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FOREWORD

The Myanmar Academy of Arts and Science (MAAS) was constituted on August-16, 1999 with four major fields of endeavour, namely:

(a) Introduction to Modern Methods of Teaching and Learning
(b) Promotion of Research Activities through Research Guidelines
(c) Dissemination of Knowledge and Emerging Technologies
(d) Motivating New Generation of Experts and Academics

In pursuance of these endeavours, MAAS has, since the year 2001, held Research Conferences and published research papers in the Journal of the Myanmar Academy of Arts and Science.

At the Research Conference held on 19-21 December 2022, a total of (223) research papers were read and outstanding papers have been published in volume XXI as follows:

Vol. XXI, No.1	Chemistry, Industrial Chemistry
Vol. XXI, No.2	Physics, Mathematics and Computer Studies
Vol. XXI, No.3	Zoology, Botany, Marine Science
Vol. XXI, No.4	Myanmar, Oriental Studies, Archaeology, Anthropology and Library and Information Studies
Vol. XXI, No.5	Geography, History, International Relation, Geology, Statistics, Management Studies, Law, Journalism
Vol. XXI, No.6	Educational Theory and Management, Curriculum and Methodology
Vol. XXI, No.7	Educational Psychology

The executive committee members of Myanmar Academy of Arts and Science had been reconstituted on 4 August 2022 and again reconstituted on 8 March 2024, by the Ministry of Education with the Approval of the Government of the Union of Myanmar. Accordingly, the Publication Committee along with the Editorial Board have been formed. The primary mission of the academy is to develop and promote Higher Education in preparing future generations to meet the challenges in the 21st century.

The majority of the papers in these issues represent findings of research conducted by aspirants as well as postgraduate candidates in partial or total fulfillment of requirement for these degrees. We, the members of MAAS, do appreciate the editing work done by senior professors and scholars of high standing, these papers would prove useful, and not only for other candidates but also for all those who are interested in the results of systematic research and inquiry. Due to the outbreak of covid-19 pandemic; unfortunately, a delay in the date of publication had occurred.

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President
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IMPACTS OF THE COVID-19 PANDEMIC ON THE INFORMAL ECONOMY IN NAY PYI TAW, MYANMAR*

Thaw Tar Htet Het Paing[1] and Frauke Kraas[2]

Abstract

The informal economy is one of the crucial parts of a country's economy because of its essential role for the income generation of a large number of people. Developing and Least Developed Countries are to a substantial degree depending on the informal sector. During the Covid-19 pandemic the informal sector was much affected by lockdowns and restrictions in public and private spaces, including markets and restaurants. They had a significant impact on the lives of informal workers as a particularly vulnerable group of population. This study explores, based on international and national literature, the economic impacts of the Covid-19 pandemic on the street vendors and informal workers in Nay Pyi Taw, capital of Myanmar. It further develops suggestions for possible support to ease the situation of the local people and their livelihoods.

Keywords: Informal workers, informal economy, street vendors, Covid-19 pandemic, Nay Pyi Taw, Myanmar

Introduction: The Covid-19 Pandemic and Its Impacts on the Informal Economy

The world's societies have been affected severely by the Covid-19 pandemic since 2019, and its impacts hit very diversely individuals and communities. Myanmar first recorded a case of Covid-19 on 23rd March 2020. The Ministry of Health and Sport as focal Ministry for Covid-19 prevention and recovery plan launched rules and regulations, e.g., for travel restrictions, information on quarantine guidelines, supervision in Covid-19-related precaution measure including the stay at home policies, lockdowns and semi-lockdowns and domestic restrictions during the Covid-19 crisis. Moreover, the Ministry of Social Welfare, Relief and Resettlement collaborated and cooperated with different humanitarian organizations. The Ministry of Labour, Immigration and Population tried to organize the return of thousands of migrant workers working in neighboring countries (CERP, Myanmar).

Support and preventive measures to stabilise the economies in general and to protect especially the informal economies were initiated in many countries of the world, including in Myanmar. Here, like in other countries, many places like schools, workplaces and border areas were closed in order to prevent the spread of Covid-19 virus. According to the International Labour Organization (ILO 2020), about 1.6 billion workers in the informal sector had been directly impacted by the Covid-19 pandemic, facing estimates declines of their earnings to about 60%. About two billion workers and business owners of the informal sector worldwide had to stop their work or to work remotely from their homes.

Informal Economy: Definition and Concept

After the concept of the informal sector was introduced in the 1970s (Hart 1973) to describe the quickly growing urban poverty and survival economies in developing countries (e.g., micro-entrepreneurs, street food vendors, waste collectors), soon its scientific understanding and conceptual framing started to diversify. The term was introduced especially by the International

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* Best Paper Award Winning Paper in Geography (2022)

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Labour Organisation (ILO 1972). At first, it was used exclusively for (non-registered) economic activities (Sterly 2019). At that time the informal sector was understood to be fundamentally different from the formal sector, which consisted of state-registered and -legitimised businesses. Typical characteristics included its "ease of entry, reliance on traditional resources, small scale operations, labour-intensive and adapted technology, skills acquired outside the formal school system, and unregulated and competitive markets" (Sterly 2019: 149, referring to ILO 1972). Characteristic for the informal employment, family workers and other self-employed persons are that employees enjoy hardly any form of social and legal protection, predictable employment opportunities, housing subsidies, health support or pension. After the informal sector was first conceived of as problematic, it was later acknowledged as creating employment and generating income (Sethuraman 1981). Such a narrow understanding of two separate sectors which was dominant in the 1980s and 1990s, was extended to a perspective that underlined how closely coupled and connected the formal and informal parts of the economy are (Castells/Portes 1989). It became more and more obvious how intertwined both sectors in reality are. For instance, (informally) occupied employees without legal contracts can work in formally registered companies. Or production steps from larger, formal enterprises can be outsourced to smaller, informally organised units. Essential mutual dependencies and relationships, e.g. between international textile groups and their employees or suppliers, are often highlighted. Such dichotomies typical for scientific discussions in the past have meanwhile broadened, and also the previous pure economic focus was widened thematically, e.g. nowadays including further socio-economic, political or cultural entities. Also, beyond a poverty perspective, the enormous contributions of the informal sector to not only to the national economy, but particularly for securing the income generation of low-income and less educated people can hardly be underestimated. The ‘informality-formality continuum’ (Roy 005: 148), the ‘degrees of complementary and supplementary informalities’ (Altrock 2012: 176 f.) or the ‘co-production by formal and informal actors’ (Mitlin 2008: 14) are nowadays acknowledged (Sterly 2019).

In developing countries six out of every ten workers are on average absorbed by informal economy, putting the informal sector in a crucial role of the aggregated economy (Koff 2007, Dimas 2008). This underlines that larger parts of the national GDP is generated in the informal economy in developing countries. Additionally, the informal economy is not easy to measure, thus its contributions to value added, output and employment, etc. can mostly only indirectly estimated. Furthermore, the informal sector is just only one part of much wider, multiple forms, ways and dynamics of informality (Kraas et al. 2019).

Nay Pyi Taw – Capital of Myanmar: Urban planning and layout

According to the records of the Department of Urban and Housing Development (DUHD), the Myanmar government planned a special administrative city project in the middle part of Myanmar near Lewe and Pyinmana Townships in 2001. Sufficient land for the new city was acquired in July 2003. The earliest master plan included housing for about 5,000 inhabitants and its relevant socio-economic infrastructure (DUHD 2022). In 2003, ten ministries and larger housing projects were established, which were later, in 2008, increased to 55 ministerial buildings.

Nay Pyi Taw became capital and Union Territory of Myanmar in 2005, consisting of five newly built townships, namely Dekhina Thiri, Pobpa Thiri, Uttara Thiri, Zabu Thiri and Zeyar Thiri and three old urban core areas which formerly belonged to Mandalay Region, namely

Lewe, Pyinmana and Tatkone. Here, since generations, urban development took place within the context of the old connecting road between Yangon and Mandalay. In these traditional cores, formal and informal housing complexes and diversified economic activities are complementing each other, providing shelter and essential work opportunities for the people.

As Nay Pyi Taw is located in a very convenient strategic location in the middle part of Myanmar, it was equipped with good transport infrastructure, such as a main railway line and station, an international airport and a national bus terminal. Moreover, it is well connected via intra-regional transportation networks. A 1,000-bedded General Hospital, the Myanmar News and Television Center, a large Convention Centre, a sports stadium and adjacent facilities of international standard were constructed in and after 2007. In 2019, already a total of 798,142 inhabitants were living in Nay Pyi Taw (DoP 2022), mostly public servants. Most of the people are living in civic buildings and government staff quarters. Moreover, the government implemented 3,000 affordable housing units in Nay Pyi Taw which are finished to about 70%. Recently, the implementation of a National State Academy (NSA) Project with a National Comprehensive University and an International Comprehensive University was launched. The Ministry of Science and Technology announced that students passing the Matriculation Examination in 2022 can apply for admission to the University of Technology in Nay Pyi Taw. From the beginning onwards, Nay Pyi Taw was constructed based on internationally-oriented plans with a clear layout (Fig. 1). Recently also, an integrated comprehensive plan for Nay Pyi Taw's sustainable development vision 2040 was published, following the vison for the city to be "green, intelligent and smart".

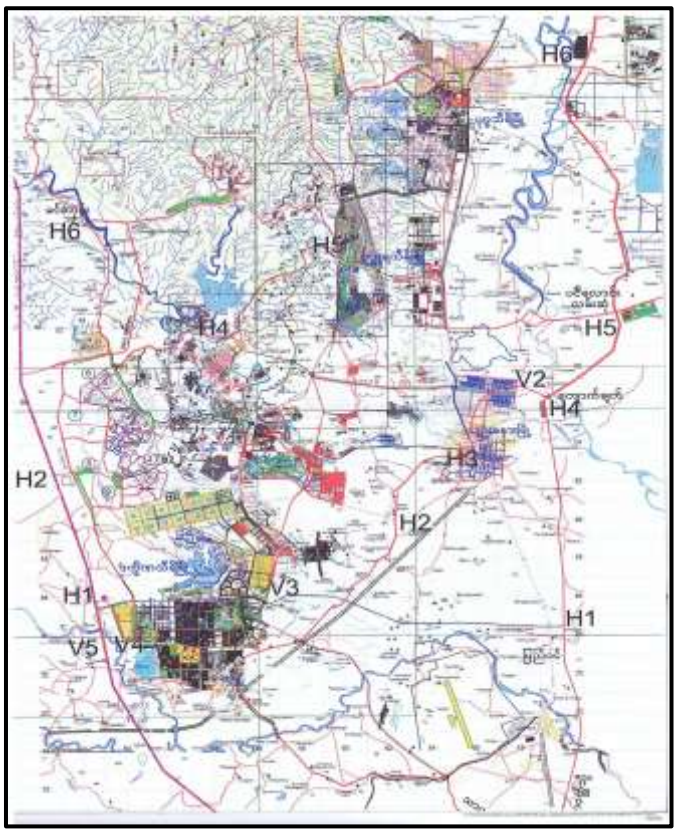

Figure. 1: The Layout Development Plan of Nay Pyi Taw
Source: Department of Urban and Housing Development, Ministry of Construction

Aims and Research Questions

Against the background of its special history as planned national capital – with substantial population in the old urban cores – the article aims at investigating in which way and to what extent informal housing and the informal sector were challenged by the Covid-19 pandemic and and what kind of impacts of the Covid-19 pandemic can be found on the informal sector in Nay Pyi Taw. Based on the findings, suggestions for possible support to ease the situation of the local people and their livelihoods are developed. The guiding research questions are:

1. What role do informal settlements and the informal economy play in Nay Pyi Taw?
2. What are the main impacts of the Covid-19 pandemic on Nay Pyi Taw‘s informal economy and how has it changed?
3. Which suggestions and recommendations can be derived from the findings to ease the situation for the local people?

Material and Methods

The research is based, first, on a systematic literature study of recent national and international publications on informality, informal economy, urban street vendors and the impacts of the Covid-19 pandemic on urban informal economies. Second, available statistical data from the national and local administration on informal settlements, labour force and informal economy in Myanmar and in Nay Pyi Taw were collected and analysed. Third and predominantly, a qualitative approach using field observation, unsystematic talks and in-depth interviews in Nay Pyi Taw was applied in order to understand and evaluate the complex impacts of the Covid-19 pandemic on the informal settlements and economy. Here, knowledge, perceptions and evaluations of the local people on the impacts of the Covid-19 pandemic on the informal economy were collected. The cross-sectional qualitative survey was conducted between 1st June and 15th August 2022 with a survey and in total 25 in-depth interviews. Twenty interviews, all in Myanmar language, were made with informal workers and street vendors and five with urban experts (three with officers from the Nay Pyi Taw City Development Committee (NCDC), two from government residents in Nay Pyi Taw). During the interviews, careful note-taking, based on questionnaire forms, documented key statements were first compiled in Myanmar language, then translated into English. Quotes of interviewees are, as international standard, presented in an anonymized way, using abbreviations to distinguish the backgrounds of the interviewees, namely: “AO” indicates interviews with officers, “GR” with residents from government buildings, “SV” with street vendors and “IW” with informal workers. The interviews contained two parts, a) with general and related survey questions and b) with in-depth interview questions related to the research topic of the study. During the interview processes, the author used note taking that helped to remember the information and important data.

The quantitative questionnaire and qualitative guiding questions were developed based on literature and anchored in the conceptual framework of the study. The questionnaire includes five thematic parts (with altogether 44 questions), including demographic characteristic of the residents or migrants, reason for migration, expenditure of the informal workers and households, housing and living conditions and the impact of Covid-19 pandemic for informal workers. The

qualitative interviews were numbered with cipher numbers and codes (indicated with abbreviations behind statements and quotes).

Results and Findings

Informal Settlements in Nay Pyi Taw

According to an expert interview (AO.02), over 1,700 households in Nay Pyi Taw were living in informal settlements in 2020. Due to its rapid urbanisation, the fastly growing capital of Nay Pyi Taw on plenty of available land offers vast work opportunities, especially for street vending and transportation. Thus, Nay Pyi Taw is among one of the most attractive cities for migrants since its construction started in about 2003 (DUHD 2022). The informal settlements can mainly be found behind government housing units and near hostels. About 30 per cent of the migrants in the five new townships migrated there from the old three townships; they now often live in rented housing. Nearly 70 per cent of the migrants came from other states and regions. Currently, many more migrants from some of the conflict-affected areas moved to Nay Pyi Taw during 2021-2022 in order to seek opportunities for their livelihoods.

Labour and Employment in Myanmar

In the fiscal year 2019-2000, over 1,081 thousand persons were registered in 91 Labour Exchange Offices of the Department of Labour from different townships across Myanmar, including 18 in the Yangon branches and 73 in the other states and regional branches (MMSIS 2023). The characteristics of the labour force in 2019 can be summarised as follows (Table. 1): The composition of labour force in 2019 shows a clear concentration in the agriculture and agricultural procession sectors, followed by the construction sector and then the industry and services sectors. Myanmar still has a strong agricultural economy, with most of the people are living in rural areas and working in the agricultural sector. During the Covid-19 pandemic and the currently country's situation, people form rural and agricultural communities are facing disadvantages because of limited labour exchange, transportation barriers and high inflation rates.

Table 1: **Labour Force Participation Rate, Unemployment Rate, Composite Rate Labour Underutilization and Employment to Population Ratio by Age Group**

Age Group	Labor Force Participation Rate	Unemployment Rate	Composite Rate of Labor Underutilization	Employment to Population Ratio
15-19	25.8	1.9	9.1	25.3
20-24	67.8	1.2	5.4	67.0
25-29	79.4	0.6	3.6	78.9
30-34	77.8	0.3	2.8	77.6
35-39	76.6	0.2	2.7	76.5
40-44	74.7	0.1	2.5	74.7
45-49	71.3	0.2	2.5	71.2
50-54	65.9	0.1	2.1	65.8

Age Group	Labor Force Participation Rate	Unemployment Rate	Composite Rate of Labor Underutilization	Employment to Population Ratio
55-59	57.9	0.2	1.9	57.8
60-64	37.3	0.1	1.7	37.3
65*	13.8	0.2	1.5	13.7
Youth (15-24)	**45.7**	**1.4**	**6.5**	**45.1**
Working Age Population				
(15+)	**59.4**	**0.5**	**3.3**	**59.1**

Source: Annual Labor Force Survey 2019 (Myanmar Statistical Yearbook 2021; MMSIS 2023)

Informal Economy in Myanmar

According to data from the World Bank, Myanmar has 54.8 million people with a median age of 27.1 years. Life expectancy at birth is at 64.7 and 28.6 % of the population are children of 0-14 years, 65.6 % are working group people with an average age of 15 to 64 years (all data: 2021; World Bank n.d.). Because of this age composition, coupled with low proportions in the industry, many, especially young people, have limited access to the labour market. Two key events within the last 15 years triggered accelerated migration dynamics which were also affecting Nay Pyi Taw substantially, namely the Cycle Nargis disaster and the Covid-19 pandemic.

Myanmar as one of the most disaster-affected countries, is exposed to multiple types of hazards, including cyclones, earthquakes, flooding, landslides and droughts. After Cyclone Nargis hit in 2008, hundreds of thousands of the disaster-effected people moved as migrants to the urban areas of Yangon and vicinity, especially to the industrial areas of Hlaing Thar Yar, Shwe Pyi Thar and Dagon Seikkan Townships in search for job opportunities and livelihood. Most found job opportunities in the informal economy. UN-Habitat estimates that nearly 300,000 migrants moved from the Ayeyarwady Region to the area of and around Yangon after Cyclone Nargis.

During the Covid-19 pandemic, 16 large garment factories were closed in Yangon in April 2020 during semi-lockdown and lockdown announcements (Brancati/Minoletti/Riambau 2020). Myanmar's GDP growth rate declined to 0.5 % in 2020. During this time, the workers' wages also changed, for example by measures of reduced overtime hours or performance bonuses. Employers expressed that they were paying a basic salary when the factory closed (ILO 2021). The International Monetary Fund (IMF) estimated a GDP decrease of 17.9 % in the fiscal year 2021 driven by combined economic and other factors.

In Myanmar, nearly 84.7 % of the workers are engaged in the informal economy and 56 % of the workers are self-employed or work in family business (ILO 2021). Many of them moved as migrant workers from, e.g., underdeveloped and remote areas, to more prosperous urban areas, including to Nay Pyi Taw. According to the interviews, different push and pull factors, combined with social reasons meshed. While before 2020 most of the migrants came from Yangon and central Myanmar. This migration accelerated during the period of 2019 to 2022. After 2021 many migrants came from unstable areas because of their livelihoods, health

care, education for their children, social and political security (SV.08). As Nay Pyi Taw offers plenty of land, has very good infrastructural assets and is well connected within the country's transportation networks, attractive factors encourage migrants to come to and live in Nay Pyi Taw. So do the many job opportunities.

The Government of Myanmar (GoM) and Nay Pyi Taw City Development Committee (NCDC) established night markets in Nay Pyi Taw between 2009 and 2013 and accommodated street vendors, but many do not have licenses for street vending. However, the vendors need to obey the market by law. They need to pay daily tax to NCDC (AO.01).

At the beginning of April 2020, GoM introduced domestic restrictions such as stay at home programs, work from home, semi-lockdowns in cities and towns and lockdowns for schools and workplaces including markets. So, Nay Pyi Taw's night markets had to be closed three times during the lockdown periods from September to November 2020, from 1st to 24th May 2021, and from June to November 2021. But all daily markets had been kept open with time limitations, especially shops with essential goods such as food, medicine or purified water. However, NCDC did not permit to keep shops open offering commodities goods. Restaurants were allowed to practice takeaway delivery. NCDC provided handwashing stations with soap and disinfection opportunities which they arranged at the entrances of the markets. They also supported essential information and established points for knowledge sharing of Covid-19 rules and regulations, for instance how to wear and remove masks properly (AO.02).

Figure. 2: Announcement for Myoma Night Market Hours by NCDC. Photo: Thaw Tar

GoM has issued and implemented a comprehensive program named "Overcoming as One: Covid-19 Economic Relief Plan (CERP)" on 27 April 2020. CERP focused on protecting lives, employment and income in Myanmar during the Covid-19 pandemic. It included seven goals and respective strategies: "To improve macroeconomic environment through monetary stimulus; reduce the impact on the private sector through improvements to investment, trade and banking sectors; reduce the impact on labour and workers; reduce the impact on households; promote innovative products and platform; improve healthcare systems strengthening and increase access to Covid-19 response financing (including Contingency Funds)". These goals

were related to improve the macro-economic recovery, reduce taxes and give relief, credit and loan support for small and medium enterprises (SME). In addition, GoM contributed for households and workers such as the provision of up to 150 units for free electric consumption per month. This programme was extended until May 2021 and then finished (Ministry of Planning and Finance 2020). The interviews pointed out that cash and in-kind transfer are more useful and beneficial for households. In the same way, CERP assists a cash transfer to poor households but it is not easy to get this cash distribution. Households without have ID cards and census records cannot apply for the credit. In this point of view, the informal workers need to understand labour rights, rule and regulations. It was demanded that the respective authorities and CSOs should provide adequate knowledge sharing for the informal sector in this respect (GR.02).

