age person may be smart one due to his experience and thinking on living. As the same in Akha Proverbs, old buffalo knows old track in the field. In Myanmar Proverbs, if Shar Pin is old age, it can be gained full of good qualities for using.

Example (ii)

Akha Proverbs
=> ရွက်ပဟောင်ျိုးသော ပကြွေသည်မဟုတ် ရွက်သစ်လည်ျိုး ပကြွေတတ်သည်

Myanmar Proverbs
=> အမှည ်တဝင်ျိုးဝင်ျိုး အကင်ျိုးတဖ  တ်ဖ  တ်

Those proverbs show the natural phenomena of life and death is the same for both old and young persons simultaneously.

(5) Proverbs of Relations
Human relations within the society are very important for the development of each society.

Example (i)
Those proverbs show the relationship among in the society, bad men and good men. Each society has an evil person who can live and act together with others for the society development.

Example (ii)

Akha Proverbs
=> မသခင်သူစမ်း၊ရင်ျိုးနှျိုးလောမှကုယ်များနှျိုးနြွယ်

Myanmar Proverbs
=> ခင်ရောပြွေမ နေရောဟင်ျိုးပကောင်ျိုးပော်ရောနာဗ္ဗောန်

Those proverbs are showing the closely relationship is important for each society. In the first meeting someone should be a stranger. However, after several meeting, he or she can be close friend as a relative.

Review

As above mentioned, the study of Akha proverbs and Myanmar proverbs comparatively, they are showing that those proverbs are more or less very similar ideas and culture to each other even Akha and Myanmar people are living different areas in Myanmar.

Our ancestors left us those valuable proverbs depending on their thoughts and experience to develop our society and our knowledge of language and literature. Proverbs may show every important thing in each society and their cultures. Moreover, they can develop the language and literature of our society and control them to be smarter one in future.

VII. CONCLUSION

It is a comparative study on some Akha proverbs and Myanmar proverbs. According to this study, the characteristics of Akha and Myanmar societies are very near and more or less the same idea and closely related. Proverbs can show the life long history of each society and their closely relationship for a long time. Therefore, proverbs should be studied and maintained properly because they can keep and show our society thinking, believing, relationships, language, literature, culture and their development in our society.

By study of Akha proverbs and Myanmar proverbs comparatively, it is known that these proverbs are same value, same idea, and same culture even though they are living a far away from each other.

Therefore, those Akha and Myanmar people living in Myanmar are staying at rather different area, but, their quite similar culture and habits shown by comparative study of their proverbs that those peoples Akha and Myanmar societies have been closely related each other from the past up to present time as one family nature.

ACKNOWLEDGMENT

Firstly, I would like to pay gratitude to Professor Dr. May Yee Thein, retired Pro-Rector, Kyaing Tone University for her permission of doing this research at Kyaing Tone University in 2013-2014. Then, I would like to express my sincere thanks to Professor Dr.Thar Htun Maung, Pro-Rector, Kalay University and Professor Dr.Aung Nay Myo, Professor & Head, Department of Myanmar, Kalay University, for their kindly given permission to submit this research paper to Myanmar Universities Research Conference, 2019. Last, but not the least, I also would like to thank to Professor Dr. Than Htut Lwin, Principal, Taunggoke Degree College for his general supports for the preparation of this research paper during staying at Taunggoke Degree College.

REFERENCES
[1] မြန်မာစာအဖ ွဲ့၊ မြန်မာစကားပုုံ၊ ရန်ကုန်၊ ပညာဝရာေနကားဌာန၊ ၁၉၉၆
[2] မြန်မာွဲ့စယ်စုုံကြ်ား (၁၄)၊ စာဝပဗသြာန်၊ ၁၉၇၅
[3] ဟုတ်ေြ်၊ ဝြာင်၊ စသန်ပန်ားမပာအက်ဝဆာာား၊ ရန်ကုန်၊ ဓူုံပုုံနှသပ်တသုက်၊ ၂၀၀၄
The text provided seems to be a page from a document written in a language that is not English. The text appears to be a combination of random letters and symbols, which does not convey a coherent message. It is difficult to interpret the content due to the lack of recognizable words or phrases in English.


Legislative Oversight in Security Sector Governance of Myanmar: Constitutional Provisions and Actual Implementation

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Abstract— It is important to design effective reform or approach in order to develop democratic transition in which comprehensive security sector reform or security sector governance can create more avenues and wider participation of concerned executive agencies, legislative bodies and general public at all levels of implementation. Of democratic transition countries in the world, Myanmar with its unique way to democratic transition since 2010 has also needed inevitably to fulfill such significant democratic benchmarks as transparency, accountability, good governance and clean government measures. In order to carrying out these democratic benchmarks or norms, mostly designed by neoliberalist idea, security sector governance is the most important topic needed to be discussed in the larger extent including cooperation and coordination of four pillars of government - executive, legislature, judicial, media and civil society. It cannot be denied that none of the legislative chambers in Myanmar either in lower house or upper house, either at the Union-level Legislative Chambers (Pyidaungsu Hluttaw) or State/Region-level Legislative Chambers are strong enough in the questions of how to oversight or how to carry out rule-based avenues for security sector governance in case of structural reform of Myanmar Police Force in crowd management and community policing, excessive use of police force to crack down on students’ strike against National Education Law in 2014, communal violence in Rakhine State and Mandalay Region, budgetary control and Hluttaw Committees for security sector governance. Currently, under the 2008 Constitution, legislative oversight of security matters in terms of drafting motions and bills, laws and amending provisions had sometimes encountered with legal and factual limitations. Upon this backdrop, this paper aims to highlight the potential strength and existing limitation in security sector governance by the Union Legislative Body or Pyidaungsu Hluttaw which is composed of two assemblies.

Research Question and Method

Firstly, it is needed to clarify what does security sector governance means to Myanmar since the word “security” is quite sensitive in its politics. This paper highlights the power and functions of legislature including oversight and representation. Then, it is necessary to answer how to grab effective and accountable security sector governance. It will answer the strength and limitation in carrying out effective Parliament (Hluttaws), especially in overseeing security sector governance. Besides the role and power of Hluttaw Committees and Commissions in legislature is necessary to explain. Then, this research tries to answer the major areas of security sector governance – provisions of 2008 constitution, partially discussed bill on National Defense and Security Council on 21 December 2015 during the first regular session of the Pyidaungsu Hluttaw, the formation of National Defense & Security Council overseen by the Parliament. It also trace the creation of State Counsellor post is supportive for parliament in pragmatic oversight of security sector governance that is, in real, necessary to balance between parliament efficiency and role of military security without hampering civil-military relations since the role of Tatmadaw had strong for many years. It is to explore the importance of legislative oversight by applying either Proactive Governance or Reactive Governance on security sector. It is no way to deny that well-established legislative institutions in overseeing the policies and implementation can lead to good security governance. Primarily, this paper is descriptive and qualitative one focusing on such official published documents of governments and Hluttaws (Parliament) including books, newspapers, and periodicals. It also selects some reliable articles and opinion papers published by private journals and broadcasting services Myanmar media environ. The theoretical observation on security sector governance is highly relied on the sources jointly published by Geneva Center for Democratic Control of Armed Forces and Inter-Parliamentary Union in 2003 which provides scholars with
wide range of security sector and its process to reform. It also refers some state building efforts by the EU in some Eastern European countries by applying its soft power. To be a qualitative research, some scholarly observed published books are also referred in this paper. To have qualitative analysis, interviews were conducted with officials of executive agencies to sound out their perspective and opinion on security sector reform which is however referred as anonymous answer.

Myanmar Experience on Democratic Reform and Security Sector Governance

Observations from Myanmar historical records published by Myanmar History Commission in 1999 highlighted the important role of Parliament in national security and political environs during Anti-Fascist Peoples’ Freedom League (AFPFL). Although the rules and regulations approved by the Parliament, it was proved that a single deadlock between political and security considerations, trust between majority and minority, power politics between leaders of nationalistic politicians and of security-centric military forces were very important in democratic consolidation of transitional Myanmar at that time. It is still a prevailing factor today. It was a short breath of democracy for the people of Myanmar without any focus on good democratic governance constitutionally or informally. Mutual trust, empathy and compromise were the basic factors in Myanmar political development throughout its history since independence.

Elections in 1990 were viewed as the most free and fair elections in Myanmar history though transfer of power, the main objective of holding elections was totally neglected due to lack of trust, pursuance of confrontation by political parties against Myanmar Tatmadaw, lack of reliable constitution and tough as well as deadlock stands between security sector agencies, particularly, Myanmar Defense Force and electing winning political parties. Violent and confrontational approaches by political parties on one hand and persistent suppression by security agents on the other also caused deep and severe mistrust in the initial stage of Myanmar democracy movement. It was not clear that whether consideration on democratic governance and security sector governance has been initiated or not until 2010 though there were many fictions between President U Thein Sein Cabinet and Speaker Thura U Shwe Mann Union Assembly (Pyidaungsu Hluttaw) that led to the power struggle inside Union Solidarity and Development Party in the late 2014.

Structure and Power of Legislature under 2008 Constitution

A well-known initial step in Myanmar political development, the Seven-Points Road Map was laid down on 30 August 2003 with the aim to support country’s future democratic proceedings. These steps are:

**Step 1.** To hold National Convention with different representative including representative from political parties in 1990.

**Step 2.** To adopt detailed basic principles for drafting the Constitution.

**Step 3.** To draft an enduring the State Constitution.

**Step 4.** To hold National Referendum

**Step 5.** To hold 2010 Multiparty Democracy General Election

**Step 6.** To prepare transfer of political power to the winning political parties

**Step 7.** To form democratically elected government

Of important functions of legislature, representation to different level of legislative assemblies is outlined in the 2008 Constitution. When 2010 Multi Party General Elections were successfully held with many questionable issues, the Constitutional Hluttaws at all levels have been consequently established. Representation through election and through appointment by Commander-in-Chief at all Hluttaws is a significant feature. The procedure and process of delineating constituencies are stipulated under Section 109 and Section 141 of the 2008 State’s Constitution based on population size in Pyithu Hluttaw (House of Representatives) and equal representation of constituency in Amyotha Hluttaw (House of Nationalities). It was announced by the Elections Commission on 11 August 2010. Total number of constituencies from 325 to 330 including new capital Nay Pyi Taw had been issued in the General Administration Department’s gazette in September 2009 so that the number of seats in the Pyithu Hluttaw raises up to 330 seats.

For the procedure of delineating the Amyotha Hluttaw constituencies as provided by Section 141 of the State’s Constitution (2008), there are twelve constituencies for each of the states and regions, a total of 168. These constituencies are formed by combining townships into a single constituency, or splitting a township into two constituencies, taking into account the population of each, so as to form twelve constituencies in each region or state.

Remarkable provisions of Section 109 (b) and Section 141 (b) prescribed for the Defense Service personnel in each Hluttaw was the significant feature of 2010 Multiparty Democracy elections. On an account of constituency, according to State Constitution 2008, the Elections Commission announced 330 constituencies for Pyithu Hluttaw and 168 constituencies for Amyotha Hluttaw, 673 constituencies for State/Region Hluttaw. In each Hluttaw, one-thirds of Hluttaw representatives were constitutionally composed of the personnel of the Defense Services. In effect, the total number of representatives-elect and military appointees reached to 1163 constituencies.

As provided in the Section 109 (b) and Section 141 (a) and (b) of the 2008 State’s Constitution, one-thirds of total representatives-elect in each Hluttaw, were appointed by the C-in-C of Defense Services of the Republic of the Union of Myanmar. The following table and figure show the ratio between representative-elects and military appointees by C-in-C to the respective Hluttaws.
Table 1: Designated Number of Constituencies and Seats in the Three Hluttaw

<table>
<thead>
<tr>
<th>Region</th>
<th>Pyithu Hluttaw (House of Representatives)</th>
<th>Armyotha Hluttaw (House of Nationalities)</th>
<th>Pyidaundus Hluttaw (Union Assembly)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elected Seat (1 constituency for each of 330 township)</td>
<td>Elected Seat (12 each for each Region/State Hluttaw)</td>
<td>Total Elected Seat</td>
</tr>
<tr>
<td></td>
<td>Military Appointees</td>
<td>Military Appointees</td>
<td>Total Military Appointees</td>
</tr>
<tr>
<td></td>
<td>Elected and Appointees Seats</td>
<td>Elected and Appointees Seats</td>
<td>Total Elected and Appointees Seats</td>
</tr>
<tr>
<td></td>
<td>330</td>
<td>110</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td>168</td>
<td>56</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td>498</td>
<td>166</td>
<td>664</td>
</tr>
</tbody>
</table>

Source: (a) The New Light of Myanmar, 12 August 2012

As provided in Region Hluttaw or State Hluttaw Law, and as stipulated in Section 161 under the Chapter IV of the 2008 State’s Constitution, there are two constituencies for each township. Total of 636 constituencies for Region or State Hluttaw have been designated by the Union Election Commission. As stipulated in the Region or State Hluttaw Law, one-third of military appointees of total number of representative-elect nominated by the C-in-C are added to the respective Region or State Hluttaw, that is, 222 seats. Thus, total number of representatives-elect and military appointees in all State or Region Hluttaws including Self-Administered Area and Division reached to 887. The following table shows the number of seats at the Region or State Hluttaw after holding the 2010 elections on 6 November 2010 and 2015 elections held on 8 November 2015. A total of 6189 candidates contested in 2015 elections.

Table 2: No. of Constituencies in Region or State Hluttaw

<table>
<thead>
<tr>
<th>Region/State</th>
<th>No. of Elected Seats</th>
<th>No. of Military Appointees Seats</th>
<th>No. of Additional Minority Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayeyawady</td>
<td>52</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Bago</td>
<td>56</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Magway</td>
<td>50</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Mandalay</td>
<td>56</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>Sagaing</td>
<td>74</td>
<td>*25</td>
<td>2</td>
</tr>
<tr>
<td>Tanintharayi</td>
<td>20</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Yangon</td>
<td>90</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Kachin</td>
<td>36</td>
<td>*13</td>
<td>4</td>
</tr>
<tr>
<td>Kayin</td>
<td>14</td>
<td>*6</td>
<td>3</td>
</tr>
<tr>
<td>Kayah</td>
<td>14</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Chin</td>
<td>18</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: (a) Countdown to the Myanmar Elections, SSRC, pp. 11-13, 25 August 2010

Diagram 1: NLD Led Pyithu Hluttaw and Armyotha Hluttaw Structure after 2015 Elections

Source: www.myanmarparliament.gov.mm

The power vested to the legislature is prescribed under Chapter 3 of the 2008 Constitution. Pyidaungsu Hluttaw, composed of Pyithu Hluttaw and Amyotha Hluttaw is responsible for nation’s executive through Presidential Electoral College under the Section 60. The constitution permits all three groups of representatives – elected Pyithu Hluttaw, Amyotha Hluttaw and appointed Military representatives – elect or propose three vice presidents inside or outside elected representatives. Collectively, all elected representatives and appointed military representative voted for one of the three vice presidents to assume presidency. On 31 March 2011, U Thein Sein, the Chairman of USDP became first president under 2008 Constitution and on 22 February 2016, U Htin Kyaw of NLD became the first civilian president respectively.

Similarly, the Head and Deputy Head at the different level (Pyidaungsu Hluttaw, Amyotha Hluttaw, Pyithu Hluttaw and Region /State Hluttaw) are to be elected to supervise and conduct respective Hluttaw sessions under the Section 75. The Head and Deputy Head of Hluttaws are called Speaker and Deputy Speakers of Pyidaungsu Hluttaw, Pyithu Hluttaw, Amyotha Hluttaw and Region and State Hluttaws.

In the context of legislative function, there are three types of law making – bills, motion and proposals – by MPs either in Amyotha Hluttaw or Pyithu Hluttaw under the section 95. A bill can be originated to discuss in either Amyotha Hluttaw or Pyithu Hluttaw by drafting the executive agency or a MP or an organization to promulgate as law. There are roughly three forms in approving bills as law. First, agreed bill, second disagreed bill and agreed bill with amendment if bill is disagreed by two Hluttaws or President’s comments. If such bill is approved at either Hluttaw, it is deemed that bill shall be approved by the Pyidaungsu Hluttaw (Union Legislative Body) as law. The President has to sign and send the bills with or without comment to Pyidaungsu Hluttaw within 14 days to promulgate as laws. Union Legislative Assembly can find to solve the bill upon the president’s
request or resolve the bill without consideration on President’s comment. It is then necessary to send back to president who has to sign the resent bills. It is clear that the Union Legislative Assembly as legislative body has the power in making law and approving laws necessary to regulate functions of the executive agencies as in other democratic countries.

There is a strong point for the union legislature to oversight executive branch through submitting bill at Pyidaungsu Hluttaw. Union legislative lists under the Section 96 clearly stipulates as Schedule One under which Pyidaungsu Hluttaw has the power to enact laws relating 11 sectors including security sector. Including financial sector, the Union Legislative Lists for Defense and Security Sector under the Schedule One of Union Legislative List stipulates as follow:

“(a) Defence of the Republic of the Union of Myanmar and every part thereof and preparation for such defence; (b) Defence and Security industries; (c) Arms, ammunition and explosives including biological and chemical weapons; (d) Atomic energy, nuclear fuel and radiation and mineral resources essential to its production; (e) Declaration of war and conclusion of peace; (f) Stability, peace and tranquility of the Union and prevalence of law and order; and (g) Police force.”

Above stipulation outlines the security sector under the 2008 Constitution covers defense forces including police force as executive agencies which are regulated by the laws and bylaws promulgated by the Union Legislative Branch (Pyidaungsu Hluttaw).

Besides, in the context of budget approval function, next important power of legislature, the Section 103 of the 2008 Constitution precisely stipulates the legislative power of Hluttaw in submitting the Union Budget Bill for salary, expenditure and allowance for Union level heads, members and organizations. It also implies to debt, expenses and loan for which the Union government is liable, expenditure required to satisfy judgment, decree and order of any Court or Tribunal including other expenditures charged by any existing laws or any international law. More significantly, Pyidaungsu Hluttaw is empowered to approve, refuse or curtail any other expenditure specifying under the Union Budget Bill with the majority consent of Pyidaungsu Hluttaw. In this context, the Union Government has to perform in accord with the Union Budget Law and Supplementary Appropriation Law with the majority consent of the Pyidaungsu Hluttaw.

“The President or person by him, on behalf the Union Government, shall submit the Union Budget Bill to the Pyidaungsu Hluttaw in the matters of salary for union level personnel and organizations, debt, expenditure and loans concerning the whole Union.”

The first six months of NLD-led government under the President U Htin Kyaw faced significant economic stagnation and fiscal challenges. In that case, the President himself took the chairman of Financial Commission to reform monetary sector and to revise budget deficit while the government has been criticized by domestic and international partners due to lack of clear economic policy and anti-business approaches of new government. It is the first time the NLD led government used the term “reform” in public media. The numbers of ministries are reformed from 37 ministries under previous government to 22 ministries under the current NLD government so that Union Budget Bill has been amended at the second regular session of Pyidaungsu Hluttaw and then will be submitted to third regular session of Pyidaungsu Hluttaw at the end of November 2016. So, all government ministries have to wait to spend respective revised budget which in turn affect domestic market and economic imbalance.

It is clear that major MPs representing the NLD in both legislative bodies are very important how to manipulate government sectors including security sector governance since Myanmar political development has been dominated by military. As provided in Section 122 and Section 153, Defense Service personnel as representative of both houses are appointed with the approval of C-in-C. This type of representation appointed by C-in-C has caused a number of frictions in first regular sessions of both houses in approving State Counsellor Bill, cancellation of Overnight Registration Law and amendment in Peaceful Assembly Law in NLD majority Hluttaws between March and May 2016. There are many criticisms on the Speakers of both Hluttaws who are trying to limit or ban some motions, proposals and questions of MPs that restrict access for State Counsellor’s led government during Hluttaw Sessions. Theoretically, democratic consolidation increases its momentum only when the separation of power and check-and-balance among branches of government were strong enough. It is important to channel security sector governance through the strong legislature and its Houses’ members.

There have been many passive as well as sensitive security issues in reform process since 2010 elections. Current NLD-led government after 2015 election avoided the use of reform instead the U Htin Kyaw administration favored the term “Change”. The importance of security including economic and financial security as well as democratic and socio-economic development of Myanmar has been important to security and development in Southeast Asia recognized by most bilateral and multilateral donors in recent years.

It is completely factual that both “reform” articulated by previous President U Thein Sein Administration and “change” clearly expressed by President U Htin Kyaw Administration on security sector governance focusing on institutional development for defense forces, accountability of Police Force and Ethnic Armed Organizations (EAOs). Both administrations decisively emphasize the need of effective security sector governance or security institution reform.

Briefly, legislative power and function are constitutionally promulgated under the 2008 Constitution in which a number of powers are vested to both Houses to issue decrees and ordinance, to promulgate laws, to control budget and to oversight executive functions. The foremost security sector governance has been carried out during the previous President U Thein Sein Administration with the support of the European Union and its Parliament.
which provided a number of projects on police accountability, crowd management and community policing designating two special townships in the Yangon Region even though Myanmar Police Force (MPF) is being organized under the Ministry of Home Affairs directly administered by the C-in-C in accordance with the Constitution. Budgetary control over security sector is not clearly outlined and articulated in the Hluttaws so far though the Finance Commission headed by the President revised the Union Budget Bill on 1 November 2016. Moreover, representatives at the both Houses are now facing with the pressure of civil society organizations and activists of rule of law for the promulgation of Right to Recall Law at the Union Legislative Assembly.

**Legislative Committees and Commission on Security Sector Governance**

For security sector governance, such executive agencies as Myanmar Defense Force (Tatmadaw), Myanmar Police Force (MPF) and related agencies and institutions are needed to oversight by legislature. Besides Ethnic Armed Organizations (EAOs), Border Guard Force (BGF) and ethnic armed groups are also important in security sector stability. On the side of legislature, such legislative or Hluttaw Standing Committees and Commission are important to take the role of oversight in executive agents, ethnic groups agents with or without signing Nationwide Ceasefire Agreement (NCA). The Section 115 (a) and 147 (a) of 2008 Constitution stipulates as follows:

- The Pyithu Hluttaw shall form Bill Committee, Public Accounts Committee, Hluttaw Rights Committee, and Government’s Guarantees, Pledges and Undertakings Vetting Committee with the Pyithu Hluttaw representatives.
- The Amyotha Hluttaw shall form Bill Committee, Public Accounts, Committee, Hluttaw Rights Committee, and Government’s Guarantees, Pledges and Undertakings Vetting Committee with the Amyotha Hluttaw representatives.

Currently, there are one Standing Commission and 15 Committees each in Pyithu Hluttaw and Amyotha Hluttaw during the first Hluttaws sessions (2010-2015). Of fifteen Hluttaw committees, Bill Committees, Budget Committees, Government’s Guarantees, Pledges and Undertaking Vetting Committees, International Relations Committees, Social and Educational Promotion Committee, Ethnic Affairs Committee and Economic Committees are set up with each representative representing state/region constituencies and military representatives. Joint Committees are also formed to carry out legislative functions in both Houses with equal numbers of representatives from each house. One significant structure is the formation of Commission for Legal Affairs and Special Issues at Pyithu Hluttaw which primarily focuses on special cases in law enforcement and security sector governance under the Section 134 of 2008 Constitution. The military committees in both houses have not been set up as provided in section 115 (b) and section 147 (b) which stipulates as follows:

When the occasion arises to have studies made and submitted on defence and security matters or Military affairs, the Pyithu Hluttaw shall form the Defence and Security Committee with the Pyithu Hluttaw representatives who are the Defence Services Personnel for a limited time. The Defence and Security Committee so formed may, if necessary, be included suitable Pyithu Hluttaw representatives who are not the Defence Services personnel in accord with the volume of work.

When the occasion arises to have studies made and submitted on defence and security matters or Military affairs, the Amyotha Hluttaw shall form the Defence and Security Committee with the Amyotha Hluttaw representatives who are the Defence Services personnel, for a limited time. The Defence and Security Committee so formed may, if necessary, be included suitable Amyotha Hluttaw representatives who are not the Defence Services personnel in accord with the volume of work.

It is clear that the National Security and Defense Committee headed by the President is the only security and defense body to handle national security issues which is out of oversight from legislature to some extent. The first NSDC Meeting has held on 11 November 2016 after the terrorist attacks on Police Outpost stationed near Myanmar-Bangladesh Border. It is a threat to national sovereignty and existence of statehood for Myanmar. In an attempt to security sector governance, the concept of statehood is to extent contrary to security sector governance. It is necessary to avoid restructuring the government and bureaucratic apparatus, political parties and public institutions focusing the accomplishment of security governance objective only. Political decision making in security sector governance is very crucial especially in post conflict countries. Although there prevailed dilemma between statehood stability and security sector reform in short term, for long term it is necessary to create tangible security sector governance depending on domestic political situation.

In short, Myanmar has limited experience of parliamentary oversight on security sector since military operation as only means to consolidate national security especially under Government of the Burma Socialist Programme Party (BSPP) during which total of 742 military operations were launched against ethnic armed groups without getting approval of Parliament of AFPFL or of the getting consent of People’s Assembly of BSPP.

The controversial 2008 Constitution has been drafted by the National Convention of the SPDC for nearly 20 years before the referendum was held on 4 May 2008. Most of its articles seemed to be interpreted some articles of American Constitution except President’s Veto power and some salient points of Pakistan constitution. Although the provisions of the 2008 Constitution are criticized by many constitutional experts, it is now a workable constitution of Myanmar democratization.

In the context of security sector governance, two main institutions – Myanmar Defense Force and Myanmar Police Force – had been primarily emphasized since 88 students uprising. More attention on questionable incidents known as 2007 Saffron Revolution and 2013 Students’ Strike against the National Education Law shed lighted the importance of accountability and transparency in security sector governance of Myanmar. Asking to accelerate the
prevalence of rule of law and reform for security institutions are the popular debate at all works of life among people.

**Myanmar Defense Force (Tatmadaw)**

There is no separation of power among three branches of government as the country was ruled by notifications and orders issued by the SLORC and SPDC until 2010. Of two security institutions, Myanmar Defense Force is no doubt influential in Myanmar politics since independence. After a brief period of democratic system between 1948 and 1958, Myanmar was under the military rule for more than six decades even though the BSP government evolved as regularly elected government until 1988. The role of **Tatmadaw** was strong and unable to neglect after 1988 because all bureaucratic and big businesses as well as enterprises had been controlled by the then SLORC and SPDC governments. Myanmar Defense Force enlarged its force from 200,000 to 400,000 forces during 1988 to 2010. Military expenditure during these years had exceeded over 48% to 52% of GDP without the approval of parliament. In fact, SLORC and SPDC lacked separation of power among three branches of government as the Chairmen of both military governments (**Tatmadaw**) were the five-starred commander-in-chief, the highest figure as the Head of State representing executive and legislature. A proxy head for legislative body was formed under the Attorney General while Chief Justice was also appointed as to highlight the judiciary independence. Total of 37 ministries were composed of more than one deputy ministers.

Before 2010 elections, more complex administrative and military structures have been established. For administrative structure, Myanmar was composed of 7 states and 7 divisions which were headed by State or Division Administrative Officer for administrative purpose. Seven Divisions are Magwe, Mandalay, Bago, Yangon, Ayeyarwady, Tanintharyi and Sagaing. Seven States are Kachin, Kayin, Kayah, Chin, Mon, Rakhine and Shan. At the same time, 14 military commands were established as a parallel administrative structure. Fourteen military commands were Northern, Northeastern, Shan (North), Shan (South), Shan (East), Golden Triangle Command, Southeast, Southern, Southwest, Western, Northwest, Costal Command (Tanintharyi), Costal Command (Rakhine and Mideast Command. In 2017, Koh Lang Command has been established on the river bank of Thanlwin to control the existing 4 commands of Shan State. Each command was headed by Regional Command Commander directly appointed by the C-in-C and every Regional Command Commander has the power to approve, decide and administer all administrative and business matters including judicial issues to certain degree. Each commander was responsible for the state or region they were assigned to and they directly reported to the C-in-C.

Substantial influence of **Tatmadaw** could be found in domestic politics. It made complex and overlapped orders for administrative mechanism carried out by the government ministries and subordinate agencies especially regional development plans. In the areas like “Wa” and Kokang areas which were under the dual administration of Regional Command Commander and ethnic leaders, it was difficult to identify who controls political authority in practice. National Security and Defense Council (NSDC) composed of C-in-C, Deputy C-in-C, Joint Chief of Staff (Army, Navy, Air), Chief of Staff (Army), Rear Admiral and Chief of Staff (Navy). Before 9 October 2004, the Head of Military Intelligence was a powerful figure of NSDC. Many civilian posts in executive agencies were filled up with retired or current military officials. The decade long system of paternalistic feeling and top-down administrative structure severely hampered some civilian-led administrative structures for many years. For instance, the senior level posts of the Myanmar Police Force under the Ministry of Home Affairs were occupied by military men although the nature of police force and defense force were quite different.

Having political power in the hands military elites caused illegal business conducts and deep-rooted corruption especially in natural resource rich areas of ethnic minorities in the Kachin, Rakhine and Shan states. To maintain peace and stability in border areas, 17 armed ethnic groups concluded ceasefire agreements including Mong Tai Army (MTA).

Apart from political power, financial power of Myanmar Defense Force was established under the title of the Union of Myanmar Economic Holding (UMEHL). It was the only source to which all foreign direct investments were monopolized without much accountability and transparency. Besides it was undeniable that the role of military in civil administration was very influential and independent which caused tough mindset to operate civilian-controlled bureaucratic mechanism. In fact, Myanmar Defense Force was very independent in administration, politics and economics before 2010 as no oversight mechanism or regulations were stipulated. Expose Facto Law is clearly outlined in 2008 Constitution to protect suing state agents for actions performed during their official duty.

However, after 2010 elections, the role of Myanmar Defense Force (**Tatmadaw**) has been under the hybrid civilian government. There have been no significant changes in organizational structure of Myanmar Defense Force. C-in-C was ranked as third highest position of National Defense and Security Council during U Thein Sein’s presidency. However, after 2015 elections, when NLD led government accepted transfer of power, the State Counsellor post has been created and the size of NSDC is being expanded to 12 members instead of 11 members. Before 2015, C-in-C with Defense Minister, Home Affairs Minister and Border Areas Development Minister are included in the Cabinet as well. The appointment of such three ministries requires approval of C-in-C. Although there were several meetings of NSDC during U Thein Sein administration, the first NSDC meeting after 2015 election was convened when terrorist attack against outposts of Myanmar Police Force in the Northern Rakhine State near Myanmar-Bangladesh border on 9 October 2016.

At least, there are four relevant areas from which Pyidaungsu Hluttaw or parliament stretches its oversight power on security organizations of executive agencies. These areas include under democratic civilian control over military and security forces, budget control power of parliament, parliament role in reviewing laws drafted by executive and parliament awareness on security concerns
of citizens. In the case of Myanmar, it is necessary to consider how to amend undemocratic provisions in 2008 Constitution as an entry point to establish security governance and parliament oversight over security sector reform. On the contrary, how to extend current space and pace of parliament over National Security and Defense Council since legislature and executive are in unification due to creation of State Counsellor post in April 2016. It is obvious that without amending a single provision under 2008 Constitution, National Defense and Security Council, currently composed of 12 members headed by the President has been formed with the inclusion of State Counsellor.

The problem here is the formation of National Defense and Security Council and inclusion of members who are not elected by people but appointed by C-in-C. It has been criticized by institutions inside and outside of Myanmar as non-democratic institution and process. It is necessary to aware that legislature as well as politicians needs to understand strategy and policy relating security and defense institutions with the approval of legislative approval whereas defense forces in domestic political control can destabilize in long term.

This shift also needs parallel implementation of security and development concepts in short and long terms as the two concepts are the two sides of the same coin for good security governance. A limitation in this matter is low degree of public awareness on parliament oversight in security sector reform of Myanmar. Only 10 percent of general population acknowledged the important role of members of parliament (MP) in making law. Only 6 percent of population knew the parliament has the power to oversight over executive agencies through asking questions and testimonies.

Amending or deleting the Sections of 2008 Constitution which are contrary to democratic transition and consolidation is a positive way upon which parliament must have effective control and oversight the laws drafted by security agencies of executive. Generally it is vaguely stipulated that 2008 Constitution is, to the extent, composed of many undemocratic drawbacks, particularly in Chapter (5). Such chapter stipulates the power and functions of Executives and formation of National Defesne and Security Committee which reflected the controversial opinion from democratic norms of a country. There are at least 88 sections under 2008 Constitution to be amended due to inconsistency against democratic rules and regulations. The most distinctive provisions which are difficult to be relevant with democratic norms are military representatives and their role in selecting vice-president. For instance, Section 60 (b) (3) for appointing military representatives by C-in-C to Hluttaws. Moreover, as many critics pointed out that four ministries directly relating to national defense and security are under the control and direct appointment of C-in-C under the provisions of Article (20)(b).

There is a strong provision in the 2008 Constitution of State of Emergency under Chapter XI. Although the President has the power to declare state of emergency with the approval of NDSC in time of crisis whether the member of NDSC can discuss or not with the President, the C-in-C has the power to dissolve both legislative assemblies in order to issue emergency ordinance and decrees, and to transfer administrative power from president. It stipulates under the Sections 417 and 419 as follows:

“The Commander-in-Chief of the Defence Services to whom the sovereign power has been transferred shall have the right to exercise the powers of legislature, executive and judiciary. The Commander-in-Chief of the Defence Services may exercise the legislative power either by himself or by a body including him. The executive power and the judicial power may be transferred to and exercised by an appropriate body that has been formed or a suitable person.

Legislative oversight on judiciary can also be traced in the Sections 298 and 299 of the 2008 Constitution. It elaborates the power vested to legislature in an appointment of Chief Justice of the Union upon the nomination of the President. But both Hluttaws (Houses) have no right to refuse the person nominated by the President as the Chief Justice of Union. However, the controversial legislative decisions have been carried out in Pyidaungsu Hluttaw in 2014 and 2016 respectively. In 2013, there was a tug-of-war upon the definition of the term “Union Level” between Pyidaungsu Hluttaw and Constitutional Tribunal, the highest institution in constitutional implication in accordance with the Constitution. The President U Thein Sein offered two channels to solve this issue through impeachment process or reconciliation. Upon the impeachment process decided by the Pyidaungsu Hluttaw, all members of the Constitutional Tribunal resigned from their duties. Since that time on ward, Constitutional Tribunal has been defunct in carrying out its constitutional vetted power. In 2016 again, attempt to impeach three members of the Myanmar National Human Rights Commission in case of human trafficking and slavery committed by a Ava Tailoring, such members resigned from their duties. In both cases, although both cases were constitutionally to decide under the presidential power and function, Pyidaungsu Hluttaw clearly intervened through impeachment procedure which is oversight by the Union Legislative Assembly. It is necessary to understand check-and-balance among three branches. It can be said that independent judiciary is important in line with constitutional provisions that shall lead to security sector governance at the same time. If the Constitutional Tribunal is defunct due to excess legislative oversight, there will be frail in security sector governance.

**Myanmar Police Force**

It is another security force next to Myanmar Defense Force which needed to reform provided by the EU members since 2010. The MPF in 1948 consisted of civil police and military police which were formed into battalion. Two or more British officers were attached to each battalion in which Myanmar nationals were being employed before WW II. Changes in Myanmar administrative and political system after 1988 had profound impact on police governance, police force setup, role and mandate of MPF remarkably. MPF was reorganized with several significant changes to personnel and structure, for many senior and top positions of MPF were occupied by military officers and current name MPF.
was also designated by the then-ruling SPDC. However, its ability to operate community policing and credibility became grew. But expending and modernizing MPF had been far left behind Defense Force which recruited its members from 200,000 to 400,000 between 1988 and 2002. Upgrading and modernization of MPF still remained in low profile position though majority of general public and local community were trapped in civil clashes and ethnic insurgent fighting.

In practice, police cadet candidates who joined to MPF voluntarily were limited in their professional and carrier development. Instead of organizing as independent civilian institution, several police mandate and intelligent functions still continued to be handled by military in terms of training and equipment allocations. In 2004, following the purge of military intelligent, MPF regained its greater independent intelligent and internal security role in Myanmar. The MPF is headed by Police Colonel whose background is from military officer. There are total of 73 specialized Police Forces all over Myanmar. Since 2007, a total of 821 local police stations have operated in various locations to serve public safety. The ratio between police force and public is now 1 to 1248 which is an immediate limitation in introducing community policing. The MPF headquarters is the principal to distribute the detail instructions for implementation of the plan to the regional commands. In MPF headquarters, there is a Complaint Center for the public.

A Hluttaw Committee on Rule of Law Enforcement headed by Daw Aung San Suu Kyi is concerned with oversight activity as well as a channel for complaints to the Hluttaw. Thither is a Committee to investigate problems and will bear to post the complaint letter who seeks explanation from the Police. MPF is quite different from Myanmar Defense Force in terms of political and financial power though top layer of MPF is being controlled by military officials which caused mixed feeling of police forces whose major background focused on police professionalization.

**Power and Functions of Legislature to Oversight Security Sector Governance**

In the context of power and function of legislature (Amyotha Hluttaw, Pyithu Hluttwa & Pyidaungsu Hluttaw), Pyidaungsu Hluttaw, a combined body of Amyotha and Pyidaungsu Hluttaw), is vested to select the Executive through proportionately selected representative for the purpose to nominate three vice presidential candidates by each groups. Among three vice presidents – one elected by Amyotha Hluttaw, one elected by Pyithu Hluttaw and one nominated by military representatives - who are either elected MP or not, are to be proposed to Pyidaungsu Hluttaw to elect the President who obtained the highest score in each representative group. In this scenario, it can be observed that how military participated in the role of executive, that is, deputy executive or vice president definitely represents the Defense Force in line with constitutional provision. He became one of the National Security Council member too headed by the President.

Apart from selecting the Executive Head, the President, Pyidaungsu Hluttaw has the power of national legislation. Legislative power is entrusted to the Union Hluttaw (Pyidaungsu Hluttaw) and the state/region Hluttaws under the Section 188. More specific law making process has been prescribed under the Section 188 to 196. There is constitutional provision for sharing power between Union and State/Region governments whose power and functions. The list of bills that shall be permitted to submit to the Pyidaungsu Hluttaw only have been described under Schedule One. The list of bills that is vested to state/region Hluttaws only has been described under the Schedule Two of 2008 Constitution. All bills concerning the powers mentioned under Article 190 (a) shall be submitted to state/region Hluttaw in the prescribed manner either elected MP or group of MPs It means there are two levels of submitting the bills to the Union level and state/region level. Similarly, all bills concerning the powers vested to the Union Legislative Branch shall be submitted to either Amyotha Hluttaw or Pyithu Hluttaw by either any MP or any executive agency. Besides, there is the same manner in submitting bill in the government of Self-Administered Areas.