During the Covid-19 pandemic, the lockdown and semi-lockdown restrictions including restaurants and food shops affected for food and vegetable vendors as an economically especially vulnerable group – though essential for the food supply of the entire population. It became evident that the customers changed their behaviour in ordering more goods and services online via phone apps and online shops. They also want to reduce their travel time, obey the Covid-19 restriction's regulation, avoid crowded places and enjoy e-commerce. Some consumers were willing to buy food and beverage from online sale markets. Thus, some of the street vendors transformed their businesses to mobile selling and they tried to sell their products, e.g. fruits, vegetables and other goods, to buyers online. Significantly, customers also enjoyed the food ordering process and bought from mobile vendors because it was easy to select based on criteria like fair price, availability, quality and convenience.

Most of the workers lost their employment and income, some received reduced wages (SV.05). So not only they individually but also their families do not have any incomes. Some are jobless and are facing hunger. So, many become street beggars, including women and children. They are willing to get credit or investment opportunities from the government or private sectors but it is not easy to get those for the time being. Very often CSOs and individual donors provide rice, food and clothes. One of the striking advantages in Nay Pyi Taw is the very good situation of health care facilities because the GoM provides public hospitals and clinics – and even workers and vendors can and do frequently visit them. So they can save enormous amounts of money instead of spending it in private health care facilities (Table. 2 and 3: Health care facilities in Nay Pyi Taw).

Due to the lockdown in Nay Pyi Taw, most of the food and vegetable sellers from the night markets and many of the daily wage workers became street vendors during the pandemic. They are now selling their product to customers near hostels, open and public spaces. Many are practicing mobile types of vending with motorcycles, Tuktuks and hand barrows. Many are street vendors for almost three years now but they still have no vending licenses. Many are requesting upgrading of facilities provided, e.g. waste disposal bins and storage facilities near their shops. The reason is that they are living in informal areas so some of their selling products and material are difficult to store and carry (SV.09). Apart from the fact that the lockdown was impacting their livelihoods, they do not want to move to other places as they said that Nay Pyi Taw is very convenient due to very good health care facilities and affordable education for their children. Even though they live in informal settlements they could get medical treatment from public hospitals and clinic. Most of them were fully vaccinated against Covid-19 at the time of the fieldwork.

Figure. 3 Women selling vegetables as significant contribution to the country's economy. Photo: Thaw Tar

In interviews with daily wages workers (e.g. IW.10), it turned out that several people moved with their families from Yangon to Nay Pyi Taw about ten years ago. Many grew up or stayed in informal settlements in Nay Pyi Taw. Many got jobs in the service sector, e.g. as cleaners in ministries first, later applied for better jobs at the same ministry. Many migrants worked hard to improve their qualifications and incomes; their children passed the matriculation exams and want to work in the formal economy. They are realizing the benefits of the formal economy and want to get the same social protection and benefits such as pensions, housing subsidies etc. Many migrants lived in informal settlement first, where the water supply situation is very difficult as is the electricity supply. Many are using solar energy for lighting and receive water supply from the vicinity of monasteries. Many migrants raise worries in respect to the situation of higher education because there are, apart from Yezin Agricultural University, the University of Veterinary Science and the University of Forestry and Environmental Science. There is no art and science universities or colleges of Higher Education yet in Nay Pyi Taw (IW.10).

Some street vendors and workers voluntarily undertook a transition from the formal to the informal economy because of the good income opportunities (IW.02). One person mentioned that he decided to leave his former employment in the formal sector as upper divisional clerk (with an income of 198,000 MMK per month and government-provided housing) before the Covid-19 pandemic. After his transition to the informal economy, his income as self-employed person rose to between 15,000 and 20,000 MMK per day. The costs for rental housing only was 50,000 MMK per month. When the GoM ordered the Covid-19 restrictions and lockdown instructions for all workplaces in April 2020, he started to face problems such as the access to market was very limited for all people due to the travel restrictions. Difficulties to get raw material from suppliers. Also it was difficult to apply for SME loans from the GoM. Sometimes, respondents underlined that they want to participate in the government activities to return to formal jobs.

Housing and Quality of Life

According to an urban expert (AO.03), the quality of life in Nay Pyi Taw is on high level. The environmentally friendly and livable city offers technically up-to-date hard and soft infrastructure, institutions and stakeholder participation as we as an educated clientele with creative, aware and educated mindsets. As Nay Pyi Taw is a safe and less crowded city compared to Yangon and Mandalay, some people bought plots for a second home. Thus with rapid urbanisation, land prices doubled and a lot of land speculation occurred particularly during 2021 and 2022. So, the respective departments need to control and regulate the planning guidelines. Interviewees further mentioned that Nay Pyi Taw recently offers less job opportunities, mostly for street vendors and construction workers. The expert raised the demand that the GoM should undertake further development opportunities for residents as the city already implemented an industrial zones, hotel zones and numerous MICE infrastructures. During the Covid-19 period, some of the construction works and hotel services were closed. Quality of life is also affected by contrasting experiences: GR.01, e.g., mentioned controversies with residents from informal settlements behind their housing units because of insufficient water supply and waste management in the informal settlements. While most of the food vendors can be found there, customers and sellers should be more aware about food hygiene and related issues. Further, serious health worries for the informal settlement areas were raised. Health education was explicitly mentioned in order to lift the general health levels and food safety for their agricultural products.

Consequences of the Covid-19 Pandemic: Potentials and Constraints

Apart from the already mentioned consequences, further specific potentials and constraints because of the consequences of the Covid-19 pandemic were mentioned in the interviews.

Development Potentials

- The pandemic has raised substantially the awareness on the importance of food security for all. As the suppliers tried to promote their products via different online channels and established delivery systems with suitable prices, with emerging supply also job opportunities were created. Likewise, as the suppliers promoted their products or goods as fresh, they became more accessible and affordable for all communities, creating a win-win situation for both sides. But also food ordering patterns slightly changed during the Covid-19 pandemic as many customers changed their behavior from ordering food to preparing food by themselves.
- During the Covid-19 pandemic, gender roles in the work places and processes started to change, as was mentioned several times. Women were able to work more independently and use their skills from home, they can offer self-prepared food and sell it online.

Constraints

- For many residents in informal settlements, it was difficult to get the necessary financial capital for small and medium enterprises (SMEs) (GR.02).
- As the inflation rate increased, partly day by day, adequate access to credit was lacking (GR.02).
- The same held true for adequate investment opportunities (SV.05).
- Due to lockdowns and restrictions the municipal services, especially for informal settlements and informal workers decreased, such as the water supply or the electricity and waste management (IW.10)
- Further, the public transportation system was neglected and has difficulties to rejuvenate – due to limited customers and growing wishes to travel self-independently (IW.02)
- Due to restricted and decreased transportation, street vending had to expand and required suitable space for storage facilities (SV.09)
- Also some interviewees mentioned the raise of domestic violent, especially against women and children in the informal settlements, during the Covid-19 Crisis (IW.09)

Discussion, Suggestions and Recommendations

Based on the field survey and interviews, the following suggestions and recommendations can be made which shall assist and support the people in the informal settlements and the informal sector and can help easing their livelihoods. First, the focus is on general requirements of informal settlements and the informal economy, second on specific needs of street vendors in the informal economy in times of the Covid-19 pandemic.

- The government should consider and decide to equip street vendors with sufficient potable water and electricity supply as well as appropriate drainage and services (according to GR.01).
- NCDC as well as the city's municipal body is one of the responsible institutions for street vending, so NCDC needs to review and monitor the street vending activities in respect to, e.g., food safety, location, time and obstruction to traffic (according to AO.03).
- The authorities and communities need to provide more small business and social support facilities such as suitable market places for street vendors (according to SV.05).
- Capacity enhancement and knowledge sharing for street food safety and food hygienic practice as essential for improved food preparation processes need to be taken into account in order to reduce the danger of food-borne diseases for communities (according to GR.01).
- A proper monitoring of the informal economy is needed. The authorities should listen to the essential needs, different voices or the perspectives of those who are working in the informal sector (according to IW.12).
- The authorities should invite representatives from the informal settlements in order to jointly develop inclusive policies. The representatives from street vendors and informal workers should be encouraged to participate and engage in dialogue discussions with the local government or authorities (according to AO.03).

- Academics and researchers should be encouraged to conduct more surveys and research investigations on and for the informal economy and the informal settlements in order to understand the special needs and to develop adequate responses and concrete suggestions for their social protection, labour rights, training and capacity building for their livelihoods (according to GR.02).
- The informal workers should collaborate and cooperate with the local government, NCDC and the authorities. Active participation and engagement are important for all level of decision-making processes. So, the street vendors, entrepreneurs and informal workers should build good communication bridges between the local authorities and them because this may lead to constructive exchange to reduce burdens in different stages (according to IW.02).
- Street vendors and food sellers should practice food hygiene processes, i.e. they should be aware not only cook, prepare, and store food, but to use safe raw material. Further, waste should be disposed into garbage containers (according to GR.01).
- Both customers and sellers should wear masks and obey the Covid-19 instructions and related policies (according to AO.02)

Conclusion

This study emphasises the impacts of the Covid-19 pandemic on the informal settlements and informal economy using primary data form in-depth interviews and survey conducted (marked as IW, SV, AO and GR) in Nay Pyi Taw. The finding reveal how the informal sector has been affected by the consequences of the Covid-19 pandemic. The impacts, however, show various specific challenges in respect to income and expenditure, working hours, employment status, location and livelihood of the informal sector in Nay Pyi Taw. According to interviewees, the GoM provided some cash transfers to low-income families but there were limitations. Kinds of social assistances (both as cash- and in-kind transfer) are effective tools for a government for a positive intervention during the Covid-19 pandemic. It is possible, however, that the GoM and civil society organisations may need to contribute in cash-based programs and as in-kind programs and tax breaks for short periods. It is also recommendable that the GoM should consider long-term business performance and competitiveness for an adequate private sector participation. Without support to the low-income families and the informal sector increasing poverty due to the Covid-19 pandemic will become widespread. The GoM, local authorities and the private sector should cooperate and, for instance, design vocational training programs that provide technical assistance for market-based training to support the livelihood of people in the informal sector. Such programs should especially be targeted to the youth, to women and people with handicaps and for persons from the informal sector. Furthermore, specific programmes are needed to adequately improve the potentials of the existing hotel zone and the industrial complex. A special street vendor registration scheme could be established throughout the country.

Appendix

Table 2: Public Hospitals in Nay Pyi Taw (2015-2020)

Year	Specialist Hospital		Specialist Services		Others		Station		Total	
	No.	Scheduled Bed	No.	Schedule Bed	No.	Schedule Bed	No.	Schedule Bed	No.	Schedule Bed
2015-2016	4	2,000	5	1,700	7	325	7	112	23	4.137
2016-2017	4	2,000	5	1,700	7	325	7	112112	23	4.137
2017-2018	5	2,050	5	1,700	6	275	7	112	23	4.137
2018-2019	5	2,050	5	1,700	6	275	7	112	23	4.137
2019-2020	5	2,050	5	1,700	6	275	7	112	23	4.137

Source: Department of Medical Services

Table 3: Availability and Utilization of Hospital Resources (absolute, average and percentage value)

Year	Total number of surgical operations	Average number of out-patient per day	Average number of in-patients per day	Average duration of stay (in day)	Percentage of occupancy based on available beds	Percentage of occupancy based on sanctioned beds	Averages turnover of patients per bed per year	Average turnover interval (in days)
2016	20,251	2.115	1.125	5.1	53	44	38	4.4
2017	23,423	2,138	1,154	5.3	545	46	37	4.5
2018	26,027	2,451	1,275	5.5	58	43	39	3.9

Source: Health Management Information System, Department of Public Health

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VEGETABLE CULTIVATION AND PERCEPTION OF VEGETABLE GROWERS IN TWANTAY TOWNSHIP

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Abstract

Twantay Township is located at the urban fringe area of Yangon City. Good accessibility and nearness to Yangon City is a locational advantage for vegetable cultivation in Twantay Township. Existing large agriculture land also supports vegetable cultivation and vegetables such as roselle, water cress, carrot, gourd, etc are extensively grown in the area. Seasonal changes in vegetable cultivation are found due to market demand, climatic favourability, etc. due to short growing period. Although chemical fertilizer use increase vegetable production, it has negative consequences on human health and environmental pollution. Local people also use natural and artificial fertilizers that give less negative impacts on human health and environment. The objectives of the paper are to explicit present vegetable cultivation of Twantay Township, to explore supporting factors on vegetable supply of the study area and to find out vegetable growers' perception on input uses and market demand. Primary data on vegetable cultivation, vegetable supply and vegetable growers' perception were mainly applied and situational analysis was also applied in presenting the paper.

Keywords: vegetable cultivation, accessibility, market demand, investment, net benefit, growers' perception

Introduction

Vegetables have played an important role in local and national food security as well as the national economy (Prodhan et al. 2017). To meet the basic food need of the ever-increasing human population and to get higher seasonal income, vegetables are widely grown. (Bisbis et al. 2018) also wrote vegetables provide maximum output and more income per unit area of land to small-scale farmers, particularly when compared to cereals. World vegetable production has increased for the purpose of meeting the need of the increasing population and there was over a four-fold increase in world vegetable production from 1970 until 2009 (FAO, 2011).

Nutritional guidelines recommend the consumption of at least two servings of fruits and three servings of vegetables per day (World Health Report, 2002) because fruits and vegetables are good for health. In developing countries, people's daily consumption includes vegetables regardless to health knowledge due to low income countries and cheaper cost. People in developing countries eat one or more vegetables as the main dish or side dish for the purpose of saving the consumption cost.

Vegetables can be grown in home garden and in large areas on agriculture land. Although Twantay Township is located in Yangon fringe area possessing large agriculture land, local people grow vegetables year round because paddy cultivation gives low and irregular income. Dung et al, 1997, stated that environmental problems relating to farming and farming practices have become distinct in recent years due to the misuse of chemical fertilizers and pesticides. To get more profit in vegetable cultivation, amount of fertilizer use is more than recommended level. The unsystematic fertilizer use is not sustainable in the long- run and its effects on environment as well as human being.

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To present vegetable cultivation and related accessibility, market demand, impacts of input uses, local growers' perception, etc, Twantay Township was selected as the study area and presented from the geographical point of view.

Study area

Twantay Township is located in the western part of the Yangon Region and it has an area of 724.94 square kilometers (279.90 square miles).

Figure 1: Location of Yangon Region

Source: MIMU

Figure 2: Village Tracts of Twantay Township

Source: MIMU

The urban area comprising 8 wards is only 3.99 square kilometers (1.54 square miles) and the rural area covering 65 village tracts including 235 villages occupies the remaining 720.95 square kilometers (278.36 square miles). Extensive agriculture land of the area support vegetable cultivation and vegetables are mainly sent to Yangon City, major market area, through road transportation and waterway.

Objectives

The objectives of the paper are:

- To explicit present vegetable cultivation of Twantay Township,
- To explore supporting factors on vegetable supply of the study area and
- To find out vegetable growers' perception input uses and market demand

Data and Methodology

To present the paper, primary data such as types of vegetables, price, perception of the growers, pesticide use, types of fertilizer, etc. were collected through semi structured interviews and key informant interviews where the village tracts is accessible as well as phone interviews where the village tracts is inaccessible due to Covid-19 and security. Key informant interviews conducted to understand the vegetable cultivation and production for the purpose of presenting challenges facing vegetable production. Primary data were collected from 15 sample villages and 75 interviewees were selected by using purposive sampling method. Secondary data were also applied to present changes in the area of vegetables. Qualitative and quantitative method was

applied in presenting paper and GIS tools in drawing maps on vegetable cultivation and transportation.

Results and Findings

Twantay Township is located in Yangon fringe area and it possesses large agricultural land that is 47709.65 hectares (65.81% of the township's area). In the study area, *le land* in 2020-21 was 35569.07 hectares and paddy is grown on *le land* in the rainy season and vegetables were grown after harvesting monsoon paddy. *Kaing-kyun Land* area was 474.70 hectares in which gourd, cucumber, pumpkins, tomato and chilli, and *garden land* 11000 hectares covering Roselle, okra, asparagus beans (string bean), snake gourd, winged bean (goa bean), bitter gourd, lettuce, coriander, amaranth, and other vegetables. Nearness to Yangon City, major market, is the locational advantage and good accessibility is a supporting factor for vegetable Cultivation owing to highly perishable products.

Growth of Vegetable Cultivated Area

In the area, two types of vegetables: leaf vegetables and fruit vegetables are mainly grown because of high market demand. Fruit vegetables are mainly grown on *garden land* and leaf vegetables are grown on *le land* after harvesting paddy because they need short growing period.

Table 1: Vegetable Cultivated Area of Twantay Township

	Fruit Vegetables	Leaf Vegetables	Total area (ha)
2010-11	1165.09	930.37	2095.46
2011-12	1167.52	938.87	2106.39
2012-13	1212.84	936.04	2148.88
2013-14	1260.19	953.04	2213.23
2014-15	1331.01	1006.05	2337.06
2015-16	1358.53	1067.97	2426.5
2016-17	1437.85	1095.49	2533.33
2017-18	1511.5	960.32	2471.82
2018-19	1577.06	961.94	2539
2019-20	1613.08	996.74	2609.82
2020-21	1640.19	1017.38	2657.57

Source: Department of Agricultural Land Management Statistics

Area of fruit vegetables cultivating gourd, cucumber, pumpkins, okra and chilli, is larger than leaf vegetables such as roselle, lettuce, spinach, etc. To cultivate fruit vegetables such as long beans, gourd, etc., growers usually built bamboo trellis for the purpose of climbing that cover large area. Therefore, the fruit vegetable cultivated area is larger in Twantay Township.

Vegetable cultivated area generally increased from 2095.46 hectares in 2010 to 2657.57 hectares in 2020. It is due to higher demand of Yangon City, high economic return and better accessibility from the study area to Yangon City.

Fruit Vegetables

Fruit vegetables includes chilli, cucumber, eggplant, long bean, bitter gourd, okra, etc. Among fruit vegetables, area occupied by chilli increased distinctly in the study period. Chilli are less perishable items and it can be stored the whole year round and chilli can be sent to other towns and cities. Moreover, after 2000 Covid-19 pandemic period, chilli from the central dry zone has not been carried to southern Myanmar including Yangon and the price became higher. Therefore, local growers extensively cultivate chilli on *le land*, *kaing-kyun land* as well as *garden land*.

Plate 1: Long bean cultivation

Source: Field Survey

Plate2:BitterGourd cultivation

Source: Field Survey

Plate 3: Gourd cultivation

Source: Field Survey

Leaf Vegetables

Generally, the total leaf vegetables cultivated area increased in the study area although there is fluctuation in the cultivated area of some types of vegetables. Among these vegetables, water cress cultivated area is highly fluctuated and it distinctly increased in 2016-17. Water cress cultivated area is fluctuated and it is related to area of fish pond and price of water cress. Water cress is grown in *le land* as well as fish ponds and water cress cultivated area decreased when the number of fish pond decreased. In the study period, in 2015, price of roselle increased to 200ks per bundle and local growers wanted to grow roselle due to high economic return. Therefore, local growers grow roselle extensively. In that year, price decreased and pest occurrence causes loss and high investment due to high pesticide price. After that, roselle cultivated area decreased in the study area.

Plate 4: Roselle cultivation

Source: Field Survey

Plate 5: Lettuce cultivation

Source: Field Survey

Plate 6: Spinach cultivation

Source: Field Survey

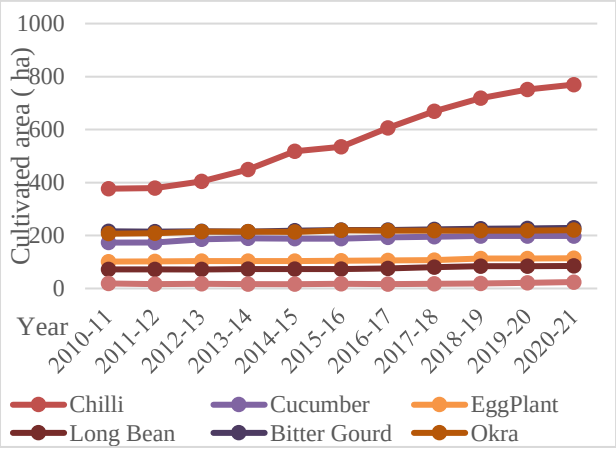

Figure 3: Fruit Vegetable cultivation
Source: Field Survey

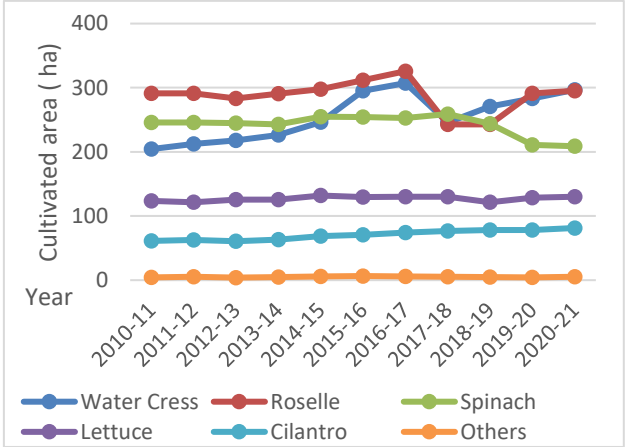

Figure 4: Leaf Vegetable cultivation
Source: Field Survey

Vegetable cultivated areas

Although vegetables are widely grown in Twantay Township, vegetable cultivated areas are mainly concentrated in the western part of the township. Of 65 village tracts, vegetables are cultivated in 43 village tracts having 2421 hectares. The village tracts possessing cultivated area of more than 100 hectares are Sarphyusu, Kywedayut, Letpangwa, Hteintapin and Khattiya that are found in the western part. In the central area, the village tracts cultivating vegetables with an area of less than 20 hectares are Phayargyi, Mayantapin, Pauktaw, Kyunbet, Yangonparda, Kyaikthale, Tamargyi, Ahyoetaung, Kalihtaw, Talokehtaw and Thawuntaw. Twenty-two village tracts do not have vegetable cultivated area.