It cannot be denied that there have been unavoidable fractions in security sector reform between minority appointed military representatives and majority elected representatives in promulgating laws referring 2008 Constitution. Such unavoidable fractions have been occurred after NLD overwhelmed majority in Parliament after 2015 general elections. Fractions occurred frequently in relating to State Counsellor and peaceful assembly law, abolishing of Visitors’ Overnight Registration Law and traveling permit, approving the law concerning the formation of Committee on Counter-demonstration and Riot Control and Advisory Commission on the Rakhine State. All these legislative attempts have directly or indirectly involved in good security sector governance under the controversial 2008 Constitution.

**Civil Society in Security Sector Governance**

There are some contradictory attempts in Security sector reform which is also an important matter for armed ethnic groups or what Ulrich Schnecknere pointed out as armed non-state actors in the failed states. Ethnic armed group leaders are holding a three-day workshop on Security Sector Reform (SSR) in Myanmar, which started on 8 August 2016 in the northern Thai city of Chiang Mai. Major participants are UNFC, ABSDF, KNU and other previous government officials under U Thein Sein Administration. Major discussions have focused on Disarmament, Demobilization and Reintegration (DDR) as security sector reform demanded by Myanmar Defense Force in peace process with respect to armed ethnic groups. Armed ethnic groups responded with the demand for reform Myanmar Tatmadaw in security sector including the formation of federal army incorporation ethnic armed groups. It is quite contrary to formation of BGF under the NCA principles.

It is very important not to trap security sector reform as legislative nightmare, particularly in the context of materializing parliamentary oversight on security sector governance. There occurred some latent voices from ethnic minorities whose voices are needed to be considered for long term sustainability of security sector reform. The power and ability of parliament to oversight security sector governance or reform seems to be incomprehensible after Mai Ja Yang Conference which
was held by Ethnic Armed Organizations (EAOs) in July 2016. There were all together five conferences held by EAOs before Peace Process of 21st century Panglong held on 31 August 2016 – two conferences in Lai Zar in the Kachin State and two conferences in Lawkeehlar in the Kayin State. United Nationalities Federal Council (UNFC) also held separate meeting with the ethnic groups who failed to sign Nationwide Ceasefire Agreement (NCA) with the previous government as a conflict resolution.

As a preliminary meeting before Peace Process of 21st Century Panglong Conference, Mai Ja Yang Conference also focused on four main topics – approval of Panglong Charter, basic principles for federal democratic constitution, basic principles for national security and defense, and renew framework on political dialogue. At the conference, ethnic nationalities discussed and submitted some specific principles regarding federal democratic constitution and basic principles for national security and defense in the context of DDR as Security Sector Reform. EAOs steadfastly uphold the UN proposed Tripartite Political Dialogue which includes “government-military-Hluttaw or Legislative Body”, the EAOs and all registered political parties.

Although peace-making and rule of law are the two priority agendas of NLD led government, increasing crime rate and questionable crime prevention measures are leveling the ratio in an unprecedented increase. On 24 August 2016, lawmakers of Pyithu Hluttaw (Lower House) debated the amendments to Peaceful Assembly and Procession Law proposed by the Amyotha Hluttaw (Upper House). The Pyithu Hluttaw approved the draft law to amend the Peaceful Assembly and Peaceful Procession Law including Freedom of Association Law. At the same time lower house MP U Win Myat Aung of Debayin Constituency asked government’s plan to form committee to supervise prisons and take care of inmates. Therefore, a series of lengthy reform measures are necessary to have effective Proactive Oversight of parliament over security sector reform. It can be seen that parliament oversight on security sector reform needs more democratic oversight not only from legislative but also from community participation to be transparent and accountable as much as possible.

Security Sector Reform in the Context of Independent Institutions or Actors Monitoring

Apart from Proactive oversight of legislature of SSR, the role and oversight of independent institutions, media and Civil Society Organizations (CSOs) is also effective in Reactive Oversight which focuses on democratically investigation and solution finding in security sector reform issues. Complaint mechanisms for general public through these institutions and CSOs to national level commissions formed by executive or legislative bodies but with independent autonomy are very important to establish effective democratic oversight of security sector reform. Normally these cases ranged from minor public dissatisfaction to bribery and corruption on national budget, consistency of government policies, the rule of law investigation, independent investigation among general public and among executive agencies concerning human rights and education campaigns on human right.

Such CSOs as Think Tank Organizations, NGOs and responsible media are the primary bodies to oversight security sector reform through the dissemination of security policy and persuasion to observe published reports between general public and MPs.

Through these activist groups and CSOs, national defense policy of its own country and diverse nature of human needs on security services can be observed that lead to effective oversight of security sector governance. A typical important matter is the emergence of genuine CSOs and community-based organizations. It is very central to give priority to public interest only. For instance, Myanmar Women Organization (MWO), once established along Myanmar-Thai border as informal CSOs is now accepted as formal women rights groups by previous government in empowering women and women MPs, relief assistance to IDP camps in the Kachin and Rakhine States too. Some active NGOs like Equality Myanmar with National NGOs Network have pointed the inconsistency in provisions under the Freedom of Association Law and Right to Peaceful Assembly Law and Peaceful Procession Law concerning voluntary registration of association. The same happened in discussions on transitional justice upon which former activist and political prisoners or prisoners of conscious are now taking role in identifying the norms and models of transitional justice in democratic transition. Myanmar Defense Force campaign against child soldiers, budget allocation to national defense sector and suspension of Myitsone Dam Project campaigned by environmental conservation focused CSOs and NGOs are also the good results of independent institutions oversight of security sector.

However, there still prevails limited rooms for participation of Think Tank and CSOs in some security related issues like miserable homicide of two Kachin voluntary school teachers in 2015, miserable communal clashes in the Rakhine State, the cancellation of Ta’agn Palaung National Liberation Army (TNLA) Press Conference arranged Ta’ang Women Organization (TWO) in Yangon on 26 July. 2016 and the death of journalist Ko Par Gyi which highlight the importance of professional and responsible journalists in crisis areas. In 2017 again, the so-called Reporters working for Reuters News Agency have been prosecuted by the NLD led government because of the confused news reporting during 2017 Rakhine issue.

Since the uprising of 2017 Arakan Rohingya Salvation Army (ARSA), the international outcry for Bengali issues and release of two reporters working for Reuters News Agency is a pressing issue for NLD government while security concern in the Rakhine state and elsewhere in Kachin and Shan states are the same as important as Rakhine issue to handling by the Myanmar government. It is a critical consideration for civilian NLD led government while NCA is in stagnant before May 2019. At the same time, 2020 elections is an anther pressure for NLD government while Arakan Army (AA) in many Rakhine villages is causing alarming among local villagers during Myanmar Defense Force operations against AA armed group. But, AA is invited to talk to the negotiation table for NCA. At these junctures, legislative oversight on executive particularly security sector is very sensitive issue while Joint Committee for Amending the
The Constitution is progressively attempting to have negotiated agreement on some provisions of 2008 Constitution.

Theoretically, it is clear that emphasis on national security concern is very tough to oversight security sector governance which is a dire benchmark for democratic transition. For Myanmar under domestic and international pressure, it has to balance too much oversight on security agencies under Reactive Oversight under SSR not to derailed to conservative attitudes. There are many evidences that national security concern is the vital national interests and uncompromised national sovereignty considered by pragmatic governments around the world especially internal national security is very sensitive to handle by the government in power. It is necessary to adjust between legislative oversight on security sector governance which has huge negative impact in domestic tranquility in time of instability and international norms relating to security sector governance in handling domestic problems, especially for transitional countries.

So, it can be suggested that formation National Ombudsmen Commission and official State apology are necessary to remedy for those suffered from past account in order to have national reconciliation which can sustain security sector reform of Myanmar. For instance, the Commissioners or the Public Compliant Committee in Nigeria and Indonesia were certain extent successful in dealing with armed forces and person suffers from past account.

II. CONCLUSION

The idea, legislative oversight on security sector reform or governance is at least certain extent strange for MPs or Representatives in both Hluttaws as well. It is important for legislative Houses and its representatives who will take the oversight role in security sector must have enough efficiency in creating more laws, rules and regulation on decentralization bases so that it can lead creating more avenue for security sector in carrying out citizens interests. At the same time, too much oversight on security sector or executive is dangerous for countries in transition to democracy especially when it turns to more conservative attitude at a very minor shift. It is agreeable that the budget control is an effective means to oversight security sector reform, but modernization of security sector is crucial especially in cases of danger posed to national sovereignty and statehood existence. Controlling budget and expenditure of security sector as a soft approach since investment in security sector is non-productive in terms of economic aspect. Currently, another soft approach, implementing Extractive Industries Transparency Initiative (EITI) can encourage Myanmar government in its budget and revenue allocations through Budget Committees at both Hluttaws.

The most important attitude in security sector oversight by legislative branch is to establish compromise culture among three branches of governments, among different committees and commissions of both Hluttaws, among political parties and media and civil society. Conflict between Myanmar Tatmadaw and government on one hand and rivalries among ethnic groups fighting had severely deteriorated mutual trust and confidence which blocked compromise culture in Myanmar political development. Empowering legislative representatives who will oversight security sector reform should be farsighted and prudent in considering the long term national interest, security and defense on one hand and should be efficient in exploring more legally decentralized avenue for effective security governance. Myanmar political as well as ethnic leaders and defense leaders in future should have to cooperate through formal dialogue and negotiation or through informal debates in the near future.

Lastly, it can be possible that security sector governance over sighted by Legislative Body can be preceded through forming Hluttaw Committee instead of amending the 2008 Constitution that has been composed of federal in nature to certain extent. The reason is that amending the constitution is a tough and time-consuming process. It is also needed to have trust-building with integrity between legislative body and all armed groups including Myanmar Tatmadaw, MPF and EAOs which have long history of trust deficiency in Myanmar politics.

Amending the constitution through Joint Committee for Amending Constitution is a legal-based approach in which legislative oversight of security sector governance can be carried out in long term. On the other hand, Hluttaw Committee for Testimony over Armed Forces as a factual-based approach can be set up in short term to have effective legislative oversight. Above all, financial resources and human resources are important matters in both constitutional amendment and legislative oversight of security sector governance.

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Abstract—The Mandalay Hill was one of the sites of the 47 sites in twenty towns which had been taken care and propagated by the Hermit U Khanti. U Khanti had used to encourage the Myanmar artists and let them to draw the paintings in his propagating works. There were therefore so many paintings drawn by the Myanmar artists in the colonial period under his direction and management at some pagodas on Mandalay Hill. Most of them were were drawn on the plywood and galvanized iron sheets. But, the paintings drawn at the Dhattaw Pagoda on Mandalay were drawn on the stucco pillars of the vestibule as like as mural paintings in-similar to the others. They are depicted on the life stories of Buddha and 550 jataka stories not only to decorate the building but also to educate and to propagate the people. Yhis paper is intended to the preservation and maintenance of these paintings.

I. INTRODUCTION

According to the lithic inscription inscribed under the reign of King Shwe-nann-Kyawt-shin of Inwa in 1501, Mandalay Hill had been entitled once as Mannale Taung then. As the nine mounts had surrounded and gathered there, it was also known as Mannale Taung. The some chronicles state that the hill had been also called Minkalay Taung (Young King Hill). In the reign of King Anawrahta in 1017, the king went to China in order to bring the scared tooth relics of the Lord Buddha and then he built the Su-Taung-Pyeh Pagoda on Mandalay Hill on his return to Bagan.

In 1472, Mahathihathura, the son of King Narapati, renewed and renovated the pagoda and then public hall (zayet) and vestibule were also built and donated. In Konbaung period, the Crown Prince Maha Thihathura, the father of king Bagiyadaw, renovated the pagoda again and put a new umbrella. Then a vestibule and a terrace (tan-saung) was also built and donated there. According to the lithic inscription under the reign of king Bagiyadaw, the king renovated the deteriorated pagoda together with the vestibule and terrace which was the meritorious deeds of his father, and the pagoda was re-gilded again. At the four sides on the precinct, four public halls were built and also a tank was dug on the hill.

In 1859 under the reign of king Mindon, the king gave order to the Myataung-Myosa (the Minister of Gunner) and let him to carve the Buddha Image in standing pose with the style of prophecy. This Buddha image was gilded fully and placed in the vestibule. Similarly, the king also donated many other terraces and vestibules which were built under the supervision of his princes, ministers and Township officers (Myosa). These Buddha Image, vestibules and terraces on Mandalay Hill donated by King Mindon were destroyed and lost by the great fire of 1883. ( Bhaddanta Jotika Bhivamsa, The New History, 2007, P-11-22)

The Mandalay Hill was one of the sites of the 47 sites in 20 towns which were patronized and propagated by the hermit U Khan Ti. The hermit came to Mandalay in 1907. In renovating the ruined buildings which were donated by the successive kings, the hermit used iron, brick, stone and stucco instead of wood and big and small buildings were built and donated. Through from 1907 onward till to the 1948, the total cost for the building of religious establishments on Mandalay Hill used by U Khanti was 11639980 in Myanmar Kyat. ( Bhaddanta Jotika Bhivamsa, The New History, 2007, P-123)

In the building of these pagoda vestibules, the hermit had also ordered the famous artists of Mandalay of that time and let them to draw the Jataka stories with the intentions to decorate the vestibules and pagodas, to educate the pilgrims and to propagate. These famous artists were Saya Chon, Saya Pon, Saya Aye, Shwepyi Saya Myagyi, Saya Ni and U Saw Maung. Among these artists, Saya Aye was an expert in drawing the 550 Jataka stories, the life stories of the Lord Buddha and Yazawins as well as he paid attention to draw the royal costumes, regalia, court etiquettes, articles used by the members of royal families, and royal ceremonies in drawing the jataka stories. For this matter, the hermit U Khanti had entrusted him to the Wetmasut Wundaukmín. ( Natmauk Tun Shein, Yatanabon Mandalay, 2011, P-26-27)

Therefore many paintings of Jataka story were developed around the Mandalay Hill and at the vestibules of pagodas under the endeavors of U Khanti and Wetmasut Wundaukmín. Dhattaw Pagoda was built by stucco building with 9 chambers in order to be enshrined the casket with the scared relics of Lord Buddha from India in the midst of the eastern terrace. It was completed in 1923 and relic was enshrined there on October, 24, 1923. Therefore, it can be suggested that the date for the drawing of these paintings perhaps would be around this year. At this vestibule there are 36 outer pillars, 28 inner pillars and 20 inner most pillars and total number is 84. At each outer pillar, a painting was drawn on the side facing to the pagoda. On the inner and the inner most pillars, the paintings were seemed to have been drawn on every four side. All together there seemed to have been 228 paintings but some are totally destroyed and merely the frames are left out. These frames were also made by stucco and painted the red paint.
Their frames in each side are also about 4˝ in length and 3´ 5˝ in width (height). The size of the paintings on the northern side of the vestibule is 3´4˝ in length and 3´9˝ in width. The frame in each side is about 4˝. The lengths of the inner pillars and inner most pillars at the northern side of the vestibule is 3´4˝ in length and 3´9˝ in width (height). The size of the paintings on the eastern and western surfaces of the inner pillars and inner most pillars at the northern side of the vestibule is 3´4˝ in length and 3´9˝ in width (height). The size of the paintings on the northern and southern surfaces is 3´ 5˝ in length and 3´9˝ in width. Their frames in each side are also about 4˝.

It is found that the surfaces of the inner pillars and inner most pillars of the southern side of the vestibule are slightly narrow. The size of the paintings on the eastern and western surfaces of the inner pillars and inner most pillars at the northern side of the vestibule is 3´4˝ in length and 3´9˝ in width (height). The size of the paintings on the northern and southern surfaces is 3´ 5˝ in length and 3´9˝ in width. Their frames in each side are also about 4˝.

The workmanship of the paintings of Dhattaw pagoda is differentiated from the other paintings of Mandalay Hill. These paintings are drawn on the surface of the stucco pillar whereas the others are on the plywood or galvanized iron sheet. Although these paintings are Jataka stories, the artist came to assert the some drawing resemblance among these paintings in my comparisons. The workmanship of these paintings and those of Saya Aye which are located in Shwe Sawlu Pagoda in Myinmu Township and a zayet donated by U Phyu and Daw Htwe at the Eindawyar Pagoda in Mandalay. There are altogether 32 paintings of Saya Aye at Shwe Saw Lue Pagoda and 11 in Eindawyar Pagoda.

TABLE 1, The List of the paintings on Mandalay Hill and their sites

<table>
<thead>
<tr>
<th>#</th>
<th>Site</th>
<th>Artist</th>
<th>Number</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kusumayon Pagoda</td>
<td>Paitama SayaMya</td>
<td>8</td>
<td>Veissantara Jataka</td>
</tr>
<tr>
<td>2</td>
<td>The Foot Print Pagoda (Upper)</td>
<td>Unknown</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The Foot Print Pagoda (Lower)</td>
<td>U Htein Maung</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sambudhike Pagoda</td>
<td>Maung Yin, Pupil of Saya Mya</td>
<td>20</td>
<td>Patisalda Jataka</td>
</tr>
<tr>
<td></td>
<td>U Saw Maung</td>
<td></td>
<td>12</td>
<td>Shwe Hinthamin Jataka</td>
</tr>
<tr>
<td>5</td>
<td>Banyangyi(U/Khante's Pavillion)</td>
<td>Saya N. U Ba yi, U Chat Mya</td>
<td>16</td>
<td>Documentary of Mandalay Hill</td>
</tr>
<tr>
<td>6</td>
<td>Vestibule of Aung Company</td>
<td>U Chi Mya</td>
<td>18</td>
<td>Veissantara Jataka</td>
</tr>
<tr>
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<td>Vestibule of Saya Maung</td>
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<td>Buddha Dhamma</td>
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<td>Ma Sone U's Story</td>
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<td>Relief Pagoda of Shwekyin Sayadaw, northern Terrace</td>
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<td>Northern Vestibule</td>
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<td>Veissantara Jataka</td>
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<td>12</td>
<td>Southern Vestibule</td>
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The artist used the method of light and shade in some pictures and therefore they are not in deadpan look. It is same exactly in the drawing of a coach. Therefore, the lost artist of these paintings probably would be Saya Aye. He was a pupil of Saya Khyun, a royal artist, and also the father of U Saw Maung, a well-known artist in later. He was entitled as “Ni-pat-taw-yay Saya Aye”. He came to touch with the methods of western in drawing under the patronization of Wetmasut Wundaukmin.
Fig. 3, Temiya Jataka on the Inner most pillars

Fig. 4, Veissantara Jataka on the Outer Pillars

Fig. 5, Temiya Jataka on the Inner most pillars

Fig. 6, The Portrait of the Hermit U Khanti drawn by U Saw Maung

Fig. 7, The Life stories of Buddha on the inner pillars
TABLE 2. The condition of the paintings on the outer pillars

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<th>Pillar</th>
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Fig. 8, Veissantara Jataka on Outer Pillars

TABLE 3. The condition of the paintings on the inner most pillars

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TABLE 4. The condition of the paintings on the Inner Pillars

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The main reasons that create the damage of the ancient heritages are Human and its environment, wind, water vapor, illumination, temperature and natural disasters. (Ba Tint, Wall Painting, 2014, P-21) Among the paintings of Dhattaw Pagoda, those from the eastern, southern and western sides of the vestibule are largely damaged as they are in the direction of wind and directly affected by the illumination and temperature of sun. Some are destroyed by the water and some liquids come from the canopy of the vestibule. The most dangerous is the lack of preservation and the some renovations without consideration of the people. According to my studies, 30.26% of the paintings on the all pillars are in good condition, 43.86 % is in dust and the others are totally damaged and blank.

CONCLUSION

The paintings of the Dhattaw Pagoda may be regarded not only as the figurehead of the renaissance of Jataka stories, but it also as the conclusion of mural paintings of
Myanmar. Although they are not massive as much as the
cultural heritages of Pyu, Bagan, and other periods, they
can tell us about the history of Myanmar painting as well
as the standard of the Myanmar artists. They are
combination of tradition with modernity. But they are
seeing regretfully as like as the forgotten cultural
heritages because their survival is uncertainty.

Fig. 10. A workmanship of Saya Aye at the Eindawyar Pagoda in
Mandalay

Fig. 11. A workmanship of Saya Aye at Shwe Saw Lue Pagoda in Myin
mu Township

The Map that shows the location of the paintings
on Mandalay Hill
REFERENCE

5. Minbu Aung Kyaing, Myanmar Paintings from the successive Periods, Yangon, Thiriwatsa Book House, 2018
Beliefs and Practices: The Social Network of Bamar Society and Brass Gong Culture, Mandalay Region, Myanmar

Dr. Lei Shwe Sin Myint*1
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Abstract — Every society has its own identity, worldview and culture. Each society represents a unique feature that brings richness and diversity. In addition, Bamar society has its own Myanmar traditional culture. It is also important to highlight, brass gongs are one of the ancient musical instruments of Myanmar handicraft. Brass gongs were widely used by the Royal family in Myanmar kingdom. The brass gongs are used for the purpose of religious and social functions to create hospitality during Myanmar kingdom. The aim of this study is to analyze the beliefs and practices of brass gongs and how they are used in Bamar Society. The objectives of this paper are to identify the role and functions of the brass gongs in Bamar culture. Additionally, to study the material culture and non-material culture of brass gongs plays a key role valuable activity in Bamar society. Data are acquired through field research and book research. Field research was collected by ethnographic method: the methods of observations, focus group discussion, and in-depth interview, key informant interview, photograph-taking and video-taking are used. As a result, it can be seen that brass gong culture existed during the time of Myanmar kings is still accepted and frequently seen in some Bamar societies. The evidence highlights that brass gongs are still used in religious, administrative, and social functions in some societies in Myanmar. Likewise, brass gong culture founded in religious, social, administrative activities in Myanmar is unique in the world. Moreover, during the time of Myanmar kings, brass gongs were struck to alarm the people that it was the time for them to play taxes. At present time brass gongs are still used directly or indirectly or as the logo for some advertisements. It can be assumed that as people change in different situations, periods and places, they also develop their tradition through generations. In conclusion, brass gongs do not speak. However, it may not be wrong to say that the sound of brass gongs used to represent the orders of the kings in ancient time.

keywords — Bamar society, kingdom, Brass gong

I. INTRODUCTION

Anthropology is the study of human ways of life. Anthropology is so diversified to achieve precision, its practitioners must specialize. Four major in anthropology are: 1) physical anthropology, 2) social or cultural anthropology, 3) linguistics and 4) archaeology. Social or cultural anthropology deals with learned behaviors in human societies [1]. According to Keesing [3], cultural anthropology describes and seeks general understandings about human "customs" or "cultural behaviors". Particular cultures vary among themselves in specific form and content, but all are alike in general respects; i.e., all have tools, language, customs, beliefs, music, etc.

In some societies music serves as an important accompaniment to ritual and may have little other function. In such cultures, music is performed only when certain ceremonies are performed. Music is often associated with ceremony and ritual. In the ancient courts of Asia, music was part of the emblem of the king, emperor or sultan. Certain music when played announced the presence of the ruler and some music when played indicated that even when the ruler was not present, the performance had royal authority. Music is often used in religious ceremonies. In Japan one of the important annual religious festivals is the kagura, which means “music of the gods”. In this ceremony, the performance of the music itself is the ceremony, the songs and dances being intended as entertainment for the gods. In Islam music cannot be associated with religion in any way. Even the reciting of the sacred Koran, which we would regard as singing, is never referred to as singing but as a special form of recitation because music of any kind is strictly forbidden in connection with any religious observation.

The tradition of religious music in the West until the Middle Ages was essentially the intoning of the sacred scriptures. It is likely that rather than actually singing the scriptures as we think of singing today, the text may have been intoned, that is recited as though speaking in tone. Many examples of this use of the human voice made divine by the addition of tone and yet not actually singing exist in many cultures. These are usually situations in which the sacred or magic character of the text is most important and it suggests that early Christian and Jewish liturgy may have been performed in such a manner [9].

However, the musical culture of Malaysia is very much influenced by foreign elements, especially Hindu culture from India, Islamic culture from Arab countries, and later on from the Western world. It is believed that there already existed various types of native musical culture, especially for ritualistic purposes, by the time the natives came into contact with Indian and Muslim traders. Furthermore, such musical culture, untouched by Hindu, Islam and Western elements, can be identified based on the existing performances such as in rhythms for mantras and incantations in animistic belief [4].

Myanmar lies between two great civilizations, India and China. Buddhism has an influence on the daily lives of the Myanmar people. Before sunrise, at around four or five in the morning, villagers are woken up by the thumping of the time log. It is time to cook rice and curry to offer to the Buddha at the shrine and to the monks on their early alms round: Kaladet, the time log, is a huge hollowed log for Buddha at the shrine and to the monks on their early alms round: Kaladet, the time log, is a huge hollowed log for striking time or signal, usually kept under village monasteries. It is also known as ohn-mong, tone-mong, or tone.

The brass gong is one of Myanmar's most important musical instruments, it is suggested by U Min Naing (1987) [5] reviews, musical instruments since the Pyu era, 1500 years ago. He shows how the gong instrument initially appeared as naji instrument. The Pyu had a close relationship with neighboring countries like China and India through Buddhism. Some names of musical
instruments played in Srikitra, Pyu era are found in Bagan inscriptions. Some musical troupes of naiji and musical instruments used in Bagan era are mentioned in pagoda inscriptions such as Kyan-Thai-Gyi-Thamee and Taung-Gu-Ni of AD-1081, Dhammarājika pagoda inscription (1196-1198) and Myauk-Gu-Ni of AD-1214. According to the latter, in Bagan there were so-called naiji troupes, which included kyaye-waing (gong, oboe, small brass cymbals, and drum). The specific term naiji-sara appeared and it is suggested that naiji is a Mon word which means gong of crescent shape; the Mon ancient musical instrument strung with copper wire had its origin in naiji-sara of Bagan era.

According to Tin Tun Oo (2005) [8], he suggested that there was the triangular brass gong (naung-nin or kyaye-naung). The word naung-nin is found in Zayathein inscription of 559 ME and Myauk-gunj pagoda inscription in 603 ME. It was found in lines of 9 to 34 inscribed in Myauk-gunj pagoda inscription, that ‘eight naiji-sara, nine naung-nin, three cymbals and three jingle bells are donated to the Buddha’. The term naiji was derived from naiji-sara instrument of Bagan era. The brass gong would appear to have been modified gradually from 1266 ME. The numbers of gongs included in the orchestra changed from 7, 9, 14 and lastly 17 gongs, as seen the present-day Myanmar orchestra. In Myanmar musical, troupes, the brass gong had 7 gong sounds. Thus, brass gongs originally emerged from naiji gong and the brass gong tunes combine the individual pitches of each gong according to their number in the orchestra.

Another perspective is Aung Nyein Chan (2005) [2]; he showed that brass gongs are described as musical instruments played by Myanmar orchestras on religious and social occasions. It is also described as a royal artifact. In the reign of Myanmar kings during ceremonies to celebrate any success (in Myanmar Thgingyan-daw-khow) this gong was struck. This included announcements to the public for amnesty such as ‘during seven days from that day onwards people are not to be tethered or shackled’. The brass gong was struck when the king went in and out of the palace. Similarly, there were time-keeping gongs that involved warning and reminding of certain events. In the past, there were time-keepers. When he went by land or sea, the auspicious gold gong was struck in front of the royal procession. Gold and silver gongs with royal drums were therefore critical accompaniments of royalty.

A. Research Questions

- What value do people place on the brass gongs?
- What are the roles and function of brass gongs playing in Myanmar society?

B. Research Aims

This research aims to analyze the roles of brass gongs and how they are used in Myanmar society and to study the material culture and non-material culture of brass gongs those are based on valuable activities in Myanmar society.

C. Study design

Library research, document analysis and field study are conducted. In field study, data are collected by using focus group discussion, in-depth interview, and key informant interview. Case study design using qualitative approach was in this study because it could describe as a particular culture and in order to understand one kinds of cultural maintenance. The study site is Mandalay city, and Mandalay region, upper Myanmar. In Mandalay, these who sell gongs in stairways at pagodas, monks, Buddhists, musicians who can play well brass gongs and triangular brass gong (kyaye-mauun; kyaye-naung) were selected to collect the data of roles and function of brass gong and cultural heritage. Total study populations were 26.

D. Data collection methods

In this research, the data were collected by using available information, library research and field research. Qualitative method was used to get data. Therefore participant observation (PO), direct observation (DO), focus group discussion (FGD), in-depth interview (IDI), key informant interview (KII) were applied to collect data. Participant observation and direct observation methods were done in Mandalay region of some pagoda and somewhere.

Focus group discussion was useful to confirm the data got from the individuals and also to guess and interpret the behaviors, facial expression, and speech in order to grasp the feelings and values of craftsmen in brass gong foundries. There were 1 group of FGD was conducted with lay people of Buddhism. In each group, there were 10 persons were interviewed in FGD. A total of 10 persons included in two FGDs.

In-depth interviews were constructed to catch the experience of religious practices and how to maintain their beliefs on brass gong and religious activities. There were a number of 3 persons of Buddhism.

Key informants were chosen according to their knowledge of brass gong culture administrative person of 2 people in Chan-myaa-tha-zi Township and 2 persons of administrative staff in Mandalay. To take hold of the knowledge of brass gong culture, the native person, 2 monks, 3 persons of headmen, 4 persons of brass gong sellers, who appreciated with the regarding the role and functions of brass gongs cultural traditions were selected as key informants. There were a number of 13 persons who believed Buddhism and they lived in around Mandalay Region and other parts of Myanmar supported to grasp the functional concept of brass gong cultural valuable in religious, social and other functional activities. In this research was used to collect the data of brass gong, by using taking photographs, record with video, tape recorder and notes-taking.

II. BRASS GONGS AND RELIGIOUS BELIEFS

Brass gongs were among the treasured possession of ancient Myanmar kings. They were used for administration purposes as well as musical instruments. With the fall of the monarchical system, many valuable brass gongs passed from items in royal possession into property of all people in Myanmar. Brass gongs are widely used for religious and social purposes. Brass gongs can be seen at pagodas. At some monasteries, brass gongs are used while monks go on alms rounds. When people give donations, the sound of brass gongs are used to spread the intention to share merit around as the symbol of wholesome deeds. Besides, they are also used during the
Bavanto (ba-wun-to: in Myanmar) round, which involves going around the locality to accept offerings of food an orchestra. Alongside Buddhism, there are some who also practice spirit-worship where brass gongs are played in honour of the deities. Thus brass gongs play important role in Myanmar society and have become a symbol of Myanmar culture.

A. Brass Gongs Used for Buddhist Religious Purposes

Brass gongs are fixed at the highest places in pagodas or temples. Buddhists take refuge in the Triple Gems – the Buddha, the Dhamma, and the Sanghā. To represent the Buddha himself, they build pagodas and temples that stand as symbols of their devotion. The symbolism of the gongs is tied up with the symbolism of the umbrellas fixed at the pinnaclest of pagodas. Their history goes back to the time of Saṅkhā Brahmin, the Buddha-to-be, who placed an umbrella above the bone-relics of Susīma Pacceka Buddha, his son.

“Susīna was the son of Saṅkhā Brahmin. Susīna became Pacceka buddha and entered into Mahāparinibbāna, the final liberation. The father cleaned the place where the bone relics of Susīmapacceka buddhawere located, and placed an umbrella above the relics. Since then, it is said, that the tradition of fixing umbrellas at the top of the pagodas has continued to exist. Brass gongs are also fixed along with the umbrellas at the pagodas.”

It was said by a person who was taking care of Mātho-Shw-Gu-Shwe-Than-Daw Pagoda in Ywamissa Village in Ye-Oo Township, Sagaing Division.

The types of umbrellas usually fixed on the pagodas are of five kinds: (1) the umbrellas shaped like a ‘crested headress forming one of the ceremonial regalia of a monarch’ (magai in Myanmar), (2) ball of yarn taken from a spindle shape umbrella (chi-win in Myanmar), (3) a betel box with a procession conical cover shape umbrella (kun-dawn in Myanmar), (4) the umbrellas shaped like Inn-lay (in-le:in Myanmar), and (5) royal act of merit shape umbrella (kaung-hmato in Myanmar). The most common shape of pagoda-umbrellas in Myanmar is magai shape. An umbrella with magai shape has nine tiers. They are decorated with mouth opening (mou in Myanmar), nim leaf (dha gigi in Myanmar), eminent (hman-gji in Myanmar), floral accents festooned (pan-hmo in Myanmar), bowl (hpala: in Myanmar), the bronze-winged jacana (bi-la: in Myanmar), and terrible (naja: in Myanmar).

In this research, the umbrella at which pagoda is known by three names – Mātho, Shwe Gu, Shwe Thein Daw - in Ye Oo Township, Sagaing Division is studied as an example. The umbrella at the pagoda has been replaced six times. The first tier of the umbrella is decorated with brass gongs. The first tier of a pagoda umbrella is usually decorated with various objects – four mouth openings, four eminent, nine gongs or bowls, and neem leaf. In-between the brass gongs are flower decorations. The bronze-winged jacana and griffin (naja:) are fixed below every other gong. Under the first tier, (of a bell) decorative headstock with curved tips (in Myanmar language call bazun-dou-kwei:) are fixed to hang bells. The sixth umbrella was donated on the full moon day of March, 1993 (Tabaung, 1354) by a person from Mandalay.

Venerable Kavisāra from Shwe Thein Daw Monastery in Ywa Missa Village, Ye Oo Township, Sagaing Division explained the reason for fixing bowls on the umbrella instead of gongs Fig. 1. He said,

“The nine brass gongs that will be fixed at the pagoda are known by people as bowls. However, what is important is the intention of the donors who donate the umbrella. The number nine represents the nine attributes of the Buddha. Although the bowls are used in the donations, the donors take them to be the gongs. It is because gongs can produce sweet sound which can give the message of donation to the people around, and especially, they wish that their donation should be heard by the beings in the highest plain.”

Brass gongs are therefore valued so much so that they are fixed on the pagoda umbrellas high up in the pagodas Fig. 2.

A (2156 viss) 3556.21 kg gong was donated at the Maha-myat-muni Pagoda in Chan-Mya-Tha-Si Township, Mandalay Division. This brass gong was donated by U Nyang and Daw Shi-Shi from Mandalay in 1333 ME. It was made by U Bu Yin who lived near the Bavanto in Ba-Htoo Street, Mandalay Fig. 3. This is considered the gong of conquest. Since this brass gong was made using the traditional brass gong casting technique, it cannot produce sound. People pay respect at the brass gong folding their palms on their foreheads, and rub the brass gong with their hands Fig. 4.

“A woman, thirty years old, from Pyi-Gyi-Ta-Gon Township, Mandalay, made good wishes for her brother at the gong. Her brother, a twenty-seven year old man, applied for a job at a company. She made the wish rubbing on the face of gong and said, “May her brother be successful.” She said it twenty-seven times for her brother was twenty-seven years old.

“A twenty year old young woman, from Maha-Aung-Myae Township, Mandalay, made a good wish for her brother who was about to take the matriculation examination. She rubbed the gong nine times saying, “May her brother pass the exam”.

People believe that making wishes while rubbing that brass gong will make their dreams come true. They believe that brass gongs can bring them good luck. Therefore, it can be seen that, brass gongs, whether they produce sound or not, are considered something sacred in the practice of Myanmar Buddhists. In China, Korea and Thailand brass gongs are also in use, though they have different kinds of practice. Brass gongs are an important religious object for Myanmar Buddhists.

Brass gongs can be seen at the pagodas, hanging at some places Fig. 5. Buddhists, who visit the pagodas, strike the gongs after they have done their prayers. While striking the brass gongs, they share their merits to all beings including the other people who may hear the sound or the unseen beings. There are religious teams that, on religious occasions, chant the discourses taught by the Buddha at the pagodas. They usually chant the discourses such as wheel of Dharma; first sermon given by the Lord Buddha on attainment of Buddhahood (Dhammadakkapav-
Some meditation centers still use brass gongs. Brass gong and brass bell are played three times before meditation sections in order to gather the practice religious meditation and after the meditation sections as the symbol of sharing merits.

This tradition has existed for a long time and still continues to exist. This tradition somehow helps maintain the handcraft of casting brass gongs.

Most Buddhist monasteries in Myanmar have brass gongs that they strike as the Bawanto (ba.-wun-to: in Myanmar) which means go round village or town to accept offerings of food with music group. People strike the brass gongs around the neighborhood near monasteries to wake the devotees in the area. With the sound of the brass gong, people get out of their bed and prepare breakfast for the monks who come to their house for alms round at dawns. This used to be a common tradition in most villages and towns, and known as going Bawanto (ba.-wun-to: in Myanmar) with music group. It is called hsun:-khan in Myanmar. In some villages and towns, this tradition can still be seen. Previously, people used short drums, musical instrument consisting of a set of graduated series of gongs (maun:-saing in Myanmar), big gongs and oboes when they go Bawanto round. At present, people do not use all these musical instruments, but they still use big brass gongs.

Before dawn, a team of people go round the area carrying a big brass gong with them. A monastic school boy shouts, “Please get up to prepare offerings for monks, Bawanto ... oh ... good people.” At the end of these words, another person in the team strikes the brass gong. The sound enhances the voice of the school boy in devotional way to devoted people.

In some places, some people come to the area with the brass gong just a few minutes before the monks come for alms Fig. 8a. They strike the gong which let the people know that they should be ready to offer alms to the monk. The sound of brass gongs can go deep into the mind of hearers in a distance. This sound associates with religious practices. It can be said that gongs have been used in religious practices and have become a symbol of the religion.

In some villages and towns, during rainy retreats which last for the three rainy months; period of the Buddhist lent (wa-dwin:-ka-la in Myanmar), every eve of Sabbath Days is filled with the sound of brass gongs when groups of people go round to collect the donations around the area. The donations are meant for supporting the monasteries and Dhamma organizations in the area. One can see that monks come to the area for alms round walking in a queue with young boys before them who are carrying a brass gong on their shoulders and striking it from time to time Fig. 8b. It is called “tan-swan-kywa in Myanmar”. The sound of brass gongs can arouse devotion in the mind of people. It can be seen, therefore, that brass gongs have been playing important role of bridging between the religion and the culture in Myanmar traditional practices. People volunteer to collect the donations in their ‘community hall for religious purposes’ (dama-joun in Myanmar) in towns and villages. They usually play musical instruments such as instrument featuring a set of graduated gongs (naji: in Myanmar) or kind of long drum (byaw) (bjio: in Myanmar) while they are going around the area Fig. 9.

The term “kind of long drum” (byaw) (bjio: in Myanmar) is a short form of “sibyaw” that is a kind of percussion drum that people play by hitting them with your hand or objects such as sticks. The musician carries it on his neck with a string. The sticks used are bent at one end. The sound of this drum is said to be similar to the sound of the fruits from Eugenia trees (za-bu-dhahbej in Myanmar) falling on the water. It sounds like “pjou-pjour-pjou: in Myanmar”. According to the history of Myanmar, this musical instrument was invented during the reign of King Alon-Si-Tha. In a team of si-byaw, the musical instruments used include two “zither-like stringed instrument” (don-mins) (doun-min: in Myanmar), one big drum (si-pou in Myanmar), a set of cymbals, one to five big saxophones, three to eleven small saxophones, and seven to fifteen trumpet-shaped wind instrument (khaju in Myanmar).

Since the end of Myanmar monarchical period, byaw music has been heard only at the ordination ceremonies and donation ceremonies. Besides, the si-byaw is replaced with a short drum. In a si-byaw team, the instruments used include a short drum, a brass gong, and a maun:-saing, and an iron xylophone. Previously in Myanmar, byaw teams are commonly seen when volunteers collect the donations for religious purposes [6]. Present Myanmar, especially in most places upper Myanmar and also in some villages in lower Myanmar, still has this tradition. Therefore, as long as si-byaw musical teams exist, brass gongs will possibly exist.

It can be seen that byaw musical teams use maun:-saing. One can still see that, in some places, people from different quarters of the town or villages have competitions in their byaw music. While collecting donations, each team tries to win the attraction of more people with its music than other teams. This tradition of music is linked to the devotion that fills up the mind of Buddhist people in Myanmar.

There are some people who make good wishes at certain pagodas that are known as “the wish that is made at such pagodas will be fulfilled” (su-taug-pvae in Myanmar). They wish for success in businesses or social welfare. There are some pagodas that are considered to be special in this respect. People take some meditation retreats or donations at those pagodas, thus their wishes will be fulfilled by the power of those wholesome deeds and the power of the pagodas. Drums and brass gongs called “the drums and brass gongs that can bring success in life” (aung-si, aung-maun: in Myanmar) can be seen at those pagodas. One of those pagodas, for instant, is located in Thin-Taung-Gyi Village, Kyauck-Se Township, and Mandalay Division. It was the donation of King Anawratha. The pagoda area is consecrated as an ordination place (Simâ) by Shin Arahaha. Therefore the name of the pagoda is known as “Su-Taung-Pyaes-Shwe-Then (Simâ)-Daw” in Myanmar. People make offerings with sets of banana-and-coconut in bowls at this pagoda. They believe that this kind of offering can result in getting what they wish for. A man who works at the Shwe-Then
(Simā)-Daw pagoda described how people make wishes as follows. They have certain thing relating to businesses or social welfares in their mind.

“They make offerings at the pagoda and say, 'May my business will be successful. May I have good lucks in my business? If my wishes are fulfilled, within a month (or some people say 'two months or a year'), will come back here again and make another offering.'”

People prepare bowls of coconuts and bananas Fig. 10., donate them to the pagodas, play brass gongs three times and say “Sādhu” three times Fig. 11. People believe that with the sound of the brass gong, their sacrificial offerings are completed.
Figure 6. Pali verse consisting of the eleven prescribed suttas

Figure 7. Brass gong and drum

Figure 8 a. Before the monks come for alms striking the gong

Figure 8 b. Before the monks come for alms striking the gong

Figure 9. Donations with music (byaw)

Figure 10. Prepare bowls of coconuts and bananas
III. GONGS USED IN SPIRIT-WORSHIP PRACTICES

Bamar people use brass gongs not only in Buddhist religious practices, but also in spirit-worship practices. Spirits (nat in Myanmar language) are beings who are worshiped by some people with the belief that nats can give the worshipers rewards and protection. Spirit-worship is a practice common around the world. People believe that nats have greater power than human beings [6].

The word “nat” derives from a Pāli word “Nātha” which means “the object of taking refuge”. In many discourses taught by the Buddha, the Buddha approved traditional spirit-worship. The Buddha said that one should not neglect worshiping or honoring traditional nats [7].

People of Myanmar accept spirit-worship as a practice that can produce good results in their lives. People talk about five kinds of honoring. People who believe in traditional nats says, “there are five kinds of honoring or making offerings: (1) making offerings to nats, (2) making offerings to the guests, (3) making offerings to one’s relatives, (4) making offering in the names of late relatives and sharing the merit with them, and (5) giving taxes to the government.”

There are various nats in Myanmar that people worship. Thirty-seven inner nats (Atrin-nats in Myanmar) and thirty-seven outer nats (Apyin-nats in Myanmar) are most common local-nats. Nat festivals are seen throughout the country. The most crowded and famous nat festival is in taung-pyone. This festival takes place in taung-pyone Village, Matteya Township, and Mandalay Division every year from the eighth day of the waxing moon in August (Wakhaung in Myanmar) to the full moon day of the same month. The festival includes events such as bathing the nats, hunting rabbits, offering festival (htein-khou-pwe: in Myanmar), and offering alms to the monks.

There used to be a saying that describes the yearly events during the time of Myanmar kings. It reads, “March to the battle-front in the month of December (Nat-taw in Myanmar), retreat in the month of March (Tapaung in Myanmar), and organize spirit-worship in the month of August (Wakhaung in Myanmar)”. According to this tradition, the kings celebrate a festival at the shrine of the two taung-pyone-nats in December (Nat-taw). In March (Tapauung), they have another festival when they come back from the battle-front. In August (Wakhaung), a nat festival takes place for a week and it has been the biggest nat festival in Myanmar. There are spirit-mediums who lead the festivals. They know the tradition and sacrificial methods. The team of spirit-mediums is led by a chief who is called Queen (thous.-taung.-mi-baja: in Myanmar) and the other members act as royal members, the silver brass gong player, gold brass gong player, inner brass gong carriers, and outer brass gong carriers. A message concerning with marching to the battle-front is read, as the tradition goes, by a spirit-medium. As soon as the message is finished reading, silver brass gong is struck and then the brass gong of conquest is struck. Then the musical team at the shrine begins to play a special music for nats played at the time of propitiation of nats (nat-hsain: in Myanmar). With this music, the inner brass gong carriers, outer brass gong carriers and the commander-in-chief lead people, and go round the shrine seven times.

The festivals in taung-pyone do not have as many participants as before. However, “they try to have as many as possible”, said the spirit-mediums. Previously, in the festivals, the participants included silver brass gong carriers, gold brass gong carriers, inner brass gong carriers, and outer brass gong carriers. But they can only afford ordinary brass gong carriers.

The brass gong is kept in the shrine of the two taung-pyone-nats Fig. 12. People who come to the festivals offer the two taung-pyone-nats with money or flowers as they have promised. As taung-pyone-nat festival is the biggest and the most crowded festivals among the nat festivals in Myanmar, hundreds of thousands of people come there yearly. Not all people can go into the shrine since there are too many people during the festivals. The people who come to the festivals are basically of two kinds – those who follow the tradition of their elders in the families, and those who come to make offerings with the hope of success in their businesses or those who come to make offerings to keep their promises made to the nats. As they have promised the nats, they offer money and flowers to the nats. Only those who can manage to go into the shrine or those who have a special permission can see the face of the two nats. The spirit-mediums mention that it is not possible to play the gong for each and every one who comes to the festivals. They said they might break their arms if they do so. Thus, they play the brass gong on the last day of the festival making good wishes for everyone who comes to the festival. One can see many people are pushing one another happily around the shrine. They try to play the brass gong with the flowers in their hands while they are standing outside the shrine and reaching the brass gong through the iron bars Fig. 13. It can be noted here that brass gong culture is also belong to traditional spirit-worship.

The second biggest nat festival is that of Popa-mother (the name of Popa is mountain) (pou-pa:-medo-pwe in Myanmar). This festival is also known as pagoda festival; the name of pagoda is Ra-ta-na-gu festival (jadana-gu-pwe in Myanmar). The festival takes place yearly at the area near four villages – Shwe-Lon Village, Paramat Village, Kyaung-Sha Village, and Phaung-Taw Village – that are located in the west of Amarapura Township in Mandalay. The festival used to be a pagoda festival. It has become a Nat festival since 1183 ME, during the reign of King Bagyidaw, when Queen Namnadow and Salin-Town chief organized a nat festival along with the pagoda
festival. Later, this festival is known by people as nat festivals. This festival takes place just after taung-pyne-nat festival that is from the eighth day of waning moon of August (Wakhaung in Myanmar) to the fourteenth day of the same month. People who come to taung-pyne festival also come to Ra-ta-na-gu nat festival. Ra-ta-na-gu-nat festival is nothing to do with marching to the battle-front nor was it about coming back from the battle-front. It was only meant to be a nat-festival. Ra-ta-na-gu festival was the festival of the mother of the two taung-pyne-nats. Thus, people come to pay respect the mother when they come to pay respect to the son. Therefore, this festival has shrines for all the nats. Each nats shrine has a celebration where people try to make better than the celebrations at the other shrines. Music teams try to win the attention of the audience. There are many spirit-mediums and people dancing like spirit-mediums. There are believers who gather at shrines to ask about their future predicted by the nats through spirit-mediums Fig. 14a. Some of the shrines have brass gongs. The spirit-mediums make offerings on behalf of the believers and play the brass gongs each time they make offerings for individuals Fig. 14b. Therefore, it can be seen that brass gongs are also used in spirit-worship and traditional spiritual artifacts.

Mandalay Bo-Bo-Gyi is a famous nat well-known in Mandalay. It is means Bo-Bo-Gyiis a name of spirit worship. His shrine is frequently visited by the residents of Mandalay Fig. 15a. It is located at the foot of the Mandalay Hill. Mandalay Bo-Bo-Gyi is a local nat. There is no fixed date for the festival. However, people from Mandalay visited the place occasionally when have some businesses, buy a vehicle or when they have job interviews. They make good wishes at the shrine making offerings to Mandalay Bo-Bo-Gyi. People go to Bo-Bo-Gyi’s shrine with their new vehicles, and make offerings so that Bo-Bo-Gyi will watch them out of accidental dangers on the roads. Some business people make offerings there wishing for good businesses. Some wish to have stable jobs or some wish to get a promotion transfer in their jobs.

Some business people mentioned,

“Car-owners usually wish to have good businesses. They make promises at the shrine that they would make certain offerings to Bo-Bo-Gyi if the business meets their expectation. If they are successful, they pay a visit to the shrine and make offerings they promised. When they make promise, they usually play the gong three times.”

Some government officer workers say,

“We make offerings and wish at the shrine when we want certain things in our works. Some might want to prolong their rank or some wish to get promoted, or some prefer to get transferred to the place they wish. If they have problems at work, they come to Bo-Bo-Gyi and ask for blessing. They also make promises that they will come to make offerings if their wishes are granted. They usually play the gong three times after making those wishes.”

People believe that their wishes are fulfilled after making offerings at the Bo-Bo-Gyi’s shrine. One can witness people making wishes; promises and playing the brass gongs at the shrine Fig. 15b. Therefore, brass gongs are used as the symbol of success in traditional spirit-worship.
IV. CONCLUSION

The study of beliefs and practices of brass gong cultural tradition shows that the use of the brass gong cultural heritage, they were practices since the time of Myanmar king. In order to that in Myanmar societies, the sound of a brass gong is sweet, pleasant, soothing, and calming. Another quality of this sound is that it is very penetrating. For these reasons, Buddhists use brass gongs to attract people’s mind to wholesome activities and invite people to participate in those activities. Especially, when religious associations such as alms-offering associations, Dhamma-chanting associations, breakfast-offering associations, go round to collect donations, they play brass gongs.

The facts mentioned Buddhist religious purposes, it is seen that brass gongs, whether they produce the sound or not, are considered auspicious objects that enhance the blissful environment of the pagodas. For Buddhists, gongs serve as peculiar symbol of Buddhism.

The discussions above can be said that the sound of brass bells and brass gongs represents wholesome deeds, success in life, and fulfillment of good wishes. They serve as auspicious symbols, the instrument for blessing, and mundane and supra-mundane attainments. Therefore, brass gongs stand for the sign of propagation of Buddhism.

Brass gong culture seen in religious, social activities in Myanmar is unique in the world. There are some other countries in the world where brass gongs are used, but they only use brass gongs in religious functions and some festivals.

Along with the spread of Buddhism in Bagan Period, Nari musical teams were formed for religious purposes. In the same way Kyaye-wain which is also called kyaye-naung had its origin in Bagan Period. Marble inscriptions dated Bagan Period mentioned that kyaye-naung was called naji: musical instrument. Moreover, during the reign of King Sin Phyu Shin, the second son of King Alaungphaya, brass gongs were first used as musical instrument.

Naji: musical teams that have existed since Bagan Period still continues to exist. It is the evidence of the fact that the people of Myanmar do not fail to maintain their cultural tradition. There are some differences in appearance of present naji: teams compare to those in Bagan Period. However the purpose remains the same. Therefore, it can be said that the people of Myanmar inherit their dignity and quality from the cultural heritages handed down through generations. These cultural heritages has become their life and the environment they live in. they also maintain the heritages they have received while developing them.

There are some differences in the use of brass gongs in different regions and time, the value and importance placed on brass gongs by the people remain the same. At present, every parts of the country are filled with the sound of brass gongs.

Therefore, studies on the use of brass gongs show that the role of brass gongs at present time is not the same as it was during the time of Myanmar kings when it comes to the appearance, but it remains the same when it comes to the function. The tradition of brass gongs transforms itself from royal uses to common uses. Many ethnic groups in Myanmar share common uses of brass gongs as musical instrument. Their music is based on brass instruments, string instruments, percussion instruments, woodwind instruments, and clappers, and brass gongs are also shared as musical instrument.

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REFERENCES
A Study on the Job Satisfaction of Employees as Related to Their Self-Esteem and Work Preference

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ABSTRACT - This is an exploratory survey study dealing with the relationship between job satisfaction of employees and their work motivation and self-esteem. The objectives of this study were to investigate self-esteem, work preference, and job satisfaction characteristics of employees; to describe the relationship between self-esteem and job satisfaction of employees; to discover the relationship between work preference and job satisfaction of employees. Three types of questionnaire were developed and used in this study. They Work Preference Questionnaire (28 items), Job Satisfaction Questionnaire (27 items) and Self-esteem Questionnaire (20 items). A sample of 200 employees (61 males and 139 females) with the age range of 20 to 50 years was drawn randomly from Dawei, Yangon and Pyapon. Among the subject, 87 employees are working in the public sector and 113 employees in private sector. The questionnaire method was used for the purposes of data collection. After interpreting final data, it was found that there was found that there was a strong positive correlation between Self-esteem and Job Satisfaction, r = 50, p<0.001. Moreover, the present study also found that employees with high job satisfaction were significantly different from employees with low job satisfaction on self-esteem. Based on Korman's Theory stating that there is a positive correlation between self-esteem and performance, and the findings of Garske's study (1990) and the present study, it is suggested that an organization to be effective and successful has to employ people with high self-esteem and needs to train its employees to increase their self-esteem. It was found in this study that there was positive correlation between job satisfaction and extrinsic motivation, r = 15, p<.05 and there was also positive correlation between job satisfaction and intrinsic motivation, r = 31. p < .001. The comparison has been done between gender, age and work sector. The results showed that there was no significant difference between males and females, private sector employees and public sector employees, and employees with 30 and above 30 years of age and employees with below 30 years of age on job satisfaction, self-esteem, intrinsic motivation and extrinsic motivation.

Key words: job satisfaction, intrinsic motivation and extrinsic motivation

I. INTRODUCTION

This is an exploratory survey study dealing with the relationship between job satisfaction of employees and their work motivation and self-esteem. The purpose of this study is to investigate self-esteem, work preference (measured by extrinsic and intrinsic motivation), and job satisfaction characteristics of employees; to describe the relationship between work preference and job satisfaction of employees. The outcome is expected to be useful in helping the employees to improve their job satisfaction.

II. LITERATURE REVIEW

The recruitment and retention of qualified, skilled employees is the foundation of any business, small or large. Research indicates that employees who are satisfied jobs are more likely to stay with their employers. Keeping a cadre of happy and motivated employees, however, is often elusive as the expectations of employees shift. These changing expectations stem from demographic trends, such as growing numbers of Generation Y employees (those born after 1981) and women entering the workforce, the retirement of Baby Boomers (those born between 1954 and 1964), caring for elderly parents, and more general changes in society, such as increased stress levels as employees attempt to juggle work and personal responsibilities. As life becomes more challenging, employees may become more stressed. Therefore, the factors long thought to satisfy employees may be shifting, depending on attributes as the gender and age of employees.

Job satisfaction, a worker's sense of achievement and success, is generally perceived to be directly linked to productivity as well as to personal well-being. Job satisfaction implies doing a job one enjoys, doing it well and being suitably rewarded for one's efforts. Job satisfaction further implies enthusiasm and happiness with one's work. The Harvard Profession Group (1998) sees job
satisfaction as the key factor leads to recognition, income, promotion, and the achievement of other goals that led to a general feeling of fulfillment.

Frequently, work underlies self-esteem and identity while unemployment lowers self-worth and produces anxiety. At the same time, monotonous jobs can erode a worker's initiative and enthusiasm and can lead to absenteeism and unnecessary turnover. Job satisfaction, self-respect, self-esteem, and development. To the worker, job satisfaction rings a pleasurable state that often leads to a positive work attitude. A satisfied worker is more likely to be creative, flexible, innovation, and loyal.

For the organization, job satisfaction its workers mean a work force that is motivated and committed to high quality performance. Increased productivity – the quantity and quality of output per hour worked – seems to be a by-product of improved quality of working life. It is important to note that the literature on the relationship between job satisfaction and productivity is neither conclusive nor consistent. However, studies dating back to Herzberg's (1957) have shown at least low correlation between high moral and high productivity, and it does seem logical that more satisfied workers will tend to add more value to an organization. Unhappy employees, who are motivated by fear of job loss, will not give 100 percent of their effort for very long. Though fear is a powerful motivator, it is also a temporary one, and as soon as the threat is lifted performance will decline.

Tangible ways in which job satisfaction benefits the organization include in complaints and grievances, absenteeism, turnover, and termination; as well as improved punctuality and worker morale. Job satisfaction is also linked to a more healthy workforce and has been found to be a good indicator of longevity. And although only little correlation has been found between job satisfaction and productivity, Brown (1996) notes that some employers have found that satisfying or delighting employees is a prerequisite to satisfying or delighting customers, thus protecting the "bottom line." No wonder Andrew Carnegie is quoted as saying: "Take away my people, but leave my factories, and soon grass will grow in the factory floors. Take away my factories but leave my people, and soon we will have a new and better factory" (quoted in Brown, 1996, p. 1230).

Once an organization has selected and trained its employees, it is important that employees be both motivated by and satisfied with their jobs. Industrial psychologists generally define work motivation as the force that drives a worker to perform well. Ability and skill determine whether a worker can do the job, but motivation determines whether the worker will do it properly. Although actually testing the relationship between motivation and performance is difficult, psychologists generally agree that increased worker motivation results in increased job performance. Researchers have found three individual difference traits that are most related to work motivation: self-esteem, need for achievement, and an intrinsic motivation tendency.

Each of us has a self-concept about the way we dress, drive, speak and what kind of worker we are. We have a self-concept of ourselves about everything we do. Therefore, "self-concept" can be defined as the way we see ourselves. At the core of self-concept is "self-esteem" which can be defined as how much we like ourselves. Basically "self-esteem" is the global evaluative dimension of the self. It is also referred to as "self-worth" or "self-image" which reflects an individual's overall confidence and satisfaction with themselves.

Having a self-actualizing tendency, we become what we think we are. Therefore, there is a
direct relationship between people's feelings and their productivity. As our opinion of ourselves critically influences everything, from our performance at school, our relationship with others, our role as a teacher to our accomplishments in life, "self-esteem" becomes a major component in determining success or failure. That is why all great world leaders and teachers throughout history have concluded that one must be internally driven in order to achieve success.

Self-esteem is the extent to which a person views himself as a valuable and worthy person. In the 1970s, Korman (1970, 1976) theorized that employees high in self-esteem will be more motivated and will perform better than employees low in self-esteem. Self-esteem is the extent to which a person views himself as a valuable and worthy person. According to Korman's consistency theory, there is a positive correlation between self-esteem and performance. That is, employees who feel good about themselves are motivated to perform better at work than employees who do not feel that they are valuable and worthy people.

Employees with high self-esteem actually desire to perform at high levels and employees with low self-esteem desire to perform at low levels. In other words, employees try to perform at levels consistent with their self-esteem level. Employees with self-esteem tend to underestimate their actual ability and performance (Lindeman, Sundvik, &Rouhiainen, 1995). Thus, low-self-esteem employees will desire to perform at lower levels than their actual abilities would allow.

The theory becomes somewhat complicated in that there are three types of self-esteem. Chronic self-esteem is a person's overall feeling about himself. Situational self-esteem is a person's feeling about himself in a particular situation such as operating a machine or feels about himself on the basis of the expectations of others. All three types of self-esteem are important to job performance. For example, an employee might be low in chronic self-esteem but be very high in situational self-esteem.

If consistency theory is true, we should find that employees with high self-esteem are more motivated, perform better, and rate their own performance as being higher than employees with low self-esteem. Low self-esteem could lead to extremes of behavior. A person with high self-esteem could choose identical behavior for different reasons. He may be alone because he prefers solitude, whereas a person with low self-esteem prefers to be alone because he is uncomfortable in groups.

Like "self-esteem", "work motivation" which is measured by the Work Preference Inventory (WPI; Amabile, Hill, Hennessey, &Tighe, 1994), is the force that drives an employee to perform well. Whereas ability and skill determines whether he or she will do it properly. Motivation is something that encourages action or feeling. To motivate means to encourage and inspire. It can also be defined as motive for action. Motivation is classified into two types: external and internal. External motivation comes from outside, such as money, societal approval, fame or fear. Internal motivation comes from within, such as pride, a sense of achievement, responsibility and belief.

People differ by nature, not only in their ability to perform a specific task but also in their will to do so. People with less ability but stronger will are able to perform better than people with superior ability and lack of will. Hard work is crucial to success and achievement. This belief was underscored by Albert Einstein when he said that "genius is 10% inspiration and 90% perspiration." This "will" to do is known as motivation.
III. METHODOLOGY

A sample of 200 employees (61 males and 139 females) in the age range of 20 to 50 years from Dawei, Yangon, and Pyapon was administered with the Job Satisfaction Questionnaire, the Self-esteem Questionnaire, and the Work Preference Questionnaire. The participants were instructed to read carefully all the items and ask to choose only alternative that most fit with them in each item. It took about twenty minutes to answer the questionnaires. The data analysis was done by Descriptive method, Pearson correlation method and Independent sample t Test.

IV. RESULTS AND DISCUSSION

Results

In this study, the Job Satisfaction questionnaire, the Self-esteem questionnaire, and the Work Preference questionnaire were used to investigate the relationship between job satisfaction, self-esteem, intrinsic motivation, and extrinsic motivation of employees.

Table (1) Intercorrelations between Four Variables (N=200)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Self-esteem</td>
<td>-</td>
<td>.50**</td>
<td>-</td>
<td>.28**</td>
</tr>
<tr>
<td>2. Job Satisfaction</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-1**</td>
</tr>
<tr>
<td>3. Intrinsic</td>
<td>-</td>
<td>-</td>
<td>-1**</td>
<td>-</td>
</tr>
<tr>
<td>4. Extrinsic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**P < .001, *P < .05

Table (1) shows that all the six pairs of variables were significantly correlated. The strongest positive correlated. The strongest positive correlation was between Self-esteem and Job Satisfaction, \( r = 50, p < .001 \). This means that employees who are relatively high in Self-esteem were likely to have high Job Satisfaction. Extrinsic motivation was positively correlated with Intrinsic motivation \( (r = .41) \).

Table (2) Differences between male and female employees on job satisfaction, self-esteem, intrinsic motivation, and extrinsic motivation

(n=61 males and 139 females)

Table (2) Shows that there is no significant difference between males and females on job satisfaction, self-esteem, intrinsic motivation and extrinsic motivation.

Table (3) Differences between public sector employees and private sector employees on job satisfaction, self-esteem, intrinsic motivation, and extrinsic motivation (n=87 public and 113 private)

Table (3) Shows there is no significant difference between private sector employees and public sector employees on job satisfaction, self-esteem, intrinsic motivation and extrinsic motivation.

Table (4) Age differences of employees on job satisfaction, self-esteem, intrinsic motivation, and extrinsic motivation (n=93, >=30 year old employees and 107, <30 year old employees)
Table (4) shows that there is no significant difference between employees with 30 and above 30 years of age and employees with below 30 years of age on job satisfaction, self-esteem, intrinsic motivation and extrinsic motivation.

**Table (5) Differences of employees with high job satisfaction and low job satisfaction on self-esteem**

<table>
<thead>
<tr>
<th>Variable</th>
<th>High JS M</th>
<th>High JS SD</th>
<th>Low JS M</th>
<th>Low JS SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-esteem</td>
<td>75.3</td>
<td>2.2</td>
<td>69.5</td>
<td>2.0</td>
<td>16.1</td>
<td>198</td>
<td>.001</td>
</tr>
</tbody>
</table>

Table (5) shows that employees with high job satisfaction were significantly different from employees with low job satisfaction on self-esteem (p=.001). Inspection of the two group means indicates that employees with high job satisfaction (M=75.32) are higher than employees with low job satisfaction (M=69.50) on self-esteem.

**Table (6) Differences of employees with high extrinsic motivation (EM) and low extrinsic motivation on job satisfaction.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>High EM M</th>
<th>High EM SD</th>
<th>Low EM M</th>
<th>Low EM SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Satisfaction</td>
<td>97.6</td>
<td>6.1</td>
<td>99.5</td>
<td>6.2</td>
<td>1.1</td>
<td>198</td>
<td>N</td>
</tr>
</tbody>
</table>

In this study, it was found that there was strong positive correlation between self-esteem and job satisfaction, $r = .50$, $P < .001$. Moreover, according to findings as shown in table (5), the present study found that employees with high job satisfaction were significantly different form employees with low job satisfaction on self-esteem. Based on Korman's theory stating that there is a positive correlation between self-esteem and performance, and the findings of Garske study (1990) and the present study, it is suggested that an organization to be effective and successful has to employ people with high self-esteem and needs to train its employees to increase their self-esteem.

The present study also aimed to discover the relationship between work preference and job satisfaction of employees.

It was found in this study that there was positive correlation between job satisfaction and extrinsic motivation, $r = .15$, $P < .05$ and there was also positive correlation between job satisfaction and intrinsic motivation, $r = .31$, $P < .001$ judge, Locke, and Durham (1997) have hypothesized that four personality variables are related to people's...
predisposition to be satisfied with life and with their jobs: emotional stability, self-esteem, self-efficacy (perceived ability to master their environment) and internal locus of control (perceived ability to control their environment). That is, people prone to be satisfied with their jobs and with life in general have high self-esteem, have a feeling of being competent, are emotionally stable, and believe they have control over their lives.

It is suggested that for an organization to be effective and successful, it should employ people with high self-esteem and high level of work motivation.

Acknowledgements

My sincere thanks go to Dr. Si Si Hla Bu, the Rector of Pathein University, and Dr. Nilar Myint and Dr. Than Htun Pro-Rectors, Pathein University for their permission to do this research paper.

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REFERENCES


**Information Literacy Skills of Library Professionals in Universities’ Central Library**

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**Abstract**— Information literacy is a crucial skill in the pursuit of knowledge. As the majority of information through internet is unfiltered formats, users face with new challenges in understanding the landscape of information. Library and information professionals need to play an important role in the education process by making people aware of a need and motivating the use of information a new knowledge and a new ability. Thus, librarians and their staff are concerned with skills to acquire required information efficiently for users’ needs. This research focuses on information literacy skill of professionals in the Universities’ Central Library. The objective of the study is to examine the ability of information literacy of library professionals at Universities’ Central Library which is a leading library in Myanmar Academic libraries. The research based on qualitative research method. Questionnaire was delivered to all professionals of the library for measuring the professionals' information literacy competency. This research explores the level of information literacy skills of professionals at the Universities’ Central Library. The study concludes that information literacy skills are essential requirements for library professionals. These skills support to develop library service. Based on the assessment of their skills, the standard of universities’ central library can be evaluated.

**Keywords:** Information, Information Literacy, Information Awareness, Information Competencies, Professional Skills

**I. INTRODUCTION**

Information literacy is a set of skills which requires an individual to recognize when information is needed and has the ability to locate, evaluate and use effectively the needed information.1 Literacy is the ability to interpret information critically. Information Literacy may be defined very simply as "the ability to access, evaluate and use information from a variety of sources." Information literacy is a skill, ability, expertise, capability and competency of a person that makes him able to find the right information from the right source.2 It basically knows information about information and the source of information. Information literacy skill enables individuals to recognize not only when information is needed, but also when different kinds of information are needed.


Information seeking and use have become complex processes for college and university students due to the proliferation of information technologies and resources in all types and formats. Students at the doctoral level frequently need detailed, comprehensive information—particularly for thesis research and therefore need strong information-seeking and use skills to accomplish their research goals.³

Librarian and its staff have always been concerned with skills of their users and efficient use of documents. However, the issue of efficient use of information is complex. Research information literacy can be determined the ability to understand and use information in order to conduct research in disciplines. In the academic setting, the library as a knowledge repository plays a very important role in promoting educational standard. So that librarian and its staff as information specialist or research consultant, have a great task in solving this problem.⁴

As librarians are working closely with users who pursue information they need to provide skills to effectively and efficiently retrieve and use the information available from the treasure of resources. Information literacy becomes core competence category in librarianship. LIS professionals have to play a significant role to promote information literacy in society. As Information literacy is the ability to recognize when and what information is needed, and the knowledge of how to define appropriate search strategies, determine relevant sources, locate, critically evaluate and ethically use information in all formats, Information literacy is a vital skill in the information age.⁵

Thus, the library professionals play a vital role in creating the awareness on the availability of various electronic information resources. Otherwise, they have to be skill in information literacy. Towards this purpose, a study was conducted to assess the information literacy of library staff at Universities’ Central Library.

1.1. Information Literacy for Library Professionals

Due to the information explosion, the twenty-first century can be named the information era. With the advances in information technology, the libraries have affected significantly the nature of delivery of library resources and services. The traditional concepts of organization, bibliographic description and dissemination of information are changed to the new environment by these information technologies. So, the LIS professionals working in the environment have to face challenges concerned with ICT (Information and Communication Technology).

User cannot achieve their needs without practicing special information literacy skills. In other words information literacy skills empower

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⁴ Information Literacy Search Skills of Students in Five Selected Private... accessed August 10, 2018, https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2513&context.

users with the skills which can help them to access information sources.

Librarians and their staff are closely with scholars and researchers to provide skills to effectively and efficiently retrieve and use the information available from the large pool of resources. The information literacy becomes important for LIS professionals so that they can identify, evaluate and use the relevant information effectively.

The technological tools of information age computer networks, tele-communication system, digital information resources and databases have put an unprecedented volume of information at in finger tips. Further the students are hardly able to make distinction between internet sources and electronic information sources. Therefore, it is necessary to teach the students to acquaint with what is available, when to use it and how to find it. Information literacy is one such potential toll that empowers all learners.6

The paper identified the concept of information literary and the role of LIS professionals.

To be information literate person, the staff should have the following qualities:

- Recognizes the need for information
- Appreciates the importance of accurate and complete information to make intelligent decisions;
- Formulates questions based on information needs
- Identifies potential sources of information
- Develops appropriate search strategies;
- Accesses sources of information including computer-based and other technologies
- Evaluates information
- Organizes information for practical application
- Integrates new information into an existing body of knowledge and
- Uses information in critical thinking and problem solving7

1.2 Objectives of the Research

There are many objectives for compiling this research. The main objectives of present study are:

- To identify the information literacy skills of respondents to retrieve the information
- To know the level of awareness about different sources of information
- To determine the ability to access and evaluate the information resources
- To know the opinion of respondents on Information Literacy Programme

1.3 Scope of the Research

Although there are many university libraries, the research focuses on Universities’

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Central Library which leads all university libraries in Myanmar. The study mainly emphasizes on Information Literacy skills of professional staff at the Universities’ Central Library. Skills include the ability of searching, locating, arranging, evaluating and retrieving information.

1.4 Research Method

This research study employed a qualitative descriptive approach to determine the effectiveness of professionals’ skills at the Universities’ Central Library. A structured questionnaire was prepared and distributed all respondents of Universities’ Central Library to obtain required information with regards measure their information literacy competency. The data collected and findings observed were tabulated, analyzed and interpreted for this study.

II. LITERATURE REVIEW

Researchers have used a variety of methods and definitions of information literacy to investigate undergraduate and graduate student perceptions of information competencies. There were several studies on information literacy carried out in educational institutions throughout the world. Some important studies carried out in India and abroad were as follows:

Maidul and Rahman, (2014) examine the information literacy competency (ILC) of the arts faculty students at the University of Dhaka, Bangladesh and determine their strengths and weaknesses and it was found that students had limited skills in the area of information literacy and reasons behind it is not discussed extensively in their academic course curriculum. Murtaza, (2014) examine the level of information literacy skills of faculty members of the University of Lahore. The majority of faculty members are deficient in searching catalogue and its use, choice of information sources, selection of relevant sources and formulation of search strategies. The study helps to organize different information literacy programs in the university to promote and to develop the information literacy skills among faculty and to improve the teaching quality.

F. Chanchinmawia and Manoj Kumar Verma did a research paper titled “Assessment of Information Literacy Skills among Students of Academy of Integrated Christian Studies, Aizawl: A Survey”. The research revealed that information literacy is a major prerequisite for academic community in present ICT era because the skills and abilities are the main aspect that enables students to retrieve the right information from the right source without wasting their valuable time. Evaluation of electronic resources may be added in the information literacy program of the library. It is also remarkable that library resources, services, facilities and library personnel are inseparable in the process of organizing information literacy programs.

The research “Assessing Information Literacy Competency of Arts Faculty Students at the University of Dhaka by Md. Maidul Islam and Md. Anisur Rahman” found out the information seeking strategy and explore
information literacy skill of the faculty and identify their problems. The findings of this study show Arts faculties agree that information literacy is very important and helpful in academic work and research and it should also be introduced early in education to make it more effective.

Mr Christopher O. Ukpebor and Daniel Emojorho compiled a paper concerning with information literacy skill. The title is “Information Literacy Skills: A Survey of the Transition of Students from Secondary to University Education in Edo State, Nigeria”. This is a survey of the entry-level information literacy skills of first year students. The findings demonstrate that entry-level students have some little skills which are not enough for independent research work or library usage.

Ebele N. Anyaoku and others compiled a research titled “Information Literacy Skills and Perceptions of Librarians in Colleges of Education in Nigeria. The study concludes that there is need for IL standards that will guide information literacy development in Nigerian Colleges of Education. Librarians in the study have shown good perceptions towards IL and rated their skills high.

The research “Role of LIS Professionals in the E-Information Literacy in Digital Era by A. Jaya Prakash and V. Krishnama Charya” discussed the concept of information literacy and the role of LIS professionals in promoting electronic information literacy in Digital Libraries. The research pointed out a specific role for library professional to play in matching the user with correct information source. Library professionals with their expertise, knowledge and techniques of where to look up and how to find out information for given query can help the users in their search for information by extending personal help and assistance. Library professionals should acquire such skills in handling the information sources and users tactfully and render satisfactory information service in the fast changing digital library environment.

Prasanna Ranaweera’s “Importance of Information Literacy skills for an Information Literate society” is to present a broader analytical insight to the information literacy concept, in order to achieve an information literate society. In addition, this paper also proposes to discuss the available information literacy models and their practical approach, information literacy standards, and available frame works. A sample information literacy programme, curriculum, and assessment methods, are also elaborated in this study.

A. Jaya Prakash and V. Krishnama Charya contributed the research paper titled “Role of LIS Professionals in the E-Information Literacy in Digital Era”. The paper discussed the concept of information literacy and the role of LIS professionals in promoting electronic information literacy in Digital Libraries. This paper pointed out specific role for library professional to play in matching the user with correct information source.

III. UNIVERSITIES' CENTRAL LIBRARY
3.1 Background History

Although University of Rangoon (later Rangoon), the first university in Myanmar was established in Dec. 1920, the University of Rangoon Library was founded in 1929. In 1964, the name of library was redesigned at as the Universities’ Central Library (UCL). In 1973 construction for a new building for the Universities’ Central Library was began. In 1987, Universities’ Central Library and Rangoon University Library were separated. This library is a leading and the biggest library in Myanmar Academic Libraries. The library is oriented to meet the needs of university teachers, scholars, under graduates and post-graduates. Consequently it can be noted as a resource center for not only all faculty members and students from all academic libraries in Myanmar. It has reputation with its valuable collections and activities. UCL has the largest collection of books, palm-leaf and parabike paper manuscripts in Myanmar. The collections of UCL are mainly for research and reference.

The main sections are Myanmar Books Section, English Books Section, Periodical Section, Loan and Reference Section, Myanmar Manuscripts Section, Reprographic Section, Preservation and Conservation Section, e-Library Section, Gifts and Exchange Section, Administration Section, and Theses and Dissertation Section. It is a combined catalog and effort of 23 major University Libraries in Myanmar.9

3.2 Organizational Structure of UCL

The organizational structure of the department is very important to achieve the department’s goal and objectives. The Universities’ Central Library consists of professional and non-professional positions. In the library, there are many different classifications of employees, including professional librarians, paraprofessionals, clerical workers, technical specialists, and part-time workers such as students' assistants.

The library always has appointed 31 daily wages in various sections. Among them, 19 are working in professional areas such circulation counter, processing areas, user service areas and technical services but they are not degree holder in Library and Information Studies. The study includes only LIS professionals and permanent staff in professional area totally 28. The following table shows organizational structure of this library.

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### Table 1: Organizational Structure of UCL

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Position</th>
<th>Set-up</th>
<th>Sanctioned</th>
<th>Appointed</th>
<th>Vacant</th>
<th>Remark (Attached from Other University Library)</th>
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<tr>
<td>1</td>
<td>I</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>II</td>
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<td>1</td>
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<td>-</td>
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<td>7</td>
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<td>1</td>
<td>-</td>
<td></td>
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<td>1</td>
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<td>10</td>
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<td>11</td>
<td>XI</td>
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<td>2</td>
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<td>12</td>
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<td>2</td>
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</tr>
<tr>
<td>13</td>
<td>XIII</td>
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<td>2</td>
<td>2</td>
<td>-</td>
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<tr>
<td>14</td>
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<td>-</td>
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<td>2</td>
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<tr>
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<td>-</td>
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<td>18</td>
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<td>1</td>
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<td>19</td>
<td>Gate Keeper</td>
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<td>2</td>
<td>-</td>
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<tr>
<td>20</td>
<td>Cleaner</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>42</td>
<td>42</td>
<td>35</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Survey

I= Librarian (Head of the Library)

II= Librarian

III= Assistant Librarian

### IV. DATA ANALYSIS

Internet becomes the most powerful tool and medium to access information sources easily. Internet literacy skill is essential to access, evaluate and disseminate information. This study asked the respondents to find out most frequently used internet. Under the using internet, the research surveyed frequency, items of internet, purposes.
According to table 2, majority or 89% of the staff use internet daily and only 4% or one staff use internet once a fortnight.