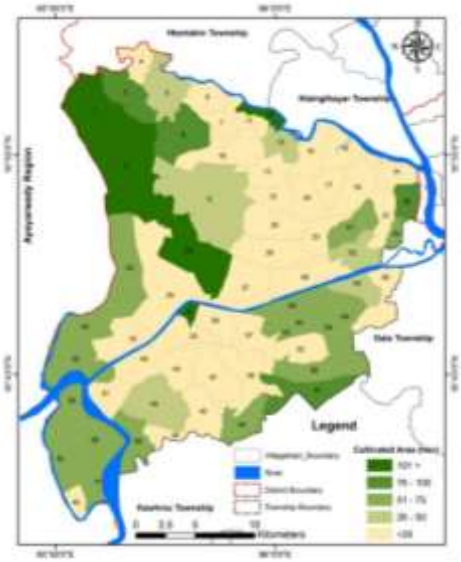

Figure 5: Vegetable Cultivated Area of Twantay Township

Source: Based on data of Department of Agricultural Land Management Statistics

Supporting factors for vegetable cultivation

Locational advantage

Nearness to Yangon City is a locational advantage for vegetable cultivation of Twantay Township. The population of Yangon has been increasing at an accelerating rate and population

growth is very distinct. To meet the basic food need consumption, vegetables are carried from nearby areas as well as Hmawbi, Taikkyi, Pyay, etc. Therefore, nearness to Yangon City is one of the major supporting factors for vegetable cultivation.

Suitable Topography

The relief of the township is low and flat with general elevation between 3.05 meters (10 feet) and 15.24 meters (50 feet) above sea-level and low lying flat lands are favourable for vegetable cultivation. The main rivers are the Panhlaing River, Yangon River, Thakhutpin creek or Pathein river, Khattiya Yakyaw Creek, Toe River or China Baykar River and Biku Creek which support water for vegetable cultivation and vegetable transportation.

Soils

Although Charrier et al. (2015) stated that vegetables need good soil and environment for better production and Comas et al. (2010) said that production depends on soil and environment, vegetables are extensively grown in the study area by upgrading the existing soils that are mixed with natural and artificial fertilizer that causes high production and low environmental pollution.

Large Number of Rural Population

Twantay Township possesses high number of rural people (nearly 60 percent of the township population) who are familiar with agriculture and engaged in agriculture. They cultivate vegetables because of short growing period of vegetables, high market demand as well as high seasonal income. Among fruits vegetables, eggplant, gourd, okra and bitter gourd gives high economic returns and water cress, roselle, spinach, lettuce, etc. in leaf vegetables.

Accessibility

Accessibility is also a supporting factor for vegetable cultivation because of perishability. Vegetables produced from the study area are carried by road transportation and some by waterway.

Figure 6: Vegetable Transporting Routes from Twantay Township to Yangon City
Source: Based on interviews and Map of MIMU

From village tracts of Twantay to Thirimingalar Market of Yangon City takes only 2 driving hours by car and it also takes about 2 hours by waterway from Twantay to Thirimingalar Market through Kyeemyindine Township. Good accessibility is one of the supporting factors for vegetable cultivation.

Net economic return

Economic benefit derived from vegetable cultivation is one of the supporting factors, because of low job opportunity in the rural area of Twantay Township. To present benefit derived from vegetable cultivation, 8 major types of vegetables were selected. In leaf vegetables cultivation, labour cost is high and cost on pesticide and trellis made by bamboo is high in fruit vegetable cultivation. Among leaf vegetables, water cress and roselle give high economic return for local grower, although net economic return depends on price. Although price of Spinach is high in the market, growers get net low economic return due to high investment costs including seed cost and labour cost. Among fruit vegetables, gourd cultivation produces high net return for the grower. Although investment is high growers sell not only gourd leaves but also gourd.

Table 2: Cost and Net Return of Vegetable Cultivation

Types of vegetable	Cost	Net Return	Cost benefit Ratio
Water cress	200,000	1,000,000	1: 5
Spinach	500,000	1,800,000	1: 4
Lettuce	400,000	1,100,000	1: 3
Roselle	300,000	1,800,000	1: 6
Gourd	800,000	1,800,000	1: 3
Bitter gourd	800,000	1,400,000	1: 2
Okra	400,000	900,000	1: 2
Eggplant	400,000	900,000	1: 2

Source: Interviews' answers

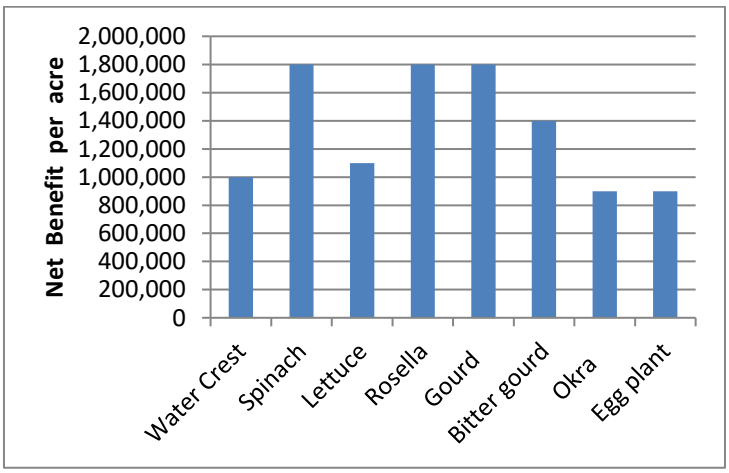

Figure 7: Net Benefit per acre in Vegetable Cultivation

Source: Table 2

Perception of the growers

The Green Revolution in 1965 focused on developing new technologies for irrigation, chemical fertilizers, herbicides and high yielding varieties. Dhital (2015) found that pesticides were used for increasing agricultural productivity without hampering the public health. Excessive use of chemicals endangered quality of soil, air and water with a high risk to environmental safety (Mehdizadeh et al., 2017).

Input uses

In the study area, vegetable growers use not only chemical inputs but also natural fertilizer made themselves.

Plate 7: Chemical Fertilizer Uses in Vegetable Cultivation

Source: Field Survey

In vegetable cultivation, chemical fertilizers such as Armo, Kawmus produced by Myanma Awba Group is used. But local people said natural fertilizers that are made by mixing cow dung, paddy stalk, etc is better for vegetable cultivation. Although it takes time, it causes low environmental impacts and less effect on human health.

According to interviews, most vegetable growers want to use natural fertilizer more and some growers who do not have large invest and time and labour for making natural fertilizer apply chemical fertilizers. The natural fertilizer made locally is called EM fertilizers (Effective Microorganism) and it is better for vegetable cultivation due to organic fertilizers that can maintain moisture in it.

Plate 8: Natural Fertilizer Making for Vegetable Cultivation in Twantay Township

Source: Field Survey

Crop Choice

Growers chose vegetable that can give high economic returns and they sometimes encountered price fluctuation and changing market demand that affect economic return of

vegetable cultivation. Sometimes, local growers encounter loss of investment due to price fluctuation and changing market demand.

Pesticide uses

Although they are aware of the negative consequences of chemical pesticides, they do not follow the instruction and guideline for the growers. Local people do not wear masks, hand gloves and long boots for the purpose of covering their bodies.

Health knowledge on vegetable cultivation

According to interviews, local people said that vegetable cultivation is more interesting and extensive cultivation is done due to daily consumption, cheaper price, etc. Some people who know health knowledge on nutrient included in vegetables search to buy 10 types of vegetables for the purpose of consuming as medicine.

According to interviews, although local growers are interested in vegetable cultivation, they only get information from pesticide shops, nearby friends and other vegetable growers. Therefore, they do not know exactly negative consequences of pesticides. They think that pesticide affects only pests and not to human. They used to pluck the vegetables 4 or 5 days later after spraying pesticides and it is harmful for human health.

Change in market system

Last 5 years ago, local growers sent their vegetables to Yangon City by rental cars. After that, due to the Covid-19 pandemic, local growers sell their vegetables to brokers who come and collect vegetables. Brokers control price and marketing system by purchasing the whole farm for the purpose of getting higher benefits for them.

Conclusion

Twantay Township is one of the township of Yangon Region that produces large amount of vegetables. Various types of vegetables are grown based on market demand and price. As vegetable cultivation is a major income source for the area, local growers cultivated several types of vegetables the whole year. They use both chemical fertilizers that give negative impacts on human health and environment and natural fertilizers. But they do not understand negative impacts of pesticides on human health.

Therefore, it is necessary to disseminate health education on vegetable cultivation and to present environmental pollution through mass media such as pamphlet, staff of agriculture department by doing workshops, training, etc. On the other hand, to get higher benefit for local growers, it is necessary to help growers through giving necessary aids such as loan for investment, pesticide, fertilizer, etc. for the purpose of getting high investment and creating firm grower organization that control market system and market price for the intention of supporting high economic return for local growers.

Furthermore, it is needed to do further researches on seasonal changes in income, negative impacts of vegetable cultivation, changing environmental situation, etc. for the purpose of being vegetable cultivation that support local people economy and that reduce negative impacts of vegetable in Twantay Township.

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LAND USE AND LAND COVER CHANGES IN MONG HSAT TOWNSHIP, EASTERN SHAN STATE

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Abstract

The study area Mong Hsat Township is situated in the Eastern Shan State, bounded on the north by Kyaing Tong Township, on the south by Thailand and on the east by Tachileik and west by Mong Tong townships. It lies between North Latitudes 20°5' 00" and 21° 43' 54", East Longitudes 99° 00' 00"and 99° 40' 00". Being on Shan massif, it has a lot of mountains and a few plains. In Mong Hsat Township, the classification of land use is based on GAD (General Administrative Department) and classified into four types of land use: Forest Area, Agricultural land, Built up Area,Water body and Bare lands. The proportional types of land use in the total area were comprised fallow land 71.33% followed by forest area 19.27%, agriculture land 9.2% and built up area 0.2% respectively. This data are not changed for a long time. In the study area changes of land use and land cover types are studied for 2000 and 2020 based on Landsat 7 and Landsat 8. By studying the changes of LULC between 2000 and 2020, forest area was **decreased** whereas the other LULC types such as settlement or Built up area, agriculture, water body and bare land were apparently seen the **increased** direction within twenty years period. In the overall changes, forest area was decreased from 2753.37 sq.km in 2000 to 1688.43 sq.km in 2020. The other areas of LULC changes were increased: agriculture from 361.83 sq.km to 945.36 km, settlement from 125.52 sq.km to 274.95 sq.km, bare land from 96.97 to 374.72 sq.km and water body 13.94 sq.km to 95.77 sq.km Therefore, the application of GIS/RS methods are to best estimate the temporal and spatial changes of the land use and land cover from the standpoint of natural resources management. It indicates that the land use pattern of office data had not been markedly changed during the period from 2000 to 2020. But the land cover areas in GIS/RS method had been clearly changed on images.

Keywords*:* LULC, GIS, RS, Mong Hsat

Introduction

Land use and land cover change (LUCC) is increasingly recognized as an important driver of environmental change on all spatial and temporal scales (Turner et. al., 1993). By viewing the challenges of the Earth, land use and land cover changes are likely to be the most significant year after year. As the anthropogenic process affected on many parts of the earth's system, climate, hydrology, global biodiversity, and environmental sustainability were experienced the deterioration in the respective spatial location. Thus, Mong Hsat is one of the spot areas on the Earth surface facing LULC change.

When it comes to the research study, Mong Hsat Township was composed of 4,911.5 sq.km (1,896.34 sq. miles) with 9 wards and 26 village tracts including Mongkhoke before 2002. However, Mongkhoke was composed of 3 wards and 6 village tracts after 2002. It was organized separately as sub-township level and excluded from Mong Hsat Township since then. Therefore, Mongkhoke sub-township is not taken into consideration in this research paper.

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In the previous time, Mong Hsat was governed by the Sawbwar. At the present time, it is composed of 6 wards, 20 village tracts and 168 villages.

In the process of studying LULC in Mong Hsat Township, Satellite Imageries with time-interval will mainly be applied and analysed by using Geographic Information Systems (GIS) software platform.

Study Area

Mong Hsat Township is one of ten townships of Eastern Shan State. It lies between North Latitudes 20°5' 00" and 21° 43' 54", East Longitudes 99° 00' 00"and 99° 40' 00". It is 72.42 kilometres (45 miles) wide from east to west and 104.61 kilometres (65 miles) long from north to south and the area is 3,352.24 square kilometres (1,294.81 square miles). It is surrounded by lofty mountains. It is fairly compact in shape. The study area is bounded on the north by Kyaing Tong Township, on the south by Thailand and on the east by Tachileik and west by Mong Tong townships (Figure 1). It is situated at an elevation about 572 meters (1,875 feet) above sea level.

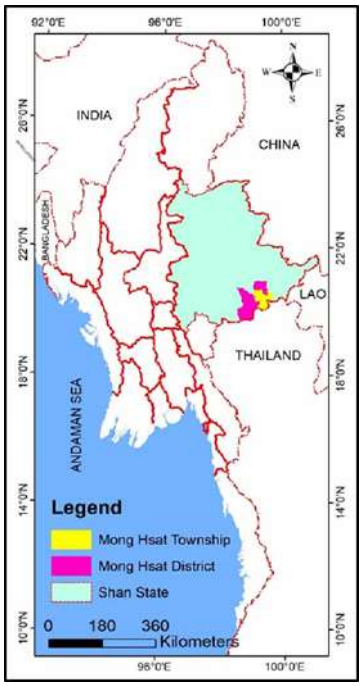

Figure 1. Location of Mong Hsat Township
Source: Myanmar Information Management Unit (MIMU_2019).

Aims

The aim of this research is to examine the Land Use and Land Cover changes pattern in the study area.

Objectives

The objectives are comparatively study to the changes of LULC types that derived from the governmental office data and remote sensing Satellite Imageries by using the application of GIS/RS methods.

Materials And Methods

Materials

There is no ideal classification of land cover, and it is unlikely that one could ever be developed. In attempting to develop a classification system for use with remote sensing techniques that will provide a frame work to satisfy the need of the majority of users, certain guidelines of criteria for evaluation must first be established (J.R. Anderson. et al.).

Land use and land cover are not separated to each other and originally closely related to each other as well. Thus, the source of data in this analysis will be applied as satellite imageries with multi-spectral scanner.

The major information of LULC is mainly obtained from Landsat TM 7 and Landsat TM 8 images with 30 metres resolution in (Table 1). The temporal variations of LULC have been revealed by different time periods of image classification data which is mainly based on object base image classification. The ground survey checking has been used as data validity of LULC classification.

Moreover, Universal Transverse Mercator (UTM) map with the scale of 1:50,000 was applied in this research. Based on those based maps, vector point of settlement's (town or village) location was created as a point algorithm and displayed on the map for ground truthing where the settlement position was. These functions help the right training samples of LULC classification as well.

Table 1. Description of the Satellite Image used in the Study

Satellite	Sensor	Date acquired	Bands used	Wavelengt (µm)	Spatial Resolutio	WRS Path/Ro
Landsat 7	Thematic Mapper (TM)	2000	Band 1 Visible blue	0.45 - 0.52	30 m	131/45
			Band 2 Visible green	0.52 - 0.60	30 m	
			Band 3 Visible red	0.63 - 0.69	30 m	
			Band 4 Near-Infrared	0.76 - 0.90	30 m	
			Band 5 Near-Infrared	1.55 - 1.75	30 m	
			Band 6 Thermal	10.40 - 12.50	120 m	
			Band 7 Mid-Infrared	2.08 - 2.35	30 m	
Landsat 8	The Operational Land Imager and Thermal Infrared Sensor (OLI_TIRS)	2020	Band 1 Coastal / Aerosol	0.433 - 0.453	30 meter	131/45
			Band 2 Visible blue	0.450 - 0.515	30 meter	
			Band 3 Visible green	0.525 - 0.600	30 meter	
			Band 4 Visible red	0.630 - 0.680	30 meter	
			Band 5 Near-infrared	0.845 - 0.885	30 meter	
			Band 6 Short wavelength infrared	1.56 - 1.66	30 meter	
			Band 7 Short wavelength infrared	2.10 - 2.30	60 meter	

Methods

Image classification was carried out to classify the land cover type in the study area. Generating a thematic map from digital remote sensing imagery by first clustering pixel are processed into classes according to their spectral similarity then using the researcher's knowledge of the area to be able to label spectral classes as a feature of interest.

In the LULC identification process, the solely geospatial techniques: GIS software 10.8.1 was operated in this research. To generate the LULC classes, False Colour Composite was used as a training sample (Trolle et al., 2019). Thus, the total training sites are collected

1,037 and 1,787 polygon samples with a variety of LULC classes in 2000 and 2020 to capture spectral variability respectively.

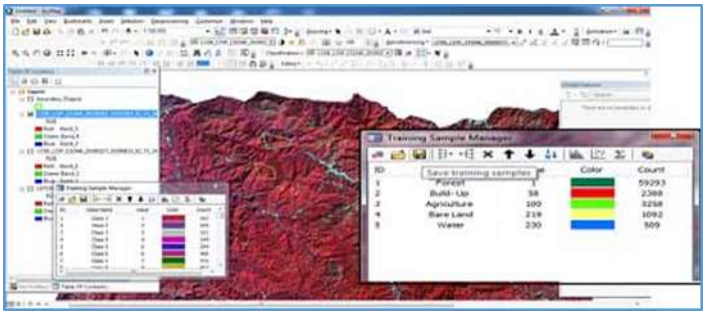

Figure 2. Training sites for five classification of false colour composite image

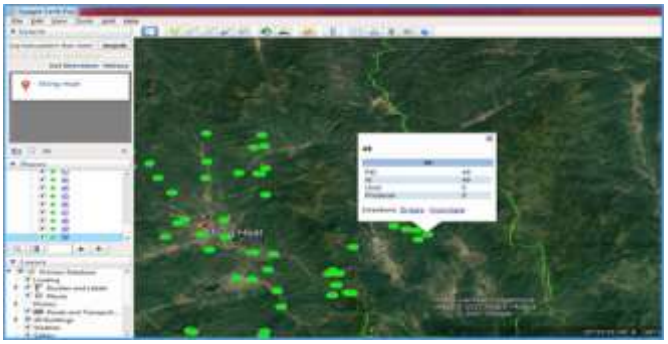

Figure 3. Connect points with Google Earth for ground truth checking
Source: Google Earth Pro

This process needs a number of training sites for all the classes spread across the study area. At that time, Maximum Likelihood Classifier was applied to extract LULC classes information from satellite images and declare training sample to be transformed as respective LULC classes. Then, the information from Satellites Imageries were classified into five LULC classes: agriculture land and bare land, built-up area, forest, and water-body in (Figure 2and 3).

Results and Discussion

Field Survey and Accuracy assessment

In the case of field survey, the wide-spread ongoing global pandemic of coronavirus disease 2019 makes a tough period for personally ground truthing. Instead of this activity, Google Earth Pro helps in checking the consistent between the data actually measured in the field and the classified remote sensed images.

The most common way to assess the accuracy of a classified map is to create a set of random points from the ground truth data and compare that to the classified images data in a confusion matrix.

In this study, LULC is defined with 50 sample points based on field observation and map measurement (satellite imagery). Water body is found 13 points (8 points on 2000 image and 5 points on 2020 image) in field observation and also found on map. So, it shows percentage accuracy with 100% in user (ground) and producer (imagery). Sometimes, types of land cover are

not the same situation in user (ground) and producer (imagery). For example, study on agriculture lands has engaged only agriculture with 12 points, 5 points are reached on other land used types such as settlement with 3 points and 2 points on bare land.The two variations of referenced between user accuracy and producer's accuracy are:_

Kappa Coefficient(T) for 2000 image = (TS*TCS)- ∑(column total X Row total)/ X 100 TS2 - ∑(column total - Row total) = 84%

Kappa Coefficient(T) for 2020 image = (TS*TCS)- ∑(column total X Row total)/ X 100 TS2 - ∑(column total - Row total) = 86%

This description can be considered to other check points of LULC types respectively. Table 2 and 3 show the five types of LULC comparison with error matrix of ground check points and satellite imagery (2000 and 2020). According to the calculation and observation data, the overall accuracy of 84% for 2000 and 86% for 2020 are defined i.e., the high enough for use.