Internet is a vast information superhighway that facilitates communication between computer users both nationally and internationally. There are valuable programs, items, resources on the internet. Regarding used item from internet, the research categorized six types of items involving writing and sending E-mail, www resources, Downloading and Uploading data, Online Databases and Using Facebook. Among these items, five staff utilized all items. The staff 18 or 64% use Email, 12 or 43% use for resources, 19 or 68% use downloading required data, 9 or 32% utilize online databases, 26 or 93% use for Facebook but only 5 or 18% use internet for uploading data.
89% use internet for personal interest, entertainment and general knowledge. Computer skill is one of the most important tools in handling information now a day. One must be aware of computer to accomplish his information needs. The study asked to the respondents seven kinds of skills concerning with computer skill: Word-processing, Spreadsheets, Desktop publishing, Power point presentation, Convert to PDF file, Scanning, and Burning CD. These skills are very basic for computer skill. According to the survey, eight staff (29%) can operate all items or above seven skills but only one who is Library Assistance-5 has not any skills concerning with computer knowledge. The following table and figure shows number of staff having computer skills.

<table>
<thead>
<tr>
<th>Types of Skills</th>
<th>No of Staff</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word-processing</td>
<td>24</td>
<td>86</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>12</td>
<td>43</td>
</tr>
<tr>
<td>Desktop Publishing</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>Power Point Presentation</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>Convert to PDF File</td>
<td>11</td>
<td>39</td>
</tr>
<tr>
<td>Scanning</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>Burning CD</td>
<td>16</td>
<td>57</td>
</tr>
<tr>
<td>No Skills</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>All Skills</td>
<td>8</td>
<td>29</td>
</tr>
</tbody>
</table>

*Source: Survey*

Figure 3: Computer Skill of Professionals

ELIB (Electronic Library on Web) software is a library management system developed by CE Technology Co. The library has used library software which is ELIB since 1999. The majority of academic libraries use it in Myanmar. According to survey, the 20 staff (71%) has knowledge to operate this software.

Search strategy is absolutely key sources for identifying and finding information from the databases, internet. A search strategy is an approach to find information using computers and to solve an information need. It can consist of a single search query or a selection of search queries. The LIS professionals should be qualified to search electronic resources effectively which are user’s demand.

Regarding the types of search strategy, the respondents were asked two types of questions ie. Google Search and Specific type of Search Strategy. The survey pointed out that most of the staff utilizes specific search type of databases but almost all can operate Google search. They always type web address directly to get required
data from the internet. Besides, the only three professionals can search required information through typing the web address directly, search engine and can consult subscription databases.

The library has a rich collection of Myanmar manuscripts on palm-leaf and parabikes as well as rare printed books which are historical and national heritages and retrospective publications of Myanmar books as early as 1872 has also been collected. There are many bound volumes of newspapers, magazines and journals published in Myanmar, some dating back to the 19th Century. It has the best collection of old, rare periodicals published in the country.

As the library has carried out digitization project for its invaluable collections as the preservation of library materials, the study asked some questions concerning with digitization of materials and technology such as OCR (Optical Character Recognition), Bibliographic Format. Optical Character Recognition (OCR) software converts a scanned image into a text file that a word processor can read. To do this, it must first recognize where the text is on the page. The survey points out that 20 professional staff or (71%) can digitize these materials but ten of them have known, eight can create OCR technology. Two of respondents didn’t answer these questions.

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Sources: Survey

V. CONCLUSION

Traditionally library professionals have to provide guidance to the users of the library by making various bibliographic tools like catalogue indexes and abstracts, so that a user himself can find out the required information. As the complicated and sophisticated information are exploded in digital era, the role of library professional is changing from time to time. The usage of electronic sources is gradually increasing. However, users face problems concerned with selecting appropriate information sources and using them effectively. Today’s library professionals must be experts in dealing with digital information. Library professionals should acquire such skills in handling the information sources and users tactfully and render satisfactory information service in the fast changing digital library environment.11


Regarding these skills, the respondents in the research were asked the skills of using internet, information acquire from the internet, search strategy, computer skills and so on. These skills are very basic skills for LIS professionals. Library professionals in the study have shown good perceptions towards information literacy and rated their skills high.

According to this survey, most of LIS professionals in the library are familiar with using internet daily. Among them, most of them use internet for the purpose of Facebook and Downloading resources. As today is information technology, the staff in library must have awareness of computer technology. Computer literacy skill is one of the most important tools in handling information now a day. Library professional must be aware of computer to accomplish his information needs. Through the research, most of staff has skill of Word-processing and they can burn CD for data carrying which they need. Among the staff (28), 8 or 29% have full skills of computer knowledge which are Word-processing, Spreadsheets, Desktop publishing, Power point presentation, Convert to PDF file, Scanning, and Burning CD. Findings also revealed that they have low skills in Convert to PDF File.

20 (71%) of the LIS professionals have knowledge of library software (ELIB). Regarding search strategy of required data from the internet, 24 or 86% of respondents utilize Google Search for finding information on the Internet.

For carrying data on the internet, 32% of respondents use both of hard or printed copy and soft copy (CD/ memory stick) while 32% have not this knowledge. The most of respondents (71%) have awareness of digitization for library materials. Among them, 36% have awareness of OCR knowledge for digital resources.

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Firstly, my sincere thanks go to the Chairman of the Myanmar Universities’ Research Conference 2019 for giving me the chance to read this paper at the conference. Furthermore, I also wish to thank to Chief Librarian and all the professional staff of the Universities' Central Library for answering the questionnaires of the researcher to get necessary data.

BIBLIOGRAPHY


Academic Freedom of Faculty Members in Myanmar

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Abstract- Academic freedom is a professional right of the faculty. It is grounded in the faculty member’s qualifications for the position as reviewed by his/her peers. It consists in the freedom to teach, research, write, and speak in our capacity as citizens without restraint by the administration. This right differs from the Constitutional right to freedom of speech and assembly guaranteed by the 2008 Constitution, in the sense that it is the necessary condition for a faculty member to fulfill his/her professional obligations and responsibilities as a teacher, researcher, and writer. It is also meant to protect faculty members from reprisal for exercising their free speech rights. In Myanmar, Ministry of Education is undertaking many educational reforms and striving to promote educational system. One of the reforms is changing autonomous system in universities. The right of academic freedom is one of the important points to implement autonomous. The intention of this study is not to define what the term ‘academic freedom’ exactly means. The first purpose of this study is to understand the perceptions of faculty members and the leadership of the Faculty of Education in Myanmar in relation to academic freedom. This study is also intended to find out how to provide and safeguard academic freedom and how to guarantee the right of freedom of research for its faculty members. Finally, the study provides insights that help to understand the concept of academic freedom and offers valuable information for those who are particularly interested in the issue of academic freedom and freedom of research. This study applies a qualitative research by literatures review and uses semi structure interviews as a method of data gathering as well as document analysis.

Introduction

Academic freedom does not lie directly within the purview of human rights, which includes freedom, but it is derived from them. Academic freedom is not only a right but also an obligation. Academic freedom is the main point for the development of education in our society. Nevertheless, in a number of countries and in a number of different ways, the rights on academic freedom are being encroached upon. Limitations on the rights of freedom of academic are restrictions that are necessary to balance competing or conflicting rights, or to harmonise rights with other public objectives.

In Myanmar, Ministry of Education is undertaking many educational reforms and striving to promote educational system. One of the reforms is changing autonomous system in universities. Therefore, academic freedom and autonomy are essential to know thoroughly.

The concept of academic freedom is widely discussed in the international field but in Myanmar. There is a debate neither relating to how academic freedom is perceived nor how academic freedom of universities can be balanced. Academic seminars and conferences seldom address the concept of academic freedom. Besides, issues of academic freedom are not directly found in articles, journals and books. These are the weaknesses relating to the concept of academic freedom in Myanmar.

I. Academic Freedom in a Myanmar Context

All Myanmar Universities aim to implement autonomous by each University. But there are many requirements for each university. The right of Academic Freedom is one of the important points to implement autonomous.

In Myanmar, there is no definite definition on academic freedom in existing Myanmar Laws. Therefore, this definition is required to define Myanmar educational laws. The term academic freedom is an amorphous quasi-legal concept that is neither precisely defined nor convincingly justified from legal principles. These two defects make the law of academic freedom difficult to understand. Academic freedom is important and desirable. Academic freedom is a valid legal doctrine with power and vitality, when in fact; it is often only empty rhetoric by professors and judges. Academic freedom in its strongest form implies the absolute personal right to pursue truth not influenced by ‘management’ and accountable only to a community of scholars. So, the heart of academic freedom is the protection of the right of teachers, students and researchers to express their ideas with intellectual honesty and without fear of reprisal.

A. Objectives and Structure of the Article

The primary objective of this study is to investigate the perceptions of faculty members of Myanmar’s Universities about academic freedom and freedom of research.

Academic freedom is a subject with many aspects: academic freedom of university professors, universities themselves, and students. This study is concerned with academic freedom of Universities’ faculty members especially emphasized on freedom of research.

The intention of this study is not to define what the term ‘academic freedom’ exactly means. The first purpose of this study is to understand the perceptions of faculty members and the leadership of the Faculty of Education in Myanmar in relation to academic freedom. This study is also intended to find out how to provide and safeguard academic freedom and how to guarantee the right of freedom of research for
its faculty members. Finally, the study provides insights that help to understand the concept of academic freedom and offers valuable information for those who are particularly interested in the issue of academic freedom and freedom of research.

The study comprises four parts. The first part deals with the background and the objectives of the study, research questions and methodology. The second part concerns with the history, different definitions and important elements of the term. The third part designs the legal framework, university policies and practices and the different ideas and opinions given by different faculty members. The last part includes the review of related literature and challenges of academic freedom and freedom of research.

B. Research Questions

This study primarily investigated the following research questions:

1. What are the gaps between domestic laws and international laws on the implementation and guarantee of the rights of Academic Freedom?
2. How do faculty members and the university education board of the faculty members in Myanmar perceive the idea of academic freedom?
3. What are the barriers and limitations of the right of freedom of research for the Faculty members of Myanmar Universities?

C. Research Methodology

To find out the answer of these questions, this study applies a qualitative research by review in related literatures and examining and collecting comprehensive and detailed information on academic freedom research strategy. It uses semi-structure interviews as a method of data gathering as well as document analysis. Interviews are conducted to obtain faculty members’ and the academic leadership’s views as well as experiences regarding academic freedom and freedom of research. There were altogether thirteen participants in the interview. The respondents were selected by using purposive sampling, such as having experiences in researches, being decision makes, etc.

By using and comparing relevant international and domestic laws, it will explain how the right to freedom of research from academic freedom is guaranteed, how it is implemented and applied and what kind of restrictions and standards are permissible under the international conventions and the domestic laws in Myanmar.

Semi-structured interviews were chosen for collecting data information relating to freedom of research. Thirteen-person interviewees are universities teachers in Myanmar who are doing research for art and science field. Other primary documents were collected from respective Ministry of Education. The primary reason for choosing semi-structure interviews is to encourage the respondents to express their personal feelings, opinions, attitudes and experiences in relation to freedom of research and about academic freedom. The other expected for selecting semi-structure is based on its nature of allowing for both flexibility as well as structure, which enables to obtain required information and to change the questions based on the answers of the respondents.

II. What is academic freedom and why is it Important?

Academic Freedom means the right of all members of the university community to inquire, discuss, speak and express themselves, study, conduct research, teach, publish, associate, create and exhibit their work without obstruction or restriction by the university or any of its representatives. However, this freedom does not include the act of hatred, contempt for any social, national or ethnic group, display incompetence in teaching or scholarship or violate the human rights of others.

It is important to emphasize at the beginning that academic freedom is not the same as freedom of speech, which is a frequent misconception held by some university professors. Accordingly, it does not amount to an unlimited freedom of the academics to speak openly on any subject. With regard to the differences, firstly, even within the classroom, academics are constrained by the professional criteria of relevance and pertinence to the subject. If a person is employed to teach property law, he would be rightly disciplined if he chose to talk about public international law instead. Secondly, a lot of academic activity does not involve speech, such as work in laboratories, scientific research or even conducting polls and interviews. Admittedly, speech is an aspect of academic activity, but not the core of it. Therefore, academic freedom and freedom of speech are not the same, although they are intertwined. In general, it is possible to identify three types of claims that can be made under academic freedom. Firstly, academic freedom can be claimed by individual scholars, as a freedom to determine how they do their work free from direction, especially how they teach and conduct their research. Secondly, universities and higher education institutions can make institutional claims to academic freedom. Thirdly, claims can be made by individual academics to ensure their participation in university governance.[1]

A. The History of the Term

Academic freedom is a complex issue. The meaning of academic freedom is different in different contexts based on historical periods and specific universities. Freedom to teach and freedom to learn without interference is the right of faculty members and students. The assumption that faculty members should be able to teach and conduct research and students should be able to study without interference has been defined as academic freedom. Academic definition of academic freedom means the freedom of teachers and students to express their ideas, thoughts, and opinions without restriction or fear of reprisals.
Legal definition of it means the right of a teacher or a student, especially at college or university level, to discuss or investigate an issue, or express any opinions on any topic without interference or fear of penalty or reprisal from either the school or the government. A school’s freedom means the power to control its own policies without government interference, penalty, or reprisal. The extent to which academic freedom exists depends upon many facts, including whether the school is a public or private institution, and whether it is a primary or secondary school or a college or university.[2]

In Myanmar, most of the education laws had not been amended for a long time ago. Therefore, they are not suitable to apply and implement in the current situations. Particularly, the Basic Education Law of 1973, the Technical and Vocational Education Law of 1983 and the University Education Law of 1973 which were enacted under the centralized system do not sufficiently support to take actions for the development of education. The University Education Law of 1973 was amended in 1998. University governance legislative framework of higher education governs with the University Education Law of 1973. Numerous amendments have been made to the law to establish specific education facilities. The State Peace and Development Council Law No. 4/98, March 1998, amended this Law and determined governance arrangements for universities in Myanmar. The Law does not provide for significant autonomy of institutions. Section 9 of the Law was amended to constitute a body to supervise all aspects of the university sector covering both content and process. The National Education Law was passed in 30, September 2014. Section 4 of this Law was amended on June 25, 2015. In particular, it mentioned that State guarantee the freedom of education.

The American Association of University Professors (AAUP) defined academic freedom in 1940 and in 1970 supplemented this definition with interpretative comments. The original definition of AAUP states that

- Teachers are entitled to full freedom in research and in the publication of the results, subject to the adequate performance of their other academic duties; but research for pecuniary return should be based upon an understanding with the authorities of the institution.

- Teachers are entitled to freedom in the classroom in discussing their subject, but they should be careful not to introduce into their teaching controversial matter, which has no relation to their subject. Limitations of academic freedom because of religious or other aims of the institution should be clearly stated in writing at the time of the appointment.

- College and university teachers are citizens, members of a learned profession, and officers of an educational institution. When they speak or write as citizens, they should be free from institutional censorship or discipline, but their special position in the community imposes special obligations. As scholars and educational officers, they should remember that the public may judge their profession and their institution by their utterances. Hence, they should at all times be accurate, should exercise appropriate restraint, should show respect for the opinions of others, and should make every effort to indicate that they are not speaking for the institution.

Both the protection of academic freedom and the requirements of academic responsibility apply not only to the full-time probationary and the tenured teacher, but also to all others, such as part-time faculty and teaching assistants, who exercise teaching responsibilities.

According to United Nations Secretary-General Kofi Annan, “academic freedom is the freedom to conduct research, teach, speak, and publish, subject to the norms and standards of scholarly inquiry, without interference or penalty, wherever the search for truth and understanding may lead”.

**B. Different Definitions of Academic Freedom**

The 1997 Recommendation of UNESCO defines that academic freedom as “the right, without constringtion by prescribed doctrine, to freedom of teaching and discussion, freedom in carrying out research and disseminating and publishing the results thereof, freedom to express freely their opinion about the institution or system in which they work, freedom from institutional censorship and freedom to participate in professional or representative academic bodies. All higher-education teaching personnel should have the right to fulfil their functions without discrimination of any kind and without fear of repression by the state or any other source.” Furthermore, the 1997 Recommendation states that: “Autonomy is the institutional form of academic freedom and a necessary precondition to guarantee the proper fulfilment of the functions entrusted to higher-education teaching personnel and institutions… Member States are under an obligation to protect higher education institutions from threats to their autonomy coming from any source”.[3]

Academic Freedom is the freedom of scholars to pursue the truth in a manner consistent with professional standards of inquiry. Liberal democracies protect academic freedom on the grounds that the open pursuit of knowledge and truth provides substantial benefits to society, and because freedom of thought is essential to the fulfilment of human nature.[4]

Academic freedom is that freedom of members of the academic community, assembled in colleges and universities, which underlines the effective performance of their functions of teaching, learning, practice of the arts and research. The right to academic freedom is recognized in order to enable faculty members and students to carry on their roles.[5]

In the eighteenth and nineteenth centuries, the political state became the sponsoring authority for most universities throughout the world—although some under religious
A. The Rights of Academic Freedom

The rights of academic divide into two categories. They are general and special rights. The general rights have a general interpersonal moral right not to be deceived. Special rights have a special interpersonal moral right. The first of these treats the right to academic freedom as directly implied by the function of institutions of higher learning. The second of these views the idea of academic freedom as an interpersonal moral right.[7] To oppose pressures hostile to academic freedom from state and local authorities, business, industry and other outsiders, there is need to erect long experience, safeguards in both state and private educational institutions.[8]

Academic freedom is a long-standing idea that came into its own in American higher education in the 20th century. The concept is propelled by three academic processes that are intended to provide a great deal of professional autonomy to faculty, instructional staff and other researchers, while, at the same, ensuring that they adhere to a body of high scholarly standards. Those three processes are tenure, peer evaluation and shared governance.

Tenure: Faculty members who earn tenure after a long probationary period are protected from sanctions for saying or writing things that a particular individual or special interest group might disagree with, but that are consistent with proper academic practice.

Peer evaluation: This is the process by which academic peers at an institution and within the scholarly disciplines continually review and evaluate academic standards, content and procedures, as well as individual performance.

Shared governance: This is the set of procedures under which institutional decision-making is shared between college and university administrators and the faculty (and, less often, non-faculty instructional staff).

The term academic freedom refers to two different concepts, professional academic freedom and constitutional academic freedom. The professional notion centers on professional ethics of self-governance and autonomy. The constitutional notion, on the other hand, is legal rather than ethical and was developed by courts after professors began to sue for academic speech rights.[9]

In Myanmar, there are four classes of academic freedom. They are freedom in the classroom, freedom of research and publication, freedom of extramural utterances and freedom of intramural utterances. Freedom in the classroom deals with freedom to teach extends from such fundamental issues as the choice of course materials, preparation of the syllabus and the conduct of lectures to the assignment of grades.

B. Important Elements of Academic Freedom

There are two types of academic freedom. They are an individual and an institutional right. The first type of academic freedom is individual academic freedom, which protects an individual professor, and the other type is institutional academic freedom, which protects universities from interference by the government. Individual academic freedom has basically two aspects regarding that “student freedom to learn and faculty freedom to teach and research”. This point of view indicates that individual academic freedom is considered for both faculty members and students in the field of teaching, learning and research. Institutional academic freedom is generally considered as the right of the higher education institution in order to determine its own goals and degree standards. It provides the right to the university to select faculty and students and to prepare curriculum content. This view is linked to university autonomy.

D. Individual Academic Freedom

This freedom protects an individual professor. In most cases, individual academic freedom is simply part of academic tradition. Thus, the routine ways that faculty boards, heads of department and deans operate when they make judgment about who to hire, who to promote, who get contract or tenure, who gets larger salary increases and who gets their employment contract terminated. Individual academic freedom is a relationship between professors and the university administration.

According to Ronald B. Standler (1999), a significant part of individual academic freedom is not a legal concept, but dependent on the internal culture among faculty and management at a university. On the other hand, the management of a university gives minimal supervision to teaching and research by faculty, except when problems occur, or when a faculty member is being evaluated for promotion, tenure or salary increases. Indeed, the faculty are trusted to do their job competently and professionally. It must be noted that freedom from detailed supervision is not a license to relax. Each professor is responsible for meeting his/her classes, teaching competently and producing a substantial series of scholarly publications. Again, faculty chooses their own textbooks. A department curriculum committee, made up of professors, sets the syllabus for courses. It is considered highly inappropriate for a professor or an administrator to tell a faculty member what grade to assign to a student. This is to say that the sense of independence is so strong among faculty, that it is often difficult to discuss teaching methods, because no faculty member wants to be accused of criticizing another.

In another context, faculty are active participants in setting all academic rules and regulations as well as selecting new faculty members, granting tenure, etc. The use of departmental boards to make first-level decision before it goes to Academic Board and Appointment and Promotion Board means that neatly all decisions by university administration have support of the majority of affected faculty.
Lastly, among the basic academic ideals is the fact that there is tolerance by both the administration and faculty for differences of opinion, methods, style and personality among the faculty. To some extent, one can say that this tolerance of unconventional views and personality is the result of an enlightened community. Professors tend to work as individuals in industrial-style team, so it does not matter if professors are compatible with each other or not.

E. Institutional Academic Freedom

Institutional academic freedom protects universities from interference by government, a right that applies to the community of scholars, not to individual faculty. It also reserves to the university itself selection of faculty and students, as well as issues in curriculum such as the content of the syllabus in each class or level. It is interesting to note that institutional academic freedom does not protect individual professors with unorthodox views from dismissal by the university administration. However, it does protect professors from dismissal by politicians.

Institutional academic freedom reserves to the University, the right of selection of faculty, supporting staffs and students. Issues are in curriculum as well as content of the courses to be delivered to student are agreed upon by departments and academic Board.[10]

So far, there is no autonomous university within the Republic of the Union of Myanmar. Therefore, the right of selection of faculty members is control by the Ministry of Education and institutional academic freedom is very limited in Myanmar.

III. Academic Freedom as a Human Right

The definition of academic freedom is not easy to define. However, it was regarded not to lie directly within the purview of human rights, which includes freedom, but it is derived from them. Academic freedom, which is linked to the individual, was designated as the right and obligation of every individual. Many aspects of academic freedom are not only individual rights but also collective or institutional rights that are often referred to as institutional autonomy. It implies that departments’ faculties and universities as a whole have the right to preserve and promote the principles of academic freedom in the conduct of their internal and external affairs.

The United Nations recognized academic freedom as part of a human right to education. As far as the normative context of the UN is concerned, both the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR) are of importance for the issue of academic freedom.

In the ICCPR, academic freedom is generally considered to be included in the guarantee of free speech, proclaimed in Article 19. Academic freedom can thus be subject to the limitations and restrictions provided by that provision. The ICESCR on the other hand expressly recognises academic freedom as part of a human right to education and progress, in its Article 15.

A. Myanmar: Academic Freedom in Law and Practice

In Myanmar, the right of academic freedom of Universities is directly related within the Constitution of the Republic of the Union of Myanmar, 11/2008 and the Law Amending the National Education Law, Law No 38/2015.

Under the 2008 Constitution, every citizen is to be at liberty in the exercise of the following rights, if not contrary to the laws, enacted for Union security, prevalence of law and order, community peace and tranquility or public order and morality:
(a) to express and publish freely their convictions and opinions;
(b) to assemble peacefully without arms and holding procession;
(c) to form associations and organizations;
(d) to develop their language, literature, culture they cherish, religion they profess, and customs without prejudice to the relations between one national race and another or among national races and to other faiths.[11]

Every citizen has the right to freely develop literature, culture, arts, customs and traditions they cherish in accordance with the law. In the process, they shall avoid any act detrimental to national solidarity. Moreover, any particular action, which might adversely affect the interests of one or several other national races, is taken only after coordinating with and obtaining the settlement of those affected.[12]

Every citizen, in accord with the educational policy lay down by the Union:
(a) has the right to education;
(b) to be given basic education which the Union prescribes by law as Compulsory;
(c) have the right to conduct scientific research explore science, work with creativity and write to develop the arts and conduct research freely other branches of culture.[13]

The Union honour and assist citizens who are outstanding in education irrespective of race, religion and sex according to their qualifications.[14]

In accordance with the Law Amending the National Education Law, 2015 and other existing educational laws in Myanmar, there is the right to academic freedom in the Union.[15] Moreover, there is the right to form associations and organizations for students and teachers in higher education institutions in accordance with respective institutional Charter.[16]

Every person has the right to choose their subject and university entrance is in accordance with the Charter of respective Universities.[17]

The right of Academic freedom differs from the Constitutional right to freedom of speech and assembly
guaranteed by the 2008 Constitution, in the sense that it is the necessary condition for a faculty member to fulfill his/her professional obligations and responsibilities as a teacher, researcher, and writer. It is also meant to protect faculty members from reprisal for exercising their free speech rights.

In many societies, currently and in the past, scholars have had to stifle their perceptions, hide their knowledge and conform to standards imposed by forces outside academia, such as politicians, government officials and pressure groups.

Academic freedom is at the very core of the mission of the university. It is essential to teaching and research. The importance of academic freedom is “the cornerstone of the university’s mission to educate students and expand the boundaries of knowledge”. In this regard, faculty members and students, who are the major concern of the university, need academic freedom to achieve their goals without external and internal interferences. The degree of academic freedom is based on wealth, ethnic homogeneity and the size of the society in which a rich society can provide more freedom for academics in their institutions and more opportunities for scholars than a poor society. Myanmar is a developing country, which has been consistently suffering from insufficient funding for higher education. The primary reason is that the government only allocates a small amount of money to higher education.

The challenge to the university is how to safeguard academic freedom of faculty members and students. Higher education institutions are the centre for teaching, learning and research. Therefore, the protection of academic freedom is usually thought to be the responsibility of universities. “Academic freedom, however, is by no means wholly or even largely dependent on formal protection for its strength and its survival. To a large extent it exists and is recognized because of professional tradition and because it resides inherently in the functions of teaching, learning, and research”.

The political style of a society is “one important element of the context in which the degree of academic freedom has to be negotiated”. The challenge of instituting academic freedom under conditions of political instability is considerable. Universities are very often centers of political and intellectual dissent, and regimes are reluctant to allow institutions the freedom and autonomy that may contribute to instability”.

The major contribution of this study is to explore the idea of academic freedom. It is assumed that when faculty and students are aware about the concept of academic freedom, they are able to minimize interference and protect the right of teaching, learning and research. This is ultimately useful to the university to accomplish the mission of teaching and research. It provides valuable information to the policy makers to develop policies of higher education in relation to academic freedom. It is also assumed that it is useful for the university leadership to safeguard academic freedom and respect each other freedom to conduct academic activities.

An institution that does not guarantee the academic freedom of its faculty and the academic freedom of its students does not deserve the autonomy that it has been given. The obligation of the institution is to protect that academic freedom, which must involve the officers of the institution actively doing so, and the faculty similarly taking active part in making sure that it exists for all. It protects the rights of both faculty members and students to perform academic activities. It also offers the autonomy to faculty members to teach and carry out research in their area of competence. Similarly, it protects the rights of students to learn without interference. In addition to these values, academic freedom is considered desirable to the university to fulfill the aims of it.

All Universities’ teachers in Myanmar are civil servants and their appointment, retire, tenure, salary are managed and controlled by the Ministry of Education. Therefore, individual academic freedom of faculty members has very limitations.

B. Legal Framework

The Universal Declaration of Human Rights guarantees, “the right to freedom of opinion and expression and to seek, receive and impart information and ideas.” [18] This right includes the right to freedom of political expression for academics and students and the right to be free from governmental interference.

The UN Committee on Economic, Social, and Cultural Rights (ESCR) emphasised that the “right to education can only be enjoyed if accompanied by the academic freedom of staff and students”. It also indicated that “staff and students in higher education are especially vulnerable to political and other pressures which undermine academic freedom”. [19]

As far as the normative context of the UN is concerned, both the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR) are of importance for the issue of academic freedom.

In the ICCPR, academic freedom is generally considered to be included in the guarantee of free speech, proclaimed in Article 19. [20] Academic freedom can, thus be subject to the limitations and restrictions provided by that provision. The ICESCR on the other hand expressly recognizes academic freedom as part of a human right to education [21] and progress, in its Article 15. The States Parties to the present Covenant undertake to respect the freedom indispensable for scientific research and creative activity. [22]

Myanmar’s 2008 Constitution include provisions on academic freedom formulate this right either in the abstract or as an individual right, often uniting and specifying a number of expressive freedoms (e.g. freedoms of speech, conscience, association, and information). It takes this approach in its constitutions. However, academic freedom, like other freedoms, can be limited, if there are solid justifications for such limitations.
C. University Policies and Manuals

Academic freedom of faculty members of Myanmar is connected with the rights of freedom to teach, freedom of research, freedom to participate in associations and freedom to participate in the governance of the University. Academic freedom of students is related to the rights of freedom to study, freedom to participate in associations and freedom to participate in the governance of the University.

Academic freedom and freedom of research in Myanmar guarantee under 2008 Constitution and Education laws in Myanmar.

The importance of academic freedom is perceived in relation to the functions of universities. The main functions of universities include generation and transmission of ideology, production and application of knowledge, improvement and development of mental and physical powers and training the skilled labour force. To fulfill these diverse educational and social functions, universities need to have a commitment to the spirit of truth and possess academic freedom.

D. Data Analysis and Interpretation of Interview

Some interviewees answered that there are many restrictions and they think no right of freedom to do research in higher education. They explained their experiences of doing research.

T3 said that her departmental research is banned by her head because her research outcome found that arsenate acid in rice because of using pesticide in agriculture.

T6 said that her research found out many viruses on public phones but it was not allowed to disclose for not harming the related business.

T2 and T11 said, “As long as administration controlled in Academic, the researchers will be depressed and there is no good research. Therefore, freedom of research is really necessary.

T10 said that administrative constraints should be released by the respective organizations so that freedom of research will be achieved.

There are still many things left to be reformed according to the national policy. Researchers should be encouraged and supported more in universities.

T1 and T5 suggested that freedom of research should be discussed in parliament.

They also said, “Reformed policies for research freedom and those of released policies should be published so that everyone can know transparently. Because of the respective authorities could not answered the questions regarding these polices, many difficulties have been encountered.”

T8 and T9 said “The difficulties have been faced for the research papers of history and geography. While the researcher records his/her findings and makes conclusions, he/she faces difficulty due to the limitations.”

“Two things are required for the success of research works. The first one is Human Resources and another one is support. Here, I mean Research Fund is established in international universities to support researchers. But here there is rare support and most researchers have to use their own budget for their researches so the desired outcome cannot meet.”

A1 and T4 could not give clear answers. Their departments do not have restriction to do research. But T7 and A2 said that they do not have any restriction to do research although there are some barriers to do research (such as data collection form government departments which cannot give to researchers for confidentiality)

The followings two events relating to the right of freedom of research were arisen during the socialist government era in Myanmar.

1. During the Socialist government era, there was a research about the hearing power of labors at Meikhtila textile factory studied by psychological department of Mandalay University. By using the test instruments, the research found out that unlike the normal people, the labors of this factory could not define very low sounds because of the exposure to the noises. The research was not accepted to be published by the government because if it was permitted, the compensation fees would have to be given to the labors.

2. One of the senior lecturers was demoted as he published his research paper in an international journal without receiving approval from the government.

E. Challenges to Academic Freedom in Myanmar in General

Generally, there are many challenges to get academic freedom in Myanmar. They are as follows;

- One challenge to academic freedom is how to safeguard the freedom of academic community.
- Political situation of the country is one of the major challenges to the university to offer academic freedom of its faculty members and students.
- Financial assistance to improve institution and research
- Centralized to transfer of teaching staffs and supporting staffs (control by Ministry of Education)
- Many restrictions to publish research
- Factors affecting academic freedom
- Standards of academic freedom are not clearly
- Requirements of University Library and research lab
- Need to internet Access
Today, the following standards of academic freedom are developed in the world.

**Teaching:** The body of faculty and instructional staff at an institution of higher education must have primacy in designing and approving the curriculum, as well as the methods of instruction, in accordance with accepted professional standards.

This principle reflects the level of collective responsibility and accountability that faculty and instructional staff should have in the self-governing partnership of the academy. Contingent faculty and instructional staff members must be treated as partners in this collective responsibility and accountability. As a practical matter, this means that instructional staff, and particularly contingent faculty, should be invited to participate in the institution’s mechanisms of self-government and, if they undertake that responsibility, they must be fairly compensated for their participation.

Individual courses and individual instructors operate in the context of a curriculum aimed at teaching the institution’s student body appropriate subject matter through appropriate means. Separating curriculum planning and implementation—i.e., curricular design and instruction—leads to the standardization of curricula and teaching.

Therefore, assigning faculty or instructional staff only the role of classroom instruction, and not the broad Academic freedom of faculty members of EYU is connected with the rights of freedom to teach, freedom of research, freedom to participate in associations and freedom to participate in the governance of the University. Academic freedom of students is related to the rights of freedom to study, freedom to participate in associations and freedom to participate in the governance of the University. The role of curriculum design takes away part of their professionalism and weakens good educational practice.

Individual faculty and instructional staff members must have primary responsibility for selecting instructional materials, defining course content and determining the methods of evaluating student performance in their classes—working in concert with their colleagues to ensure coherence of the curriculum and consistency in applying it, and subject to academic standards accepted within the community of scholars.

Within the classroom, all faculty and instructional staff are entitled to full freedom to discuss the subject matter of the course, in accordance with prevailing academic standards established within and among the academic community.

Faculty and instructional staff are entitled to exercise their professional judgment in presenting and discussing, frankly and forthrightly, controversial material relevant to their teaching subjects and methods.

Faculty and instructional staff are entitled to evaluate students in their classes based solely on their assessment of the academic merit of the students ‘work in that class. Students need to be confronted with arguments and encouraged to think critically, evaluate unfamiliar points of view, examine the intertwining of ideas across academic disciplines and the relationship of one subject area to others, and be engaged in thinking about the world we all live in.

All faculty and instructional staff are entitled to full intellectual property rights in developing and delivering their teaching materials.

**Research and publication:** All faculties, instructional staff and other professionals performing research at the institution are entitled to full freedom in choosing research subjects and methods, subject only to professional and peer-driven standards. They are entitled to full freedom in the publication of their results.

Regardless of how controversial, unconventional or unsettling their subjects, methods and results are, academics need freedom from interference in their research for the reasons cited above. They should be able to pursue ideas and knowledge wherever they may lead.

Academic integrity in research, however, requires discoveries to be shared and knowledge to be considered primarily as a public good instead of private possession.

In Myanmar, researchers have many limitations to get the right of freedom of research. For the current situation, the terms and conditions prescribed in the manual of Journal of Myanmar Academy Arts and Science for authors are still limiting the academic freedom of researchers. The followings are the list, which effects on the right to freedom of research of academic freedom. The research is:

- whether in line with our three main national causes,
- whether in line with four peoples' desire,
- to be not contrary with the principles set by the Government,
- whether the research is related to politic,
- not to be contrary with the principles set out for economic, social and politic,
- whether it includes any factor which can impact to the security of the State,
- not to harm the dignity of the Country,
- not to conflict with the cultural practices and integrity of other ethnics,
- any relationship with religious belief,
- whether it should be published or not even though it is related to religious belief,
- if the paper is relevant to international and regional concerns, whether those international and regional policies are in line with national policy or not,
- whether the paper is related to the issue of human rights, child rights and women rights,
- whether the paper should be published or not even it is relevant to the above-mentioned human rights,
- whether the paper is related to UN, INGO and NGO,
- Whether the paper should be published or not even it is related to the above-mentioned UN, INGO and NGO,
- whether the paper can give negative impact the image or integrity of Ministry of Education.
• whether the paper can give negative impact on the image or integrity of other Ministries,
• whether it is a proper research or not and
• whether the paper should be publish or not.

These factors are barriers of freedom of research for researchers in Myanmar. These restrictions are clear to annul or not. It cannot definitely say that these are still enforced or not. These do not get definite notifications from relevant Ministry and department.

**Participation in institutional governance:** All faculty and instructional staff are entitled to freedom in their institution to participate in governance, whether they are tenured or non-tenured, without fear of intimidation or retaliation.

Institutions have an obligation to provide appropriate mechanisms of shared governance, time for individuals to participate in them and, in the case of contingent faculty and instructional staff members, appropriate compensation for taking part.

All faculty and institutional staffs are entitled to participate in decisions affecting educational policy, including the development of curricula and academic programs, the establishment of accountability and outcomes assessment methods and measures, budget development and allocation of resources, and academic and administrative staffing.

All faculty and instructional staff are entitled to participation in the accrediting process internal to institutions, within accrediting associations and on accreditation visiting teams. The self-regulating system of shared governance is a pillar of academic freedom.

**Freedom in public life:** Members of the academic community—including all faculty, instructional staff and indeed all workers at the institution—are free to join or form associations and organizations; to organize and work with unions; and to state their views on any topic, subject only to the understanding that they do not speak on behalf of their institutions.

**IV. Conclusions and Recommendations**

In recently, academic freedom has been challenged by several obstacles and ongoing processes within higher education institutions. These include financial resources, overloading academics with administrative duties and internal governance. Moreover, overloading of academics with administrative duties negatively affects the quality of their intellectual production. A major obstacle for higher education development and an indirect obstacle to academic freedom is inadequate funding for our University. All Myanmar Universities’ financial support is provided by the government, which retains financial powers over the institutions.

Other serious challenges for academic freedom are needed to institutional autonomy and more accountability from the institutions in our University. This autonomy is framed within national accountability systems, which are primarily intended to promote trust between universities and the state or society.

All the executive heads, teaching staffs and supporting staffs are civil servants and their appointment, rank and transfer are control by the Ministry of Education. These factors are obstacle for our University’s academic freedom.

The current study focused on the right of academic freedom and freedom of research and freedom of faculty members. Therefore, it is suggested to carry out similar kind of study at the university level in order to investigate the perceptions of academic community and find out the possible challenges to safeguards academic freedom in detail. The further study might also include the freedom of faculty members regarding the freedom of publication and the freedom of access to higher education in the case of students.

**ACKNOWLEDGEMENT**

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**List of Interview**

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[16] Section-4 (c) of the Law Amending the National Education Law, 2015.

[17] Section-12 (b) of the Law Amending the National Education Law, 2015.


Protecting the Rights to Housing in Myanmar

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Abstract— This research addresses the protection of economic, social and cultural rights especially the right to adequate housing in the context of Myanmar laws, policies and plans. Although economic, social and cultural rights are guaranteed in the International Convenant on Economic, Social and Cultural Rights 1966, this right does not protect in the standard of living for the civil servants in the Ministry of Education (MoE) especially in East Yangon University.