Kappa Coefficient

TS = Total number of specified pixel

TCS = Total number of correctly classified pixels

Table 2. Accuracy Assessment for 2000

	Forest	Settlement	Agriculture	Water body	Bare Land	Total (user)
Forest	11	0	0	0	0	11
Settlement	1	8	1	0	0	10
Agriculture	2	0	8	0	0	10
Water body	1	1	1	8	0	11
Bare land	0	0	1	0	7	8
Total (producer)	15	9	11	8	7	50

Source: Landsat 7 (2000), Google Pro and Field Survey

Table 3. Accuracy Assessment for 2020

	Forest	Settlement	Agriculture	Water body	Bare Land	Total (user)
Forest	17	0	0	0	0	17
Settlement	1	3	3	0	0	7
Agriculture	0	0	12	0	0	12
Water	0	0	0	5	0	5
Bare land	1	0	2	0	6	9
Total (producer)	19	3	17	5	6	50

Source: Landsat 8 (2020), Google Earth Pro and Field Survey

The tabulation of accuracies, which is **user accuracy** and **producer accuracy**, per individual LULC class are illustrated in Table 2 and 3. Thus, the reflected pixel value of Satellite Images of LULC classes and the ground truth point from Google Earth Pro were checked how much consistency is? **Kappa coefficient**, the final calculation of those reference pixels and correctly classified pixels (diagonal) is resulted 84 % and 86% in each time frame, 2000 and 2020 respectively. As the Cohen's Kappa coefficient interpretation, it is revealed that almost perfect agreement because the minimum of those satisfied agreement level is 85%.

LULC Distribution Pattern

The area composition of LULC in Mong Hsat Township in Table 4 and Figure 4.

Table 4. Types of LULC Condition in Mong Hsat Township

No.	LULC Types	2000		2020	
		Area (sq.km)	%	Area (sq.km)	%
1	Forest	2,753.97	82.15	1,688.43	50.37
2	Settlement	125.52	3.74	274.95	8.20
3	Agriculture	361.83	10.79	945.36	28.20
4	Water Body	13.94	0.42	95.77	2.86
5	Bare Land	96.97	2.89	347.72	10.37
Total		3,352.24	100.00	3,352.24	100.00

Source: Landsat 7 and Landsat 8

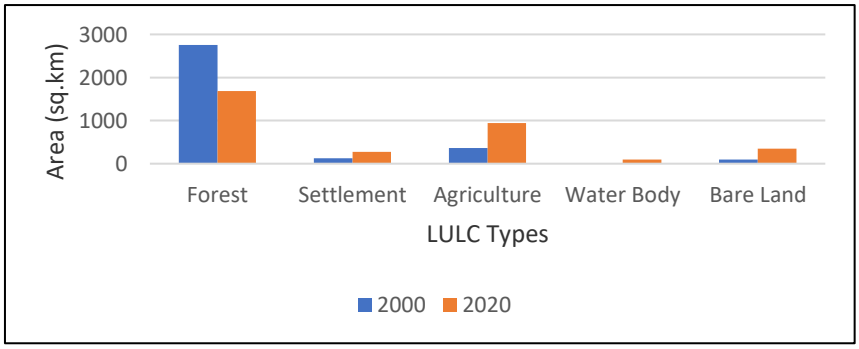

Figure 4. Area Composition of LULC Types in 2000 and 2020

Source: Table 4

By studying the changes of LULC between 2000 and 2020, forest area was in the **decreased** trend, whereas the other LULC types such as settlement, agriculture, water body and bare land were apparently seen in **increased** direction within twenty years period.

The most significant change area of LULC types was found in forest land. The change in forest area was the largest change of land use and land cover during the 20 years period from 2000 to 2020. In 2000, the forest area was 2,753.37 sq.km which accounted for 82.15 percent of the total study area. However, in the year 2020, it was decreased to 1,688.43 sq.km which accounted for 50.37 percent of the study area. The decrease of forest area during the 20 years period was 1,065.54 sq.km with 31.79% (Table 5, Figure 5 and Figure 6). The decrease of forest area was due to the expansion of population and deforestation in the study area.

The other changes of LULC types were agriculture land which was occupied 361.83 sq.km in 2020 and 945.36 sq.km in 2020. It was increased 583.53 sq.km or 17.41% during twenty years' time span. Population number and agriculture land is directly correlated with each other. Therefore, the more population number was increased, agriculture land was also increased. The other LULC types such as bare land, settlement and water body area were increased with less changes of 250.75 sq.km or 7.48%, 149.43 sq.km or 4.46% and 81.83 sq.km or 2.44% respectively (Table 5, Figure 5). The increased area of agriculture land and settlement area was subjected to population number increased as well. The total population was 70,065 persons in 2017 and 8,8516 persons in 2019. It was increased 1,8451 persons even during 3 years period.

Table 5. Changes of LULC Types in Mong Hsat Township

No.	LULC Types	2000		2020		Increase or Decrease	
		Area (sq.km)	%	Area (sq.km)	%	Area (sq.km)	%
1	Forest	2,753.97	82.15	1,688.43	50.37	-1,065.54	-31.79
2	Settlement	125.52	3.74	274.95	8.20	149.43	4.46
3	Agriculture	361.83	10.79	945.36	28.20	583.53	17.41
4	Water Body	13.94	0.42	95.77	2.86	81.83	2.44
5	Bare Land	96.97	2.89	347.72	10.37	250.75	7.48
Total		3,352.24	100.00	3,352.24	100.00		

Source: Landsat 7 and Landsat 8, Google Earth Pro

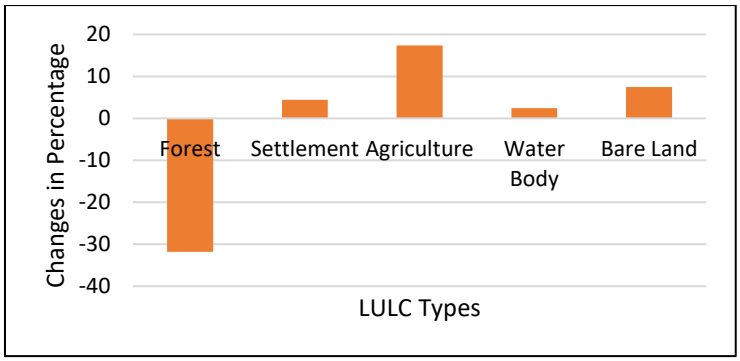

Figure 5. Changes in Percentage of LULC Types between 2000 and 2020
Source: Table 6

After classification, land cover map is produced. To get the ground truth for image classification and accuracy assessment, many sample points are surveyed in the field. These sampling points cover all land cover classes of the classified satellite image. Considering the accessibility, these points are not randomly distributed but practically selected for convenience purpose. Figure 6 shows the land cover classification of the study area for the years 2000 and 2020 respectively.

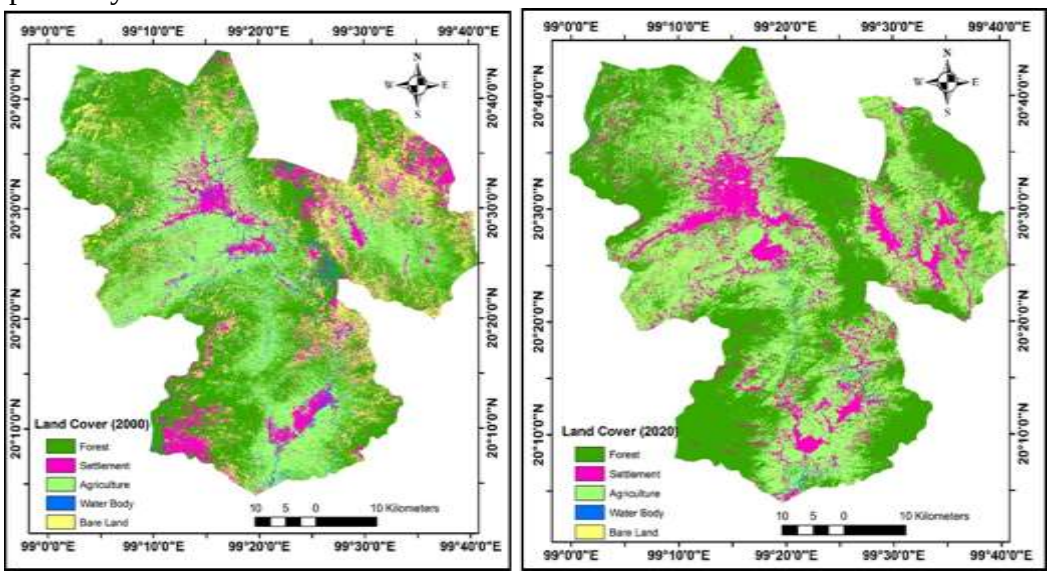

Figure 6. Changes Area of LULC Classification in the Study Area (2000 and 2020)
Source: Landsat 7 ETM and Landsat 8 (OLI_TIRS) satellite image, 30 m resolution

Change Matrix of LULC Types in Mong Hsat Township

In the change matrix portion, the retrieved sources of data from Landsat 7 and Landsat 8 were portrayed over twenty years period between 2000 and 2020 in the study area of Mong Hsat Township. This matrix table shows the main information of LULC categories. The detailed results of LULC change is shown in Table 4. The bold or highlighted grid cells were shown the stable or no change area in the respective types whereas the other cells were illustrated the dynamic or change types of LULC.

In the overall changes, forest area was decreased from 2753.37 sq.km in 2000 to 1688.43 sq.km in 2020. The other areas of LULC changes were increased: agriculture from 361.83 sq.km to 945.36 km, settlement from 125.52 sq.km to 274.95 sq.km, bare land from 96.97 to 374.72 sq.km and water body 13.94 sq.km to 95.77 sq.km Table 6.

Table 6. **Land Cover Change Area (sq.km) between 2000 and 2020**

LULC (2000)	LULC (2020)						
		Forest	**Settlement**	**Agriculture**	**Water Body**	**Bare Land**	**Total in 2000**
	Forest	**1,688.43**	131.68	713.61	54.77	165.48	2,753.97
	Settlement	-	**33.10**	46.81	17.55	28.07	125.52
	Agriculture	-	64.26	**152.81**	19.83	124.92	361.83
	Water Body	-	1.61	7.27	**0.82**	4.24	13.94
	Bare Land	-	44.30	24.86	2.80	**25.01**	96.97
	Total in 2020	1,688.43	274.95	945.36	95.77	347.72	3,352.24

Source: Satellite Imagery 2000 and 2020

Changes of LULC Types in Mong Hsat Township

During twenty years period, from 2000 to 2020, there are three types of changes in LULC types: positive change, negative change and no change in Mong Hsat Township. The positive changed area is found 1,066.72 sq.km, the negative changed with 385.36 sq.km and no change area with 1,900.18 sq.km respectively (Table 7).

Table 7. Changes of LULC Types within 20 years period

Increased Change		Decreased Change		No Change	
Land Cover Type	**Area (sq-km)**	**Land Cover Type**	**Area (sq-km)**	**Land Cover Type**	**Area (sq-km)**
Forest to Agriculture	418.68	Forest to Bare Land	143.20	Forest to Forest	1,688.43
Bare Land to Agriculture	24.86	Agriculture to Bare Land	124.92	Bare Land to Bare Land	25.01
Forest to Settlement	48.84	Forest to Water Body	44.75	Agriculture to Agriculture	152.82
Bare Land to Settlement	44.30	Settlement to Bare Land	28.07	Settlement to Settlement	33.10
Bare Land to Forest	22.28	Bare Land to Water Body	2.81	Water Body to Water Body	0.82
Agriculture to Settlement	64.26	Agriculture to Water Body	19.83		
Agriculture to Forest	294.93	Settlement to Water Body	17.55		
Settlement to Forest	82.85	Water Body to Bare Land	4.24		
Settlement to Agriculture	46.82				
Water Body to Forest	10.03				
Water Body to Agriculture	7.27				
Water Body to Settlement	1.60				
Total	1,066.72	Total	385.36	Total	1,900.18

Source: Satellite Imagery 2000 and 2020

Spatially, the **increase changed** area was distinctly found in the southern and western parts of Mong Hsat Township (Figure 7 and Figure 8). Those areas are converted **from forest**

land to agriculture land and then from agricultural land to settlement area. In addition, the **decrease changed** areas are found as scatter patterns within the whole of the study area. It was discovered **the transition from forest to bare land area and water body**. Lastly, Most of the Mong Hsat area are found **no changed** areas especially in the northwest parts and in the eastern peripheral area of the township (Figure 8). In the stable area, villages and settlement area is not found in the higher elevation and rugged ranges region. The range of elevation between 943 and 1,149, 1,149 and 1,397, and 1,397 and 2,104 meters are rarely found settlement settled area. Moreover, no villages are found in altitude above 1,397 meters.

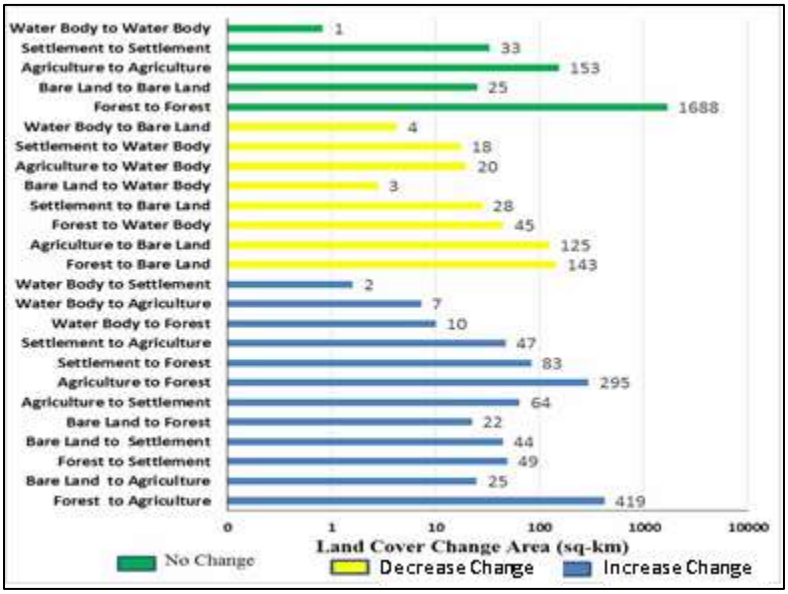

Figure 7. Land Cover Change Types for 2000 and 2020
Source: table 7

In the changes pattern, the prominent one is settlement among five types of land use and land cover. These changes are especially found in the urban area Figure 9.

For the Mong Hsat, the settlement or built up areas were 6.66 sq km in Office data, but on the 2020 satellite image, the area of settlement land is 125.52 square kilometers and on the 2020 satellite image, the area of settlement land is clearly increasing to 274.95 square kilometers. These land use areas are not changed in office records, although the area under settlement area changed as positive change which revealed in GIS-RS images. Beside the land use for railway, roads, and industrial are double records for the settlement or built up areas in the office data. These records are not included as double on images.

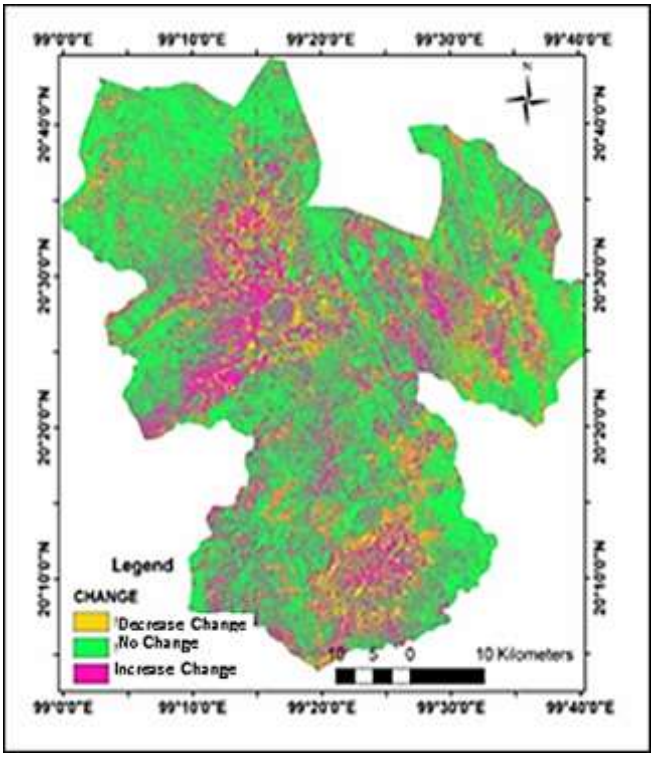

Figure 8. LULC Change Types of Mong Hsat Area (sq.km)
Source: Satellite Imagery 2000 and 2020

Change Detection

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it in different times (Singh, 1989). This is considered an important process in monitoring LULC because it provides quantitative analysis of the spatial distribution.

In the change detection portion, change matrix from the reference source Landsat 7 and Landsat 8 were analysed over 20 years period between 2000 and 2020. Change matrix displays the key information of LULC. (Shalaby and Tateishi, 2007).

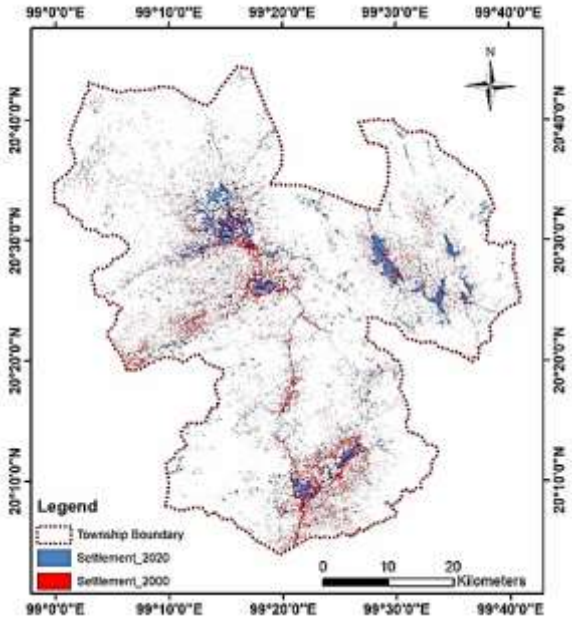

Figure 9. Changes of Settlement Pattern between 2000 and 2020
Source: Landsat 7 and Landsat 8

The detail result of change matrix is shown in (Table 6). Mong Hast Township is composed of six wards and twenty village tracts. The total area cover is 3,352.24 square kilometres (1,294.81 square miles). The statistical data of land use in Mong Hsat Township is applied from the Department of Agricultural Land Management and Statistics (DALMS) office data in 2019.

Types of land use vary from rural area to urban area in Mong Hsat Township. Generally, built up area and agriculture land are found in the urban area and near the environs of settlement pattern. However, forest area and fallow land are fairly occurred in the remote area.

Table 8. Land Use Types and Its Proportional Area in Mong Hsat Township (2019)

No.	Type of Landuse		Area (sq.km)	Area (sq.km)	%
1	Forest Area		645.96	645.96	19.27
2	Build up Area	Industrial Land Area	0.04	6.66	0.20
		Urban Settlement	1.40		
		Rural Settlement	5.22		
3	Agriculture Land	Le Land	50.15	308.50	9.20
		Ya Land	75.16		
		Taungya Land	44.60		
		Garden Land	132.09		
		Uncultivable Land	6.49		
4	Fallow Land	Le Land	0.40	2,391.12	71.33
		Ya Land	3.36		
		Wild Land	1,167.81		
		Virgin Land	1,219.54		
Total				3,352.24	100.00

Source: Compiled by Researcher based on DALMS, Mong Hsat

According to the available data, the change area or type of land use cannot be compared, because the acquired data is only one year. Therefore, only land use data in 2019 can be described in Table 8 and Figure 10. The proportional types of land use in the total area comprised fallow land 71.33% followed by forest area 19.27%, agriculture land 9.2% and built up area 0.2% respectively.

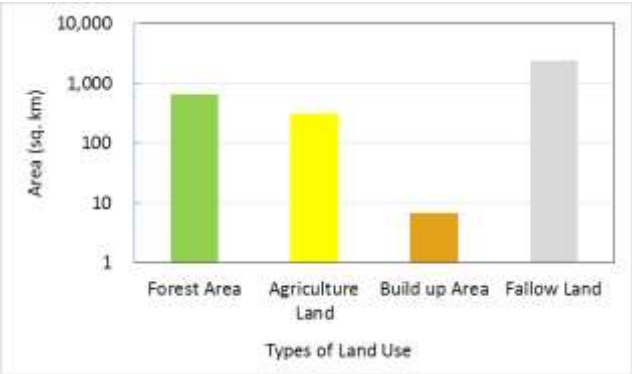

Figure 10. Types of Land Use and Its Proportional Area in Mong Hsat Township (2019)

Source: Table 8

Forest area is the second largest proportion in the study area. By the quantitative data, forest area covers 19% or 645.96 sq.km of its township. This area is especially found in the higher elevation area in the peripheral region of its township where the settlement pattern is sparse.

This area is especially found in the urban area and rural settlement pattern gathered area. It was accounted for the least area among land use area in its township. Built up area includes industrial land area, urban settlement area and rural settlement area with 0.04, 1.4 and 5.22 square kilometres respectively. The total area was 6.66 square kilometres and constituted as 0.2 percent of its township area Table 8 and Figure 10.