The State through the relevant governmental agencies has to take steps towards the full realisation of housing rights articulated in ICESCR which is the focus of this paper, in a manner that pointed out the relating provisions for the Myanmar citizen and the civil servants in service.

This study was conducted by reference to both primary and secondary data which were collected with the aim of collating relevant information on SERs and especially the progressive realisation of the right to adequate housing in Myanmar. It will be based on review and analysis of literature relevant to the area of study. Primary sources such as international instruments in the area of economic, social and cultural rights such as the ICESCR, General Comments of both the CESC or and the Human Rights Committee (HRC). The secondary data was mainly collected from the University library at the East Yangon University, from which relevant materials including; legal books, articles, academic commentaries, journals and newspapers and previous studies done on SERs. To supplement the material obtained in the library, and utilized the internet to access articles, commentaries and reports on SERs in Myanmar.

Abbreviation- CRPs, HLP, MoE, SERs, UDHR, ICESCR, YCDC. CPRs, DUHD, HLP, ICCPR, ICESCR, IDPs, ILO, KMIC, MoE, SERs, UDHR, UAGO, YCDC.

I. INTRODUCTION

Human rights are granted to all human beings by virtue of being human, they inhere in humanity. [1] The Universal Declaration of Human Rights (UDHR) though not a binding document, was the first formal international recognition of human rights and it is regarded as the basis for the human rights movement. [2] It contains provisions for both Civil and Political Rights (CPRs) and Social and Economic Rights (SERs) but these were later codified in two separate Covenants; the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic Social and Cultural Rights (ICESCR). [3]

The importance of Economic, Social and Cultural rights cannot be overstated. Poverty and exclusion lie behind many of the security threats that it be continue to face both within and across borders and thus place at risk the promotion and protection of all human rights. [4] The research focus on the historical background of housing rights in Myanmar and current status of civil servants in East Yangon University.

II. THE RIGHTS OF HOUSING

A. What is the right to housing?

“The recognition of housing rights by the United Nations began immediately following the creation of the organization itself in the 1948 Universal Declaration of Human Rights, which included both housing rights and property rights.” [5] “Everyone has a fundamental human right to housing, which ensures access to a safe, secure, habitable, and affordable home with freedom from forced eviction.” [6] Thus, everyone has the rights to housing, adequate housing, as a component of an adequate standard of living, is fundamental to the enjoyment of all economic, social and cultural rights.

B. The right to housing in Myanmar

Myanmar’s national housing policy evolution were traditional shelter, space and local needs in early Myanmar Kingdom. In pre-independence period from 1920 to 1947, Myanmar citizen have faced the situation of colonization & urbanization. After independence from 1950 to 1970, the government passed the the State Public Housing Rehabilitation and Urban Rural Development Board Act, 1951 for public housing and social needs which was known the implementation of Pyi Taw Thar Housing project.

Myanmar applied the market orientation & public-private partnership (PPP) in housing project during (1980 and 2000) including Private Sector Participation in Housing Delivery. To meet the housing needs of the civil servants the State, Law and Order, Restoration Council the new township was developed for civil servants in different regions of Myanmar. Between 2000 and 2011, Myanmar government changed their role from provider to facilitator in implementing the housing plan. The idea was to move from the lack of housing policy for low income people to the adequate housing for all citizens. [7]

Nothless, the implementation of adequate housing has not been realized until 2018. This situation was acknowledged by the government as the President U Win Myint mentioned in his New Year Greetings Speech. President U Win Myint said that three basic needs of the citizens which are “food, clothing and shelter”, it has been found that housing is the people is the vital need in Myanmar. He also noticed the suffering of the people who have to live in make-shift shelters because they do not have a place to live. Among our civil servant personnel who are still in active service, there are some who do not have proper housing and a great number of civil personal after retirement are suffering greatly because they do not have housing. That is why Union Government will work hard on a priority basis so that civil service personnel will have at least a house or an apartment and live in dignity by the time they retire, during the two years term of the Union Government, they have already built (4627) housing units for public service personnel in States and Regions. In the
remaining three years also, the government have already planned to build more than (7000) housing units for civil service personnel. In the remaining three years, by extending this programme, (10,000) housing units will be built and sold for civil service personnel to be repaid in installments on a monthly basis. [8]

Regarding not having the adequate housing until now, UN Habitat in Myanmar figured out the issue as follows. “During five decades of socialist and military rule in Myanmar, many of the institutions, laws and processes that underpin a modern housing sector were neglected. Myanmar faces major problems in modernizing its housing stock and dealing with squatter incursions, but there is no single body or authority taking responsibility for housing construction or housing issues, and a policy focus is lacking. Most of Myanmar’s housing problems are in the large cities where land has become expensive.” [9]

“The challenges therefore for Myanmar are significant – on the one hand to create a modernized formal housing sector for the middle class, on the other to house large numbers of very poor people in a way that is sustainable, safe, affordable and which meets their present and future living requirements.” [10]

Currently, the Urban and Housing Development Bureau under the Ministry of Construction is tasked to the development programme with the cheap, moderate and high price housing level. The implementation of this programme is the Union Level and State and Division Level. The main task force is municipal department. The aim of the special programme is to access the stipulation of the capable to purchase realty project.

Nonetheless, Myanmar does not have a housing strategy for civil servants who do not have equal access to enjoy housing rights. Thus, the focus of this research is to analyze the situation of civil servants particularly teaching staffs in higher education under the Ministry of Education in accessing the right to housing during in service in Myanmar. Civil servants are not given housing for the duration of their services, even though their salaries are not enough to afford the minimum standards connected to the right to housing. As an obligation of State party of ICESCR, “Myanmar should establish housing subsidies for those unable to obtain affordable housing, as well as forms and levels of housing finance with adequately reflect housing needs.” [11] This obligation is not fulfilled by Myanmar to its civil servants particularly for teaching staffs in higher education under Ministry of Education.

The housing right under ICESCR requires the State to ensure “to all persons irrespective of income or access to economic resources”. [12] This is relevant for the Myanmar context because, in general, and in particular it is relevant for civil servants, who do not earn sufficiently in order to afford adequate housing as it is required by the ICESCR, which Myanmar has ratified on 6th October 2017.

C. Research questions

1. Do Myanmar’s housing laws and policies live up to international human rights standards, including principles of non-discrimination, with regard to civil servants?

2. What could be done to improve the right to housing of civil servants in a Myanmar context?

D. Methodology

The study used documentary legal analysis and in-depth interview which is the qualitative research approach to make interview two interviewees from East Yangon University, one interviewee from Union Attorney General Office and one interviewee from Department of Urban and Housing Development (DUHD) under Ministry of Construction with semi-structure in each five minutes. Extent and Nature of the problem: Data, including statistical data from the Ministry of Construction, specifically the Department of Urban and Housing Development will be used to provide an analysis of the national housing deficit and the low-income housing situation in Myanmar, specifically connected to civil servants.

E. Structure of the paper

The paper includes the international human rights standard on housing, the key components of the right to housing, the situation of the right to housing in Myanmar and the gaps and challenges in relation to the right to housing for civil servants in Myanmar.

III. INTERNATIONAL HUMAN RIGHTS STANDARDS ON HOUSING

Human rights are a core set of rights that human beings possess by simple virtue of their humanity. These rights are spelled out in a number of international human rights instruments which determine their validity as well as the extend to which they bind states. The scope of the right to adequate housing has been more precisely defined by three General Comments of the UN Committee on Economic, Social and Cultural Rights General Comment No.4 (the right to adequate housing), 7 (forced evictions) and 16 (the equal right of men and women to the enjoyment of all economic, social and cultural rights).

A. Main documents relating to the housing rights

The right to an adequate standard of living, is protected by Article 25 (1) of the Universal Declaration of Human Rights (UDHR), Article 11 (1) of the International Covenant on Economic, Social and Cultural Rights (ICESCR). According to the United Nations Committee on Economic, Social and Cultural Rights has underlined that the right to adequate housing, it “should be seen as the rights to live somewhere in security, peace and dignity”. [13]

Though there are other international human rights treaties that recognize the right to adequate housing as follows, the scope of this study was limited to Article 25 (1) of UDHR and Article 11 (1) of ICESCR which is directly relevant to housing.

- The 1951 Convention Relating to the Status of Refugees (Art. 21).
- The International Labour Organization’s 1962 Convention No. 117 concerning Basic Aims and Standards of Social Policy (Art. 5 (2)).
- The 1965 International Convention on the Elimination of All Forms of Racial Discrimination (Art. 5 (e) (iii)).
B. The components of the right to housing

The fundamental rights to equality and nondiscrimination are not unique to the ICESCR and are at the heart of human rights law and are enshrined in all major international and regional human rights treaties [14] and have been said to be part of customary international law. [15] Nondiscrimination and equality are fundamental components of international human rights law and essential to the exercise and enjoyment of economic, social and cultural rights. [16]

The principle of non-discrimination in the guarantee of economic and social rights is spelled out in the ICESCR, at article 2(2) and it requires equality in both allocation and distribution of resources. This provision in particular requires that SERs are available to all people without discrimination [17] regardless of the individual’s race, colour, sex, language, religion, political and other opinion, national or social origin, property, birth or other status. [18] It is the obligation of the state party to “guarantee” that Covenant rights will be exercised without discrimination of any kind, and that any form of discrimination must be eliminated both formally" [19] and substantively. [20]

In addition to refraining from discriminatory actions, States parties should take concrete, deliberate and targeted measures to ensure that discrimination in the exercise of Covenant rights is eliminated. [21] These measures include formulation of legislation that addresses and seeks to remedy historical and systematic discrimination, putting in place policies and plans aimed at eliminating discrimination among others. Temporary special measures are provided for under a number of international human rights treaties for the purpose of redressing disadvantage faced by certain vulnerable groups. [22]

Such measures are not considered discriminatory within the terms of the various conventions including the ICESCR in respect of which the CESCR in its General Comment No. 16, paragraph 15, explains that temporary special measures may sometimes be needed in order to bring disadvantaged or marginalized persons or groups of persons to the same substantive level as other members of the society. Further that, in so far as these measures are necessary to redress discrimination and are terminated when equality is achieved, such differentiation is legitimate and justifiable. [23]

Article 2 (2) of ICESCR prohibits housing discrimination, providing that all the rights in the Covenant, including the right to adequate housing, should be exercised without discrimination on any kind of grounds. In its general comment No. 4, the CESCR has pointed out that housing discrimination not only affects the enjoyment of SERs but also might curtail the enjoyment of a range of CPRs such as the right to freedom of movement and residence.

The right to adequate housing is enshrined in Article 25(1) of the UDHR and Article 11(1) of the ICESCR. The General Comment Number 4" [24] identifies seven essential elements that comprise the right to adequate housing and which are discussed in detail below. Security of tenure

Housing is not adequate if its occupants do not have a degree of tenure security which guarantees legal protection against forced evictions, harassment and other threats.

Availability of services, materials, facilities and infrastructure

Housing is not adequate if its occupants do not have safe drinking water, adequate sanitation, energy for cooking, heating, lighting, food storage or refuse disposal.

Affordability

Housing is not adequate if its cost threatens or compromises the occupants’ enjoyment of other human rights.

Habitability

Housing is not adequate if it does not guarantee physical safety or provide adequate space, as well as protection against the cold, damp, heat, rain, wind, other threats to health and structural hazards.

Accessibility

Housing is not adequate if the specific needs of disadvantaged and marginalized groups are not considering.

Location

Housing is not adequate if it is cut off from employment opportunities, health-care services, schools, childcare centres and other social facilities, or if located in polluted or dangerous areas.

Cultural adequacy

Housing is not adequate if it does not respect and consider the expression of cultural identity. [25]

C. Progressive realization of the rights to housing in Myanmar

According to Article 2 (1) of ICESCR, the Government must identify immediate obligation such as by providing legal framework or action plan and progressive realization of the right by implementing the rights based on available resources of the country. When necessary, the government must cooperate with international communities to receive assistance. The following paragraphs showed the efforts of the government in housing area.

Ministry of Construction issued to establish Notifications No. 73/2017 (Building Sub-Committee) for
Civil Servants Housing and Civil Servants Lodging-house, No.74/2017 (Lodging-house Disposing Sub-Committee) and No.75/2017 (Civil Servants Housing Instalment Sub-Committee). These Notifications have to implement and support the rights to housing for civil servants in Myanmar.

Currently, Department of Urban and Housing Development is building the apartments, under the supervision of Yangon Regional Government Shwe Pauk Kan, Shwe Linban, Kanaung and Yuzana low-cost housing apartments. The department is also planning to build more housing apartments in other townships. Yangon regional government has announced that those who want to purchase low-cost housing apartments must have a monthly income of between Ks 300,000 to Ks 500,000. The Ministry of Construction has already issued an announcement that the company’s staffs needs to pay a 25 per cent down payment of the value of these apartments, whereas the government staffs need a down payment of 15 per cent of the value of an apartment.

Yangon region government is planning to sells apartments from Inwa and Kaung Santha housing estates in Dagon Myothit (South), Yuzana housing part 1 and 2, and Kanaung housing estates in Dagon Myothit (Seikkan), Kyi Pwar Yay housing estates in Thingangun Township, Shwe Liban and Htee hlaing housing estates in Hlaingthayar Township, Shop Houses from Shwe Pyi Tha Township and Shwe Pauk Kan housing estates in North Okkalapa Township. [26]

The National Apartment Law is being discussed at the Pyidaungsu Hluttaw construction meeting. According to the Constitution, the Apartment Law can also be enacted at the states and regions levels. Before, work begins on a building, the construction plan needs to be submitted six months in advance to the Yangon City Development Committee (YCDC) for approval as designing buildings, copying municipals maps, etc., take time. [27]

The Ministry of Construction is currently drafting the National Housing Development Bill. The Department of Urban and Housing Development has completed 6 townships in the annual shortlist from April 2018 to February 2019. The Korea-Myanmar Industrial Complex (KMIC) is in the construction phase on 558 acres of Nyaung Napin training school in Hlegu Township. The ‘Housing Finance Development Project, MY 24 from JICA’s ODA Two-Step Loan aims to provide people with low income in chance to own low-cost housings at low interests’ rates. [28] 1

Main actors of housing sectors cooperate Japan (Japan Bank of International Cooperation (JBIC), Japan International Cooperation Agency (JICA), Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan (MLIT), Singapore, Korea, ADB and UN Habitat with Myanmar responsible ministry.

The Ministry of Construction plays an important role in building the capacity of regions and states in developing appropriate policies and action responses to housing situations in their regions. In the past, housing activities were seen mainly from the perspective of budget- and time-bound construction projects, which accorded the the Department of Urban and Housing Development (DUHD) the role of a provider and implementer. [29]

The multi-stakeholder’s cooperation is not the possible solution to attain the rights to housing for civil servants in Myanmar.

Like civil and political rights, economic, social and cultural rights impose three different types of obligations on States: the obligations to respect, protect and fulfil. Failure to perform any one of these three obligations constitutes a violation of such rights. The obligation to respect requires States to refrain from interfering with the enjoyment of economic, social and cultural rights. [30] Thus, the right to housing is violated if the State engages in arbitrary forced evictions. The obligation to protect requires States to prevent violations of such rights by third parties. Thus, the failure to ensure that private employers comply with basic labour standards may amount to a violation of the right to work or the right to just and favourable conditions of work. The obligation to fulfil requires States to take appropriate legislative, administrative, budgetary, judicial and other measures towards the full realization of such rights. Thus, the failure of States to provide essential primary health care to those in need may amount to a violation. [31]

Overall, the expansion of housing projects in Yangon as well as other states and regions, the plan of drafting housing law and the cooperation with international communities should be acknowledged the great efforts of the government. However, how much extents those projects fulfill the needs of civil servants especially for staffs from Ministry of Education is another thing to be considered.

IV. THE RIGHT TO HOUSING FOR WORKERS

Myanmar has ratified three of the eight ILO Conventions designed to protect and promote these core labour standards. The average number of core Conventions ratified by ASEAN countries, with eight of ten ASEAN Member States having ratified a majority of the core Conventions, and three countries (Cambodia, Indonesia and the Philippines) having ratified all eight. As noted above, every ILO member State is committed to respect and promote these universal principles and rights even if the State has not ratified the eight ILO Conventions covered by the Declaration on Fundamental Principles and Rights at Work. [32]

According to Article 3, 7 and 19 of the Worker’s Housing Recommendation, 1961 (No. 115) specifically provides that the rights to housing for workers with a decent living. That why, Myanmar need to support the government staffs housing in line with ILO standards.

A. The right to housing for workers in Ministry of Education

The maximum of teaching staffs and administrative staffs get Ks 300,000 income per month. The minimum rental fees of apartment will sum between 100,000 to 150,000 fees in Yangon to depict the vulnerable situation of the civil servants. In this way, this situation will reflect to low-income people not to reach the accessibility and affordability of the housing rights. That why, the right to housing is important for staffs under the Ministry of Education.

As Ministry of Education (MoE) is not an income-generated ministry under the current system, it has been

using the union budget for all the necessary implementation costs. MoE has allocated 8.53% from total expenditure of Union budget in 2017-2018 fiscal year. At that year, MoE used Ks 1,726,539.333 million from this budget. [33] However, most of the budget was spent for the school buildings, expenditure for free and compulsory elementary schools, to employ an additional 50,000 teachers for basic education, to university stipends and scholarships, [34] and supplementing fees at technical institution. [35] Though there are some budgets for the dormitory for teaching staffs, the Ministry could not fully provide for all the teaching staffs. Although the union allocates many budgets to MoE every fiscal year, not all teaching staffs are entitled to housing rights in service. The meaning is that, MoE should prioritize on the realization of housing rights of teaching staffs. In the current situation, MoE does not apply facility for their staffs than other ministries.

All ministry’s civil servants have to enjoy facility such as housing, car etc during their in-service period. Moreover, MoE has not applied the principle of non-discrimination between single and marriage status when providing the housing. The other fact taken into account by MoE is years of service. The said two discrimination and years of service are applied especially when there is in adequate budjects to provide housing for civil servants such as East Yangon University. Myanmar does not have a housing strategy for civil servants who do not have equal access to enjoy housing rights in service.

In East Yangon University, there were 522 teaching staffs and 287 administrative staffs, in totally 809 persons were working in 2016 academic year. Although them, 168 of teaching staffs and 5 of administration staffs applied to the Higher Education Department to access the housing located in EYU and managed by EYU. The number of applicants from administrative increased to staffs 60 persons who applied to live in housing in EYU in 2017 fiscal years. Nonetheless, two teaching staffs and 24 administrative staffs are allowed to access the housing in EYU by Higher Education Department. [36] EYU has not plan to get housing for teaching staffs and no housing yet. EYU arranged to lived for teaching staffs at Sorority. The following graph show the situtation of accessibility and availability of housing rights in EYU.

B. The contemporary legal framework in Myanmar

“The Union shall protect the citizen’s privacy and security of home under the law in accordance with the Constitution of the Republic of the Union of Myanmar, 2008.” [37] “The Union shall strive to promote the living standards of the people as the basic principles of the Union.” [38] Constitution of the Republic of the Union of Myanmar, 2008 Section 96 provides that the Pyidaungsu Hluttaw shall have the right to enact laws for the entire or any part of the Union related to matters prescribed in Schedule One of the Union Legislative List. In Schedule I, 8 (n) Television, satellite communication, transmission and reception, and similar means of communication and housing and buildings.

According to Section 188 of the Constitution of the Union of Myanmar, the Region or State Hluttaw shall have the right to enact laws for the entire or any part of the Region or State related to matters prescribed in Schedule Two of the Region or State Hluttaw Legislative List. Schedule II, 8 (b) states that Town and housing development.

The 2008 Myanmar Constitution does not explicitly single out recognition of general housing, land or property rights, as such, but it does recognize a series of central HLP rights themes, and may, therefore, be useful as a foundational basis in pursuing an improved HLP legal environment in the country.

Section 21 (a) of the Constitution of the Republic of the Union of Myanmar, 2008 provides for every citizen shall enjoy the right of equality, the right of liberty and the right of justice, as prescribed in this Contition. In addition, Section 26 (b) of the Constitution which espouses the Union shall enact necessary laws for Civil Services personnel to have security and sufficiency of food, clothing and shelter.
Myanmar have the State Public Housing Rehabilitation and Urban Rural Development Board Act, 1951; the State Public Housing Rehabilitation and Urban Rural Development Board Act Amendment, 1962; the new National Housing Development Bill, which is being drafted by the Department of Urban and Housing Development. However, those laws have never been amended. The objective of new National Housing Development Bill is to promote high living standard for all citizens. As a result, new legal framework is necessary to catch up the contemporary issue such as lack of enough housing for civil servants.

To cope the contemporary issues in Myanmar, a number of legal frameworks have been drafted since 2014, which includes the drafting of Urban & Regional Development Planning Bill and Myanmar National Building Code and National Housing Development Bill. Even though the relevant laws have not been formally legislated yet, Yangon City Development Committee (YCDC) is conducting the development permit systems in operation. [39] Urban & Regional Development Planning Bill includes 16 Chapters and 77 Articles in all, and defines, among others, establishment of Urban and Housing Development Region/State Committee, tasks of concerned departments and types of plans to be formulated. National Housing Development Bill was drafted and approved by Minster of Construction, and submitted to Union Attorney General Office (UAGO) for consideration, and is under final revision based on their comments. The bill does not clearly define the development permit, the authority of the housing development organization, the composition of organization, procedures, the authority of the developers, and the procedure of applying for the development permit, so that it is necessary to materialize in the bill. [40] It is a hope for civil servants to fully access the housing projects without discrimination under the term ‘all citizens’ used in the new Bill.

Myanmar has not directly implemented law the right to housing for civil servants. As the development of housing sector, the government should enact relating housing law, such as Apartment Law, Real Estate Law, civil service law and directly housing development law. These laws will control high price of land, strong assets and the chance of possessing the rights to housing. Moreover, there are other policy agenda mentioned as follow.

According to 2014 census, the number of housing in Myanmar increased from 6.5 million in 1983 to 10.88 million in 2014. “Based on an estimate number of homeless people and those living in other collective quarters, and the number of low-income people with deficient living conditions, a core housing need of 3.8 million units was estimated for the country” (DOP, 2017). It is expected to reach 15.68 million housing units for 70.56 percent of housing need in 2040. Therefore, additional housing needed will be 4.8 million units if it is assumed to be 4.5 person per housing units. 40 current housing need based on 2014 census and expected housing need in 2040. According to the results, current housing provision plan for low-income people is not enough for all to meet the aim of a Government Policy, “Adequate housing for all citizens”. Even though the relevant laws have not been formally legislated yet, Yangon City Development Committee (YCDC) is conducting the development permit systems in operation. [41] Myanmar government has announced “a million homes plan” to fulfil the housing need for its citizens. The government housing department, Department of Urban and Housing Development (DUHD) has planned to provide 20 percent of total targeted housing units and 80 percent of housing need to be provided by the government and private sectors. [42] However, as shown in the previous section about housing rights of civil servants particularly in East Yangon University, it is still questionable on whether the government’s target really fulfill, accomplish on time and cover for the civil servants. In addition, it is not clear reflects how is cooperation between DUHD and MoE.

C. GAPS AND CHALLENGES IN RELATION TO THE RIGHT TO HOUSING FOR CIVIL SERVANTS IN MYANMAR

Myanmar have many gaps and challenges in relation to the right to housing for civil servants.

It is not directed law to enjoy the right to housing to the civil servant in accordance with ILO Convention and Worker’s Housing Recommendation, 1961 (No. 115) as above mentioned in the rights to housing for workers.

The current situation does not meet the 7 essential components of the realization of housing rights guaranteed and explained in ICESCR and its general comments.

Myanmar need to reach the price of housing for the poorest citizens which is unaffordable and inaccessible for civil servant who get salary only to buy enough for basic needs of their life.

Main actors responsible for implementation take into consideration all sectors such as mortgage, budget. There is not having affected cooperation within the Ministries or effective consultation with affected civil servants, or not having any transparency on the budget in housing sectors.

Along with proportion directed to low income families.

Existing law and policies relating to housing are to ensure the fair and justice between the status of the low-income people and women. Most of low-income families are affected by the government uncertain housing strategy and plan detail mentioned in the previous sections.

V. CONCLUSION

There is need to define what “adequate housing” entails in the context of the Myanmar situation so as to be enable policy makers, planners in different governmental ministries and other stakeholders to identify the challenges and appropriate solutions and begin to give full effect of housing rights.

There are gaps in the existing legislation on housing in Myanmar and in addition to these gaps in legislation there is need to amend the existing laws to bring them in conformity with the spirit of Constitution. Government should be sufficiently empowered to be able to develop and implement appropriate policies and legislation for the provision of basic services including the prioritization of fulfillment of the right to adequate housing for the neediest in their areas of jurisdiction to complement the efforts of the national government in provision of adequate housing.

Myanmar does not have in place a monitoring system for the right to housing and could adopt some of the indicators set out by South East Asia and UN HABITAT in
developing a monitoring system to cater for the particular circumstances of the Myanmar citizen. State needs to put in place a dependable system or process for the sustainable production of sufficient and good quality data to enable monitor the progressive realization of housing rights and socioeconomic rights in general. Non-governmental organizations, civil society organizations (CSOs) and community-based organizations play a key role in advancing socio-economic rights which should be encouraged.

This paper analyses the implementation of progressive realisation of the right to adequate housing of teaching staffs in higher education sector in Myanmar in line with International Standard. The government should enact the national housing development law, the apartment law and the real estate law as soon as possible.

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[6] ICESCR, General Comment No.4: What is the human right to housing?
[12] ICESCR, General Comment No.4: The Right to Adequate Housing (Art. 11(1) of the Covenant), paragraph 7.
[14] International Convention on the Elimination of All Forms of Racial Discrimination (ICERD); Convention on Elimination of All Forms of Discrimination Against Women (CEDAW); Convention relating to the Status of Refugees; Convention relating to the Status of Stateless Persons; Convention on the Rights of the Child (CRC); International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (CMW); Convention on the Rights of Persons with Disabilities (CRPD),

while other treaties require the elimination of discrimination in specific fields, such as employment and education. (ILO Convention No. Ill, Discrimination in Respect of Employment and Occupation; UNESCO Convention against Discrimination in Education.)
[18] The preamble. Articles 1(3) and 55 of the UN Charter and Article 2(1) of the Universal Declaration of Human Rights prohibit discrimination in the enjoyment of economic, social and cultural rights.
[19] Requires ensuring that a State’s constitution, laws and policy documents do not discriminate on prohibited grounds; for example, laws should not deny equal social security benefits to women on the basis of their marital status.
[20] Eliminating discrimination in practice requires paying sufficient attention to groups of individuals which suffer historical or persistent. States parties must therefore immediately adopt the necessary measures to prevent, diminish and eliminate the conditions and attitudes which cause or perpetuate substantive. States parties may be, and in some cases are, under an obligation to adopt special measures or affirmative action to suppress conditions that perpetuate discrimination.
[22] For example, CEDAW, article 4 allows for the adoption of temporary special measures that are ‘aimed at accelerating de facto equality between men and women’ (see also the Convention on the Elimination of Racial Discrimination, article 1 (4) and the Convention on the Rights of Persons with Disabilities, article 5).
[23] CESCR General Comment No. 16 para 15.
[31] Ibid
[34] The Government has been providing 117 scholars in Germany, England, the United States of America, Australia, People Republic of China and Thailand to study different disciplines including medicine and engineering, See: http://www.moe.gov.mm/en
[36] East Yangon University, Sorority and Housing Assignment and Discipline Committee.
[41] Legal framework for housing supply.
Importance of Monastic Education for Needy Family and Ethnic Children

Zin Mar Oo

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Abstract—This paper presents the role and importance of Monastic Education in Myanmar that effective support on the provision of basic education of children who are unable to attend due to various factors although they are in school age. Most of the people from different ethnic minority groups have sent their children to Charity-based monasteries for monks and nuns as they faced different kinds of difficulties. By sending like this, these places provide not only education in free of charge but also basic human needs such as shelter and food etc. to their children. In this way, these places, charity-based monasteries, became the very important ones for those who want to study in developed plain regions from underdeveloped ethnic regions. These places are those where anyone who wants to live and study is accepted without the discrimination in terms of class, race and gender and the government recognized them as accredited organizations for basic education. In these places, not only the basic education but also the morality and ethical concepts are taught and practiced to become responsible good citizens.

In this way, the monastic education schools are contributing the support not only for education but also for other basic human needs such as shelter but some of them gradually less functional and finally closed due to various challenges especially financial things. The first objective of this paper, therefore, is to explore the current functioning system, institutional structure, methodology of teaching and other constraints of monastic education schools. Secondly, it is for the wide awareness of this situation by the donors and public while the third one is to have sustainable form of running these institutions and to support them financially and materially or in other ways by the public and government.

This study is how these monastic education schools solve the problems of basic needs of children, in what approaches and methodologies they apply in teaching children and the challenges of these institutions. In performing the research, the target institutions are Mahā Paññārāma and Nay Min Monastic Education Schools from Mandalay and the methodologies that used in this study are key informant interview with the elder monks of the Baka Education Center, informal interview with teacher, students and parents and observation. The finding is that these educational institutions can enhance human resource development of country with the more advanced and modernized ways through the multi-tiered support both from public and the government and very important for those who need help. Monastic education includes the important role for needy and ethnic children. So It should be supported by public and government for sustainable.

Keywords: Monastic Education, Needy Family, Ethnic Children, Mahā Paññārāma Monastic Schools, Nay Min Monastic Schools

I. INTRODUCTION

For the comprehensive development of a country, education is the most important key factor and every citizen fundamentally needs to be educated. Nowadays, not only rich parents but also poor and ethnic ones also focus on their children’s educational prospects. Some elite class even prefers the high class educational centers and proficiency in foreign languages such as English and Mandarin. In particular, for needy families those who are in this trend, monastic education plays an important role.

Due to political situation, social-economic problem, majority of ethnic people cannot catch the opportunities for education in their native places. To the monasteries and nunneries from many major cities, therefore, they send their children for education opportunity. By sending like this, it provides both enjoying the free educational service and supporting the basic needs such as food and shelter. Moreover, these educational centers are places where the religious and ethical teachings are taught meaning that these are the ones where propagation and flourishing of religious teachings and the culture are carried out.

Therefore, these centers play a significance role for those who come from the ethnic areas for educational opportunity. In this paper, the importance of monastic educational centers throughout the history, current functioning and administrative systems, and these institutions are solving the basic needs of children are presented. The targeted studied places are Mahā Paññārāma and the Nay Min monastic education centers from Pyigyidagon Township in Mandalay.

II. MONASTIC EDUCATION SYSTEM OF MYANMAR (HISTORICAL BACKGROUND)

Myanmar Monastic Education System is fundamentally based in Buddhism. Since the time of King Anawrahta (1044-1287) in Bagan Era, Buddha Sāsanā (Buddhism) began to flourish in Myanmar. At that time, the king and citizens promoted the study of Buddhist Pali literatures with the aim of living in harmony according to the teachings of Buddha and therefore the primary focus of study at that time was Pāli Literatures. The intention of monastic education in Bagan period was on two main themes; to expertise in Buddhist teachings and to enhance the basic skills on reading, writing and Mathematics. The preference study theme of Bagan period was Pāli grammar. After studying for some time, most of the students dropped out for helping their parents in their work although they acquired only basic reading and writing skill.

Most of the teachers were monks and the king and people supported the monasteries of at that time with giving rice and many hectares of lands for the material and financial requirements of these institutions[2].

In the remain periods of Pinnya, Sagaing, Innwa, Taunggu and Nyaunghan (1287 – 1752), there was...
fluctuation of the condition of literacy rate and standard of literature depending upon the capacity of leaders of at that respective period and socio-political conditions of the state[4]. In Pinya period, Pāli Buddhist literatures were studied in Burmese language while Inwa period had more systematic study plan for education sector[6]. The objectives of monastic education at that time were to respect the role of five infinite venerable, to avoid evil deeds, thoughts and speeches, to be good citizens in terms of morality and ethics, to be proficient in modernized academic fields[6].

In the time of Kongboung period (1752-1885), there was a continuation of activities of monastic education system. As King Mindon was one who especially focused on the flourishing of Buddhist Śāsanā, there was significance development in the sector of monastic education system with the increasing numbers of students into many thousands and the situation of education sector improved in both basic literacy skills and in advanced religious studies. Many famous and outstanding scholars had arisen at that time but when Myanmar was under British colonial rule, the monastic education centers in lower Myanmar gradually diminished[6].

In colonial period (1885-1942), Myanmar was introduced with the western-style education system and then gradual fading out of traditional Buddhist monastic education system was inevitably occurred. Although there were many efforts to insert western-based teaching methodologies, curriculums and teaching aid materials into traditional monastic centers, some of the challenges were the strong tradition and existing role of these centers in education sector. One of the reform activities was the registration of these centers. As the reform process had gained acceleration, the trend of decreasing on the number of students occurred but the changing situation was only in urban areas while there was taking responsibility for the education opportunity of children in rural areas by traditional monastic education centers[6].

In the Japanese occupation period (1942-1945), the situation of the monastic education system was worse than in the colonial period. Destruction of religious building such as pagodas and monasteries indicated the condition of the time but monks had been trying their best to educate the children of lay people at every possible place[6].

In the time of ending World War II (1945-1948), there was still monastic education system. After independence (1948-1958), the newly union government promoted the old monastic system to start the implementation of primary education system on the basis of former monastic education system[1]. Therefore, the government started collecting the list of monasteries and registration, support of infrastructures, holding the education seminars for teaching methodologies to create the uniform standards of these monasteries as the government ones. Although there was no condition of having a primary school in every village, the school-aged children could study in these monasteries. In 1962, the monastic education system was under the management of ministry of education[2].

In the area of revolutionary council, there was a sub-department for monastic education under the department of basic education but it was terminated in 1972 although these monastic education centers had been offering the study opportunities for children in most of the rural areas of Myanmar[6].

‘Salay’ Monastic School ran classes from Kindergarten to Grade 5 from 1962 to 1982. This is the very first monastic school (Baka school) in Mandalay. From 1982 to 1991, Baka monastic schools were forced to suspend. However, even at that time, the monastic schools taught poor children and novices the basic teachings of the Buddha and secular education[3].

In 1992, the monastic schools were legally allowed to run again by the National law & order and Reconstruction Department. Therefore they started opening classes for children again[6, 22]. Nowadays, the monastic schools assist in basic education needs of the country especially for children from needy families, orphans and ethnic children from remote areas and have been sent by senior monks from their villages and small towns filling the significant gap in the education system. The Primary school children of Myanmar attend the Buddhist monasteries to acquire literacy and numeracy skills as well as knowledge of the Buddha’s teachings. Thus, the schools provide curriculum education and ethics and moral foundation. Their role as principal education providers may have ceased for many years, but their contribution is still significant in 21st century. Supplementing the government elementary school, they provide underprivileged children all the basic education needs as it government elementary schools by using the same curriculum. Some operate similarly as boarding schools and some as day schools depending on the situation and support of public.

At the present time in Myanmar, there are 1527 Monastic and nunny schools, population of the students are 309938[5]. In Mandalay Region, there are 81 monastic and nunny schools and providing the primary and secondary education to 43735 children [5].

III. MAHĀ PAÑṆṆĀRĀMA MONASTIC EDUCATION CENTER

This center is situated in Kuthodaw Street, (Ga) quarter of Pyigyidagon Township in Mandalay. The head monk of this center is Ven. Paññārāma and his nationality is Bamar and has five assistant monks. The center was founded on 16.12.2000. With the permission of Department for Promotion and Propagation of Śāsanā, No (10) Mahā Paññārama monastic education school was opened from the (2000-2001) academic year for primary level.

In (2004-2005) academic year, it become post primary level. In the starting year, the total number of students was 46 and the most updated data in the (2018/2019) academic year, the total number of students 350, two main categories of students are; totally 90 in the form of border students and 260 day students who live nearby. There are 187 students in primary school level, 143 students in middle school level, 20 students in high school level. Table I. shows the yearly lists of the students of Mahā Paññārama monastic schools.

<table>
<thead>
<tr>
<th>TABLE I. THE LIST OF THE STUDENTS OF MAHĀ PAÑṆṆĀRĀMA</th>
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<tbody>
<tr>
<td>MONASTIC SCHOOL IN ACADEMIC YEAR FROM 2012-2013 TO 2018-2019</td>
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<table>
<thead>
<tr>
<th>The list of Primary and</th>
<th>Academic year from 2000-2001 to 2018-2019</th>
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<td>2001</td>
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<td>2017</td>
<td>2018</td>
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<tr>
<td>2019</td>
<td>2020</td>
</tr>
</tbody>
</table>

287
The school council is made up of fifteen members and the frequency of meeting is three times a year and discussed the necessary things for the center. Provision of lunch for outsider students is carried out with the donations. When the individual or group donors come, head monk arranges to meet with the members of student council.

In admission procedures for new students, there is no need to pay any charge for not only education services but also other facilities and the responsible department is student affairs section and performs admission schemes with application forms. The health care services for students, however, has some weaknesses that is no particular team for health facilities and if there is any case, the patients are sent to near clinics. Providing health services to students by local health care department twice a year. Dental health care service is also provided by dentists. Most of the border students are Paos, Shan, Palong and Kachin from different ethnic areas. Most of the students are from Muse, Pansai, Kyaukme, Loikow, Mahlaing, Myotha and their different background are poor, parentless, LDPs and some difficulties to continue to study. Due to the handover of information by parents, the children from different areas were sent to the center. Some head monks from rural areas had friendly relationship with the head monk of the center and the young children are sent to study at the center. To be happy and familiar in new environment, the novices from ethnic areas are planned to participate in the fun fairs and lucky draw programs. Some novices are offered to be the sponsor of monkhood by providing washing the robes, providing personal hygiene and giving necessary support. The children are very young and therefore Sayadaw created a playground for them.

### A. Current Function System

As this center is credited by government as Basic Primary School, middle school level students can study at the center and high school level students have to go to other private high schools. As the whole year program, in every Sunday, Dhamma School is opened for the whole academic year and the center provides textbooks for all the students free of charge and all the students must wear Yogi Uniform at that day. The center held English Language and sports programs. School library is also in functioning condition. Table II. presents the daily activities of the students.

**TABLE II. THE TIMETABLE FOR DAILY ACTIVITIES OF MAHĀ PAÑΝĀRĀMA MONASTIC SCHOOL**

<table>
<thead>
<tr>
<th>Daily activities of Mahā Paññārāma Monastic School</th>
<th>Timetable</th>
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<tbody>
<tr>
<td>Getting up Time</td>
<td>From: 4:00 am to 4:30 am</td>
</tr>
<tr>
<td>Paying Homage to the Buddha</td>
<td>From: 4:30 am to 5:00 am</td>
</tr>
<tr>
<td>Breakfast</td>
<td>From: 5:00 am to 5:30 am</td>
</tr>
<tr>
<td>wondering for alms</td>
<td>From: 6:00 am to 8:00 am</td>
</tr>
<tr>
<td>Paying Homage to the Buddha for students</td>
<td>From: 8:00 am to 9:00 am</td>
</tr>
<tr>
<td>School Starting time</td>
<td>From: 9:00 am to 11:15 am</td>
</tr>
<tr>
<td>Lunch time</td>
<td>From: 11:15 am to 11:30 am</td>
</tr>
<tr>
<td>Break time</td>
<td>From: 11:30 am to 1:00 pm</td>
</tr>
<tr>
<td>School time</td>
<td>From: 1:00 pm to 4:00 pm</td>
</tr>
<tr>
<td>Personal Hygiene</td>
<td>From: 5:00 pm to 6:00 pm</td>
</tr>
<tr>
<td>Paying Homage to the Buddha</td>
<td>From: 6:00 pm to 7:00 pm</td>
</tr>
<tr>
<td>Study time (Primary)</td>
<td>From: 7:00 pm to 8:00 pm</td>
</tr>
<tr>
<td>Study time (Middle)</td>
<td>From: 7:00 pm to 9:00 pm</td>
</tr>
<tr>
<td>Study time (High)</td>
<td>From: 7:00 pm to 10:00 pm</td>
</tr>
<tr>
<td>Rest</td>
<td>From: 10:00 pm to 4:00 am</td>
</tr>
</tbody>
</table>

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### Administrative System and Teaching Staff

Fig. 1 presents there are three main departments under Principal Bhaddanda Pannasara in Mahā Pannarama Monastic Education School. They are Administrative Department, Teaching & Development Department and Finance & Account Department. Under Administrative Department, Bhaddanda Pannasara is a manager. U Aung Zaw Lin is in charge of General Administration and Daw Mya Hnin Win is in charge of Staff Administration. Under Teaching & Development Department, Daw Khing Thandar Win and Daw Mya Hnin Win are working as charge teachers. There are four assistant teachers - Daw Ngwe Oo Khin, Daw May Zin Khing, Daw Zin Mar Lwin and Daw Nwe Nwe Oo. In addition, Daw May Thet Htar Wai is in charge of Students' Affair. Under Finance & Account Department, Daw Mya Hnin Win is an accountant, U Soe Myint is a treasurer and U Maung Thawn is a financial controller.

In Mahā Paññārāma Monastic Education Center, total number of teaching staff is seven consisting of one monk and six female teachers. Teachers in Monastic schools are not required by law to achieve a certificate in education. Some of them are graduated while some are still in ongoing process such as second year or final year to participate in graduation. Some of them are freshly passed matriculation exam from this center and they serve in these posts for the return to the gratitude of this center but Sayadaw provides them in terms of salary. The average rate is started from 80000 MMK and increasing salaries is linked with promotion scheme depending upon the service time. The maximum amount of salary is 150000 MMK.

Appointment of these teachers is based on application form to the head monk and he selected and appointed them. For capacity building of teachers, they are planned to attend teacher capacity building training programs and
teaching methodology training programs. The in and out of teachers is frequently occurred at the center and the reason may be the lower rate in salary. Some teachers come from other town or village and therefore the center has to arrange to live there. For the food of teachers, the center takes responsibility and so the uniforms of them. The head monk has intended to appoint more teachers in coming academic year[7].

Sayama Daw Mya Hnin Win said that she has been attended to Baka training programs for management and staff administration and teaching methodology training program.

Online education system developed by Phaungdawoo monastery is taught with projectors and this monastery also donates teaching aids materials. The classrooms are sufficient for all of the students and the attendance record system is also established. The teacher who teaches Mathematics must teach this subject in all classes, also other subjects are like this teaching style.

For the exams, questions for grade 5, government sent it to the center before the exam time. Kg, grade 2 and grade 3 have no exam according to the system. For grade 4,6,7 and 8, question was sent by the center of Baka and for the grade nine and high school students, the affiliated schools are the exam centers[15].

C. Solving the daily basic needs of children

The buildings for living and teaching are constructed by various donors and even an INGO from Thailand donated concrete road for the center.

For the food provision, in every morning, novices from the center are wondering for the food but the obtained food is sufficient for all of them. So the center has to arrange to cook and make a preparation of dinner for very young children. In a month, some days of alms offering ceremony at the center can be occurred but it is not regular. The financial support from the government is based on the population of students in the center with the two times payment scheme and the average amount for each time is about 700000 MMK. The government also provides 36000 MMK for the salary of primary teachers and 41000 MMK for middle school teachers. There have also the individual and group donors for financial support. Sayardaw manages all these donations and they all are sufficient for the one academic year functions[15].

Activities of Mahā Paññārāma Monastic Education Center

Head monk, Ven. Paññasāra performed these activities for those who lived in his center.

- The teaching of literatures both on worldly things and on supra worldly things
- providing post primary level education services for those who unable to afford to attend school due to some of the challenges and those who are from different ethnic areas
- providing middle level education services and planning to sit for exam in Salay Baka school
- providing high school level education services by referring to other private School
- providing financial and other necessary assistance for higher education opportunities

The objectives of Mahā Paññārāma Monastic Education School

1. to provide free education service for poor children for increasing literacy rate

B. Teaching Methodology

In this center, student-centered approach is mainly used and in each and every classes and grades, the teaching methodology and curriculum are the same as in the government schools. Promoting critical thinking skill also takes the serious consideration in this center. Most of the students are ethnic children and encountered a language barrier problem for Kg class.

Figure 1. Mahā Paññārāma Monastic Education School Line & Staff Organization.
2. to nurture the students for becoming good citizens for the religion, nationality and nation through monastic education system
3. to become good Buddhist disciples through the nurturing of orphanages
4. to live according to the ethical conducts and to protect and preserve Myanmar traditional culture
5. to cultivate the spirit of Parahita, respect to elders and helping to others
6. to become civic and civilized citizens with the faith on religion by opening annual trainings on Ethical conducts and Etiquette[7].

**Sayardaw’s steps forward**

- Expansion of scope of educational service provision like upgrading of center from primary to upper primary level
- Provision of IT skills
- Acceptance of more border students into 150 in number
- Plan to provide education services for high school level students
- Opening of practical science laboratories.

The center and Sayadaw are also trying to support the basic education sector at their best.

In summary, for children with needs, such kind of center is very important to fulfill the basic needs and safety life of them and play an essential role in the education center[7].

**IV. NAY MIN MONASTIC EDUCATION CENTER**

It locates in the compound of Mahā Vijitārāma monastery in Chanmya Thayar Quarter, Pyigyidagon Township of Mandalay Region. The head monk of this monastery is Ven. Khemācāra and his ethnic nationality is Palong and has five assistant monks in that center. The center was founded on 11.1.2002. With the permission of Department for Promotion and Propagation of Sāsānā, No (16) Nay Min monastic education school was opened from the (2012-2013) academic year.

In the starting year, the total number of students was 109 and the most updated data in the (2018-2019) academic year, the total number of students are 452, two main categories of students are; totally 350 in the form of border students and 102 day students. There are 325 students in primary school level, 112 students in middle school level, 15 students in high school level. Table III, presents the yearly lists of the students of Nay Min monastic schools.

**TABLE III. THE LIST OF THE STUDENT NAY MIN MONASTIC SCHOOL IN THE ACADEMIC YEAR FROM 2012-2013 TO 2018-2019**

<table>
<thead>
<tr>
<th>The list of</th>
<th>Academic year from 2012-2013 to 2018-2019</th>
</tr>
</thead>
</table>

**TABLE I. THE LIST OF THE STUDENT NAY MIN MONASTIC SCHOOL IN THE ACADEMIC YEAR FROM 2012-2013 TO 2018-2019**

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-2013</td>
<td>110</td>
<td>7</td>
</tr>
<tr>
<td>2013-2014</td>
<td>120</td>
<td>9</td>
</tr>
<tr>
<td>2014-2015</td>
<td>130</td>
<td>9</td>
</tr>
<tr>
<td>2015-2016</td>
<td>140</td>
<td>9</td>
</tr>
<tr>
<td>2016-2017</td>
<td>150</td>
<td>9</td>
</tr>
<tr>
<td>2017-2018</td>
<td>160</td>
<td>9</td>
</tr>
<tr>
<td>2018-2019</td>
<td>170</td>
<td>9</td>
</tr>
</tbody>
</table>

**A. Current Functions System**

As this center is credited by government as Basic Primary School, midlevel students have to go to Baka (2) school and high school level students to Sale Monastic education high school. As summer programs, the center held English Language and Computer classes. Volunteers from foreign countries such as US, Canada, Australia teach in English Language classes with one person one month basis for the whole academic year. The school council is made up of fifteen members and the frequency of meeting is three times a year. Another institution is school supporting committee consisting of 12 members in one year term and the task is to fulfill the needs of center. In admission procedures for new students, there is no need to pay any charge for not only education services but also other facilities. The health care services for students, however, has some weaknesses that is no particular team for health facilities and if there is any case, the patients are sent to clinics. Providing health services to students by local health care department twice a year. Most of the border students are Paoh, Shan, Palong and Kachin from different ethnic areas. Due to the handover of information by parents, the children from different areas were sent to the center. Head monk of the center also one of Palong nationalities from northern Shan region and some children are familiar to the Sayadaw[12]. Table IV. presents daily activity of the students.

**TABLE IV. THE TIMETABLE FOR DAILY ACTIVITIES OF NAY MIN MONASTIC SCHOOL**

<table>
<thead>
<tr>
<th>Daily activities of Nay Min Monastic Education Center</th>
<th>Timetable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting up time</td>
<td>4:00 am</td>
</tr>
<tr>
<td>Paying Homage to the Buddha</td>
<td>4:30 am</td>
</tr>
<tr>
<td>Breakfast</td>
<td>5:00 am</td>
</tr>
<tr>
<td>Time of wondering for alms</td>
<td>6:00 am</td>
</tr>
<tr>
<td>Break time</td>
<td>8:30 am</td>
</tr>
<tr>
<td>School Starting Time</td>
<td>9:00 am</td>
</tr>
<tr>
<td>Lunch time</td>
<td>11:00 am</td>
</tr>
<tr>
<td>Break time</td>
<td>11:45 am</td>
</tr>
<tr>
<td>Study time</td>
<td>1:00 pm</td>
</tr>
<tr>
<td>Personal Hygiene</td>
<td>3:30 pm</td>
</tr>
<tr>
<td>Study time</td>
<td>5:00 pm</td>
</tr>
<tr>
<td>Paying Homage to the Buddha</td>
<td>6:30 pm</td>
</tr>
<tr>
<td>Study time</td>
<td>7:00 pm</td>
</tr>
<tr>
<td>Rest</td>
<td>9:00 pm</td>
</tr>
</tbody>
</table>

**Administrative System and Teaching Staff**

Fig. 2 shows line and staff of Nay Min Monastic Education School, there are two main monks who are leading. The first one is Bhaddanda Khemācāra, the
Principal. The second one is Bhaddanda Kavinda, the Associate Principal. There are three main departments - Administration Department, Teaching & Development and Finance & Account Department. Under the Administrative Department, Bhaddanda Khemācāra is a manager. Bhaddanda Kavinda is in charge of General Administration and Bhaddanda Indācāra is a staff to manage affairs. Teaching & Development Department is fully under the control of Bhaddanda Indācāra who is an assistant to the Principal. Under him, Daw Moe Moe Aye is charge teacher (1) and Daw Aye Aye Thin is charge teacher (2). There are also eight teachers in this school. U Hla Kyaw is in charge of Students’ affair. Under Finance & Account Department, Bhaddanda Khemācāra is an accountant and Bhaddanda Indācāra is a treasurer.

In Nay Min Monastic Education Center, total number of teaching staff is eleven consisting of one monk, two male teachers and eight female teachers. Some of them are graduated while some are still in ongoing process such as first year, second year or final year to participate in graduation. Some of them are freshly passed matriculation exam from this center and they serve in these posts for the return to the gratitude of this center but Sayadaw provides them in terms of salary. The average rate is started from 36000 MMK and increasing salaries is linked with promotion scheme depending upon the service time. The maximum amount of salary is 120000 MMK. Some of the female teachers are from ethnic areas and they stayed long in this center[18]. Appointment of these teachers is based on application form to the head monk and he selected and appointed them. For capacity building of teachers, they are planned to attend teacher capacity building trainings programs and teaching methodology training program [20,21]. Sayama Daw Moe Moe Khaing said that she has been attended to government program Kg class training and budged[19].

![Diagram of Nay Min Monastic Education Center](image)

Figure 2. Nay Min Monastic Education School Line & Staff Organization.

B. Teaching Methodology

In this center, student-centered approach is mainly used and in each and every classes and grades, the teaching methodology and curriculum are the same as in the government schools. Promoting critical thinking skill also takes the serious consideration in this center. Most of the students are Palong children and encountered a language barrier problem but it was solved by the ethnic teachers[19,20].

For the exams, questions for grade 5, government sent it to the center before the exam time. Kg, grade 2 and grade 3 have no exam according to the system. Question for grade 4 was developed by the center of Baka schools and for the middle and high school students, the affiliated schools are the exam centers[12].

C. Solving the daily basic needs of children

The buildings for living and teaching are constructed by various donors and even an INGO from Taiwan donated a building for the center.

For the food provision, in every morning, novices from the center are wondering for the food but the obtained food is insufficient for all of them. So the center has to cook for lunch. The center also has to arrange to cook and make a preparation of dinner for very young children. The outsider students come back to their homes for lunch at the time of lunch break. In a month, there are about twenty days of alms offering ceremony at the center but it is not regular. Monthly income from donations is about 15,25000 MMK and there are other types of food donations such as individual donor donates eggs for one month and vegetables from bazaars. The financial support from the government is based on the population of students in the center with the two times payment scheme and the average amount for each time is about 700000 MMK. The government also provides 360000 MMK for the salary of teachers. Sayadaw manages all these donations and they all are sufficient for the one academic year functions[18].

It can clearly be seen that Nay Min Monastic Education Center is running with the donations from the community and support from the government and dependency on them is one serious consideration for the sustainability of this center.

Activities of Nay Min Monastic Education Center

Head monk, Ven. Khemācāra performed these activities for those who lived in his center.

- The teaching of literatures both on worldly things and on supra worldly things
- providing primary level education services for those who unable to afford to attend school due to some of the challenges and those who are from different ethnic areas
- providing secondary or middle level education services and planning to sit for exam in Baka (2)
- providing high school level education services by referring to Sale Baka Monastery
- providing financial and other necessary assistance for higher education opportunities

The objectives of Nay Min Monastic Education Center

1. to provide basic literacy skills such as reading, writing through the free-of-charge service of the center without discriminating in terms of gender, locality and property
2. to nurture the students for becoming good citizens who follow morality and ethics
3. to become good Buddhist lay disciples who can propagate and flourish the teachings of Buddha (future Sāsanā)
4. to promote the knowledge level and following of Buddhist ethics

Sayardaw’s steps forward

- Expansion of scope of educational service provision like upgrading of center from primary to post primary level
- Provision of support those who are not afford to continue their education opportunity
- Acceptance of more enrollments of students by construction of more buildings
- Plan to provide multiple capacity building programs and other types of trainings
- Opening of a school library.
- To become good Buddhist lay disciples who can propagate and flourish the teachings of Buddha (future Sāsanā)
- To promote the knowledge level and following of Buddhist ethics

The center and Sayadaw are trying to improve human resources not only for becoming good and responsible citizens but also for protecting Sāsanā.

By studying ‘Mahā Paññārāma’ and ‘Nay Min’ monastic schools, these monastic schools train the children to work systemically with discipline and with time table. Like government schools, they have also formed organizations and departments. There are also enough class teachers for every class and class room. While students are studying at night, the teachers stay with them to help and guide them. During Summer holidays and school holidays, these schools provide the children with English language classes as well as sports to have knowledge, skills and experiences in many different ways. These monastic schools are also a safe place for children away from their parents and home from different parts of the country. I have also found that the donors offer money and things to these monasteries enthusiastically. This kind of volunteer work can be undertaken if we have strong passion, goodwill and patience. Therefore the monastic schools are essential for our country, religion and people.

According to the yearly lists of the students of Nay Min and Mahā Paññārāma monastic schools, the numbers of the students are increasing year after year. Among them, most of the students who live at the monastic schools are multi-ethnic children. As the monastic schools teach the children basic literacy and numeracy skills as well as knowledge of the Buddha’s teachings since they were very young, the children become more polite and educated and have good character and moral foundation. Their parents and educated local ethnic people expect their children to be educated and then when they grow older, to be the ones to make their villages or places develop and prosper in the future[13,14]. Among the students who have been learning at monastic schools, some have left school and are working outside. Some have become government staff such as army doctor, teachers, scholar to other country etc.

Students at the Nay Min monastic school include nine year old novice Mai Aik Oo (Paio) from Mai Kai village, southern Shan state, he want an education. He want to become a teacher in his native village[17].

Novice Nandamālā at Mahā Paññārāma monastic school, 17 year old, from Mahlaing township Soun Kone village, last two year ago, he arrived this school because his village is not good education. So he entered the village life and attend to monastic school in Mandalay[16]. Therefore, the monastic schools are producing human resources for the country and the good novices for the ‘Sāsanā’ (the order of the Buddha’s teaching).

V. CONCLUSION

After the advent of Buddhism to Myanmar, arise of monasteries occurred and national integrity and developments in culture, literature, arts and education sectors gradually accelerated. In Bagan period, flourishing of Buddha Sāsanā started and study of Buddhist literatures was the main theme in the monasteries in villages to propagate Theravada Buddhist Sāsanā. Throughout the Pinnya, Sagaing, Innwa, Nyaungyan and Kongboung periods, education system of monarchial Myanmar was based on monasteries. As these institutions taught Buddhist literatures and skills for societal affairs, both of the sectors developed in parallel manner.

As these were the center to educate people from different backgrounds, they were famous and play a vital role in the history of Myanmar. Although the original objective of monasteries was to promote and propagate Buddha Sāsanā, later they also focused in the various affairs of lay disciples especially in basic life skills and education sectors. In this way, the role of monasteries played up or down according to the situation and desire of rulers but it is very clear that they never disappeared totally.

Nowadays, these monasteries are very important centers of education for parentless, poor children with fewer opportunities from different parts of the country because these centers are providing not only basic needs of life but also education and health care. Moreover, various capacity building programs like computer trainings, language classes, sports affairs and other types of civic engagement promoting Buddhist ethical conducts and Sāsanā.

In performing their education programs, their plans are the same as in Government schools with text books, teaching aids materials and the methodology they used is also student-centered approach. Despite low salary, the teachers actively participated in the Center’s activities. Although the task force to teach is sufficient currently but need to do more recruitment and it can be seen that even monks take part in teaching programs.

Financial and other types of support for the children are provided by individual donors, group donors, monthly donors, daily donors and associations. Financial support for salary of teachers is reinforced with the donations but there are still some challenges for increasing number of high school students in terms of finance. Current situation is ok for functioning of these centers but in long term the
sustainability of them will be mainly dependent on community support by both financially and policies. Government should also support with supportive policies to enhance the sustainability of them.

In this paper, the current functioning system of Nay Min monastic Education Center and Mahā Paññārāma Monastic Education Center, teaching methodologies and approaches, the provisions of basic needs of children are presented in descriptive method.

In summary, monastic education centers which are providing educational opportunities for those who cannot afford to continue to study from the different areas of country are very important for human resource development of the country especially for parentless children, poor ones and ones from remote areas. As these institutions are nurturing the future generations of Buddha Sāsanā, we, people and government should support them. If so the above mentioned children can learn various kinds of skill knowledge and improve their standard of life. In other words, supporting these monastic educational institutions means supporting not only the human resource development of country but also the promotion and propagation of Buddha Sāsanā through the process of study in these monastic education centers on the themes of Buddhist ethical conducts and modernized disciplines. The recommendation from this paper, therefore, is to provide these institutions in terms of both finance and policy to have sustainable development of this sector.

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[20] Interview with Daw Win Thu Zar, (G2, Kg) Teacher of Nay Min Monastic School, Date of interview 12 April 2019.
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Buddhism and Tolerance:
Toward Living with Peace and Harmony of Multiculturalism
Myat Myat Htun

Abstract— In the world, there are many crises of views concerning multiculturalism and some are the sensitive of their beliefs. Some are soft but some are strong of their point of view of religious power. All people want to live peace and harmony of their living in daily life. Everywhere are challenges of the power influence of the world. They had been forgot loving-kindness and tolerance with each other in their societies. They are riding and leading of selfish and conceit. These are troubling to stay with peace and stability of the world. By holding the narrow-intolerance stance on their extreme ism, there is no gain for the peace of the world. This research paper attempts the tolerance of Buddhism and to live the peaceful world for the future pleasant world. The peace and stability are depended on the tolerance of human being. Everyone has to apply on the practice of noble sublime: mettā, karuṇā, muditā and upekkhā. Having practices with noble sublime, this is needed to live with tolerance. The tolerance is important for living of peace and stability in the world. By holding these noble sublime can create peace and stability. The Buddha propagates his missionaries with tolerance and forgiveness. The Buddha, himself is threatened by multiculturalism. The Buddha solve and conquered the problem with tolerance in his missionary. Nowadays, the world is burning with isms, political, social, economic, environment, etc. so that the tolerance is needed to live in harmony with multiculturalism.

Key words: Buddhism, Tolerance, Multiculturalism, Loving-kindness

INTRODUCTION

The world is burning with lobha-greed, dosa-anger and moha-delusion which are heading toward their desire and selfish. Every person wants to live and please their minds which are not free from worry. In the burning world, people have to calm the mind with free from lobha, dosa and moha. That’s why everyone has to reduce these matters with the tolerance.

What is Tolerance?
The tolerance is called Khanti in Pali word. Khanti is one the perfection of Buddha (Dasa parami). The word is simple, but also the practice is difficult for the human society. There are three kinds of Khanti: bearing with patience the vicissitudes which endanger one’s external object is Khanti Parami; bearing with patience the vicissitudes which endanger one’s limbs such as hands, feet, etc. is Khanti Upaparami; bearing with patience the vicissitudes which endanger one’s life is Khanti Paramattha Parami. Buddha (otherwise Buddha-to-be) endeavors for an accumulation of incomparable merit and wisdom, not shared by common people, made for the sake of infinite beings and his thorough, careful fulfillment to the basic conditions of the Paramis.

The Causes of Anger

Of all the emotions that affected a personality adversely, of them anger is the worst emotion of in the society. There are nine causes of anger which arises in relation to oneself, to friends, loved ones or to one's enemies. It may also arise regarding actions in the past, present or future. Thus there are nine causes of anger arising with regard to individuals and with regard to time:

1. One is angry in relation to oneself, thinking, "he has caused damage to my interest"
2. One is angry in relation to oneself, thinking, "he is causing damage to my interest"
3. One is angry in relation to oneself, thinking, "he will cause damage to my interest"
4. One is angry in relation to one's friends thinking, "he has caused damage to the interest of my friend"
5. One is angry in relation to one's friend, thinking, "he is causing damage to the interest of my friend"
6. One is angry in relation to one's friend, thinking, "he will cause damage to the interest of my friend"
7. One is angry in relation to one's enemies, thinking, he has promoted the interest of my enemies
8. One is angry in relation to one's enemies, thinking, "he is proofing the interest of my enemies"
9. One is angry in relation to one's enemies, thinking, he will promote the interest of my enemies

How to apply the tolerance

Nowadays, the world has depending on their religions, social, economic, education and so on. They have different colors and different views. Everything has diversity of their all affairs. There exists diversity in the world; even though people have to pass over what is diversity with tolerance. Diversity is diversity, that no need to consider what the diversity of other religions, social, economic, education is. Therefore, every person have to go on the way of peace and stability of the world with the noble sublime; mettā, karuṇā, muditā, and upekkhā.

These are essential needed for the social welfare and the relationship of the world. For the relationship of multiculturalism, loving kindness makes the welfare of
people in the world. Every person want to be live safely and peacefully of their society. That is why they create the world to be the peace and harmony of living their society with mettā (loving-kindness).

Every person has different colors, ethics, languages, and isms and so on. It is called diversity, which is not problem for the people but the main object is the only one to live together with peace and harmony. As Buddhism, they believe that all are saṁsāra travelers of the world. There are differences and dissimilarities among human being in the world. According to this nature, there is diversity of human being. Because of no two of them are exactly alike. Diversity of character is due to their unequal activity. So, let’s be friends each other multiculturalism and enjoy very cooperative community as well as the richness and diversity of different colors, ethics, languages, and isms.

The teaching of the Buddha is not to commit any sin, not to do evil, to do good deed (merit) to others, and to purify one’s own mind. Patience is the highest penance and long suffering is the highest Nibbāna. Not to blame, not to strike, to live restrained under the law, to be moderate in eating, to sleep and sit alone and to dwell on the highest thoughts this is the teaching of the Buddha.

Buddhism has to respect the right of people to enquire freely and to choose for them, it is tolerant towards other faiths. Buddhism teaches one to live in harmony with all, regardless of race or religion. This attitude of tolerance is particularly important in a society. One should not discriminate against people because of their ism. One should not discriminate against people based on color, ethic, languages, and ism and so on. But one has to discriminate the other who makes extremism of the world. Therefore everyone has to create the peace of world as much as they can and that which needed the living of the people in the world may be peaceful. Peace is preventing the world with loving kindness and tolerance of people mind.

Tolerance is the most effective weapon for the peace and it is useful for the peace maker. If one who is not at peace with himself cannot be at peace with the world, and the crisis and conflict of wars have to continue in order to hide the fact from individuals that the real war is within. War is created by the human mind, and the same human can create peace with justice if only man uses his unbiased mind.

Moreover, one has to choose the way of peaceful life; it is leading the way of peace, which can make the stability of the world. Though, some people are discussing about the diversity on the table, but also apply and in-search common ground what is the practice of peace and stability of the world. Diversity is no problem to living in the world. Everyone have to choose the way of peace, unity, reconciliation of other isms. That is why people have to pick up the same way to live harmony in the society. They have to go on the way which is called peace and stability of the world. Peace and tolerance are stand together as the one and we have to create the one of world. The world must come together as one. Therefore, people are to be tolerance and make of all are peace of makers; all in one and one in all in their society.

The peace of world is depending on the tolerance of human being. The tolerance is controlled by loving kindness. Loving kindness can make tranquility, stability and peace as well tolerance. Mutual understanding is needed to live in the human society of the world. To get the peace opportunity that one must create what the peaceful world with living the loving kindness.

Loving kindness is the most effective tool of our society. And mutual understanding and mutual respect are essential elements of successful communication of the society. However, when loving kindness is lost between in our society and it is replaced by dosa (hatred, anger), the unity is broken, the essence is destroyed and the life of the lovers falls apart. This falling apart of the lovers might bring about the breaking up of the family. When a family is held together (join in hand) by ties of loving kindness, there is solidarity. Though by appearance, they are many, in essence, they are like one. When love goes away and hatred comes into the family, there will be no more unity in the family. The peace will be gone. Then solidarity will break down. The collapse of solidarity in the family might often bring about the breaking up of the national life of a country. Therefore, loving kindness among the members of a family can bring about peace in the national life.

**Power of Loving Kindness**

Loving kindness has a great power. The power of love is needed for the human society. Loving kindness is providing shelter and security. In the Āṅguttara Nikāya, it is expounded the eleven advantages that accrue repeatedly to him who develops loving kindness.

1. He sleeps well in peace
2. He wakes up well in peace
3. He dreams no bad dreams
4. He is dearly loved by human being
5. He is dearly loved by non-human beings (ogres and petas)
6. He is protected by Devas
7. He is not afflicted by fire, poison and weapons
8. He mind is easily concentrated
9. His face is calm and clear
10. He dies unconfused, and
11. If he cannot penetrate higher Dhamma, Arahattamagga and Phala, in this life, he will take rebirth in the Brahman world.

Therefore it is clear that loving-kindness is more powerful than the other three sublime mental states.

_Sabbe sattā sukho hontu, ’May all beings be happy physically’_
Sabbasattā khemino hontu, May all beings be free from dangers'
Sabbasattā sukhitattā hontu, May all beings be happy mentally'

Similarly, thoughts of loving-kindness developed with the desire to see others free from misfortune and not suffering are called Ahitadukkhānāgamapathanā mettā. This kind of loving kindness is described in Pāli:-
Na paro paraṁ nikubbethu
Na'timaññetha kathaci na kañci
Vyārosanā paṭighasanāṁ
Nā'nmamaññassa dukkha iccheyya.

The meaning is:- May not one being deceive another; may not one despise another; may they not wish to cause suffering to one another by offending and hurting physically, verbally and mentally.

As loving kindness is one of the ten perfections (Dasa Paramis), it should be directed towards other beings until they return their good-will. Therefore, disappearance of anger leads to appearance of loving-kindness.

The causes of hatred

The world is getting warm because of many reasons of environment, religion crises, economic crises, political crises and educational crises. Due to without patience of the people, their selfish are dominated each other society. They are disregarded and threaten of security of world peace. There are not getting the peace and stability. These are threatened the stability of the world. People failed to show reverential regard for the leaders and elders, to fulfill their duties towards parents, sāmaṇa and brāhmaṇas. There also developed intense mutual aversion, ill will, thoughts of killing one another, followed by fighting, devastation and carnage. According to Cakkavatti Sutta, Pāṭhika Vagga, Dīgha Nikāya, it is explained that there are the consequences of the poverty in accordance with the thirty points, there are as follow:-

1. Lack of property, poverty becomes rife
2. From poverty, stealing becomes increased
3. From the increase of theft, the use of weapon increases
4. From the increased use of weapons, the taking of life increases
5. From the increased taking of life, telling increases
6. From the increased telling lies, back-biting increases
7. From the increased back-biting, sexual misconduct increases
8. From the increased sexual misconduct, harsh words and vain talks increases
9. From the increased harsh words and vain talks, covetousness and hatred increases
10. From the increased covetousness and hatred, false opinions increase
11. From the increased opinions, incest, excessive greed and deviant practices increase
12. From the incest, excessive greed and deviant practices, lack of responsibility and of respect for mother and father, monks and Brahmmins and elders decreases.
13. From such lacks, people's life-span and their beauty decrease. These are causes of threatened the stability of the world.

The world is threatened of many crises of views with religions and some are the sensitive of their beliefs. Some are soft but some are strong of their point of view of religious power. Some are completely create and dominate of the power influence of their ism. Everywhere are challenges of the power influence of the world. They had been forgetting loving-kindness and tolerance with each other. They do not regard to other ism. These are threatened for living of the world peace.

All people want to live peace and harmony of their living in daily life. To achieve success in solving world problems, it is vital that people need to learn to understand each other better by drawing closer and act together as member of one family, regardless of color, ethnic, languages, and ism and so on.

The Buddha teaches the Dhamma that which can destroy the sin, and Dhamma is therein described to consist in the dutiful and faithful performance of some rules of daily conduct and some moral virtues. The Buddha guided to the people to live the peace and stability, whose has reduce the hatred, selfish, conceit of their mind. In his missionary, the Buddha applies his teaching with tolerance, loving-kindness and forgiveness. The Buddha propagates his missionaries with tolerance and forgiveness. The Buddha, himself is threatened by other religions. He solved and conquered the problem with tolerance. Therefore the tolerance is needed to live in harmony with other religions.

Hatred is overcome by non-hatred

A man should overcome anger by love. Let him overcome evil by good; let him overcome the greedy by liberality and the liar by truth. He who is tolerant, free from hatred and fear is learned.

In the Dhammapādana, the Buddha taught that-
akkoci maṁ avadhi maṁ ajini mā ahāsi,
ye taṁ na upanayantī tesam verāṁ sammati
Overcome the angry by non-anger; overcome the wicked with good.

Overcome the miserly by giving, the teller of lies with truth.

Living in human society, people often quarrel with one another. When such conflicts occur, people often keep thinking about the wrongs done to them by others. When that happens, their anger tends to grow. But in those who forgive and forget the wrongs done to them, anger quickly vanishes. They are at peace.

idha verāṁ kudācanaṁ na hi sammantā averena ca sammanti, esa sanantano dhammo
Those who attempt to conquer hatred by non-hatred are like warriors who take weapons to overcome others who bear arms. There is not end hatred, but gives it room to grow. But, ancient wisdom has advocated a different timeless strategy to overcome hatred. Quarrels can never come to an end by quarrelling. War can never end through further wars. Enmity never ends by returning enmity for enmity. Only by giving up anger, enmity, quarrelling and wars can these evils be stopped. It is through friendliness, forgiving and forgetting that enmity ceases.

A fool who thinks himself wise is a fool indeed. If a fool is associated with a wise man even all his life, he will perceive truth to some extent. If an intelligent man is associated with a wise man for a moment, he will soon perceive the truth. As long as the evil deed done does not bear fruit, the fool thinks it is like honey but when it ripens, and then the fool suffers grief. A fool wishes for a false reputation. That's why do not associate with the fool.

Discussion
In the Dhammapada, Citta Vagga mentioned that some people are delighted in evil activities. They enjoyed in hatred, greed and delusion. To decrease these three activities, Buddha instructed that a man should hasten towards good and should keep his thought away from evil. If a man commits a sin, let him not repeat it. If a man does what is good, let him not do it again. A man should think lightly of evil. If a man offends a harmless, pure and innocent person, the evil falls back upon that fool. Wise people after they have listened to the laws, become serene. Good men walk under all circumstances. A wise man should leave the dark state of ordinary life and follow the bright state of the noble one.

That is why let's abandon anger. Give up pride fully. Get rid of all clinging. To that person who is not attracted to name and form and is free of appendages, no sufferings befall. The Dhammapada Commentary explained as the word kodha is anger. Of all emotions that affect a person, anger is the worst. Even anger at injustice done to others is not a state of mind which is conducive to a right solution. But in dealing with oneself, this mood of anger cannot outlast a calm analysis. Anger soon subsides and often is forgotten in the interest of discovering the cause. Afterwards, conscious of having avoided the probably foolish action that would have followed if anger had taken its course, we are glad that we observed such self-control.

The Buddha taught that one should give up anger, renounce pride, and overcome all fetters. Suffering never befalls him who clings not to mind and body and is detached. That person who is capable of curbing sudden anger is like the expert charioteer who restrains a chariot rushing out of control. That person describes as a true charioteer. The other type of charioteer is a mere holder of the reins. Moreover, overcome the angry by non-anger, overcome the wicked by goodness, overcome the miser by generosity, overcome the liar by truth.

Anger is leading to the way of the defected situation. It does not harmonious of the living of society. But no one cannot patience their behavior and attitude of their mind self. There is no change for their situations. If, one holds his selfish attitude, there has no gain the peace. Otherwise, everyone appreciate each other attitude. Toward the leading the world peace, everyone must to give up the selfish.

Every person has to appreciate other ism. Every ism has the value and appreciates of their ism. People have to apply to get rid of the hatred. There are six things to get rid of the hatred; (1) getting loving-kindness objects (2) sending loving-kindness (practicing loving-kindness meditation) (3) thinking and reflecting that everybody has one's own action (4) wisdom (5) good-heart (6) do not talk the hate speech or harsh speech.

Therefore, the Buddha instructs and guards against anger erupting in body; be restrained and having abandoned bodily misconduct, live conducting oneself well in body. Guard against anger erupting in speech; be restrained and having abandoned speech misconduct, live conducting oneself well in speech. Guard against anger erupting in mind; be restrained. Having abandoned mind misconduct, live conducting oneself well in mind.

Conclusion
Religion is an education of the heart with a view to refining our nature and elevating us in the scale of human beings. To achieve success in solving global problems, it is vital that people need to learn to understand each other better by drawing closer and act together as members of one family, regardless of race, caste and religion.

Do not tell hate speech otherwise harsh speech each other and have to see with loving-kindness. Speak only words of kindness, never words unkind. For him who spoke him fair, he moved a heavy load, and brought him wealth for love. In addition, all people are getting hand to hand with the tolerance of our mind. It can be seen the world with lovely eyes and live together to be tolerance. One may slay anger without having to repent; one may abandon ingratitude to gain praise from the virtuous; one should bear with patience abusive, harsh words from everyone, whether superior, equal or inferior, the virtuous call this the highest form of patience. If may be possible to put up with the abusive, harsh words of those who are superior or one's equal but why should one tolerate the rude words coming from one's inferiors. Therefore, let's control temper and bear them patiently with the loving-kindness. It is believed that loving-kindness is as medicine to cure the people who have suffering of their society.
Acknowledgement

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Abstract— Ayeyarwady Region occupies the southwestern part of Myanmar and it lies between North Latitudes 15° 43' 00" and 18° 30' 30" and between East Longitudes 94° 14' 00" and 96° 06' 30". It is bounded by Rakhine State and Bago Region on the north, Bago and Yangon Region on the east, Andaman Sea on the south and Rakhine State and Bay of Bengal on the west. Ayeyarwady Region covers 35032 square kilometres (13525.9 square miles) and comprises 26 townships. The length of land boundary is 720 km (450 miles) and sea boundary is 385 km (241 miles). The Ayeyarwady, the largest river of Myanmar, flows from north to south across the study area and enters the Andaman Sea with nine mouths. All these rivers are affected by tidal action. The objective of the study is to examine the condition of saline water intrusion along the delta coast of the Ayeyarwady Region. To identify the salinity of seawater in the study area, a number of water samples were taken for measuring the degree of salinity. The saline waters from 183 points of the rivers and streams along the delta coast of the Ayeyarwady Region were taken on 23rd January, 2014 to 8th February, 2014. The salinity varies depending on high tide and low tide. The range of salinity from high tide and low tide is 1 ppt according to field survey. Salinity structure for the Ayeyarwady Region is analysed by interpolation method. The waters in Bogalay, Pyapon, Thandi and Toe, located to the east of the Ayeyarwady River are low in salinity due to the large volume of freshwater drainage. The lower parts of Pyinzalu, Pyamalaw, Ngawun rivers, located to the west of the Ayeyarwady River have water high in salinity. Furthermore, saline water front was gradually intruding into the interior of the study area.

Keywords: Delta coast, tidal action, saline water intrusion, interpolation method

I. INTRODUCTION

The length of Ayeyarwady from the mouth of Toe river to the confluence is 1,160 miles (1,861 km), and to the source is 1,290 miles (2,056 km) (Nyi Nyi, 1967)[3]; According to Bender (1983)[1], the length of Ayeyarwady River is 1,241 miles (2,010 km) and catchment area is 16,410 sq. miles (415, 700 km²). The present apex of the Ayeyarwady Delta begins at Myaung about 53 miles (85.3 km) below Pyay or 58 miles (93 km) above Hinthada (Henzada). The rivers and streams crisscross the Delta. Ayeyarwady enters the sea by nine mouths; Pathein (with its distributary Thetkethaung), Ywe, Pyamalaw, Pyinsalu, Ayeyarwady, Bogalay, Pyapon, Thandi and Toe rivers (Hla Tun Aung, 2003)[2]. Myanmar is bordered by the Bay of Bangal on the west, Gulf of Moattama (Martaban) and Andaman Sea on the south. The coastline from the mouth of Naaf River to Bayintnaung Point (Vitoria Point) in Kawthaung is 1,385 mile (2228.47 km). Length of Rakhine coast is 443 miles (712.79 km), Delta coast is 272 miles (437.65 km) and Mon-Tanintharyi coast is 670 miles (1,078,03 km) long respectively (Hla Tun Aung, 2003)[2].