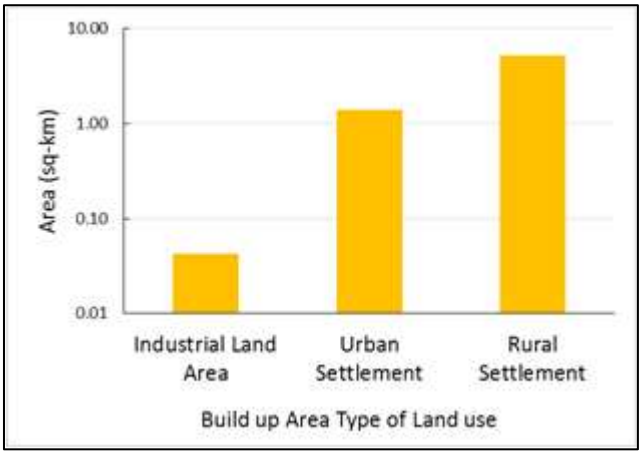

Figure 11. Built up Area Type of Land Use in Mong Hsat Township (2019)
Source: Table 8

Agriculture is the main economic activity and widely spread in Mong Hsat and represented the third largest area of its township. Garden land was composed of 132.09 square kilometres, followed by *Ya* land with 75.16 square kilometres, Le land was accounted for 50.15 square kilometres, Taungya land with 44.6 square kilometres, and Uncultivable land for agriculture with 6.49 square kilometres. The most significant one in agriculture land is garden land which is occurred the highest area in its land use pattern Table 8 and Figure 12. The cultivated land is widely spread in the whole township.

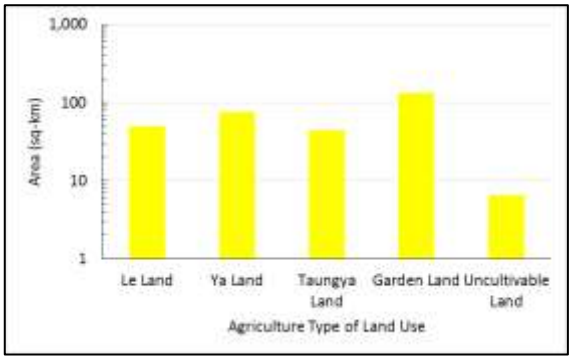

Figure 12. Agriculture Land Type of Land Use in Mong Hsat Township (2019)
Source: Table 8

Fallow Land is the most dominant type of land use in Mong Hsat Township. It was comprised the largest area with 71.33% and 2391.12 square kilometres of its township Table 8 and Figure 13. Fallow land covered three fourths or three quarters of its township area. Among them, Virgin land is found 1219.54 sq.km, Wild land with 1167.81 sq.km, Ya land with 3.36 sq.km and Le land with 0.4 sq.km respectively.

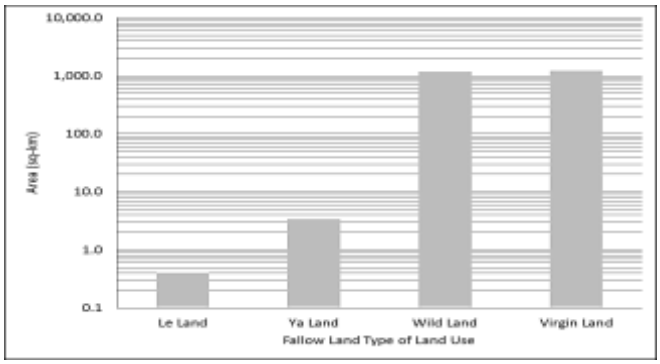

Figure 13. Fallow Land Type of Land Use in Mong Hsat Township (2019)
Source: Table 8

Conclusion

Land use and land cover (LULC) is the most prominent configuration of the environmental change phenomenon occurring at spatial and temporal scales. This research is conducted to identify the LULC changes pattern in the two time-frames of 2000 and 2020 in Mong Hsat Township. LULC classes had been produced on the basis of remote sensing Landsat data sources.

The population or the residing people in a particular area plays an important role for the changing pattern of land use and land cover. In the study area, the growth of population is the major factor for degradation of soil and deforestation which in turn caused to change both land use and land cover of the study area.

In Mong Hsat Township, the main drivers of LULC change are physical setting and social factors. Based on the physical environments such as relief and drainage, natural vegetation, soil and climate, the existence of land use and land cover is the existing LULC types. As well as the non-physical factors such as demographic factors: population, population growth, distribution and density and housing number is also affected on land use and land cover. Thus, human activity is the most important driving force for land use and land cover change especially population growth.

The total population was 70,065 persons in 2017 and 8,8516 persons in 2019. It was increased 1,8451 persons even during 3 years period.

In the accuracy validation process, the remote sensing images and ground truth (Office data) data were compared and checked to be consistent with those sources of data.

The types of land use recorded by General Administrative Department (GAD) shows that the area of the reserved forest and protected forest in Mong Hsat Township are 645.96 sq.km, but on the image the remaining forest area is 1688.43 sq-km, therefore about 1000 sq-km area of forests are not found, although 713 sq-km which is far from the area of the agriculture cover as revealed by the GIS–RS images. Likewise, the areas of the office data for the Fallow Land areas 2391 sq-km are revealed as Bare Land (347.72 sq-km), Agriculture (945.36 sq-km), Settlement (274.95 sq km), Water Body (95.77 sq km) and other spreading in Forest covered by GIS- RS images has been observed. Therefore, bare land cover on images are significant differences with the office land used data. Water Body area is not defined at office land use data. Fallow lands are also being used on satellite imagery as bare lands and agricultural lands, as well as settlement areas and water body areas.

For this reason, the land cover estimation is seen to be fairly good as compared to the total land use area recorded by GAD of the Mong Hsat. Office data does not show land use and land cover by location, but satellite imagery and google images show the actual use of different types of land use on the ground. The sequences of the land cover changes are seen to be "from forest to agricultural lands", "from agricultural lands to settlement" as the increasingly changed from 2000 to 2020, 20 years periods. In the study area, the settlement or built up areas were 6.66 sq. km in office data, but on the 2020 satellite image, the area of settlement land is noticeable increasing to 274.95 square kilometers because of population growth. Therefore, the application of GIS/RS methods are best estimate for the temporal and spatial changes of the land use and land cover particularly agriculture and settlement types of land cover in the whole of Mong Hsat Township from the standpoint of natural resources management.

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SUSTAINABLE URBAN DEVELOPMENT FOR MYANMAR

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Abstract

Like other Southeast Asian countries, Myanmar is experiencing a continuous urbanisation process since its independence in 1948. The urban population has risen from 2.6 million in 1953 to 8.5 million in 1983 and up to 17.4 million 2021. This growth has transformed the Myanmar's urban system substantially. Today, it is characterised by a tripolar structure headed by the largest three cities – Yangon, Mandalay and Nay Pyi Taw, and almost 400 cities and towns of regional and local importance. While Myanmar's urban system is still remarkably balanced, numerous regional cities and local towns throughout the country are expanding and became drivers of regional development. Many cities and towns in border, mountain and coastal areas have expanded with growing economic activities and (inter)national investments which accelerated domestic migration. Substantial impulses have been drawn from international discussions. The 'National Sustainable Development Strategy for Myanmar' (2009) and the 'Myanmar Sustainable Development Plan' (2018) had already address the key principles of sustainability. These were applied in urban strategies inspired by the Millennium Development Goals (MDGs) and especially the Sustainable Development Goals (in particular: SDG 11) and the New Urban Agenda (2016). Against this background, this paper aims to investigate, first, the recent urbanisation dynamics in Myanmar and, second, general principles and strategies of urban sustainability in order to stimulate scientific discussion on sustainable development in Myanmar. The study is based on a mixed method approach, combining a review of (inter)national literature and planning documents with an analysis of secondary data and qualitative expert interviews. Finally, it summarises recommendations for priorities of a more sustainable urbanisation in Myanmar.

Keywords: Sustainable urban development, New Urban Agenda, urbanisation processes, urban systems, Myanmar

Introduction

Pathways to Sustainable Urbanisation

At the third World Summit on Human Settlements, the United Nations Habitat III Conference held at Quito, Ecuador, in 2016, the New Urban Agenda was adopted and signed by more than 170 nations, including Myanmar. After two previous conferences – in Vancouver in 1976 (focusing on the problem of housing) and in Istanbul in 1996 (the "Cities Summit", on issues of global slum formation and informal settlements), the Habitat III conference focused on sustainability goals. Thus, the main aims shifted from ensuring minimum services for all people – primarily: access to adequate housing, health and education facilities, and food security – to multidimensional issues of sustainable urban development as adopted in the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs). Since UN-Habitat's content reorientation in 2011, it has concentrated on seven thematic areas: (1) basic services and technology, (2) housing and upgrading informal settlements, (3) urban economy and (4) governance, (5) urban planning and spatial or urban design, (6) risk prevention and reconstruction, and (7) research and capacity building (UN-Habitat 2013). In the run-up to the Habitat III conference, three additional focal points were added, namely (8) issues of social cohesion and inclusion, (9) the right to the city, and (10) urban sociocultural heritage. Ten so-called Policy Units with core recommendations address these focal points in detail (UN-Habitat 2016).

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New Urban Agenda: Aims and Limitations

The New Urban Agenda aims to guide the next 20 years of global urban development and provide essential impetus for sustainable global urban development. The international community of states agreed on important policy goals, including (A) the ability of cities to act, (B) inclusive and people-oriented urban development, and (C) resource conservation (WBGU 2016). The action-oriented document provides key global urban principles, policies and standards required to achieve sustainable urban development, to transform the way we construct, manage, operate and live in cities. The New Urban Agenda follows three guiding principles: (1) Ensuring urban equity and eradicating poverty, (2) achieving sustainable and inclusive prosperity and opportunities for all, (3) fostering ecological and resilient cities and human settlements. It brings together in 175 paragraphs a thematically very broad range of different fields of knowledge and action. Focus topics are, e.g., adequate housing, sustainable human settlements, equity, safety, security, risk reduction, urban resilience, global monitoring mechanism and urban heritage.

The New Urban Agenda underlines that it is important to realise that sustainable urban development can only be successful through close cooperation between many different actors. Successful urban development thus requires dialogue and cooperation between multi-stakeholders including national and local governments, the private sector, experts from social and natural sciences, societal institutions and civil society. This cooperation process includes policy-making, planning, scientific analysis, design, implementation, operation, management, maintenance, monitoring and financing and delivery of urban services. For the first time, the New Urban Agenda addresses the entire international community and not only urbanisation processes in developing countries, as was the case at previous conferences.

In an assessment, the challenges and limitations of the New Urban Agenda become clear: It lists many different topics of sustainable urban development, which, however, are not linked holistically and congruently in an overarching objective and approach (Kroll/Kraas 2017, Watson 2016). Three points in particular are seen critically: First, while the New Urban Agenda aims to build a bridge to the Sustainable Development Goals (SDGs) and the Paris Agreement and provides concrete targets for local development processes in cities (WBGU 2016), it does not provide concrete instructions on how its goals can be achieved within the framework of the global sustainability agreements agreed to date. Second, it lacks a long-term vision that goes beyond incremental improvements and overcomes the management of the current “urban status quo”. It further lacks powerful recommendations for how a comprehensive transformation of urban systems toward greater sustainability can occur, what concepts should be developed to achieve this, and what specific targets should be developed. The results of upstream science conferences have hardly been included. Third, essential topics such as integrative urban development (see, for example, Leipzig Charter 2007 and the New Leipzig Charter 2020), the avoidance of unsustainable path dependencies (e.g., in infrastructures), the strengthening of local governance, the promotion of multi-level governance, polycentric structures, or the handling of informality are not sufficiently addressed (WBGU 2016). The important contribution of cities to global environmental and climate protection, as discussed e.g. in the Paris Agreement, is also insufficiently taken into account; compliance with the planetary guard rails for the protection of natural life-support systems is hardly addressed (WBGU 2016).

Sustainable Urban Development: Implementation in the National Contexts

The results and agreements of the Habitat conferences are not binding under international law. The New Urban Agenda was negotiated with national government representatives, whereas cities themselves, their administrations, the private sector and civil society organisations, were only given observer status. Implementation is anchored solely at the national level. Thus, while municipalities and cities are recognised as key actors of sustainable development in the New Urban Agenda, the focus is on nation-state governments as key actors and it does not receive solutions for institutional upgrading, capacity enhancement and empowerment of actors at the local level, namely city governments, and collaborations between local decision makers (UN 2017). This is a shortcoming for the implementation of the New Urban Agenda guidelines. However, important developments can be observed: Through their association in regional, national and global city networks, cities are increasingly exchanging information on sustainability issues ("good practices"), forming alliances and entering into voluntary commitments (Acuto 2016). In this way, cities can take on important pioneering roles in adapting urbanisation processes to the given needs.

A specific problem is the fact that the New Urban Agenda does not contain any detailed references to the importance of the spatial scale levels and specific contexts of cities for a successful sustainability policy. Specifically, the local context (namely: neighborhoods and districts) or the socio-cultural specificities and path dependencies of urban development at the local and national level are not considered. As is well known, cities face very different problems depending on their respective geographical location, specific demographic, economic, socio-cultural and political developments. They have different social (such as: human capital), financial (such as: tax revenues) and political (such as: capacity to act) resources for addressing existing urban problems as well as creating sustainable path dependencies for the future. The New Urban Agenda hardly addresses these widely different sets of problems. It is therefore important to encourage the formation of expert panels at the nation-state and regional levels (e.g., ASEAN, national institutions or think tanks) to develop context-specific strategies for the future of cities and towns in different states or regions. A positive example is, for instance, the Leipzig Charter on Integrated Urban Development in Europe, first adopted at the European Union level in 2007 and fully updated in 2020. States and associations of states – such as the Association of Southeast Asian Nations (ASEAN) – are currently developing national and regional urban development strategies. In addition, globally active city networks – such as ICLEI, C40 or UCLG – support the transfer of knowledge on successful urban development policies.

Urbanisation Processes in Myanmar

After the end of British colonial rule, the urban population as a percentage of the total population fluctuated considerably, falling from 12.3% (947,000 persons, 1891) to 9.3% (991,000, 1901), 9.3% (1.13 million, 1911) and 9.8% (1.3 million, 1921) and then rising to 10.4% (1.52 million, 1931). Improvements in the agricultural economy had a dampening effect on migration and more efficient census data gathering in rural areas is also likely to be reflected in the statistics (Hla Tun Aung 2003: 204-205). Like other Southeast Asian states, Myanmar is facing a continuous urbanisation process since its independence in 1948 with growingly rapid urbanisation dynamics in the last decade. The urban population has risen from 13.5% (2.6 million, 1953), 23.6% (6.8 million, 1973) and 24% (8.5 million, 1983) to 28.8% (13.1 million, 1996) (Hla Tun Aung 2003: 205). Over the last decade, it rose from 28.9% (14.5 million, 2010)

and 29.7% (15.4 million, 2014) to 31.4% (17.4 million, 2021) (UN-DESA 2019). Urban growth accelerated with the introduction of a market-oriented economy in the late 1980s/early 1990s which has transformed Myanmar's urbanisation trends and its urban system substantially.

Substantial impulses, also for urbanisation in Myanmar, have been drawn from international discussions: While the 'Myanmar Agenda 21' (1997) already addressed key principles of sustainability which were later included in the 'National Sustainable Development Strategy for Myanmar' (2009) and the 'Myanmar Sustainable Development Plan' (2018), these were applied in urban strategies in Myanmar inspired by the Millennium Development Goals (MDGs) and especially the Sustainable Development Goals (in particular: SDG 11) and the New Urban Agenda (2016).

Research Questions

Against this background, this paper aims to investigate, first, the recent urbanisation dynamics in Myanmar and, second, general principles and strategies of urban sustainability in order to stimulate scientific discussion on sustainable development in Myanmar. Finally, it summarises recommendations for priorities of a more sustainable urbanisation in Myanmar. Thus, the guiding research questions are:

(a) What are the key characteristics of the recent urbanisation dynamics in Myanmar?
(b) Which main general principles and strategies of urban sustainability in Myanmar are discussed and can be applied?
(c) Which recommendations for appropriate priorities of a more sustainable urbanisation in Myanmar can be made in order that all parts of the society can benefit?

Material and Methods

The study is based on a mixed method approach, combining a review of international and national literature and planning documents with an analysis of secondary data, from international and national sources, and more than 30 qualitative expert interviews which were conducted between 2011 and 2020, allowing for a deeper understanding of the phenomena, processes and priorities of urbanisation in Myanmar. Knowledge, perceptions and evaluations of different stakeholders and experts on the urbanisation processes were collected and recommendations drawn based on the expert interviews.

Results and Findings

Recent Urbanisation Dynamics in Myanmar

With the start of Myanmar's transition and the introduction of a market economy in 1988/90, urbanisation picked up pace, initially and most visibly in the then capital Yangon (Yin May 1962 and 1999, Seekins 2005, Zin Nwe Myint 2006a, b, Kraas et al. 2014) and in Mandalay. From the mid to late 1990s, visible signs of urban transformation could also be observed in other larger cities (Mawlamyine, Bago, Monywa, Pathein, Meiktila and Sittwe) and in some settlements close to borders and transportation corridors (e.g. Lashio, Muse, Myitkyina, Dawai or Kengtung), where transregional trade strengthened markets and transport hubs. The extent to which these trends – no longer isolated cases by then – can be described as a system or network of cities/settlements merits further discussion.

Since the introduction of a market-oriented economy in 1988, the pace of urbanisation has accelerated significantly. For example, the urbanisation rate – i.e., the urban population as a percentage of the total population – in Myanmar has increased from less than 20% (1980) to 31.9% (2007) and 29.6% (2014). The urbanisation rates in the states and regions vary considerably: Yangon Region has the highest urban proportion (70.1%), followed by Kachin State (36.1%), Mandalay Region (34.8%), Nay Pyi Taw Capital Region (32.3%), Mon State (27.9%) and Kayah State (25.3%). Less than a quarter of the population is urban in Shan State (24.0%), Tanintharyi Region (24.0%), Bago Region (22.0%), Kayin State (21.9%), Chin State (20.8%), Sagaing Region (17.1%), Rakhine State (16.9%), Magway Region (15.0%) and Ayeyarwady Region (14.1%; MoIP 2015: 5). Along emerging development corridors (e.g. the Taunggyi west-east axis, the corridor east of Mawlamyine towards Thailand or the link from Mandalay to China, first to the northeast and then switching north), the onset of increasing urbanisation is evident. The same is true of several border towns, e.g. the growing trade centres of Muse, Tachileik or Myawaddy (Kraas/Spohner/Aye Aye Myint 2017).

With its 367 cities and towns (MoC 2016a, b) and degree of equilibrium in its urban system, Myanmar still has the potential to expand its regional and small towns into drivers of relatively well-balanced national development through a policy of decentralised concentration. However, since reform policy commenced in 2010, development processes have begun to be concentrated to an ever greater extent on Yangon and Mandalay – similarly to urbanisation processes in other rapidly developing Southeast Asian countries (Kraas/Yin May/Zin Nwe Myint 2010).

With the construction of the new capital Nay Pyi Taw – Myanmar's official seat of government since 6 November 2005– key administrative functions and a substantial number of officials employed by the ministries and public authorities have relocated or are commuting regularly to Nay Pyi Taw. This shift north has moved the capital back to the traditional pre-colonial heartland of Upper Myanmar.

The numerous regional towns – each with a population of less than 200,000 and in most cases between 10,000 and 25,000 – are strung out like pearls along the country's main infrastructure corridors. Yangon and Mandalay are linked by three transport routes, with the western route passing through Pyay and the two eastern corridors – one the old highway, the other the new expressway – running to some extent in parallel through Bago, Nay Pyi Taw and Meiktila. The transport link from Bago via Mawlamyine to the south of Myanmar also passes through numerous settlements.

This has been accompanied by a gain in significance for the urban economy in the national context and by broad differentiation between the formal and the informal sectors, especially in the cities. In view of the still moderate development dynamics and relatively strong municipal administrations in Myanmar, signs of strain on the urban infrastructure – typical of other Southeast Asian countries – are since a few years being observed and include traffic congestion, infrastructural bottlenecks, energy and electricity constraints (leading to high woodfuel consumption; Zin Nwe Myint 2006a), pollution and displacement of social groups. However, urban expansion and peri-urban developments – the encroachment of the cities into surrounding green and agricultural space – is clearly taking place, along with the emergence of gated communities (self-standing newly constructed settlements for the middle class and elites, with their own security personnel) and structural change in inner cities, with a functional shift

away from housing and towards offices at the most sought-after locations, especially in downtown Yangon and Mandalay.

Since 2005, the urban system it is growingly characterised by a tripolar structure headed by the most important three cities – Yangon as international megacity (Kraas/Yin May/Zin Nwe Myint 2010), Mandalay as metropolitan hub in central Myanmar and Nay Pyi Taw as national capital – and about 400 cities and towns of regional and local importance. While Myanmar's urban system is, compared to other urban systems in Southeast Asia, still remarkably balanced it is facing recent changes: Numerous regional cities and local towns throughout the country are expanding and became drivers of regional development with economic growth and internationalization in line with the national policy of 'decentralised concentration'. Many cities and towns in border, mountain and coastal areas have expanded with growing economic activities and (inter)national investments which accelerated domestic migration.

Since the introduction of the market economy, visible processes of urbanisation have been discernible in almost all of Myanmar's cities as a consequence of the surge in private sector start-ups, especially in commerce, finance and tourism services. The pace of transformation varies, however, according to local economic conditions and is most dynamic in the seven largest cities – Yangon, Mandalay, Mawlamyine, Bago, Monywa, Meiktila and Pathein. The most obvious processes are catch-up tertiarisation and city-building and the emergence of real estate markets (land and property). The inner-city market and distribution systems are also evolving dynamically, with supermarkets and shopping malls springing up alongside traditional local markets. The boom in construction by private developers, especially the transition 'winners', and the construction of new tower blocks or the addition of storeys to existing buildings are resulting in social polarisation and partly resettlement. As a result of a surge in car ownership and the expansion and upgrading of much of the road network, suburbanisation is occurring in outlying areas. Although still at an early stage, some urban districts are beginning to form separate enclaves in the general cityscape; examples are international shopping malls and complexes with serviced apartments and gated communities. These new features of the urban landscape are planned, constructed, marketed and operated mainly by private developers and management companies and therefore evade strong regulation – evidence of the increasing importance of private capital-driven urban development based on international paradigms. Furthermore, the urban fringe – hitherto used for agricultural purposes – is increasingly being absorbed by new districts (such as Thanlyin to the southeast of Yangon) with conceptually integrated and coherent functionality and futuristic architecture. This shows the extent to which the demands of the transformation-induced emerging middle class are encroaching on space and having a visible impact on the urban landscape.

The most obvious change has taken place in the old quarters whose design and architecture date back to colonial times – in Yangon, this is the old city between Merchant and Anawrahta Road near the Sule Pagoda (Hlaing Maw Oo 2006, Kraas/Hlaing Maw Oo/Spohner 2014). Here, large swathes of the old city – urban heritage of importance to the city's identity and citizens' identification with it (Hlaing Maw Oo 2006, Roberts 2016) – are being demolished to make way for new development (shopping malls, office blocks and apartment buildings, often financed with foreign capital). With selective upgrading and gentrification, it may still be possible to save the substantial urban heritage in Yangon and many other regional cities, even in the peripheries (Zin Nwe Myint 2016, Zin Nwe Myint et al. 2016). However, the fact that these

downtown neighbourhoods are characterised by colonial-era architecture and stylistic elements can pose problems, as some decision-makers regard their upgrading as undesirable. In addition, there is a risk that some modernisation projects lack sensitivity, with displacement of lower-income groups and much of the informal sector, with the threat that the vibrant and organic life of these downtown communities will give way to sterile urban development.

Principles and Strategies of Urban Sustainability

The guiding principles of urban development, seeking to integrate social and environmental systems, can only be achieved through sustainable resource use. For more than three decades, engineers, economists, and natural and social scientists have been working on technologies and strategies to make a transition from a resource-intensive to a resource-light and more environmentally compatible economy possible. These efforts follow the principles of efficiency (improved resource productivity), consistency (use of renewable resources), and sufficiency (reduced consumption) (Kraas/Kroll 2017).

The *efficiency strategy*, as a technical solution, focuses on the minimization of material and energy use per production unit. The ratio between input of capital, labour, resources, or prefabricated goods and the production output, can be improved through the increase of resource productivity and the improvement of organisational structures (Grunwald/Kopfmüller 2006: 76). Ideally, economic growth can be decoupled from increasing resource use through the dematerialisation of economic activity, in order to enable long-term economic growth within the limits of ecological carrying capacities. More efficient resource use also implies that resources can only be used up to a level where they still are able to regenerate. In urban areas this can refer to the use of groundwater within its capacity to regenerate or balanced land use systems. Central to the efficiency strategy are approaches that (further) develop resource-efficient technologies for production and product use, which include production strategies that utilize repurposed waste or increase product lifetimes.

Furthermore, concepts to quantify the material intensity of products and services, and consumption patterns of different population groups have been developed (e.g. approaches of the "ecological backpack" (Stengel 2011) and the "ecological footprint" (Rees 1997)).

The *consistency strategy*, also a technological solution, focuses on renewable resources by aiming towards improved compatibility of nature and technology, qualitative aspects of environmental consumption. Based on this strategy, the flows of energy and materials produced by human economic activity need to be organised in a more environmentally compatible manner and adapted to resemble processes of a natural metabolism (Grunwald/Kopfmüller 2006: 77), in recent times further developed in the direction of so-called nature-based solutions (Lechner et al. 2020). Accordingly, industrial processes should not disturb the natural metabolism, but the two should complement or augment one another. When this is not possible, environmentally hazardous materials should be directed into fail-safe, independent technological cycles or should be phased out. The design of environmentally compatible cycles should avoid waste production, ideally using residuals of one production step as raw material for the next (Stengel 2011: 131). Furthermore, the consistency strategy reflects a holistic perspective, considering the different subsystems as part of an entire system. For the urban metabolism concept, this implies an interference-free coexistence of different subsystems, such as water cycle, transportation,

industry, and recreation. Thus, the main focus of the consistency strategy is on the more environmentally compatible use of materials and energy, less on the reduction of material flows.

The sufficiency strategy views consumer behavior from a social perspective focusing on "frugality" or "moderation" with an orientation of consumption along criteria of environmental, social and economic sustainability (e.g. purchasing reusable instead of disposable products, durable energy-efficient products, or travelling shorter distances for recreation. Thus it is on changes in consumption structure, with substantial effects on resource consumption, even without technological changes in the production process (Stengel 2011: 140).

All in all, it becomes apparent that sustainable development can only be achieved through the interaction of all three strategies, as each of them has its own significance and limitations: Efficiency targets the rational use of resources, sufficiency their economical use and consistency aims at nature-oriented economic activities. Cities, because of their compact form, spatial organization, dense infrastructure and concentrated economic and social activities offer large potential for a more efficient resource use, the establishment of more sustainable and integrated cycles. More sustainability-focused awareness, institutional management and social behaviour can be realized in many fields, from water, energy and resource saving to waste separation.

Nevertheless, it needs to be taken into consideration that the implementation of these strategies will only achieve somewhat limited results, as resources are still required for the development of efficient technologies. The consistency strategy is so far only applicable in limited areas, and both approaches are ineffective for certain environmental problems. Especially through a growing population and increasing consumption needs, worldwide resource exploitation will rise more than their use can be curbed through efficiency or consistency strategies (Stengel 2011: 133).

Discussion, Suggestions and Recommendations

Recommendations for Priorities of a More Sustainable Urbanisation in Myanmar

The task of politics is to regulate the process of urban development such that a balance between different dimensions and aims can be achieved. City governments usually have three important instruments for urban planning and design at their disposal: infrastructure policy, finance policy (taxes and subsidies), and land use policy (Hall/Pfeiffer 2000: 434). Against this background, opportunities and risks for sustainable urban development are directly related to the risks and opportunities of urbanisation. The considerations around the theoretical approximation of urban sustainability has shown that several recommendations can be drawn from the international discussion.

Holistic perspective: Different approaches have to treat the different sustainability dimensions in a holistic and integrated manner. Thus, a more holistic understanding of research and planning and a change in perspective including a more comprehensive consideration of the multitude of actors and their motives implies a deeper understanding of the multi-level driving forces of urbanization and their interconnections.

Urban governance: The implementation of sustainable development in cities requires adequate regulatory mechanisms, i.e. good urban governance, in a political multi-level system with the involvement of different groups of actors.

Urban systems: A spatial focus on urban systems puts in the focus the interdependency and interconnectedness of cities within the nation state. Viewing urban systems as metabolic entities with their own input-output relationships offers an appropriate starting point for sustainability research in urban settings. Decentralisation policies and the development of a polycentric urban system supports creating balanced development and helps limiting regional inequalities.

Guiding principles: In order to make the abstract concept of sustainable development tangible for the public, sustainability goals, developed for respective local contexts, need to be made more concrete through the establishment of guiding principles, such as the guiding principle of the "liveable", "walkable" or "compact city".

Approaches: For long-term success with the reconciliation of often incompatible priorities between environment and economic and societal development, three approaches appear to be appropriate: the efficiency, consistency and sufficiency strategy.

Transformative action fields: Most promising are leverage effects in pioneering transformative fields of action, focusing, e.g., on decarbonisation, energy and climate protection, urban health, mobility and transport, the structural-spatial design of cities, adaptation to climate change, poverty reduction and socio-economic disparities.

Alliances: In view of evolving globalisation processes and effects, urban groups of actors will have to cooperate in strategic alliances and networks, in order to enhance synergies, to avoid double-investing through a division of responsibilities, and, in the context of urban development policies, be able to react to increasing global-urban competition. Conversely, the specific contribution of cities to shaping global development processes in a more sustainable manner should not be underestimated.

Knowledge transfer: Effective components of a (more) sustainable globalisation are knowledge transfer, in the sense of exchanging successful strategies and best practices, capacity building for necessary problem-solving skills, and intercultural convergence.

Dialogue: Cities and urban societies concentrate experience and expertise, which are valuable resources that can be applied to the development of flexible, innovative and reliable approaches to problem solving. They open up opportunities for mutual learning and "city to city" dialogues.

Social coherence: The strengthening of social coherence and local identity, with a concurrent growth in public responsibility and ownership of civil society networks and institutions, can only be achieved through a change in public awareness and an expansion of public participation and dialogue.

Conclusion

Differences in urban development can be partly explained by differences in the regulatory circumstances of institutions and administrative settings in different cities. As government and administrative operations have become increasingly more complex in recent decades, especially in fast growing cities, urban governments face significant challenges. In the past, the political and economic coordination of development projects were of primary concern. However, since the introduction of the concept of sustainable development, the social and environmental dimensions have been added and have gained prominence. Modern urban systems are characterised by

complex interdependencies and interactions of different institutions, actors, functions, and spatial levels, and therefore require connected institutions and new forms of interaction between government and urban society.

Thus, urban governance comprises similar components as governance, with a focus on urban space as a geographic entity. Good urban governance can be succinctly defined as desired standards of practice which explicitly includes the safeguarding of basic needs such as safe shelter, food, drinking water, and sanitary facilities for the population, as well as access to basic social services such as education and health facilities. These aspects correspond with those of the social dimension of sustainable development. Hall and Pfeiffer therefore link good urban governance with the concept of sustainable development: Good urban governance is the "(…) driving political force that keeps individual aspects of sustainable development in balance and integrates them in the different areas of policy" (2000: 217).

In order to realize positive urban development outcomes, individual actors and institutions in a city have to reliably take on responsibility: "Sustainability as a principle, good governance as its implementation – these are the two inseparable aspects of a positive urban development" (Hall/Pfeiffer 2000: 217). In addition, they identify several guidelines to be followed in order to reach the goal of positive urban development based on the principle of subsidiarity in a way that decisions need to be made or services to be provided at the lowest level of government that can perform functions efficiently and effectively. This principle is closely linked to decentralisation, a functioning feedback system, good coordination of decision-making processes and consultation between the different levels of government.

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JĀTAKA STORIES: THE ANTERIOR LIVES OF BUDDHA (JĀ.1- JĀ.547) INTERPRETED DURING THE BAGAN PERIOD*

Ko Ko Toe Lwin Thaw[1]

Abstract

Among the themes of Buddhist visual art, *Jātaka* stories have mostly reflected on social lives of Bagan people especially on performers and the characters intermingle as main icons and supporting icons in a single scene of *jataka* stories. The stories gave moral and ethical education to the common people and they were reflected with Bagan life-style. *Jātaka* stories are depicted at the most temples as interior wall mural painting decoration and adorned at many prominent solid-pagodas as the exterior glaze plaque decoration. *Jātakas* are mostly illustrated on the side walls of vestibule or entrance hall in the temples. In fact, these real narrative stories are transformed into the static scenes of narrative performance. Most *Jātaka* plaques and mural panels have serial numbers, captions of title and mentioned notes under them. They can be identified easily by mean of iconic and narrative patterns if they have without captions. The kind of *Jātaka* with Burman caption is different from those with Mon caption on figural attitude and scenic composition and even interpretation on each story is distinguished each other because of their religious concepts and different times of early and later periods. Most Bagan narrative stories murals and plaques are arranged in the pattern of square or rectangular panels. Few are in the pattern of circular tondos. The study will comparatively focus and examine the *Jātaka* stories between plaques and murals.

Keywords *Jātaka*, interpret, icon, mural, glaze, decoration, caption, panels, tondos

Research Method qualitative, quantitative, descriptive, comparative and field research methods

Introduction

The *Jātaka* stories especially the last ten stories of previous lives of Buddha are the favourite themes of Bagan people. In fact, *Jātakas* were used as popular media of instruction in ethical and moral ideas and illustrative education. But Ananda *Jātaka* plaques are situated in the inaccessible and invisible places for the common folks so they were probably used for canonical references only that will be sometime used to compromise as evidential criterions.[2] Among the themes of Buddhist visual art, *Jātaka* stories have mostly reflected on social lives of Bagan people. The characters intermingle as main icons and supporting icons in the single scene to illustrate 537 short *Jātaka* stories. Few last ten *Jātaka* stories found in Bagan are illustrated in many scenes. The *Jātaka* stories gave moral and ethical education to the common people and they were reflected with Bagan life-style, so the themes and events of these stories will be explicitly examined in prior.

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* Best Paper Award Winning Paper in History (2022)

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[2] See Figure 1 Source, Photo Taken by Than Zaw (Bagan), Private Communication

Figure 1 Glaze Plaques of *Jātaka* Stories, as Exterior Decoration, the Upper Part of Ananda[1]

Jātakas constitute 547 stories of former births of Buddha that can be divided as the 537 shorter stories of former 21 books and the last ten longer stories of 22nd book. *Jātaka* stories are depicted at the most temples as interior wall painting decoration and adorned at many prominent solid-pagodas as the exterior glaze plaque decoration. *Jātakas* are mostly illustrated on the side walls of vestibule or entrance hall in the temples. In fact, these narrative stories are transformed and illustrated as the static scenes of narrative performance. The interpretation of earlier short 537 stories and the last ten long stories are distinctively verified and examined.

The Comparative Study between *Jātaka* Plaques and *Jātaka* Mural Panels of Bagan

Most *Jātaka* plaques and mural panels have serial numbers, captions of title and mentioned notes under them. They can be identified easily by mean of iconic and narrative patterns if they have without captions. For instance, in some narrative scenes of later Bagan period, images of Bodhisattva called *purhā loṅ* meaning the Buddha-to-be are frequently illustrated under parasols as Burman style which are traditionally used as a piece of regalia for royalty. In the small panel scenes of *Jātaka* depicted with small figures on nearly full of wall, they are difficult to be identified who Bodhisattva is there, so it can be pointed out with an umbrella that distinguished with others. Some images can be identified according to head dresses for example, royalty has adorned with crown and others have various hair-knots.[2]

[1] Most figures used in this paper is supported by Than Zaw (Bagan) who is a Bagan Mural specialist.

[2] See Figure 2 and Figure 3, Source- Photo Taken by Researcher, each scene is composed of three different kinds of social life-styles _the king, minister/ chaplain and an average person of attendant with each has own hair dress

Caption / ဂါမဏိဇာတ် ပုရာလောင် အမှတ် ၈

//gāmani jat purhāloṅ amat 8

Caption /သိလဝိမသ် ဇာတ် ဗြောဟိတ်။ ၈၆။

// silavimaṅsa jat brohit //86//

Figure 2 (left) JĀ. 8, Gāmani *Jātaka*: Minister Who Is Bodhisattva with Parasol, Wetkyi-in Kubyauk-gyi

Figure 3 (right) JĀ. 86 Sīlavimaṁsana *Jātaka*: Chaplain with Parasol, Wetkyi-in Kubyauk-gyi

Jātaka with Burman caption is different from those with Mon caption as well as figural attitude and scene composition and even interpretation on each story is distinguished between each other because of their religious concepts and different times. Most Bagan plaques and murals of narrative stories or *Jātakas* are arranged in the pattern of square or rectangular panels, but few figures are in tondos that can be seen in illustrating tondo *Jātakas* in M.1826 temple.[1]

Figure 4 Tondo Art, the Rows of Tangent Circular Floral, *Jātakas* and Floral Friezes from Vaulted Ceiling down to Upper Wall, M. 1826, Source- Photo Taken by Researcher

As the said scenes of *Jātakas* are one of the favourite themes of Bagan muralists and sculptors as well as of Bagan audiences. In Bagan period, "among the *Jātakas*, the last ten longer stories, especially *Sama* JĀ-538, *Janaka* JĀ-539, *Mahosada* JĀ-542 and *Vessantara* JĀ-547, were most prized and read; they have been translated in prose and verse, and turned into

[1] See Figure 4, M is referred to Monument. Source- Photo Taken by Researcher

theatrical plays or dramas".[1] The plaques and panel scenes of murals illustrated with *Jātaka* stories can be defined as static performance which reflects real live performances and real life-styles of Bagan people.

"A number of inscriptions at Bagan refer to the paintings, mentioning that 'on the walls were beautifully painted the scenes from the 500 *Jātakas*', and that 'on the walls of the hollow-pagoda were painted 14,619 Buddhas and scenes from the 550 *Jātakas*".[2] To compare with stupa, temple seemed to be more popular as they provide many interior walls and ceilings on which the scenes from the *Jātaka* could be painted as decoration and education. "Moreover, the paintings of canonical narrative scenes were the most effective means of convincing the common folk how to get the merit of giving alms and of meditation".[3]

In the inscription dated A.D. 1239, a donor, *Siri Mahādhammarajapaṇḍit* recorded Pali Pitaka texts following as // *Visuddhimagga 1 klam*//*Sut Sīlakkhandhā 1 klam Majjipannāsa, Suttanipat* // *Dhātuvaṅ*// *Mahāvaṅ* / *Catu-nipat Jat Athakathā* / *Nibbāna sut*//.[4] Among these texts, some Buddhist narrative stories would be cited and represented for narrative scenes and real performance. So many Pitaka texts were used to be dedicated to the monks, they became references of monks who would instruct the artists to illustrate the stories.

Stories of the anterior births of Gautama Buddha known to the old Burmans sometimes as *jat ṅā ryā*_ 500 birth stories, and sometimes as *jat 550*_ 550 birth stories, are also popular themes for painting on interior walls of temples and for plaques decorated on the outer parts of hollow-pagodas and solid-pagodas. Actually, there are only 547 stories. Strangely the *Jātaka* plaques at West Phetleik pagoda, found in earliest time of Bagan period so far, mentioned complete 550 stories. To reach number 550, the 547 *Jātakas* are added three stories such as *Velāma Jātaka, Mahagovinda Jātaka* (Dhīgha Nikāya, Mahagovindasutta) and *Sumeda- paṇdita Jātaka*. There are six other pagodas belong to Bagan period which have only number 547 each. The six pagodas for plaques in exterior walls are: the East Phetleik solid-pagoda (by Aniruddha), the Shwe Sandaw solid-pagoda (by Aniruddha), the Shwezigon solid-pagoda (by *Thiluiṅmaṅ*), the Ananda hollow-pagoda (by *Thiluiṅmaṅ*), the Dhammayazika mix type of temples and stupa, (by *Cañsū* II) and the Mingalazedi solid-pagoda (by *Tarukpliy*).[5]

Most temples are mainly decorated with *Jātakas* in the entrance vestibule or entrance hall. Good examples of displaying mural *Jātakas* can be seen in the temples of Myinkaga Kubyauk-gyi(M-1323), Pahtothamya (M-1605), Lokahteikpan (M-1580), Wetkyi-in Kubyauk-gyi(M-298), Maungyon (M-600), Vinido (M-659) and Thingayaza (M-1051) which have captions of titles and brief mentioned notes engraved under narrative images of each plot of *Jātaka*. The ink gloss captions of *Jātakas* of the first three temples are in old Mon. In the scene of Lokahteikpan, caption is labeled using bilingual of Mon and Myanmar for *Jātaka* stories_ the twenty shorter stories from the first twenty books are captioned in Mon and a story from 21st book and the last ten stories from 22nd book in Burman. *Jātakas* of the rest temples above are mentioned only in

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[1] Chas. Duroiselle, "The Talaing Plaques on the Ananda, Text", *Epigraphia Birmanica*, Vol. II, Part I, Yangon, Government Printing,1921 p. V (Hereafter cited as Chas. Duroiselle, "The Talaing Plaques on the Ananda, Text")

[2] (a)Pl.105, (b)Claudine Bautze-Picron, *The Buddhist Murals of Pagan: Timeless Vistas of the Cosmos*, Bangkok, Orchid Press, 2003, p.2, (Hereafter cited as Bautze-Picron, *The Buddhist Murals of Pagan*) (c)Dr. Than Tun, "History of Buddhism in Burma", *A.D. 1000-1300*, Ph.D. Thesis Submitted to SOAS, Revised and Enlarged Edition, *Journal of Burma Research Society, Vol. LXI, i & ii,* Yangon, Burma Research Society, 1978, pp.64,141(Hereafter cited as Dr. Than Tun, "History of Buddhism in Burma")

[3] Dr. Than Tun, "History of Buddhism in Burma", p.141

[4] U Nyein Maung, ရှေးဟောင်းမြန်မာကျောက်စာများ (*Old Burma Inscriptions*), Vol.1, (Hand Writing), Yangon, Archaeological Department, 1972, p. 289 (Hereafter cited as *OBI-I*)

[5] Dr. Than Tun, "History of Buddhism in Burma", p.65

old Burman. The above captions also define the three cultural periods of Bagan called early (Mon), transitional (Mon and Burman) and later (Burman) periods.