II. OBJECTIVE

The objective of this paper is to examine the condition of saline water intrusion along the delta coast of the Ayeyarwady Region. (See Figure.1)

III. MATERIAL AND METHOD

To identify the salinity of seawater in the study area, a number of water samples were taken for measuring the degree of salinity. The saline waters from 183 points of the rivers and streams along the delta coast of the Ayeyarwady
Salinity values are measured by using the hand-held salinity refractometer. Salinity structure for the Ayeyarwady Region is analysed by interpolation method.

IV. RESULT AND DISCUSSION

A. Average Saline Water Intrusion along the Delta Coast

Saline water intrusion measurements are done at the river mouths of Ayeyarwady Delta once a year at the end of the dry season (March), when the salinity intrusion is at its maximum due to low river flows, and more precisely on the dates on which high tide water levels occur. The measurement consists of identifying the location to which the 1 ppt salt concentration penetrates the rivers. The 1 ppt concentration is defined as the suitability limit for irrigation water. All the measurements are done manually; there is currently no permanent monitoring station (Wim van Driel, 2015)[4]. Figure 2 presents the progressive salinity intrusion in the delta during the dry season (November, December, January, February and March).

B. Saline Water Intrusion along the Delta Coast for the year 2014

To identify the salinity of seawater in the study area, a number of water samples were taken for measuring the degree of salinity. The saline waters from 183 points of the rivers and streams in Ayeyarwady Region were taken on 23rd January, 2014 and 8th February, 2014. The salinity varies depending on high tide and low tide. The range of salinity from high tide and low tide is 1 ppt according to field survey.

Table 1 shows the degree of salinity of 28 sample points taken from along the Ngawun River on 23rd January, 2014.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>Ngawun River</td>
<td>16.2804</td>
<td>94.6654</td>
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<td>16.0423</td>
<td>94.5915833</td>
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<tr>
<td>3</td>
<td>Ngawun River</td>
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<td>94.4728833</td>
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</tr>
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<td>Ngawun River</td>
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<td>Ngawun River</td>
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<td>94.5009</td>
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<td>94.52315</td>
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<tr>
<td>9</td>
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</tr>
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<td>Ngawun River</td>
<td>16.178676</td>
<td>94.497455</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: Field Survey, 23rd January, 2014

On 29th January, 2014, 10 sample waters were taken from the rivers and streams near Zeechaing, Mawtin, Kanchaung, Pyinkhayaing, Thetkethaung, Thaunglay, Kyaukkalat, Phonetawpyae, Magyichaing and Asinchaung. The location from which sample waters were taken and the degrees of salinity are presented in Table 2. As shown in table the salinity is highest at point near Zeechaing Village with 32 ppt, followed by Mawtin and Kangyaing with 30 ppt. Pyinkhayaing with 28 ppt, Kyaaukkalat, Oketwin, Magyichaing and Asinchaung with...
27 ppt, Thetkethaung and Thaunglay with 25 ppt and 24 ppt respectively. Table 2 shows the salinity of 6 water samples taken from Maekhaye Creek on 29th January, 2014. The degree of salinity is 25 ppt at Maekhaye, Kalarmakwin and Konetan villages, 23 ppt at Latpan and Sarphogyi villages and 20 ppt at Kyonkwin. There are salt works along the creek.

TABLE 2. Location of Water Sample Points and Salinity of Maekhaye Creek along the creek of Kalarmakwin and Konetan villages, 23 ppt at Latpan and Sarphogyi villages and 20 ppt at Kyonkwin. There are salt works along the creek.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MaeKhaye</td>
<td>16.0352</td>
<td>94.323</td>
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<td>2</td>
<td>Kalmakwin</td>
<td>16.04</td>
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<td>3</td>
<td>Kontan</td>
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<td>94.3044</td>
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</tr>
<tr>
<td>4</td>
<td>Latpan</td>
<td>16.0505</td>
<td>94.3197</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>Sarphogyi</td>
<td>16.0668</td>
<td>94.3311</td>
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<td>6</td>
<td>Kyonkwin</td>
<td>16.0782</td>
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<td>7</td>
<td>Mawtin</td>
<td>15.9517</td>
<td>94.2449</td>
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<td>8</td>
<td>Zeegyaing</td>
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<td>Asingyaing</td>
<td>15.8552</td>
<td>94.4196</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: Field Survey, 29th January, 2014

In the Pyunwa Creek and Lungan Creek, 8 water samples were taken on 23rd January, 2014. The salinity of the sample waters ranges between 27 ppt and 17 ppt (Table 3). On 23rd January, 2014, water samples were taken from 12 points along the Thetkethaung River. The salinity of the respective points is mentioned in Table 4, ranging between 27 ppt and 21 ppt.

TABLE 3. Location of Water Sample Points and Salinity of Pyunwa and Lungan Creek

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pyunwa Creek</td>
<td>16.0611</td>
<td>94.5726</td>
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<td>Pyunwa Creek</td>
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<td>Pyunwa Creek</td>
<td>16.18</td>
<td>94.6489</td>
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</tr>
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<td>4</td>
<td>Pyunwa Creek</td>
<td>16.1296</td>
<td>94.6189</td>
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<td>5</td>
<td>Pyunwa Creek</td>
<td>16.1145</td>
<td>94.5909</td>
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<td>6</td>
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<td>94.5834</td>
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<tr>
<td>7</td>
<td>Lungan Creek</td>
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<td>94.574</td>
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<td>8</td>
<td>Lungan Creek</td>
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<td>94.5687</td>
<td>17</td>
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</tbody>
</table>

Source: Field Survey, 23rd January, 2014

Table 5 shows the salinity of waters taken from 2 points along the Gyawchaung Creek on 23rd January, 2014. The results of measurements are 26 ppt and 16 ppt respectively.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Thetkethaung River</td>
<td>16.0305</td>
<td>94.5879</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>Thetkethaung River</td>
<td>16.0158</td>
<td>94.577</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Thetkethaung River</td>
<td>15.9962</td>
<td>94.5615</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Thetkethaung River</td>
<td>15.9953</td>
<td>94.5511</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>Thetkethaung River</td>
<td>16.2271</td>
<td>94.6582</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>Thetkethaung River</td>
<td>16.0481</td>
<td>94.6154</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>Thetkethaung River</td>
<td>16.0624</td>
<td>94.6265</td>
<td>26</td>
</tr>
<tr>
<td>8</td>
<td>Thetkethaung River</td>
<td>16.0732</td>
<td>94.6373</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>Thetkethaung River</td>
<td>16.0838</td>
<td>94.6515</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>Thetkethaung River</td>
<td>16.1033</td>
<td>94.6598</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>Thetkethaung River</td>
<td>16.1231</td>
<td>94.6681</td>
<td>21</td>
</tr>
<tr>
<td>12</td>
<td>Thetkethaung River</td>
<td>16.135</td>
<td>94.6727</td>
<td>22</td>
</tr>
</tbody>
</table>

Source: Field Survey, 23rd January, 2014

On 24th January, 2014, 3 water samples are taken from Sarrkyin Creek and the locations and degrees of salinity are shown in Table 6. The range of salinity is between 10 ppt and 15 ppt. Three saline water samples are taken from Ywe River on 24th January, 2014. The range of salinity is between 7 ppt and 25 ppt. Table 7.

TABLE 4. Location of Water Sample Points and Salinity of Thetkethaung River

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gwaychaung Creek</td>
<td>16.0089</td>
<td>94.5408</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>Gwaychaung Creek</td>
<td>16.0223</td>
<td>94.5272</td>
<td>16</td>
</tr>
</tbody>
</table>

Source: Field Survey, 23rd January, 2014

TABLE 5. Location of Water Sample Points and Salinity of Gwaychaung Creek

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sarrkyin Creek</td>
<td>16.118</td>
<td>94.686</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Sarrkyin Creek</td>
<td>16.1153</td>
<td>94.7159</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Sarrkyin Creek</td>
<td>16.138</td>
<td>94.753</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Field Survey, 23rd January, 2014

TABLE 6. Location of Water Sample Points and Salinity of Sarrkyin Creek

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ywe River</td>
<td>16.1436</td>
<td>94.7781</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Ywe River</td>
<td>15.9636</td>
<td>94.6589</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Ywe River</td>
<td>15.9634</td>
<td>94.6358</td>
<td>22</td>
</tr>
</tbody>
</table>

Source: Field Survey, 24th January, 2014

Table 8 shows the location and degree of salinity for 10 points along the Pyamalaw River from which water samples were taken on 24th January 2014. The salinity of the creek waters is relatively low, ranging between 11 ppt and 3 ppt.

On 27th January, 2014, 51 water samples were taken from Bogalay River, being a long stream. As shown in Table 9 salinity decreases from 17 ppt northward to 0 ppt.
Along the Toe River, 25 water samples were taken on 8th February, 2014 and the locations and degree of salinity are presented in Table 10. The salinity is 10 ppt near the sea and decreases gradually upward to 0 ppt.

### TABLE 8. Location of Water Sample Points and Salinity of Pyamalaw River

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pyamalaw River</td>
<td>16.1085</td>
<td>94.8387</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Pyamalaw River</td>
<td>16.0918</td>
<td>94.8439</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Pyamalaw River</td>
<td>16.0721</td>
<td>94.8484</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Pyamalaw River</td>
<td>16.0551</td>
<td>94.8546</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Pyamalaw River</td>
<td>16.0323</td>
<td>94.8551</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Pyamalaw River</td>
<td>16.0128</td>
<td>94.8498</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Pyamalaw River</td>
<td>15.9978</td>
<td>94.8342</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Pyamalaw River</td>
<td>15.9703</td>
<td>94.8071</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Pyamalaw River</td>
<td>15.9585</td>
<td>94.7899</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>Pyamalaw River</td>
<td>15.9705</td>
<td>94.7537</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Field Survey, 24th January, 2014

### TABLE 9. Location of Water Sample Points and Salinity of Bogalay River (continued)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Bogalay River</td>
<td>16.0203</td>
<td>95.3199</td>
<td>7</td>
</tr>
<tr>
<td>26</td>
<td>Bogalay River</td>
<td>16.0395</td>
<td>95.3184</td>
<td>6</td>
</tr>
<tr>
<td>27</td>
<td>Bogalay River</td>
<td>16.0456</td>
<td>95.3102</td>
<td>6</td>
</tr>
<tr>
<td>28</td>
<td>Bogalay River</td>
<td>16.0536</td>
<td>95.3143</td>
<td>7</td>
</tr>
<tr>
<td>29</td>
<td>Bogalay River</td>
<td>16.0611</td>
<td>95.3142</td>
<td>7</td>
</tr>
<tr>
<td>30</td>
<td>Bogalay River</td>
<td>16.0658</td>
<td>95.3135</td>
<td>7</td>
</tr>
<tr>
<td>31</td>
<td>Bogalay River</td>
<td>16.0729</td>
<td>95.3138</td>
<td>6</td>
</tr>
<tr>
<td>32</td>
<td>Bogalay River</td>
<td>16.0688</td>
<td>95.3077</td>
<td>6</td>
</tr>
<tr>
<td>33</td>
<td>Bogalay River</td>
<td>16.0655</td>
<td>95.3002</td>
<td>5</td>
</tr>
<tr>
<td>34</td>
<td>Bogalay River</td>
<td>16.0634</td>
<td>95.2974</td>
<td>5</td>
</tr>
<tr>
<td>35</td>
<td>Bogalay River</td>
<td>16.0517</td>
<td>95.2854</td>
<td>6</td>
</tr>
<tr>
<td>36</td>
<td>Bogalay River</td>
<td>16.0477</td>
<td>95.2774</td>
<td>6</td>
</tr>
<tr>
<td>37</td>
<td>Bogalay River</td>
<td>16.0435</td>
<td>95.2773</td>
<td>6</td>
</tr>
<tr>
<td>38</td>
<td>Bogalay River</td>
<td>16.0313</td>
<td>95.2695</td>
<td>6</td>
</tr>
<tr>
<td>39</td>
<td>Bogalay River</td>
<td>16.017</td>
<td>95.2533</td>
<td>7</td>
</tr>
<tr>
<td>40</td>
<td>Bogalay River</td>
<td>16.0017</td>
<td>95.2665</td>
<td>8</td>
</tr>
<tr>
<td>41</td>
<td>Bogalay River</td>
<td>15.9669</td>
<td>95.2677</td>
<td>10</td>
</tr>
<tr>
<td>42</td>
<td>Bogalay River</td>
<td>15.9703</td>
<td>95.2689</td>
<td>10</td>
</tr>
<tr>
<td>43</td>
<td>Bogalay River</td>
<td>15.9566</td>
<td>95.27</td>
<td>10</td>
</tr>
<tr>
<td>44</td>
<td>Bogalay River</td>
<td>15.9436</td>
<td>95.266</td>
<td>10</td>
</tr>
<tr>
<td>45</td>
<td>Bogalay River</td>
<td>15.9317</td>
<td>95.2586</td>
<td>11</td>
</tr>
<tr>
<td>46</td>
<td>Bogalay River</td>
<td>15.9188</td>
<td>95.2509</td>
<td>12</td>
</tr>
<tr>
<td>47</td>
<td>Bogalay River</td>
<td>15.9045</td>
<td>95.2413</td>
<td>11</td>
</tr>
<tr>
<td>48</td>
<td>Bogalay River</td>
<td>15.8977</td>
<td>95.238</td>
<td>12</td>
</tr>
<tr>
<td>49</td>
<td>Bogalay River</td>
<td>15.9084</td>
<td>95.2933</td>
<td>12</td>
</tr>
<tr>
<td>50</td>
<td>Bogalay River</td>
<td>15.9205</td>
<td>95.3008</td>
<td>12</td>
</tr>
<tr>
<td>51</td>
<td>Bogalay River</td>
<td>15.9336</td>
<td>95.3082</td>
<td>11</td>
</tr>
<tr>
<td>52</td>
<td>Bogalay River</td>
<td>15.9475</td>
<td>95.3145</td>
<td>11</td>
</tr>
<tr>
<td>53</td>
<td>Bogalay River</td>
<td>15.9606</td>
<td>95.3253</td>
<td>10</td>
</tr>
<tr>
<td>54</td>
<td>Bogalay River</td>
<td>15.9651</td>
<td>95.3273</td>
<td>9</td>
</tr>
<tr>
<td>55</td>
<td>Bogalay River</td>
<td>15.9709</td>
<td>95.336</td>
<td>10</td>
</tr>
<tr>
<td>56</td>
<td>Bogalay River</td>
<td>15.9839</td>
<td>95.3401</td>
<td>9</td>
</tr>
<tr>
<td>57</td>
<td>Bogalay River</td>
<td>15.9683</td>
<td>95.3351</td>
<td>10</td>
</tr>
<tr>
<td>58</td>
<td>Bogalay River</td>
<td>15.9661</td>
<td>95.3304</td>
<td>10</td>
</tr>
<tr>
<td>59</td>
<td>Bogalay River</td>
<td>15.9674</td>
<td>95.3157</td>
<td>10</td>
</tr>
<tr>
<td>60</td>
<td>Bogalay River</td>
<td>15.9811</td>
<td>95.315</td>
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</tr>
<tr>
<td>61</td>
<td>Bogalay River</td>
<td>16.0085</td>
<td>95.3209</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: Field Survey, 27th January, 2014

On 3rd February, 2014, the salinity of water from the river draining close to the Ngapataw Town in the Ayeyarwady Region was measured, salinity with 3 ppt, while that of other points (24 points) near large town are assumed as 0 ppt.

According to salinity measurements conducted during the period from 23rd January, 2014 to 8th February, 2014, salinity of rivers and creeks gradually decrease from west to east. In response to salinity most salt farms are found in the western part whereas the eastern part has only a few.

Altogether 183 water samples were taken for salinity measurement. Figure 3 shows the locations of water sample points.
TABLE 10 Location of Water Sample Points and Salinity of Toe River

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Latitude (Y)</th>
<th>Longitude (X)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Toe River</td>
<td>16.4117</td>
<td>95.89</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Toe River</td>
<td>16.4054</td>
<td>95.9072</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Toe River</td>
<td>16.4033</td>
<td>95.914</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Toe River</td>
<td>16.403</td>
<td>95.9216</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Toe River</td>
<td>16.4042</td>
<td>95.9306</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Toe River</td>
<td>16.4066</td>
<td>95.9381</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Toe River</td>
<td>16.4089</td>
<td>95.9488</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Toe River</td>
<td>16.4105</td>
<td>95.9568</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Toe River</td>
<td>16.41</td>
<td>95.9649</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Toe River</td>
<td>16.4084</td>
<td>95.9724</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>Toe River</td>
<td>16.4043</td>
<td>95.9823</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>Toe River</td>
<td>16.4023</td>
<td>95.9886</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Toe River</td>
<td>16.3977</td>
<td>95.9987</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>Toe River</td>
<td>16.3935</td>
<td>96.0041</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Toe River</td>
<td>16.3877</td>
<td>96.0102</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Toe River</td>
<td>16.3814</td>
<td>96.015</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>Toe River</td>
<td>16.3758</td>
<td>96.0211</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td>Toe River</td>
<td>16.3689</td>
<td>96.0289</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>Toe River</td>
<td>16.3644</td>
<td>96.0346</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>Toe River</td>
<td>16.3596</td>
<td>96.0418</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>Toe River</td>
<td>16.3556</td>
<td>96.0483</td>
<td>5</td>
</tr>
<tr>
<td>22</td>
<td>Toe River</td>
<td>16.3514</td>
<td>96.0557</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>Toe River</td>
<td>16.3483</td>
<td>96.0609</td>
<td>7</td>
</tr>
<tr>
<td>24</td>
<td>Toe River</td>
<td>16.3442</td>
<td>96.0692</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>Toe River</td>
<td>16.3385</td>
<td>96.0746</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Field Survey, 8th February, 2014

Depending on the degree of salinity, they are classed by Interpolation technique into two classes and presented in Figure 4. Class 1 is 0-1 ppt level and class 2 is 1-33 ppt level respectively. According to this reclass, 1 ppt saline water front line closed to the middle part of the Delta area.

Electrical conductivity of surface water (when it is present) can be used to estimate the salinity type of mineral wetlands based on the ranges listed in Table 11. This table shows Alberta Wetland Classification System, 2015, (W. Matthew, 2015)[5].

TABLE 11. Salinity Types and Corresponding Conductivity Ranges (adapted from Stewart and Kantrud, 1971)

<table>
<thead>
<tr>
<th>Wetland type</th>
<th>Conductivity (μS/cm)</th>
<th>Salinity (ppt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>freshwater</td>
<td>less than 500</td>
<td>less than 0.32</td>
</tr>
<tr>
<td>slightly brackish</td>
<td>500 to 2,000</td>
<td>0.32 to 1.28</td>
</tr>
<tr>
<td>moderately brackish</td>
<td>2,000 to 5,000</td>
<td>1.28 to 3.2</td>
</tr>
<tr>
<td>brackish</td>
<td>5,000 to 15,000</td>
<td>3.2 to 9.6</td>
</tr>
<tr>
<td>sub-saline</td>
<td>15,000 to 45,000</td>
<td>9.6 to 28.8</td>
</tr>
<tr>
<td>saline</td>
<td>greater than 45,000</td>
<td>greater than 28.8</td>
</tr>
</tbody>
</table>

Source: Alberta Wetland Classification System, 2015

According to the Alberta Wetland Classification System, 1/3 collected sample salinity value (ppt) can be grouped into 6 Classes and presented in Figure 5. Class 1 (Freshwater), the salinity is less than 0.32 ppt. Class 2 (Slightly brackish water), the salinity is between 0.32-1.28 ppt. Class 3 (Moderately brackish water), the salinity is between 1.28-3.2 ppt. Class 4 (Brackish water), the salinity is between 3.2-9.6 ppt. Class 5 (Sub-saline water), the salinity is between 9.6-28.8 ppt. Class 6 (saline water), the salinity is greater than 28.8 ppt.
Due to the salinity result, 38 village tracts in Bogale Township, 49 village tracts in Dedaye Township, 104 village tracts in Labutta Township, 22 village tracts in Mawlamyinegyun Township, 41 village tracts in Myaungmya Township, 48 village tracts in Ngaputaw Township and 33 village tracts in Pyapon Township and about 144,400 hectares (356,818 acres) of cultivated land are faced to the saline water intrusion problems.

V. CONCLUSIONS

Salinity is one of the most severe environmental factors limiting the productivity of agricultural crops. Most crops are sensitive to salinity caused by high concentration of salts in the soil. As yield of crop production had been reduced due to salinity, the cost of production had gradually increased. In addition to this enormous financial cost of production, there are other serious impacts of salinity on infrastructure, water supplies, on soil structure and stability of communities. Minimum saline water intrusion in Delta coast of the Ayeyarwady Region occurs during the monsoon period (June-October) and maximum saline water intrusion occurs during March-April. According to the result, the waters in Bogalay, Pyapon, Thandi and Toe, located to the east of the Ayeyarwady River are low in salinity due to the large volume of freshwater drainage. The lower parts of Pyinzalu, Pyamalaw, Ywe, Thetkethaung and Ngawun rivers, located to the west of the Ayeyarwady River have water high in salinity. Furthermore, saline water front was gradually intruding into the interior of the study area.

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REFERENCES

TRADITIONAL FOREST LAND MANAGEMENT PRACTICES OF KAYAN INDIGENOUS PEOPLE IN THE SOUTHERN SHAN HIGHLANDS

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Abstract – The traditional forest land management practices of the Kayan indigenous people have evolved over the centuries and remain the prominent method of forest resource conservation in Hpekone Township in southern Shan State, Myanmar. This study provides an overview of the Kayan’s role in and contributions to the conservation of the southern Shan Highland’s remaining natural vegetation alongside an overview of the threats and challenges facing local users and resources. Extensive field observations and in-depth interviews in the local dialect with Kayan leaders and community members as well as with local and national authorities were undertaken to thoroughly understand the nature of indigenous cultural practices and their impact on nature resources management in Hpekone Township. The author used Geographic Information System (GIS) and Remote Sensing to study the effect of indigenous agricultural practices on vegetation cover in the region. Mixed methods were employed in data analysis and interpretation. In order to halt forest degradation and sustain the customary forest conservation system, this paper offers four recommendations: first, further in-depth study of the Kayan’s traditional forest land management practices and related knowledge—and that of other indigenous peoples in highland areas in Myanmar—is a necessary first step. Second, awareness-raising activities on land, forest and environmental issues to better inform communities and cultivators will place more power in the hands of local users. Third, reserved and protected forests are not an adequate or culturally-effective solution in the fight against forest degradation—other alternatives are needed. Finally, land and forest conservation laws in Myanmar are not adequate and should be amended in consultation with local users and with acknowledgement their vast local knowledge.

I. INTRODUCTION

Myanmar (also known as Burma) is a country characterized by the diversity of its indigenous peoples whose presence determined the modern-day borders of the country’s seven states. Comprising one-quarter of Myanmar’s total area, Shan state is the largest of Myanmar’s administrative regions and fascinating in its diversity—it is home to 35 indigenous peoples with distinct cultural beliefs, practices and histories. This study focuses on the Kayan indigenous people residing in Hpekone Township, located in the south of Shan state in the Taunggyi District, where populations of 15 indigenous peoples live together in harmony: Kayan (Karen), Kâchin, Kayah, Kayin, Chin, Mon, Bamar, Yakhine, Shan, Palaung, Intha, PaO’, Taungyoe, Danu and Lahu. The Kayan population in Hpekone Township in 2017 was 105,117 or 77% of the Township’s population [1].

The Kayan people live in inter-ethnic communities and despite the relentless approach of modernity, the majority of these peoples continue to live “in a timeless fashion” [2]. Land and native title traditional laws and customs are central to the Kayan identity, and the people’s strong spiritual and cultural connection to the land has an impact on both their livelihood practices and their conservation activities. Individual and community land owners play an active role in many areas of forest land management and resource conservation in Hpekone Township. This paper will delve into these traditional forest land management practices to reveal how the Kayan in Hpekone Township positively contribute to maintaining their lands and offer recommendations for conserving the locality’s remaining natural vegetation.
II. DATA AND METHODOLOGY

This study integrates a mixed methods approach. The author has been working with the Kayan community in Hpekone Township for over six years and extensive fieldwork has contributed to a thorough understanding of the Kayan’s traditional knowledge framework and how they employ conservation practices to effectively utilize and maintain forest land and related resources. Between December 2012 and April 2018, the author conducted over 20 in-depth interviews with local indigenous people and local and national authorities, and facilitated four focus group discussions. The author conducted these knowledge collection activities in local dialects, which allows for a deeper understanding of the culture and offers a clearer picture of the issues in the Township.

This data is complemented by a literature review focusing on the role of Indigenous Knowledge in forest land management and secondary data, such as population statistics and other related reports, from both government institutions and non-government organizations. Landsat images from 1990 and 2015 were the main data used for classification and change analysis, especially for land cover changes due to agricultural practices. The Landsat images are: Landsat-7/TM 1990, Path/Row: 132/46, 47 and Landsat-8/ 2015, Path/Row: 132/46, 47. Ancillary data utilized during analysis included topographic maps, field data, thematic layers (roads and towns, etc.) and boundaries. The eCognition Developer version 4.0.6 software was employed for land cover classification processing. Object-oriented image analysis was divided into three steps: multiresolution segmentation, creation of general classes, and classification of rules [3]

III. KAYAN INDIGENOUS PEOPLE

The Kayan indigenous people have been living in Myanmar since the ancestors’ times. Nationally, the important homelands for this ethnic group are Hpekone, Pinlaung and Hsiseng Townships in southern Shan State, and Demoso Township in northeastern Kayah state. They were also the aborigines of southern Shan state [4]. Smaller populations also live in Than Taung Township in northern Kayin state and in the eastern section of Pyinmana Township in the Mandalay region. Topographically, the areas of the Kayan are generally mountainous terrain. Communities are built in the hills or mountains and near water sources.

The origin of the Kayan who live in these regions, which are endowed with natural resources, are revealed through historical records and sayings passed down through the generations. The original name of the Kayan is “Kan Yan,” and the Kayan claim that their original name is “Kan-yan.” “Kan” mean “the territory” and “Yan” is “the tenacity” or “being well settled.” Accordingly, Kan-yan means “the people who settle in a certain territory without moving anywhere.” As time elapsed, Kan-Yan gradually became Kayan [5]. The four major tribes of the Kayan are: Kayan Lahwi (Kayan Padaung), Kayan Kangan (Yinbaw), Kayan Kakhaung (Gekho, Geebar), and Kayan Lahta (Zayein) [5,6].

Plate.1 Kayan Padaung women
Source :Gomyanmartours
IV. NATURAL RESOURCES AND IDENTITY

The Kayan indigenous people do not have an exact term that can be translated into the English phrase “natural resources,” however there are phrases in Kayan that describe the concept of natural resources, including: Su Kan (the territory), Tamon Tabon (the plants), Thowa (trees and bamboo), Su Lao (the stream), So (the mountain), Tamyu (wildlife and animals), and Thapho Tatha (fruits and flowers). So that, for the Kayan, like indigenous peoples in other indigenous people in Myanmar as well as other places in Southeast Asia, natural resources are therefore understood to be an all-encompassing concept that includes land, forest, water bodies, trees, wildlife, agricultural areas and watershed areas, all having cultural, economic, political and spiritual significance [7].

For the Kayan, like many other indigenous peoples globally, land and natural resource management denotes the application of traditional knowledge of land to utilize and maintain this resource, which is an integral part of quotidian life. Taboos and rituals that express respect and devotion to the spirits that are believed to guard different natural resources not only serve important ceremonial roles but also ensure that community members adhere to traditional norms of forest land management and resource use.

Plate (2) Hlalya community forest, Saikhu area, Hpekone Township.
Source: Author (2018)

V. TRADITIONAL FOREST LAND MANAGEMENT

In cases of land use, other ethnic groups or outside entities must secure permission from the Kayan for all forest resources uses related activities within their territory. Within the Kayan ethnic groups, there are four major groups that have a role in forest land management within their respective territory: Kayan Lawi, Kayanlahta, Kayan Kakhaung and Kayan Kangan, and each major group has sub-groups (e.g., Kabla, Hansi, Salin and others). Ownership of forest land is demarcated with clefts, large trees, man-made stone piles, walls and drains. Sub-family or individual forest landowners fall under sub-groupings in the top-down structure. There are also Kayan forests that belong to and are managed by community.

Land management in Kayan territory more generally involves all levels of society—communities, family groups, sub-family groups and individuals—who have successfully managed their lands through principled decisions since the time of the ancestors. The Kayan, though, use a bottom-up hierarchy for agricultural land use in contrast to forest land management. An individual or sub-family owns land and there is also a long tradition of permitting members of other indigenous groups to use land suitable for shifting cultivation or other purposes, with the permission of and remuneration to the landowners.

Even within Hpekone Township, forest land management practices vary depending on the area and the predominant culture. For example, in the mountainous, western part of Hpekone Township, indigenous groups have common customs, including how they value agricultural land and forests. Individual decisions produce land use and land cover changes at higher spatial levels. The forest is maintained without clear-cutting and agricultural land now in use had been retained for centuries. Forest resources extraction, especially in community forests, is only permitted when lumber is needed to build monasteries, schools, churches and other public buildings, and the cutting of forest resources for private use is strictly prohibited. On privately-owned land, only members of family groups are permitted to extract forest resources. When trees are harvested, management practices include cutting the large trees (around 12 feet) but leaving the smaller trees. All community members are duty bound to prevent accidental forest fires. These management practices are examples of the role of traditional ways in sustainable environmental conservation.
According to Kyaw Than (2009) and Aung Kyaw (2011), the Kayan value forest land more highly than gold, silver or jewelry; unlike land, the latter could be lost to one of the “five kinds of enemies” (theft, storm, fire, rain and the king or an authorized person). Understandably then, land dispute arbitration between the Kayan people is emotionally charged, with some cases taking up to 10 years to settle. Those involving land sought by two villages are the most difficult and their arbitration goes to the level of Pahein (the Circle Head) when the village head cannot settle the case [5, 6].

VI. THREATS AND CHALLENGES

While the traditional forest land management practices of the Kayan indigenous group in Hpekone Township have and will continue to positively contribute to forest resource conservation, they are coping with several threats and challenges. Among them, agricultural land use changes, especially shifting cultivation, illegal logging, infrastructure development, loss of intergenerational transfer of knowledge, interface between indigenous and statutory systems, and laws on forest land management issues and conservation.

H. Briassoulis states that in cases of land cover changes, the choice of land use and decisions to change it are influenced by the size of the household, age, gender, education, employment, attitudes, values, and personal traits of household members…land management practices, land tenure, and ownership [8].

Agricultural land use changes

In the Taunggyi District, forest cover decline due to the intensification of agricultural practices over the past four decades has become of urgent environmental concern, as illustrated in Figure 2. In Hpekone Township, the closed forest was the largest land cover type in 1990, accounting for 71,598.53 hectares or 34.29% of the total area. Within 25 years, it had been reduced by over half to 34,642.76 hectares or by 17.69%. Conversely, open forest increased from 65,097.56 hectares in 1990 to 72,612.31 hectares or to 34.77% of the total land coverage by 2015. The biggest land cover change in Hpekone Township was in agricultural land area, rising from 29.08% in 1990 to 42.97% in 2015. There was also a small rise in the percentage of settlement area, and water body coverage area shrank by 1,929.06 hectares.
Shifting cultivation

Shifting cultivation is one of the main subsistence activities of small-scale Kayan farmers, and it plays a significant role in the high levels of deforestation in the Township. It is also strongly tied with cultural practices. The first step in this centuries-old system of land use is land selection, which is determined using local custom. Farmers use select their sites very carefully—forest areas that are cultivable and free of taboos, ensuring that the area is not one that they believe should not be disturbed. A fortune teller conducts chicken bone prognostication using two thigh bones to determine if the selected plot is good or bad. In cases of Nat (traditional spirit) worship, a fortune teller squeezes a live chicken while chanting and praying. Once the merit of the land is determined, the removal of trees for land cultivation can begin. This process occurs during Tabaung (March/April) before the raining season begins. Large trees are felled by sawing and dried before being set on fire, which also clears the undergrowth. Some trees are processed for lumber to be used locally. Before burning, fire breaks are established to prevent fire spreading to adjacent land, though breaches do sometimes occur and result in the often-total loss of neighbouring forest areas. After the land is cleared by fire, the burnt logs and branches are removed. Kayan farmers plant the hill paddies during Kason (May/June) after rainfall saturates the area. They take measures to protect the land from soil erosion using the implements available to them. Farmers use the jab method to plant seeds, digging with a very small hoe so as not to destroy the soil’s upper layer. Sharpened poles are used for this purpose on very steep slopes, hoes are used on hill slopes, and sickles for harvesting [5]. Prior to the 1960s, Kayan farmers sustained the agricultural system by leaving the land fallow for 30 to 40 years before replanting. By the 1980s, the frequency had increased to one planting season every 15 years and with the area’s steady population growth, land for cultivation now lies fallow for only eight to 10 years before replanting. Sai Aung Tun emphasizes the sustainable aspects of shifting cultivation: 1) It is practiced chiefly by groups with traditional ways and smaller populations, but is used by almost all farmers in Shan state who need cropping system expediencies; 2) It involves human labour, using mostly hand tools and virtually no power tools; and 3) Crops are primarily used for subsistence [9].

Shifting cultivation is also strongly tied to Kayan customs, which they believe keep their social unity strong. Collective labour is needed to clear and prepare the land, and villagers hold a festival, complete with the partaking of traditional wine, to coincide with the burning of the area in preparation for planting. Another of these traditional customs is the annual ceremony to celebrate the year’s first crop. A sample of the new rice is taken out of the granary and pounded with a hand mortar. A new pot is used to cook the rice in spring or river water. After the rice is cooked, each family chief is the first to eat. For
the Kayan, this ritual symbolizes their annual welcoming of spring and the continuous renewal of the earth; they believe it will ensure an abundant new crop for their granary, and the paddy’s longevity and sustainability to feed the family in the future.

Plate (3) Land used for shifting cultivation after the harvest of collective crops, near the Hanhsí indigenous group’s village, Yelonyekan Village Tract, western Hpekone Township
Source: Author (2014)

Plate (4) Land used for shifting cultivation after five planting seasons, near Hanhsí village, Yelonyekan Village Tract, western Hpekone Township
Source: Author (2014)

**Illegal logging**

In a 2014 Food and Agriculture Organisation (FAO) report, Myanmar was ranked as the third-worst country in the world for deforestation and many of its forests remain beyond government control [10]. Over the last two decades, Hpekone Township’s forest resources have been gradually depleted due to several related factors, including illegal logging and other forest crimes, improper forest land management practices, and poor inspection and monitoring by the local community. Even though accurate and reliable statistics for illegal logging in Hpekone Township are not available, there is enough evidence to suggest that substantial and growing volumes of timber are illegally harvested and traded annually, and it is a cause for serious concern for the Kayan community. In the western part of the study area, harvested lumber is being traded and illegally exported to lower and central Myanmar and to China. Businessmen with close connections to local ethnic armed groups control a large percentage of this illegal trade; an example is the illicit logging activities that took place in the Larlyar indigenous people’s (Saikhu group) area in 2017. In such cases, landholders find it hard to tackle the problem on their own, despite collaboration with and support from local indigenous groups. There are also a growing number of cases across Hpekone Township where landowners have sold off their forest resources in full for personal gain. The sellers’ often lack knowledge of the situation and the consequences, and can be vulnerable to the buyer’s persuasive skills. One village source shared the veiled threat that he received from a forest resources trader: “With the emergence of democracy, all forests will be confiscated by the government. No right of ownership at all! It is therefore better for you to sell out your forests right now” [11].

Plate (5) Loggers illegally harvesting old growth trees in a community-owned forest in Larlya Village, Hpekone Township
Source: Kayan community photograph (2018)
Infrastructure development

The success or failure of a locality’s development is an important aspect in the discussion of forest land management. In line with booming infrastructure development across the country, the absence of adequate environmental impact mitigation measures in many cases has meant that these developments have had severe impacts on the region’s forests. Road building, for example, can cause forest fragmentation and loss, encourage human settlement in previously remote areas, and facilitate extraction of forest resources [12]. In the west of Hpekone Township, infrastructure development has made it increasingly difficult for the Kayan and other indigenous people to manage natural forest areas. Transportation and communication infrastructure improvements have been ongoing since 2010 in what was previously a remote, isolated area that was inaccessible to outsiders and where the forests remained unviolated. By 2017, the area road network was about 116 kilometres (72 miles) or 40% of the total region. While these improvements have aided the population, they have also facilitated the activities of those who engage in unofficial resource harvesting as well as illegal farming.

Intergenerational transfer of knowledge

The Kayan, like others indigenous groups globally, have developed systems of natural resource management that are centred on traditional knowledge, which have been tested and passed down from generation to generation for hundreds of years. There are many customs and mores to govern the practices of forest land management within the communities. Elders play a vital role in ensuring that knowledge is passed down to the next generation, whether it be through proverbs, stories, poetry, songs, ritual chants or riddles. However, external factors (socio-economic, institutional and political) are influencing these customary ways, and much of the body of indigenous knowledge is being threatened here, like it is worldwide. More worryingly, the younger generations are not as keen to learn and use traditional knowledge from
their elders, which is an urgent challenge to the future sustainability of indigenous natural resource management.

**Interface between indigenous and statutory systems, and laws on forest land management**

During the period from 1988 when the State Peace and Development Council (SPDC) took power in Myanmar until the present government, led by the National League for Democracy (NLD), there have not been adequate updates to provisions in the country’s Constitution to uphold customary traditions. With the regard to the environmental protection, the 2008 Constitution still needs to guarantee the rights of local indigenous people such as freedom of information, participation in natural resource management, customary land ownership, information in local languages, and equitable benefit sharing [13]. In practice, however, informal overlap between customary and statutory laws and practices still exist.

K. Eberhardt (2003) and Maung Maung Than (2015) state that all state-owned land and government-sanctioned land-use rights are granted for specific periods, dependent upon use [14,12]. In most upland areas, including those of the Kayan, land-tenure systems are based on customary rights under local institutions, as discussed earlier. In the Organisation for Economic Co-operation and Development’s (OECD) Investment Policy Review of Myanmar [15], the authors note that land tenure remains insecure for most smallholder farmers for a wide range of reasons, though largely related to a lack of recognition for and protection of traditional land and land management systems: i) a complex and long land registration process that results in low registration rates; ii) a rigid, government-imposed land classification system that does not reflect the realities of existing land use; iii) weak protection of registered land-use rights; v) inefficient land administration; and vi) state governments’ active promotion of large-scale land allocations without adequate safeguards.

**Current land use policy and indigenous groups’ perceptions**

Based on the current draft law which is called “Law Amending the Vacant, Fallow and Virgin Lands Management Law (2018) [16], most of the country’s ethnic community groups do not feel that the policy protects ethnic minorities’ rights. Among their concerns are that the policy does not prioritize and protect small-scale farmers and ethnic minorities, but gives special privileges to business investors—such an environment could spark more land grabs and create more land problems within the country. They responded that the current draft of the national land use policy does not prioritize and protect small scale farmers and minority ethnic peoples, but instead prioritizes and gives special privileges to business investors, which could spark more land grabs and create more land problems within the country. Furthermore, they also assumed that it only protects and promotes the business interests of a small group of people, and there are no explicit measures giving minority ethnic peoples decision making power and control over questions of land ownership, land use and land management, which could delay further the peace building and national reconciliation process and could create new land conflicts.

**Current land use policy and Kayan traditional land management practices**

A key problem in Hpekone Township, especially in the area where Kayan indigenous people exercise traditional forest land management, is that there is no law that formally recognizes traditional land use. Thus, there are no means to legally protect the farmer or his traditional land use practices. In some situations, the government grants land use permission without any coordination between the land owner(s) and planner(s), on the premise that any problems will be solved later as they arise. In such instances, it is questionable whether actions should be taken as per the customary law of the indigenous people holding the land where no “laws” are yet firmly prescribed. These situations often cause a great deal of difficulty for local farmers who have no exposure to or experience with the state and provincial government bodies or their associated laws. Traditional and customary laws in areas where the Kayan reside have been practiced for centuries, but the government’s land use policies have neglected these traditional laws. It is
essentially for local indigenous people to push for their recognition under the current law.

A related obstacle to local communities’ participation in forest land management is the gap between Kayan indigenous peoples’ way of life and the policies and other legal frameworks that the national government put forward that impinge on a community’s rights and ignores its people’s customs and traditions. Furthermore, the present legal framework of natural resource management in Myanmar is based on the premise that “public” resources can be divided into separate categories according to their utilitarian value, encouraging their extraction or use for commercial purposes. This perspective places an emphasis on the physical property of the resources and ignores their value in other domains such as local culture and tradition that serve as the basis for a customary legal framework for resource management. It results in statutory laws created by the national government that serve the interests of only certain groups in society. There is a need, therefore, to look at how such gaps can be negotiated. A constant point of interaction between indigenous systems and the codified system of the State is the conflict that regularly arises when these systems overlap or exclude each other, which is often the case.

The obvious example is that the draft amendment of the national land use policy “Law Amending the Vacant, Fallow and Virgin Lands Management Law (2018) [16], which is one of the factors that challenges traditional forest land management. Rather than prioritize and protect small-scale farmers and ethnic minorities, it gives special privileges to business investors, which could spark more land grabs and create more land problems within the area where indigenous groups live. Furthermore, it only seems to protect and promote the business interests of a small group of people, and could also eliminate_ The natural power of indigenous peoples—decision-making, land ownership, land use and land management patterns and could create new land conflicts. Even though the draft policy mentions the protection of ethnic peoples’ customary land use, it also still legally needs to recognize and guarantee freedom of customary collective land ownership, land use and land management of ethnic groups.

In terms of the land classification of “Vacant, Fallow, Virgin Land” in the draft policy, legally recognizing and guaranteeing freedom for ethnic groups in their customary collective land ownership, land use and land management, these criteria contradict and fail to meet the needs of local indigenous peoples’ traditional land management systems. A good example is the Kayan farmers’ methods of sustaining the forest while practicing shifting cultivation. In the 1960s, they maintained the agricultural system by leaving the land fallow for 30 to 40 years before replanting. By the 1980s, due in large part to population increases, the frequency increased to one planting season every 15 years, and currently, land for cultivation now lies fallow for only eight to 10 years before it is replanted. These rest periods allow the soil and vegetation to regenerate—it does not mean the land is “vacant.” Under the draft policy, such land use practices would fall under the aforementioned “Vacant, and Fallow” category. Without registering the land and obtaining a title under the current government vacant and fellow land policy, the land owner or community member found to be using the land in such traditional ways after a period of inactivity could automatically be arrested.

Forest conservation

In Myanmar, reserved forest is a government concept that enables it to take action to protect vegetation cover from shifting cultivation land use practices and trees from illegal logging operations. In its 30-year plan (2000–2001 to 2030–2031), the Forestry Department set a goal of establishing up to one million hectares of community plantations by 2030–31[17]. By 2015, however, they had only established around 8,093 hectares—less than one percent of the goal at the midway point. A Community Forestry National Working Group (CFNWG) is the Department’s latest response to the forest land management issues, bringing together department staff with civil society organizations and community-based organizations, including RECOFTC—the Center for People and Forests and FAO’s Forest and Farm Facility, to promote community forestry in Myanmar [12]. While forest conservation efforts may seem like the solution in areas where traditional forest land management is still widely practiced, including
the eastern part of Hpekone Township, local people are rarely consulted in the conservation processes. As a result, the local indigenous land users see these efforts to sustain forest resources as land grabbing, rather than conservation.

VII. RECOMMENDATIONS AND CONCLUSION

In 2018, the government had amended the law which is called “Law Amending the Vacant, Fallow and Virgin Lands Management Law (2018) [16]. In reality, the law has degraded into more or less a discourse of conservation, encouraging competition over forest lands between local indigenous people and outsiders. As this paper has tried to show, the problems of forest land management and resource conservation in Hpekone, Myanmar, have many complex causes that are deeply rooted in the social, economic, cultural and political structures of local societies, and these issues need to be addressed simultaneously at local and national levels.

To ban deforestation, rather than simply labelling shifting cultivation as illegal, the government needs to take the next step to find alternative livelihood options for affected subsistence farmers. According to Asia Indigenous Peoples Pact (AIPP) and International Work Group for Indigenous Affairs (IWGIA) (2011), the key issues that should be taken into account are

- Key findings of research on shifting cultivation, underpinning the dire need to earnestly consider indigenous people’s perspectives while assessing its impact on forests and climate change
- The human rights violations and other impacts resulting from state policies prohibiting or unduly restricting shifting cultivation” [18].

Improvements to transportation and communication systems in the region have improved life for the Kayan and other indigenous groups, but the side effects of this development have proven detrimental to the region’s forests in cases where preventive measures, like the absence of adequate environmental impact mitigation measures, are not in place [19]. There are many challenges to development in the Hpekone Township and the region more generally—negligible strategic planning and implementation, low inputs for land management, lack of stakeholder consultation, weak coordination between stakeholders, and a lack of monitoring systems—factors that should be analyzed in line with the United Nations Declaration on the Rights of Indigenous Peoples, Article 19, “States to consult indigenous peoples in order to obtain their free, prior and informed consent ‘before adopting and implementing legislative or administrative measure that may affect them [20,21]”, for their potential physical, social, economic and cultural impacts on local ecosystems before development commences.

At present in the study area, illegal logging and other forest crimes like they were happening in Lalya Village, in western part of Hpekone Township have spread into community-protected areas where valuable timber is still available in commercial volumes. This escalation of the problem has put further pressure on groups like the Kayan, their traditional forest land management practices, and their livelihoods. Awareness-raising activities on land, forest and environmental issues will offer an opportunity to integrate local indigenous knowledge that can contribute to and support the work of institutions to advance land use management.

The traditional forest land management system and the customs of the indigenous peoples who use this system should be accounted for in the national forest land management policy, and a stronger and more transparent political commitment is needed from the government in order to strengthen forest law enforcement to combat illegal logging and other forest crimes. Decentralization and devolution in forest land management would be beneficial to all stakeholders and should be considered in tandem with pluralism and building stakeholder capacity. Land and forest conservation laws should be amended in consultation with local peoples with rich knowledge bases. The establishment of new government units and non-governmental bodies to share and exchange information, experiences and knowledge on specific approaches to forest law enforcement is needed. It is also necessary to begin a conversation about protection for customary laws related to land use before related policies are proposed to various levels of government.
A national, reliable natural forest conservation policies, laws and instructions would be a significant step forward but in reality, they are still needed to develop in consultation with land users and the government’s commitment to forest conservation in terms of the current forestry policies are unclear. A nation-wide survey of forest types and land use to better understand the contemporary situation comes with its own difficulties and would take years to implement. The national government needs to seek out alternatives to establishing reserved and protected forests to better address the needs of all affected parties. In the case of forest conservation, a reliable natural forest conservation act (based on traditional knowledge and practices) would more likely produce positive results in these circumstances. The land use system detailed in the forestry act has yet to be exercised in the regions where indigenous peoples’ traditional ways are still widely practiced, including the study site, and the prospect of this implementation seems farfetched.

In conclusion, according to the United Nations Declaration on the Rights of Indigenous Peoples, States should consult and cooperate with Indigenous Peoples in order to obtain their Free and Prior Informed Consent prior to approval of any project affecting their land or territories and other resources (Article 32(2)) [20]. And, the power relationship between governments (national and local) and communities as well as other stakeholders involved in the processes of the decentralization and devolution of forest land management should be further analyzed to provide a clearer understanding of how each stakeholder participates in forest land management, and determine how even seemingly powerless actors, such as minor indigenous groups, can influence other actors. Furthermore, increased cooperation between a broader range of stakeholders, government or non-government actors, is also needed to improve forest and land utilization. The government has to actively engage in the development of a community-based forest land management system as well as in trying to strengthen the role of communities in said system by supporting people through a variety of policies and legal instruments, including decentralization acts and local governance ordinances, but should be in line with Article 18 of the UN Declaration on the Rights of Indigenous Peoples: “Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions” [20].

However, regulatory support and instruments to guarantee that decentralization can be implemented smoothly at the field level need to first be established. Roles and responsibilities among different actors need to be determined to enable a proper decentralization process. Moreover, clarity and increased consistency are essential when developing these new instruments to ensure that all stakeholders have a clear understanding of knowledge base traditional forest land management practices of the indigenous peoples in order to maintain their and strengthen their distinctive spiritual relationship with their land (Article 25). And, mechanisms need to be put into place that help to limit or eliminate the aspects of political structures and stakeholder inequality that sometimes leads to land management violations in line with Article 29 _1; “Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall establish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination” [21,22]

Finally, all levels of government, non-governmental organizations, professional foresters, environmentalists, academics, political leaders, researchers and other community members must work together with local indigenous people—all parties are responsible for preserving the forests for Myanmar’s future.

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Assessment on Flood Mapping in Bago River Basin in Myanmar

Using HEC-GeoHMS

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Abstract— The Bago river basin is located in Bago Region in Myanmar and total area is 2279.816 sq-kilometers. The main river is about 331.5 km long. Bago River originates from the middle mountainous region named Bago Yoma and the large portion of the river itself is within the Bago township of Bago Region. A small portion of the river (the outlet) is in Yangon Region where Bago River (the outlet) joins the Yangon River and, from there, enters the Gulf of Mottama. The Bago River is one of the most important and useful river basin in lower Myanmar which is utilized for hydropower generation, irrigation, fisheries and navigation use. It is a flood-prone area in Myanmar. In this paper, objectives of study are flooding hazard situation within the basin area respectively each basin, inflow, time series and peak discharge period. The data used in this study SRTM DEM, Meteorological and hydrological data provided by the Department of Meteorology and Hydrology (DMH), discharge developed by the Irrigation and Water Utilization Management Department (WUMD), outflow data at Zaungtu Dam provided by the Department of Hydropower Implementation (DHPI). DEM data is generated for terrain parameters as stream, basin, subbasin, slope, basin parameter and basin characteristic. Using the land use and landcover data and soil data are create to generate the CN grid value and combined the CN grid value and basin characteristic to create the HEC-HMS project. Using HEC-GeoHMS, Discharge and daily rainfall input the model parameter, assign the flood period date and base flow level to generate the model. As a result, 10 days period simulation of flood situation result is each day inflow and reaches of day the each basin. Conclusion and recommendation of this paper are before flooding, using the 10 days period flood situation alert all subbasin area, proper assessments and flood control measures to prepare for the next flood disaster and flood effect villages of 26 villages (within 13 Sub-basin area) are accurate flood extent and depths are essential for proper flood management.

Key Words: SRTM DEM, Flood Mapping, CN grid, HEC-GeoHMS

INTRODUCTION
Flood is one of the most frequent, pervasive and devastating natural hazards in the world now-a-days, particularly, densely populated regions of South Asia. One of the major challenges during flood is to get an overall view of the incident with accurate extent of the affected area and, to predict the possible developments. Using traditional methods such as ground survey and aerial observation, flood mapping is time consuming, expensive and need to be involved skilled persons. Flooding is one of the major hazards in Myanmar causing damage and losses to lives and properties. Bago River is located in the southern Myanmar. It flows through Bago Region and Yangon Region. It originates in the hills of the Pegu Range and flows into the Myitmaka River which below that point is called the Yangon River. The heavy rain and floods that began in July, 2018 continue to affect thousands of people in Myanmar. Recent monsoon downpours have caused significant flooding across Myanmar, displacing more than 150,000 people, according to the country's Disaster Management Department, in July and August, 2018. Around 12,000 hectares (30,000 acres) of farmland has been damaged or destroyed country wide by flooding, according to the Myanmar government. In this study, flood hazard assessment for the Bago river basin was
performed. The flood inundation map of the Bago river basin was developed by coupling a hydrological and hydraulic model with Geographic Information Systems.

AIM
Assessment on Flood Mapping in Bago River Basin in Myanmar Using HEC-Geo HMS

OBJECTIVES
- To validate the simulated assessment flood in the Bago River
- To estimate the peak flood period using the Geo-HMS model

STUDY AREA
Bago river basin is located in Bago Region in Myanmar and total area is 2279.816 sq.km. Main river have about 331.5 km long, lying between longitudes 95°53'30"E and 96°43'30"E and between latitudes 16°43'15" N and 18°26'17" N in lower Myanmar. Bago River originates from the middle mountainous region named Bago Yoma and the large portion of the river itself is within the Bago Township in Bago Region. A small portion of the river (the outlet) is in Yangon Region where Bago River two joins the Yangon River enters the Gulf of Mottama. The Bago River is one of the most important and useful river basins in lower Myanmar for hydropower generation, irrigation, fisheries and navigation use. It is a flood-prone area in Myanmar. In 2018, two severe floods occurred in the Bago river basin in July and August. Considering rapid urbanization and climate change, flood risk considered to increase in the basin.

DATA AND METHODS

DATA USED
For flood water mapping and analysis of the propagation of terrain data from Digital Elevation Model SRTM DEM (30 Meter Resolution) of the Bago River area and Sentinel Image was used. Rainfall data derived from the Meteorological and hydrological data provided by the Department of Meteorology and Hydrology (DMH). Discharge developed by the Irrigation and Water Utilization Department (IWUMD), outflow data at Zaungtu dam provided by the Department of Hydropower Implementation (DHPI). Some field data such as cross check of flooded area and extent and data obtained by Global Positioning System (GPS) were also used.

METHODS
The overall methodology of this study is shown in Figure 2. The methodology involved image processing, creation of flood maps and analysis of flood water propagation. From the digital Elevation Model SRTM DEM (30 Meter Resolution) of the Bago River area calculated the stream networks and subbasins. Utilized the land use and landcover data and soil data are create to generate the CN grid value and then combined the CN grid value and basin characteristic to create the HEC-HMS project. Using HEC-GeoHMS, Discharge and daily rainfall input the model parameter, assign the flood period date and base flow level to generate the model.

![Figure 1. Location of the Bago River Basin Source: Topographic Map (1:50000) and Basin Boundary from result](image1)

![Figure 2. Flowchart of Methodology](image2)
RESULT
In this analysis, combine with the data of landuse, soil, hydro DEM and CN lookup table extract to the creation of the CN grid. Hydro DEM, flow direction, flow accumulation, stream and catchment data derived from the raw SRTM Dem data. Daily rainfall data and terrain processing data input the HEC-Geo HMS Model those data assign the flood period days. As a result, 10- day period simulation of flood situation result is each day inflow and reaches of the day the each basin shown in table 1, figure 4 and 5.

Table.1. Result of 10 - day period simulation of flood situation of each basin

<table>
<thead>
<tr>
<th>Sub-basin</th>
<th>Drainage Area (Sq-Km)</th>
<th>Peak Discharge(M3/s)</th>
<th>Time of Peak</th>
<th>Volume(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W140</td>
<td>247.28</td>
<td>121.8</td>
<td>26Jul2018</td>
<td>174.56</td>
</tr>
<tr>
<td>W150</td>
<td>121.53</td>
<td>41.3</td>
<td>26Jul2018</td>
<td>129.89</td>
</tr>
<tr>
<td>W160</td>
<td>103.23</td>
<td>54.1</td>
<td>26Jul2018</td>
<td>181.02</td>
</tr>
<tr>
<td>W170</td>
<td>149.34</td>
<td>77.7</td>
<td>26Jul2018</td>
<td>180.37</td>
</tr>
<tr>
<td>W180</td>
<td>312.5</td>
<td>234.9</td>
<td>26Jul2018</td>
<td>263.64</td>
</tr>
<tr>
<td>W190</td>
<td>128.86</td>
<td>96.9</td>
<td>26Jul2018</td>
<td>263.73</td>
</tr>
<tr>
<td>W200</td>
<td>183.2</td>
<td>121.7</td>
<td>30Jul2018</td>
<td>307.38</td>
</tr>
<tr>
<td>W210</td>
<td>57.326</td>
<td>42</td>
<td>26Jul2018</td>
<td>260.1</td>
</tr>
<tr>
<td>W220</td>
<td>226.15</td>
<td>282.3</td>
<td>30Jul2018</td>
<td>327.74</td>
</tr>
<tr>
<td>W230</td>
<td>138.26</td>
<td>145.3</td>
<td>30Jul2018</td>
<td>401.55</td>
</tr>
<tr>
<td>W240</td>
<td>175.01</td>
<td>145.7</td>
<td>30Jul2018</td>
<td>295.48</td>
</tr>
<tr>
<td>W250</td>
<td>174.98</td>
<td>271.2</td>
<td>30Jul2018</td>
<td>386.44</td>
</tr>
<tr>
<td>W260</td>
<td>262.15</td>
<td>176.7</td>
<td>31Jul2018</td>
<td>202.06</td>
</tr>
</tbody>
</table>

Source: Based on Calculated the HEC-Geo HMS

Figure.3. Main River, Slope, Sub-basin, sink, outlet, CN Grid, Slope and Landuse of Bago River basin
Source: Based on Calculated the HEC-Geo HMS

Figure.4. Result of flood conditions the Gauge Station
Source: Based on result

Date: Inflow(M3/s)
23-Jul-18 151
24-Jul-18 151
25-Jul-18 254
26-Jul-18 852.1
27-Jul-18 610.9
28-Jul-18 568.7
29-Jul-18 482.3
30-Jul-18 875
31-Jul-18 572
1-Aug-18 776.4
Figure 5. Result of flood conditions the Main Outlet
Source: Based on result

<table>
<thead>
<tr>
<th>Date</th>
<th>Inflow (M3/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23-Jul-18</td>
<td>182.7</td>
</tr>
<tr>
<td>24-Jul-18</td>
<td>182.7</td>
</tr>
<tr>
<td>25-Jul-18</td>
<td>284.6</td>
</tr>
<tr>
<td>26-Jul-18</td>
<td>934.8</td>
</tr>
<tr>
<td>27-Jul-18</td>
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<td>28-Jul-18</td>
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<td>29-Jul-18</td>
<td>657.1</td>
</tr>
<tr>
<td>30-Jul-18</td>
<td>1254.5</td>
</tr>
<tr>
<td>31-Jul-18</td>
<td>810.6</td>
</tr>
<tr>
<td>1-Aug-18</td>
<td>947.9</td>
</tr>
</tbody>
</table>

Figure 6. Graph of the Precipitation, Precipitation loss, Outflow and base flow of (13) sub-basin
Source: Result of flood model

In result table, time of peak period was 30th July 2018 and high volume was 401.55 (mm) of sub-basin number W230. It is the west part of the basin. The second largest volume of sub-basin number W250 basin was the 386.44 (mm) and time of peak as the 30th July 2018. The third one was the sub-basin number W220 of the 327.74 (mm) and time of peak was the 30th July 2018.

Figure 7. Flood Period of Sentinel Image (30th July, 2018) and effect flooded villages area
Source: Sentinel Image, July 30th 2018)
CONCLUSION
In this research, the inflow rate is 1254.5M$^3$/S in 2018 30th July, at the time significant flooding caused across Myanmar, killing at least 16 people and displacing of houses and people. The number of deaths and those displaced - higher as flooding - delayed the arrival of rescue teams to some of the most impacted areas. In the hard-hit region of Bago, around 70 schools have been forced to close during the recent flooding. As this result, before flooding, using the 10 days period flood situation alert all subbasin area, proper assessments and flood control measures to prepare for the next flood disaster. In 2018 30th July Bago river flood is highest within 54 year (DWIR) Department of Water Resources and Improvement of River System. The estimate of effect villages are 26 villages (within 13 Sub-basin areas). Estimated flood villages are Zaung Tu, Ma Gyi Khon, Wet Kya, Kyet Lel Sit, Let Pan, Aing Gyi Daunt, Aung Mya, Taik Gyi, Dawei, Zee Taw, Thea Hpyu, Oke Hpo, Shwe Laung, Chin Su, Ta Mar Pin, Nat Set, Hman Taw Kwin, Kan Myint, Thit Seint Kone, Ah Seik Taung, Aung Myay Sun, Ku Taung, Kyaung Lone Gyi, War Paing, Chaung Wa and Win Kaik Sho in Bago Township. The accurate flood extent and depths are essential for proper flood management. The flood mapping of the Bago river basin was developed by coupling hydrological and hydraulic model with GIS as HEC-GeoHMS. Further study should be performed on a comprehensive integrated approach by considering tidal effects of Bago–Sittaung canal.

ACKNOWLEDGMENT
We would like to express our thanks to Dr Aye Aye Tun, Rector, Bago University for her permission and advice. And then our thanks are also due to Dr Yin Yin Than, Pro-Rector, Bago University for her encouragement and suggestion. I also thanks to Dr Min Aung Pan, Professor, Department of Geography, Bago University and Dr Mar Mar Khin, Professor, Department of Geography, Bago University for their suggestion. Moreover, we are greatly thanks to Mr. Chandra Mohan Bhatt, Course Director (RS&GIS), India Institute of Remote Sensing (IIRS), Center for Space Science and Technology Education in Asia and The Pacific (CSSTEAP), India and local people in Bago Region and all teachers of Geography Department, Bago University for their help to get the data and conducted field survey.

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A Study of Research Methodology in Philosophy

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Abstract - The aim of research is to prove that Socratic Method can be considered as the origin of qualitative research methodology used in today's academic society. The research problem is that why the proper understanding of Socratic Method is worthwhile for progression of qualitative research methodology. The descriptive and evaluative methods are used to achieve the aim of research. The research finding would be highlighted on the saying of Socrates that 'unexamined life is not worth living'. Human beings have always had a thirst for knowledge to make the world a better place and to make life better. In this respect, Socratic Method leads someone who pursues his or her goals of life to seek out the appropriate ways with its primary conception of 'only examined life is worth living' which is very near to the today's well known conception of 'lifelong learning'. His method of searching truth is primarily based on 'taking balance between observation or experiment and rationality or critical evaluation' that is the very foundation stone of qualitative research methodology. Nowadays there are many diverse issues in Myanmar such as political, economic, educational and so forth like other countries around the world since the advancement of science and technology. Hence, the policy makers and the peoples who accomplish their tasks have to understand the primary causes of those issues and need to find out most suitable ways. Accordingly, qualitative researches which can bridge different disciplines or organizations play a prominent role in today's societies. At this point, getting the proper understanding and applying Socratic Method should be considered as an important contribution for cultivating research culture in solving those problems.

Key words - Socratic Method, Qualitative Research Methodology, Quantitative Research Methodology

I. Introduction

Research in general terms is the unending quest for knowledge. The spirit of research is as old as the human spirit. Human beings always have a thirst for knowledge, of the world around them, of their origins, of why natural process happens and of how they can overcome it, have been generated life of living beings, and so forth. And thus human beings have asked questions such as -What is the nature of the world? How did it come into being? How did life originate or where did living beings come from? and so forth since primitive times.

Firstly they tried to find out the answers to those questions with mythical and supernatural explanations. Their answers may be false and their methods may be wrong but even primitive mankind was also in search of knowledge with earnest sense of curiosity and visualizations. The questions they asked have being handed over from generation to generation throughout the ages of human history for surviving or overcoming natural and social environments to make life better.

It is undeniable fact that human beings have always been in search of 'Knowledge and Truth' to make life better unlike other living beings. Ancient humans had a boundless curiosity about the world around; the sun, the moon and the stars above as well as the oceans, the mountains and the natural phenomena on the planet earth. They wondered about the origins of living beings including human beings, to know how to relate to each other and to live together peacefully in each community as well as among communities. In other words they were in search of knowledge for their survival to be alive and progress to be civilized societies.

In ancient times, therefore, mythological explanations were given to settle all arguments on the causes of natural phenomena and to moral, social and religious issues. Appeal was made to ancient stories and the testimony of authoritative persons. There were no reasoned arguments and no attempt was made to look for the causes of natural events in Nature scientifically.

It was only when Philosophy or philosophical thinking began that human beings began to look into Nature itself for the causes of natural events, and reasoning based on observation and experience replaced mythological thinking. The ancient Greeks through observation and vigorous reasoning supplemented with keen insight put forward various hypotheses and theories that foreshadowed many theories of modern science. But though they may have had keen observation and the explanations given were rational they lacked observational and experimental tools such as telescopes, microscopes and other instruments of measurement.

Thus, even if their ways of thinking could be considered as scientific and rational rather than mere mythological speculation, yet they had lacked the means to gather concrete evidence to back up their theories.

II. The Definition and Subfields of Philosophy

"Philosophy" literally means "love of wisdom". It is derive from two Greek words "Philein" and "Sophia", which mean "to love" and
"wisdom" respectively. Wisdom does not mean just knowledge of facts. In fact, wisdom is more than accumulated knowledge. It consists of insight, soundness of perspective, and balance and proportion in judgment.

The Myanmar term for philosophy is "哲学" which is derived from the Pali word "darsana" that means "vision of truth". According to the tradition of Eastern philosophy, philosophy is an attempt to reach a vision of truth and thereby lead a good and pure life in order to attain 'liberation'. Although the literal meanings of the two terms, "philosophy" and "darsana" are different, there are similarities in both views. For philosophy, the east or the west is not mere search for factual knowledge of external world, but a quest of wisdom in order to live a good life by getting knowledge of intrinsic values of all things in the world even if in nature of culture.

According to L.W. Beck, understanding of what philosophy is does not come easily. Philosophy cannot be summarized in a few words. Actually, philosophy is not a term which can be easily defined. Philosopher throughout the ages has proposed many different definitions of philosophy.

According to Weber and Perry, philosophy is the search for a comprehensive view of nature; an attempt at a universal explanation of things. It is both the summary of the sciences and their completion, and forms a separate branch among the manifestations of the human mind.

C.E.M. Joad defines philosophy as an attempt to understand life and the universe as a whole.

According to W.P. Montague, philosophy is the attempt to give a reasoned conception of the universe and of man's place in it.

J.A. Leighton says that a complete philosophy includes a world-view, or reasoned conception of the whole cosmos, and a life-view, or doctrine of the values, meanings, and purposes of human life.

These definitions give some important ideas to understand what philosophy is. Nonetheless, there are some general traits that characterize most significant features of philosophy. In general, there are six significant characteristics of philosophy. The first one is that 'philosophy is an attitude or a way of approaching diverse problems rather than a set of beliefs or doctrines'. The second is that 'philosophy is an outgrowth of ordinary reflection'. Thirdly, 'philosophy is a critical analysis and assessment of conceptions and meanings', and then 'philosophy is a free speculation' as the fourth. The fifth characteristic is that 'philosophy is concerned with the decisions about values', and finally the sixth is 'philosophy is synoptic'. At this point, it is clear that 'philosophical method is mainly concerned with 'empirical', ‘analytical’, ‘critical’, ‘rational’, and ‘synthesis’ while it basically rejects dogmatism.

Accordance with its significant characteristics, there are divided into five subfields in Philosophical studies, namely, Metaphysics, Epistemology, Logic, Ethics and the Philosophy of X.

The philosophers who engage in ‘metaphysics’ try to answer the questions about the nature of ultimate reality. This traditional notion of the real has altered somewhat over the centuries, but the questions the metaphysician asks have not: what is everything made of? Is that ultimate stuff really real? What is the origin of the totality that we call the universe? etc. The metaphysician, that philosopher who is interested in the dialectic relating to the ultimately real, wants to know the meaning of basic words like 'real', 'ultimately real', 'soul', 'universe', 'existence', etc.

The philosophers who engage in ‘epistemology’ usually try to seek out the answers of the questions about the nature of knowledge and criteria for knowledge. Philosophers want to know what meaning fundamental words like 'knowledge', 'knowing', 'evidence', belief, 'standard', or 'criteria' have. For getting clear on the meaning of concepts used in the epistemology is just as important for the epistemologist as it was previously for metaphysician.

The philosophers who engage in ‘logic’ focus on the questions about the nature of inference. Logic is in part the study of the rules that allow us to draw inferences and to conclude that those inferences are valid or invalid. Finally, the Logician, that philosopher who is interested in the nature of inference and standards for valid inference, wants to know what meaning key words in his own discipline have - words like “inference”, “valid”, “fallacy”, “logical system”, “formal system”.

The philosophers who engage in ‘ethics’ concern with the questions about nature of human conduct in so far as that conduct is called “right” or “wrong”, "good" or "bad". The moral philosopher wants to know the meaning of the fundamental words employed in the discipline of ethics, words like "human conduct", "right", and "wrong”.

The fifth and final subfield of philosophy is a relatively late development but most relevant to the nature of philosophy as its multidisciplinary character. For that reason, it is named as ‘Philosophy of X’. The word ‘X’ is variable and any disciplines or areas of study can be added in place of X. For example, Philosophy of ‘Art’, ‘Religion’, ‘Science’, ‘History’, ‘Education’, ‘Mathematics’, ‘Sports’, ‘Psychology’, and so forth.
III. Ancient Greek Philosophy

The intellectual movement possessed the distinctive character of philosophy originated in Greece. Philosophy and science are Greek inventions. Among the civilization of the world, the Greek is a late comer. Those of Egypt and Mesopotamia are older than the Greeks. Both Egypt and Babylonia furnished some knowledge which the Greeks later took over, but neither developed science nor philosophy. The knowledge they furnished was practical rather than theoretical. It was concerned with civil engineering irrigation, the construction of the correct calendar and so on. Greek philosophy falls into three periods.

(1) Pre-Socratic period, i.e., the period of the rise of Greek philosophy. (From 624 – 370 BC)
(2) The period from the Sophists to Aristotle or the period when Greek philosophy reached its maturity culminating in the philosophy of Aristotle. (From 464–322 BC)
(3) The period of post-Aristotelian philosophy constitutes the decline and fall of Greek philosophy. (From 360BC –AD 200)

The Pre-Socratic Period includes the philosophy of the Milesians, the Pythagoreans, the Eleatics, Heraclitus, Empedocles, the Atomists and Anaxagoras. The first period of Greek philosophy has for its problem the origin of the world, and the explanation of the being and becoming of nature. The philosophical problems in the first period of Greek thought are the origin of the universe and the explanation of being and Becoming of nature.

But in the second period from the Sophists to Aristotle the problem is the nature and position of man in the universe. The ideas of the early Greek philosophers are cosmological, but in the time of the Sophists the ideas are humanistic. The second period includes the philosophy of the Sophists, Socrates, Plato and Aristotle.

The Sophists made no physical and cosmological speculations. Instead, they taught the people the rhetoric, the art of speaking and politics. The famous Sophist Protagoras said that "Man is the measure of all things". Here he means the individual man, not man-kind. Each individual man is the standard of what is true to himself. According to Protagoras, what is true to me is true and what is true to you is also true. Hence there is no objective truth. Truth is subjective. So the two contradictory propositions may both be true at the same time. He taught that all opinions are true and that error is impossible. For them objective knowledge is impossible. The other Sophist, Gorgias also accepts the impossibility of knowledge. Gorgias proved the three propositions:-

1. That nothing exists.
2. That if anything exists, it cannot be known.
3. That if it can be known, the knowledge of it cannot be communicated.

The later sophists applied the subjective doctrine to the field of morality and accepted that right or wrong and good or bad are only subjective. In this way, the sophists were the first thinkers who said that there is no objective justice in law. They taught that might is right.

IV. The Socratic Method

Socrates, in contrast to the Sophists, tried to prove the possibility of knowledge. He began with ignorance of the truth of the subject under discussion. Socrates said, "Know Thyself". To reach the objective knowledge or universal agreement he used the conversational method, i.e., the method of question and answer. This method is known as dialectic. The main purpose of Socratic Method is to attain universal judgments. Socrates held that sense perception could not give genuine knowledge but mere opinion. Perhaps his most important contribution to Western thought is his dialectic method of inquiry, known as the Socratic Method or method of elenchus, which he largely applied to the examination of key moral concepts such as the virtues of piety, wisdom, temperance, courage and justice etc. Elenchus literally means 'argument of disproof or refutation; cross-examining, testing, scrutiny especially for purpose of refutation'. It is the central technique of the Socratic Method.

There are five serial steps in Socratic Method. These are:
1. Ask a question,
2. Construct a hypothesis,
3. Make the appropriate test to prove the hypothesis,
4. Make the decision whether accept/reject according to the tested results and
5. Do practice or act accordingly.

The fifth step of his method is noteworthy that can lead researcher or observer to apply or practice the reliable outcomes of the research even if it may be temporal truth. This step is very close to the aim of today's researches that focus on the beneficial values of application in societies. Socrates generally applied his method of examination to concepts that seem to lack any concrete definitions. Socrates accepted that the chief goodness consists in the caring of the soul concerned with moral truth and moral understanding, that "wealth does not bring goodness, but goodness brings wealth and every other blessing, both to the individual and to the state", and that "life without examination or dialogue is not worth living". The Socratic Method is a method...
of hypothesis elimination, in that better hypotheses are found by steadily identifying and eliminating those that lead to contradictions. The Socratic Method also searches for general, commonly accepted truths that shape beliefs and scrutinizes them to determine their consistency with other beliefs. His philosophy ends with the conclusion that the certainty of knowledge is impossible in physical science, but only in moral science, i.e., ethics, the certainty of knowledge is possible. Thus Socrates says the statement that ‘virtue is knowledge’.7

V. Research Methodologies Today

Nowadays there are two main kinds of research: Quantitative and Qualitative Research. Both research methods used in the liberal arts and humanities. For instance, philosophy and history are mostly qualitative because of focusing on the analytic, synthesis, and evaluation which are closing connected with concepts and theories. In the qualitative approach, inquiry begins with broad, general questions about the area under investigation. Psychology and economics are mostly quantitative approaches that manipulate variables and control the research setting. Quantitative designs include descriptive research, experimental research, quasi-experimental research, causal comparative research, and correlational research. Most quantitative approaches manipulate variables and control the research setting. Quantitative designs include descriptive research, experimental research, quasi-experimental research, causal comparative research, and correlational research.

There are the basic differences of qualitative research methods and quantitative research methods. These differences are objectives, types of questions asked, types of data collection instruments, forms of data they produce and degree of flexibility. The objectives of the qualitative research method focus on to describe individual experiences and beliefs. On the other hand the objectives of quantitative research method focus on describing the characteristics of a population. The types of questions asked of qualitative research methodology are ‘open ended questions’. On the other hand the types of questions asked of quantitative research methodology are ‘closed ended questions’. Data collection instrument of qualitative research is the use semi-structured methods such as in-depth interviews, focus groups and participant observation. In quantitative research method data collection instrument is the use highly structure methods such as structured observation using questionnaires and surveys. Descriptive data is used in qualitative research method and numerical data is used in quantitative research method. Lastly degree of flexibility of qualitative research method depends on participant responses affect how and which questions researchers asked next. For quantitative research methodology, the degree of flexibility depends on participant responses do not influence or determine how and which questions researchers ask next.8

Both research methods used in the liberal arts and humanities. For instance, philosophy and history are mostly qualitative because of focusing on the analytic, synthesis, and evaluation which are closing connected with concepts and theories. In the qualitative approach, inquiry begins with broad, general questions about the area under investigation. Psychology and economics are mostly quantitative approaches that manipulate variables and control the research setting. Quantitative designs include descriptive research, experimental research, quasi-experimental research, causal comparative research, and correlational research.

Qualitative research methods originate in the social and behavioral sciences. Today the world is more complicated and it is difficult to understand what people think and perceive. Qualitative research methods make it easier to understand that as it is more communicative and descriptive. Researchers seek a holistic picture—a comprehensive and complete understanding of the phenomena they are studying. They go into field to collect data. They make observations, conduct in depth, open-ended interviews; or look at written documents. Rather than numbers, the data are words that describe people's knowledge, opinions, perceptions, and feelings as well as detailed descriptions of people's actions, behaviors, activities, and interpersonal interactions.

Qualitative research may also focus on organizational processes. In other words, qualitative researches look at the essential character or nature of something, not the quantity such as how much, how many etc. This approach is sometimes called naturalistic inquiry because the research is conducted in real-world settings; no attempt is made to manipulate the environment.

VI. Conclusion

The aim of research is to prove that Socratic Method can be considered as the origin of qualitative research methodology used in today’s academic society. In the structure of using the Socratic Method, the first step is focus on a common sense statement. The second step is to find out an exception to that statement. In the third step is that to reject the statement if an exception is found. Then the respondent reformulates the statement to account for the exception is the fourth step. Finally the fifth step is to keep repeating the process until a statement cannot be overturned. In accordance with applying Socratic Method in doing research, one may become deep curiosity and self-improvement. 9The research finding would be highlighted on the saying of Socrates that ‘unexamined life is not worth living’. Human beings have always had a thirst for knowledge to make the world a better place and to make life better. In this respect, Socratic Method leads someone who pursues his or her goals of life to seek out the appropriate ways with its primary
conception of ‘only examined life is worth living’ which is very near to the today’s well known conception of ‘lifelong learning’. His method of searching truth is primarily based on ‘taking balance between observation or experiment and rationality or critical evaluation’ that is the very foundation stone of qualitative research methodology. Nowadays there are many diverse issues in Myanmar such as political, economic, educational and so forth like other countries around the world since the advancement of science and technology. Hence, the policy makers and the peoples who accomplish their tasks have to understand the primary causes of those issues and need to find out most suitable ways. Accordingly, qualitative researches which can bridge different disciplines or organizations play a prominent role in today’s societies. At this point, getting the proper understanding and applying Socratic Method should be considered as an important contribution for cultivating research culture in solving those problems.

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