The last longer ten stories of previous lives of Buddha are illustrated in many episodes but the rest former 537 *Jātakas* are always depicted in the pattern of one plaque for one scene. The media materials are always used of plaque or mural on wall_ the former is depicted on the exterior wall or in the roof decoration and the latter for an interior decoration. The Ananda pagoda has nearly 1500 *Jātaka* plaques in which the arrangement of displaying stories is made in two divisions; "the first representations of the *Jātakas*, one story to one plate from *Ekanipat* to *Arsītinipat* (Nos. 1 to 537 *Jātakas*) totally up to 537 plaques as well as the second representations for the last ten stories (*Mahanipat*) from *Mūgapakkha* (*Temi*) *Jātaka* to *Vessantarā Jātaka* (From JĀ-538 to JĀ-547) amounted to 389 are illustrated each in a series of plaques on the roof and the receding terraces. It is not peculiar to Ananda because they are found on several other pagodas and temples at Bagan. It could be sure that the feature is unique, for no other monument in the Buddhist world has so large a number of separate scenes of plaques like Ananda".[1] In *Jātaka* plaques, the caption is used for only serial number and the name of each *Jātaka* but in mural, each *Jātaka* is always labeled with number, title of *Jātaka* (always in Pali) and short mentioned note always for life or career of Bodhisattva.

The Myinkaba Gubyaul-gyi has painting of the 547 *Jātaka* stories on its walls with Mon glosses of Pali titles and short mentioned notes, but they are unnumbered.[2] The mentioned notes are little different from Mon and Burman for their own interpretations on the story. The common name of Buddha's previous existence is indicated as *Bodhisat* (Bodhisattva) in Mon and *purhā loṅ* (Buddha- to- be) in Myanmar. In the comparative study between the Mon captions of Kubyauk-gyi (Myingaba) M-1323 in A.D. 1113 and the Burman captions of Kubyauk-gyi (Wetkyi-in) M-298 in early 13th century A.D., we found the different usages between Mon and Burman i.e. ပဏ္ဍိတ် *paṇḍit* is applied in Mon and ပညာဟိသသူ *praññā hi sa sū*[3] and သုခမိန် *sukhamin*[4] in Burman for wise man or sage, အွာရ် *acār* in Mon သမာ *samā* in Burman for doctor, Deva ဒေဝ in Mon, *nat sā* နတ်သာ in Burman for celestial gods and Indra in Mon, Sakrā in Burman for the king of 33 gods. In this case, it is obviously found that Burmans of Bagan have used their own terminological roots or they have coined the new terms based on Pali by their own ways while Mon in Bagan have applied Pali-Sanskrit adaptation words as classical term.

In the representation of *Jātaka* stories, Wetkyi-in Kubyauk-gyi used the division of volumes of *Jātaka* stories which is arranged from *eka nipāta*, *dukka nipāta* etc. to *mahā nipāta*. The caption of *Sañjiva Jātaka* no. 150 shows *Disābrāmuik eka chuṁ* (a world-famous teacher, end of *Nipāta* I). The next *Jātaka* resumed with the number one of second volume, third, fourth and so on.[5] *Jātaka* stories were arranged by mean of each *Nipāta* or book. But there are some mistakes _ the number one ahead the Sinhalese order from JĀ-171 until 265 because a *jātaka* named *Supāta jat* is wrongly illustrated. The stories from JĀ-497 till JĀ -503 are omitted and some stories are actually in blank. No.272 *Jātaka* is illustrated twice. Moreover, the places from JĀ-257 till JĀ-264 are inserted with scenes and captions from *Buddhawaṁ*.[6]

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[1] Chas. Duroiselle, *The Talaing Plaques on the Ananda, text,* p. v

[2] Ibid, p.83

[3] JĀ-6, JĀ-49, JĀ-89 in the *Jātaka* Panels, Wetkyi-in Kubyauk-gyi,

[4] *Jātaka* JĀs 110,112,170, 364,401, 402, 403, 413, 441, 452 in the *Jātaka* Panels, Wetkyi-in Kubyauk-gyi

[5] See Figure 5, Source- Photo Taken by Researcher

[6] (a) Ba Shin, K. J. Whitbread and G. H. Luce, "Pagán, Wetkyi-in Kubyauk-gyi, an Early Burmese Temple with Ink-Glosses", *Artibus Asiae,* Vol. 33, No. 3, 1971, pp.200-217, (Hereafter cited as Ba Shin, "Pagán, Wetkyi-in Kubyauk-gyi)

(b) Based on *Jātaka* Stories' ink glosses in Hall-Shrine.

Caption / *စူလကာလင်္ဂဇာတ် ပုဏ္ဏာရသီ။ စတုတ် အစ။* //*culakālaṅgajat buṁnā rasi catuk ac*//

Figure 5 Brahman Hermit Beginning of *Nipāta* IV, Source- Photo Taken by Researcher

Divisions of books can be found in the mural panel scenes of the temple, Lokahteikpan. They are particularly arranged, differed to other serial order of *Jātakas,* one panel scene for one *Jātakas*, but one panel scene for one book. "The first twenty-one *nipātas* or books of *Jātakas* are summarized with a limited number of panels in which twenty *Jātakas* cover the upper two rows (Mon captions) of the western wall in the shrine and a *Jātaka*, *Sutasoma Jātaka*, JĀ-537, the extreme left part of the third row of that western wall (Burman). They are followed by a detailed rendering of the first eight *Jātakas* included in the twenty-second book entitled the 'Great *nipāta*' called *Mahānipāta*, which cover the remaining right part of the third row and the following fourth to fourteenth rows. As for the last two *Jātakas*, the *Mahosadha* and the *Vessantara*, they are on the two walls of entrance hall".[1] So can be defined that the two stories mentioned above became the favourite themes of Bagan people like those of today Myanmar but they differ to the order of *Jātakas* between them.

It is Lokahteikpan that is distinguished to the any other temples for all the scenes of *Jātakas* and *Buddavaṁ*, displayed on nearly almost all the walls are mentioned in the said two languages except 28 Buddhas on the north wall of Shrine which are captioned in only Mon language. According to the spatial art, the top two rows in Mon are reserved for Mon script writers and artists and the rest rows from the third to the lowest bottom for Burman respectively. The last ten *Jātaka* stories, *dasajati*, ten births were particularly favoured by Bagan artists and artisans. We found about the dedication of *Mahānipāta* called *Dasajat* in the inscription dated A.D. 1273 situated at Min Khaung Pagoda at Pyay, the old city.[2] In this inscription, the donor and architect of pagoda recorded as "*Pisukā Ṅa Pisaṅ nhaṅ atū pluso Dasajat 1klaṁ Abhidhammā 17klaṁ*[26-27] *ဗိသုကာ ငါသင်္ဂဉ်အတူ ပ္လုသောဒသတော် ၁ကွမ် အဘိဓမ္မာ ၁၇ ကွမ်"* means the architect, *Pisukā Ṅa Pisaṅ* and the donor made canonical texts such as a set of *Dasajat* (Last Ten Stories)

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[1] Bautze-Picron, *The Buddhist Murals of Pagan*, p.75 (Bautze-Picron mentions the shorter stories as 20 books and Mahānipāta as 21st books)

[2] U Nyein Maung, *ရှေးဟောင်းမြန်မာ ကျောက်စာများ* (*Old Burma Inscriptions*), Vol.3, (Hand Writing), Yangon, Archaeological Department, 1983, pp.87-89 (Hereafter cited as *OBI*, *III*)

and 17 sets of *Abhidhammā* for pagoda and monastery.[1] It is noted that architect, mason and painter are essential for creation of art works and religious edifices as well as they were assumedly skillful in canonical texts. So, they have received the most price and prize for their art works from donors. Whereas, *Tipitakas*, canonical texts had ever been well known by monks and educated lay people, they were distributed in public using media of visual arts and performing arts.

The performance is closely related to canonical texts especially in *Jātakas* nos. 59, 60, 116, 179, 212, 243 and 309. Bodhisattva of each *Jātaka* was reborn as a performer of specific different career as well as fairy musician, kinnara in *Jātaka* JĀ-485. The Bodhisattvas (Buddhas-to-be) were reborn as instrumentalists _a drummer (*cañ sañ*) in JĀ-59 *Bherivāda jātaka,*[2], a conch blower (*Khrusaṅ sañ*) in JĀ-60 *Saṁkhadhama Jātaka*,[3] a harpist (*coṅ tat*) in JĀ-243 *Guttila Jātaka*.

Caption /ab&Oy'Zmw aAm'ow'o aumen;rwuz/ oc"rZmw aAm'ow'o aumen;r rloi

Figure 6 (right) *Bherivāda Jātaka* JĀ-59 with the Mon Caption Means that Bodhisattva Is a Drummer,

Kubyauk-gyi (Myinkaba) Source- Photo Taken by Than Zaw (Bagan), Private Communication

Figure 7 (left) *Saṁkhadhama Jātaka* JĀ-60 with the Mon Caption Means that Bodhisattva Is a Conch Blower,

Kubyauk-gyi (Myinkaba) Source- Photo Taken by Than Zaw (Bagan), Private Communication

In the terms of old Myanmar, there is a little different word for music player between inscription and ink gloss caption for instance the former mentions *coṅ sañ*[4] for harpist instead of using *coṅ tat* in the caption of ink gloss found in a *Jātaka* called *Guttila* JĀ-243 of Kubyauk-gyi (Wetkyi-in). In Mon ink gloss of Kubyauk-gyi (Myinkaba), the caption of same *Jātaka* describes as *acār tana* (အစာရ် တန) that means a teacher for music of harp.[5] *Coṅ sañ* of inscriptions defines ordinary harpist but *coṅ tat* in old Burman and *acār tana* in old Mon captioned for *Guttila Jātaka* means a professional musician for string instrument of harp.

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[1] G.H. Luce and Pe Maung Tin. *Inscriptions of Burma*, 5 Portfolios, Oxford, Oxford University Press, 1933- 57, Plate. 242 Lines 26-27 (Hereafter cited as Pl. for example Pl.242[26-27])

[2] See Figure 6 Source- Photo Taken by Than Zaw (Bagan), Private Communication

[3] See Figure 7 Source- Photo Taken by Than Zaw (Bagan), Private Communication

[4] Pl.265[35]

[5] See Figure 8 and Figure 9 Source- Photos Taken by Than Zaw (Bagan), Private Communication

Caption / ဂုတ္တိလ္လဇာတ်။ ဗောဒီသတ်ဒသ် အစာရ်ံ တန။ ဂုတ္တိလ္လဇာတ် ၂၄၃

Figure 8 *Guttila Jātaka* with Mon Caption, Mural, Two Harpists, Dancer and King, Myinkaba Kubyauk-gyi

Figure 9 *Guttila Jātaka/*, Plaque, the Same Icons to Figure 8, Ananda, Source- Photos Taken by Than Zaw

(Bagan), Private Communication

This story mentions about the contest of plucking skill on string instrument of Harp between the teacher named *Guttila* and his pupil who finally became a loser. To depict the story, two harpists before the king are always illustrated in the scene whereas sometimes the female celestial dancer on the side of teacher is inserted in the scene to help him. In this story, Bodhisattva is *Guttila* who is a teacher of lutenists.

In JĀ-116, Dubbaca *Jātaka*, Bodhisattva became an acrobatic dancer, called in Myanmar word *khun ka so sū* (ခုန်ကသောသူ). Unfortunately, the image was damaged, but the style of the dancer can be traced in Ananda plaque of the same story.[1] In JĀ-212, *Ucchiṭṭhabhatta Jātaka*, Bodhisattva became a poor acrobatic dancer, *suchuiw ṅray kakhriy* (သူဆိုဝ်ငြယ် ကခြိယ်)[2] in which case Myanmar language refers to "a dancer" for each career but canonical texts indicates an acrobat. The term could be corrected as an acrobat with spear (လှံခုံစသောသူ) in the *Jātaka* caption of Vinido temple M-659.[3]

[1] (a)Ba Shin, "Pagán, Wetkyi-in Kubyauk-gyi", p.204
(b) See Figure 10 Source- Photo Taken by Than Zaw (Bagan), Private Communication
[2] Ba Shin, "Pagán, Wetkyi-in Kubyauk-gyi", p.207
[3] See Figure 11 Source- Photo Taken by Than Zaw (Bagan), Private Communication

Caption / ဒုဗ္ဗစောတ် ၁၁၆ **/ဒုဗ္ဗစောတ် လှုံခုန်စသော (သူ)**

Figure 10 (right) *Dubbaca jātaka* JĀ-116, an Acrobatic Dancer, Plaque, Ananda
Figure 11 (left) *Dubbaca jātaka* JĀ-116, Vinido M-659, Source- Photos Taken by Than Zaw (Bagan), Private Communication

In the last ten stories, the supporting characters of dancers and instrumentalists revealed in narrative visual scenes and scriptures are the provable evidences that performances are essential in Buddhism. They are beautifully, widely arranged and illustrated as mural panels on the interior walls of Lokahteikpan temple and as the plaques at Ananda. The paintings of Lokahteikpan can be compared with those of any other temples such as Nagayon, Pahtotharmya and even Abeyadana which is said, the best model of the finest murals. Nonetheless, the finest murals of *Mahā Nipāta* can only be seen in Lokahteikpan. The numbers of mural stories of *Maha Nipāta* in Burman style of Lokahteikpan and of glaze plaques of the longer ten stories in Mon style of Ananda, were more used to depict some scenes of *Jātakas* than others according to the profound sense of the canonical instructor, the monk.

It is noted that both Burman and Mon preferred Vessantara and Mahosadha to other eight stories of *Maha Nipāta*, but the Mons have changed the serial order of arrangement for *Maha Nipāta*, Last Ten *Jātakas*. In Lokahteikpan, two recent former life stories of Buddha are fully decorated with many narrative scenes on the two walls of entrance hall. In this case, Burman script-writer of Lokahteikpan has followed the order of Sri Lanka.

The Order of Last Ten *Jātaka* Stories

Order	Sri Lanka	Lokahteikpan	Ananda	Myinkaba Kubyauk-gyi	Modern Myanmar
1	Mūga-pakkha 538	Temiya 538	Temī	Temī	Temiya (aw)
2	Mahā Janaka 539	Janaka 539	Janak	Janak	Janaka (Z)

Order	**Sri Lanka**	**Lokahteikpan**	**Ananda**	**Myinkaba Kubyauk-gyi**	**Modern Myanmar**
3	Suvaṇṇa Sāma 540	Sāma 540	Syām	Syām	Suvaṇṇa Sāma (ok)
4	Nimi 541	Nemi 541	Nemi	Nemi	Nemi (ae)
5	Kandahāla (CandaKumāra) 542	CandaKumāra 542	Mahos	Maho	Mahosadha (r)
6	Buridatta 543	Buridatta 543	Candakumār	Candakumār	Buridatta (bk)
7	Mahānāradakassapa 544	Nārada 544	Bhūridat	Bhūridat	Canda (pef)
8	Vidhurapandita 545	Vidhura 545	Nār	Nārada	Nārada (em)
9	Mahā-Ummagga 546	Mahosadha 546	Widhir	Widhir	Vidhura (0d)
10	Vesantara 547	Vesantara 547	Wisantar	Wesantara	Vesantara (a0)

According to the canonical masters of Aananda, 124 plaques for *Wisantar* (Vesantara) and 95 plaques for *Mahos* (Mahā-Ummagga), 45 for *Janak* (Mahājanaka), 37 for *Temī* (Mūgapakkha), 24 for *Widhir* (Vidhurapandita), 21 for *Bhūridat* (Bhūridatta), 19 for *Syām* (Sāma), 13 for *Nemi* (Nimi), 9 for *Candakumār* (Khandahala) and 3 for *Nār* (Mahānārada kassapa)[1] are arranged on the second roof and three receding terraces above it of Ananda[2]. The differentiate numbers among *Jātakas* at Ananda are much more than those of Lowkahteikpan. The number of plaques gradually reduced from most favourite to the least favourable story. "The different numbers of plaques of *Jātakas* indicate the popular interesting of Bagan on the last ten stories. The great popularity of *Vessantara Jātaka* in Myanmar has been noticed for his practice of *Dāna* (charity), one of the ten perfections (*pāramī*) that was striking sympathetic chord in Bagan society".[3]

To point out the study of the visual art, the composition and attitude of imagery in the illustration of the *Jātaka* stories are important for the viewers. "There are two types of composition_ one asymmetric and imbued with movement and energy, and one based on a strict symmetry developed about a central figure. For instance, Bodhisattva alone occupied a half of the scene, usually the left one and a group of worshippers face him which implies that he is also

[1] Tun Aung Chain, *Glimpses of Myanmar History*, *Texts and Images*, Yangon, SEAMEO, 2011, p.83(Hereafter cited as Tun Aung Chain, *Glimpses of Myanmar History*)

[2] Chas. Duroiselle *The Talaing Plaques on the Ananda, Text*, p. V

[3] Tun Aung Chain, *Glimpses of Myanmar History*, *Texts and Images*, p.85

taller than his companions. The other composition is imbued with a strict symmetry showing the Bodhisattva in the foreground and in the centre of the square panel".[1]

Among the last ten stories, the *Jātakas* closely related with performance will be examined between Ananda and lokahteikpan pagodas. In the scene of *Temi* (*Mūgapakka Jātaka*), *Jātaka* plaques of Anada reveal more performing figures with the Prince *Temi* than those of Lokahteikpan mural panels. In the test scenes with devices that are related to performance of Ananda plaques, Bodhisattva is mostly in a reclining posture on his couch whereas he is always in a sitting attitude in those of Lokahteinpan murals. In Ananda, 37 plaques of separate episodes were used to illustrate *Temi Jātaka* in which the first scene starts with the episode of Indra's inviting to Future *Temi* in the Tāvatiṁsa to be reborn as a son of Candādevī, the chief queen of the king of Benares. In this story, *Temi*, actuated by the fear of hell resulted from the cause of kingship and on the advice of a goddess, pretends to be dumb.

According to the modern Myanmar texts, the king and his services test seventeen ways with many resorted devices to ascertain whether he is really so dumb, but all fail. The story discusses the *nekkhama pāramī* (perfection of renunciation) and *khantī pāramī* (perfection of forbearance). In this case, the artist and script writer used 16 plaques in Ananda for 16 scenes of testing tricks i.e. 1.*Khīra vimaṅsa*_ the trial with milk 2.*Pūwakhajjana wimaṅsana*_ the trial with cakes 3.*Biḍat ku sacchu*_ try with fruits 4.*Kīlābhaṇḍaka wimaṅsana*_ the trial with toys 5.*Bhojana wimaṅsana*_ the trial with food 6.*Biḍat ku cīṅ*_ try with elephants 7.*Biḍat ku jruṁ*_ try with snakes 8.*Samajja wimaṅsana*_ the test of the mime 9.*Biḍat ku snāk*_ try with a sword 10.*Biḍat ku saṅ*_ try with conches11.*Biḍat ku phaṁ*_ try with drums 12.*Biḍat ku pnāṅ*_ try with lamps 13.*Biḍat ku taṅglāy*_ try with molasses 14.*Biḍat ku haḍak*_ try with filth 15.*Kapalla wimaṅsana*_ the test with fire pan 16.*Nāṭaka wimaṅsana*_ trial with nautches or personal dancer.[2]

The Mon artists for Ananda, assumedly, omitted or missed the scene of the test with burning the house in which *Temi* was staying that are mentioned in old and modern Burman versions. They had chosen the test scenes as the climaxes of the story by using 16 plaques for 16 episodes that amount up to nearly the half of all scenes. Among the testing plots, the four tests are used with dancers and instrumentalists to elicit some words from Temiya. The Mon script writer used some Pali adopted words to mention the narrative episodes. The narratives are more vividly précised and more specific to cover the story than those of any other pagoda.

In the mural scenes of Lokahteikpan pagoda c.1120 A.D. that is fifteen year later than Ananda c.1105 A.D.,[3] the last ten stories are reserved for Burman script writers and artists. All last ten painted *Jātakas* have been mentioned with archaic Burman scripts as painted inscriptions. The story is illustrated in the 3rd row and 4th row on the west wall of the shrine. The scenes have continuously run from left to right, episode by episode, without partition of panels within the row. But we can easily identify the kind of scene according to the captions below each scene. In *Temiya Jātaka* of this temple, the performing images with the prince are also seen at the testing episodes.

The first scene of *Temi* starts with the episode of the monk's asking Buddha to preach the law, Dhamma for the past story of Temiya. The concept of interpretation and representation on

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[1] Bautze-Picron, *The Buddhist Murals of Pagan*, p.71

[2] (a)Chas. Duroiselle, The Talaing Plaques on the Ananda Tex*t*, pp.1-8
(b) Chas. Duroiselle, The Talaing Plaques on the Ananda Index, *Epigraphia Birmanic*a, Vol. II, Part II Yangon, Government Printing, 1961, pp.2-12, plates, I-IV (Hereafter cited as "The Talaing Plaques on the Ananda Index")

[3] G.H. Luce and Bohmu Ba Shin, "Pagan Myinkaba, Kubyauk-gyi Temple of Rājakumār (1113 A.D.) and the Old Mon Writings on its Walls" *BBHC*, II, Myanmar Historical Commission, 1961, pp.288-329 (Hereafter Cited as G.H. Luce and Bohmu Ba Shin, "Pagan Myinkaba, Kubyauk-gyi Temple")

Jātaka defers even between Mon and Myanmar as well as early and later pagodas. In fact, what the most important is, is the local art works and their talents on cannon. The caption of the first test scene is illegible.2.*Purhāloṅ sacsī phlaṅ caṁ e_* they test Buddha-to-be with fruits, 3.*Purhāloṅ chaṅ mraṅ yoṅ caṁ e_* they test Buddha-to-be with toys of elephant and horse 4.*Purhāloṅ thamaṅ caṁ e_* they test Buddha-to-be with food 5.*Purhāloṅ im phut so caṁ e_* they test Buddha-to-be by setting house fire 6.*Purhāloṅ chaṅ huyciy aṁ caṁ e_* they test Buddha-to-be by seemingly causing an elephant to charge him 7.*Purhāloṅ mruy rac so phlaṅ caṁ e _* they test Buddha-to-be by coiling him with a snake 9.*Purhāloṅ coṅ ṅheṅ phlaṅ e caṁ e _* they test Buddha-to-be with harp and trumpet 9.*Purhāloṅ snek*[1] *phlaṅ e caṁ e_* they test Buddha-to-be with the sword 10.*Purhāloṅ khuru mhut so caṁ e_* they test Buddha-to-be by blowing conch-shells 11.*Purhāloṅ miy' uiw caṁ e_* they test Buddha-to-be with clay pot-lamp 12.*Purhāloṅ keṅkrī caṁ e_* they test Buddha-to-be with excrement 13.*Purhāloṅ mī caṁ e_* they test Buddha-to-be with fire 14.*Purhāloṅ myā caṁ e_* they test Buddha-to-be with wives 15.*Purhāloṅ samī caṁ e_* they test Buddha-to-be with daughters.[2]

Caption / ပုဏ္ဏာလောင် ဆင်ဟုယ်စိယ်အံ့သောဖွင့်စေံအော်။ ပုဏ္ဏာလောင် မြှယ်ရစ်သောဖွင့်စေံအော်။ ပုဏ္ဏာလောင်စောင်ငှေင် ဖွင့်စေံအော်။ ပုဏ္ဏာလောင် သွေက်၏စံ၏။ ပုဏ္ဏာလောင် ခု…

Figure 12 Row of Long Panels and Captions are the Narrative Scenes for *Temiya Jātaka*, Second Row Is for Janaka, Lokahteikpan, Source- Photo Taken by Than Zaw (Bagan), Private Communication

In this case, Burman used more own glossaries than Mon, but the order of test is not précised and some tests are excluded such as tests with cakes, drums and molasses. They install the test with burning house that the Mon has omitted and the last two tests are overlapped. A very interesting case is that the test with entertainment is mentioned by playing harp and blowing trumpet. They are represented to the form of theatrical drama but they do not use the word *pantyā* that probably means narrative performance and performers. In the illustration of *Temiya Jātaka*, Buddha-to-be (Bodhisattva) is in sitting posture before the pair performers of whom a man is plucking five strings of *coṅ* _ Myanmar arch harp and a woman is blowing trumpet called *ṅheṅ*.

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[1] Old Mon word, compare with Ananda caption of test with sword, later, Burman of Bagan used *Sanlyak* for sword

[2] (a) Ba Shin. *Lokahteikpan: Early Burmese Culture in a Pagan Temple,* Rangoon, The Burma Historical Commission, 1962 Myanmar text, pp.53-54, English Transliteration, pp.91-92, English Translation, pp.122-123 (Hereafter cited as Ba Shin. *Lokahteikpan*) (b) See Figure 12 Source- Photo Taken by Than Zaw (Bagan), Private Communication

In two musical instruments they held, the harp is clearly prominent and the trumpet is fade out because of white wash, but it can be seen if carefully.[1]

In the scene of coronation ceremony of *Janaka Jātaka*, the elder prince namely *Aritthajanaka*, the crown prince who is sitting under a white umbrella and a Brahman who is blowing the conch for *Abhiseka* is illustrated in the mural of the fifth row on the west wall of shrine in Lokahteikpan.[2] Some figuring styles are good example of asymmetric art in which the artists magnify supporting images that can be seen at the scene of the goddess' rescuing the Bodhisattva from the sea. The scene represents that *Maṇimekhalā* carries *Janaka* in her arms by flying through air in which the movement acting posture can be well portrayed in Lokahteikpan.[3] The figure of main icon, *Janaka* is minimized and the support icon, goddess is magnified.

Caption ။ r[mZeu rnaomri oc&um tavmr rivwpum riaumiu , b{t/riom*um £r&, rir aom t&w Zeuaw; vwpum ri*armuw{t/num£rt&, t rir{t? £rt&, t rip,aom.

Figure 13 Crown Prince, *Aritthajanaka* under white Umbrella who is Father of Bodhisattva is Raised as the King, the Brahman Blows the Conch-shell for *Abhiseka*

Caption/ oiazmaumv ,{t/oiazm0u ,&um/ rearcvmEipum;q0av{t? rearcvm y&mavmiu0qm ,&, y:av{t?

Figure 14 Four Episodes of *Janaka*, the Ship Splits, *Janaka* Climbs the Ship's Mast, he Converses with *Maṇimekhalā*, the Goddess and she Carries Bodhisattva in her Arms through Air, Lokahteikpan

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[1] See Also Figure 12 Source- Photo Taken by Than Zaw (Bagan), Private Communication

[2] See figure 13 Source- Photo Taken by Than Zaw (Bagan), Private Communication

[3] See figure 14 Source- Photo Taken by Than Zaw (Bagan), Private Communication

At first, the goddess places Bodhisattva on a rock in a garden. And then the artist illustrated the plot mentioned that the princess *Sīvali* is squeezed by a minister called *amatyā* for intentionally please to her. The main climax of story continues that a 'Living State Carriage' arrives near Bodhisattva, a Brahman of royal chaplain, examines the marks on soles of the feet of Bodhisattva who is in lying attitude on the stone. The troupe scene is composed of two drummers, four singers who entertain him. The last scene in the figure is that the Bodhisattva under umbrellas who dressed the crown is raised as the king by a Brahman holding a conch to blow it as a musical instrument.[1]

Caption ။ပုရာလောင်လောင်ကိုဝ် ဥယန်တွာင်ထွောက်ထက်ထာယျေအ်။ မင်သမီသိဝိလိတေး အမတျာနှစ်ကွိုအ်စိလိုသ်ရကာခြိုယ်

qy{t/&xm&iavw&, y&mavmi [&mvma,st yemwpa,mu lc, vuem&&um y&mavmiaw; .

Figure 15 Bodhisattva Lying on the Rock who Entertained by Royal Troupe, Lokahteikpan

In *Buridatta Jātaka*, dragons of Ananda are depicted as if they are human beings who have human faces wearing dragon head-dress look like snake. The suitable costumes and head-dresses were arranged to depict the manners of characters in the stories. In fact, Nagas, the dragons have often assumed the human forms. The scenes or episodes extracted from *Jātakas* of these two pagodas are different from each other because of their script writers' interpretation on the story as they appreciated.

In Ananda the artists used 21 plaques to illustrate that story in which the first scene starts with episode of conception of *Bhūridatta* that shows the choice of important scene for first impression to attract viewers and the great skillful editing for summary of the whole story. The *Jātaka* can vividly convey to an end with the last scene, the conversations with his grandfather who is a hermit living in ascetic life. The gorgeous dance and music performance of young *nāgīs* (female dragons) are illustrated at the beginning part of the story as the supporting characters for the fifth scene of *Bhūridatta*'s observing *sīla* at *uposatha* day in the garden, *Udyā* of Nāga realm.[2] The scene is a very important cause to become apparent for the whole story because the *nāgīs'* performance displeases the Bodhisattva that incites his mind to go to human world. In that scene one *nāgī* is playing a kind of string musical instrument in a sitting position and another young *nāgī* is dancing in a pattern of celestial choreograph like a celestial dancer, apsara of Angkor temples in Cambodia (8^{th}-13^{th} centuries A.D).

[1] Figure 15 Source- Photo Taken by Than Zaw (Bagan), Private Communication

[2] See Figure 16 Source- Photo Taken by Than Zaw (Bagan), Private Communication

Caption b&'wri ov[eO'm

Figure 16 *Bhūridatta* Observe *Sīlas* in the Garden (Two Performers_ One is an Instrumentalist and Another, a Dancer before *Bhūridatta*), Ananda, Source- Photo Taken by Than Zaw (Bagan), Private communication

In the mural scenes of Lokahteikpan, there are omitted that an important climax episode of observing *sila* by *Bhūridatta*. In comparing with Ananda, the script-writers of Lokahteikpan are less skillful in *Jātaka* stories because some main scenes are absent, minor supporting and linking plots are mainly illustrated and the story does not convey to an end and stops with the scene of searching *Bhūdiatta* by his brothers who come from *Nāga* world (*nagā rwā*). The supporting images of performance are displayed as *alambāy*[1], a snake-charmer, beholding *nagā* daughters' dancing on the north wall of the arch-window[2].

Caption uvee*gtpm ca,;t/&o, owioaomtm uvera,;/ tvrm, e*gor, upaomz{?..
Figure 17 Alambāy, Snake-charmer Beholding Nagā Daughters' Dancing, Lokahteikpan

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[1] Old mon of Ananda applies the term, *alaṁbāy*, an abbreviation of Ālambayana for snake-charmer, now *alambāy* is written for the same meaning word in Mon and Burman, Chas. Duroiselle "The Talaing Plaques on the Ananda Text", p.85

[2] (a)Ba Shin. *Lokahteikpan*, Myanmar text, p.62, English Transliteration, p.100, English Translation, pp.122-123 (b)See Figure 17 Source- Photo Taken by Than Zaw (Bagan), Private Communication

In *Vidura Jātaka*, the episode concerned with dance is mentioned at 13th row on the wall to the north of the arch-window with the dancing illustration of *Nāgī Arandatī* who has the dragon head-dress. Her dance pattern looks like a celestial one that is often seen in Bagan Murals. She intentionally dances and sings on the top of the mountain to attract *Puṇṇaka*.[1] *Vessantara Jātaka* is the most favourite theme out of ten *Jātaka* stories for artists and audiences during Bagan period. In the *Vessantara Jātaka*, the scene related performance is absent in Bagan, but we found that scene in Sale temple no.94 in which a drummer and a trumpeter as the ushers noticing the crowded audience with their instruments are inserted in the narrative scene of departure.[2] Bagan artists inevitably used performance and narrative stories prohibited by Buddha for propagation and education of Buddhist teaching.

Caption ..r,mEpvp{t/ t&E0wawmixy u{t/yE,uz{t/yE,uEmie*gripumq0{t/
Figure18 Arannatī's (Nāgī Arandatī) Dance at the Top of Mountain, Being Beheld by Puṇṇaka

Figure 19 Departure of *Vessansara*, Performers as Ushers Going Ahead of Procession, Sale-94, Source- Photo Taken by Researcher

[1] See Figure 18 Source- Photo Taken by Than Zaw (Bagan), Private Communication
[2] See Figure 19 Source- Photo Taken by Researcher

Conclusion

The *Jātaka* stories from *Ekanipāta* to *Mahānipāta* are illustrated in plaques and mural panels. They were used as popular media of instruction in ethical and moral ideas and illustrative education, but those stories in the inaccessible places for the common folks were probably used for canonical references only. *Jātakas* constitute 547 stories of former births of Buddha that can be divided as the 537 shorter stories of former 21 books and the last ten longer stories of 22nd book. *Jātaka* stories are depicted at temples and solid-pagodas as an interior wall painting decoration and as an exterior glaze plaque decoration respectively. These narrative stories are transformed and illustrated as the static scenes of narrative performance. Among the themes of Buddhist visual art, *Jātaka* stories have mostly reflected on social lives of Bagan people. The last longer ten stories of previous lives of Buddha are illustrated in many episodes, but the rest former 537 *Jātakas* are always depicted in the pattern of one plaque or one panel for one scene. The plaques and panel scenes of murals illustrated with *Jātaka* stories can be defined as static performance which reflects real live performances and Bagan life-styles.

In the last ten stories, the supporting characters of dancers and instrumentalists revealed in narrative visual scenes and scriptures are so provable evident that performances are essential in Buddhism. They are beautifully, broadly arranged and illustrated as mural panels on the interior walls of Lokahteikpan temple and as the plaques at Ananda. In the pattern of serial order, the Mons have changed the serial order of arrangement for *Maha Nippāta*, Last Ten *Jātakas*. In this case, Burman script-writer of Lokahteikpan has followed the order of Sri Lanka. The component figures, both dancers and instrumentalists are related to such scenes of *Jātakas* as *Temiya*, *Janaka*, *Caṅda-kumāra*, *Buridat*, *Vidura* and *Vessantara*. The narrative scenes of *Jātakas* are unavoidably used as a media for education and propagation of religion although Buddha prohibited performing practice in the observing of *Sīla*.

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A STUDY ON THE PERIODICALS OF THE BUREAU OF SPECIAL INVESTIGATION (BSI) (Vol. IV, No. 1 – 12) FROM HISTORICAL PERSPECTIVE

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Abstract

Though the newly independent Myanmar had to deal with the tasks of reconstruction and development of the country in postwar era, it faced with instabilities in various aspects for several reasons. By taking advantages of these instabilities, some of the power holding politicians, civil servants and businessmen committed briberies and corruptions. Their misconducts caused the loss of public properties and finances seriously. In order to prevent this situation, the government extended the already formed Public Property Protection Police (PPPP) to the Bureau of Special Investigation (BSI) in 1951. With the aim of informing the people about the endeavours of BSI in protecting the public properties and finances from the misuse of corrupted persons, its administration board started to publish a monthly periodical in January 1954. This paper is an attempt to disclose the endeavours of BSI in safeguarding the public properties and finances as well as part of the history of BSI that reflects the history of the country in early years of independence by studying the available issues of BSI periodicals that published in 1958.

Keywords: Misuse of Public Property and Public Finance, Endeavours of BSI, History of BSI

Introduction

When Myanmar gained independence in 1948, Prime Minister U Nu instructed to form the Public Property Protection Police (PPPP)[1] that affiliated to the Burma (Myanmar) Police Force and assigned it to safeguard the public properties and finances from the embezzlement of corrupted responsible persons. While the country faced with the instabilities in many aspects for several reasons in its early years of independence, however, dishonest ones from the political circle, public services and business firms committed briberies and corruptions by making good use of the instabilities. In order to deal with this situation effectively, Prime Minister U Nu decided to upgrade the PPPP to be a highly authorized body. He proposed the "Special Investigation Administration Board and Bureau of Special Investigation Bill" at the Parliament on 4 October 1951 and the latter approved it as an Act. According to this Act, PPPP became a separate body with the new name of the Bureau of Special Investigation (BSI). U Nu himself acted as the Patron of the Special Investigation Administration Board and he assigned U Chan Tha (ICS) as the Chairman of the board. Since its inception, the BSI faced with both welcoming and criticizing by the optimists and pessimists. The optimists welcomed the formation of BSI with the belief that it would be able to eliminate effectively the corrupted ones from the political, public service and business circles by utilizing the authority which vested to it in accordance with the provisions of the Act. On the other hand, the pessimists criticized the BSI by predicting that U Nu would utilize it as a tool to suppress the political opponents and the ones who defined against his authority. The BSI that emerged amongst such optimistic and pessimistic views, nevertheless, carried out its assigned tasks by using accurately the authority that bestowed to it by the Act. In order to inform the endeavours of the BSI to the people, moreover, the Administration Board of BSI started to publish the BSI periodicals since 4 January 1954 as a monthly issue.

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[1] This police branch was termed in abbreviation 4Ps by the newspaper at first. Then the government itself came to use this abbreviation in mentioning it.

Nowadays, those periodicals are rare to be found and hence difficult to find out the complete set of collections. Among them, No. 1 to 12 of Volume. IV that published from January to December of 1958 are available. By studying them, the endeavours of the BSI to protect the public properties and finances from misuses; guidance to its members to follow the code of conduct in undertaking their duties; dissemination of working knowledge to its members for practical use as well as its historical events that reflect the history of the country in the early years of independence are discussed in this paper. The editor, publisher, authors, regular sections, size and layout of the periodicals are also described as the background information.

Editor, Publisher and Cover Illustration

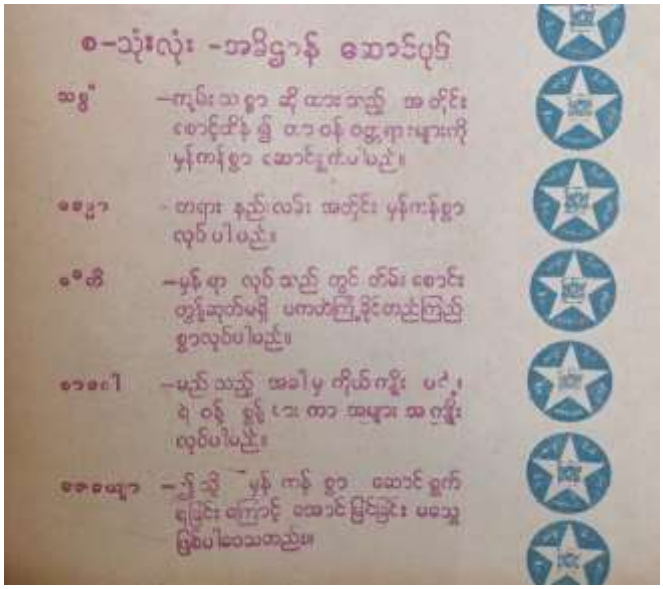
The BSI periodical that published with the Registration No. R. 252 is in fact a monthly issue like the magazines though it is named periodical. Among the available periodicals that published in 1958, it describes at the bottom of the back cover of Vol. IV, No. 1 that the periodical is edited and published by Thiri Pyanchi U Than Tint; director of the Special Investigation Administration Board. But at the same place of the later issues (Vol. IV, No. 2 to 12), it describes that it is edited and published by author Dagon Hla Pe on behalf of Special Investigation Administration Board. One distinctive thing about the front cover of 1958 issues is that the same illustration of artist U Ba Kyi is used for all issues with different colours with the exception of Vol. IV, No. 2. The illustration depicts a commander in the military uniform of monarchical time rides a horse in front of the Independence Memorial Pillar of Yangon downtown. He holds the flag mast of the Union of Burma (Myanmar) in his right hand and a shield that bears the motto oath of BSI "Thitsan, Dhamman, Dhiti, Sargaw, Zeyaw" (Oath of allegiance, Abiding the law, Conducting the tasks without shrinking, Maintenance of altruism, Gaining victory) in his left hand.[1] U Ba Kyi depicts this illustration with clear and strong lines.[2] At the front cover of Vol. IV, No. 2, it describes the same theme with the illustration of artist U Ohn Lwin that depicts the pictures in lights and shades. Moreover, U Ohn Lwin draws the name of periodical "Sa Thone Lone" (Myanmar language abbreviation of BSI) by mixing small and big sized characters at the upper part of the illustration though U Ba Kyi draws clearly those characters in the same size to each other.[3] In comparing two kinds of front cover illustrations, U Ba Kyi's illustration and character drawing are stronger and clearer than U Ohn Lwin's. Based on this fact, it can be assumed that the editor and publisher of the periodical may choose U Ba Kyi's illustration for the front cover of the rest ten issues. On the other hand, one distinctive thing about the back cover of the periodicals is that the same excerpt from the writing of Letya San Htar (a pen name of board Chairman U Chan Tha) which warns that the bribery and corruption would destroy the country; is described repeatedly for all twelve issues.[4]

[1] Original explanation of this Motto Oath is described in page 4.

[2] Though the explanatory note for that illustration is not described, it can be assumed that the commander represents the BSI and he safeguards the independence of the country.

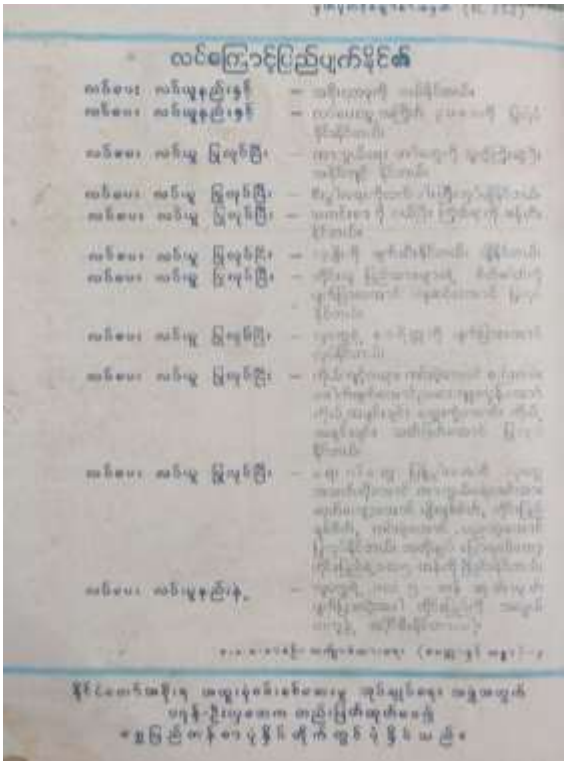
[3] Front covers of the periodicals are described in comparison in page 4.

[4] Sample of that excerpt is described in page 5.



Explanation for the Motto Oath of BSI (BSI Periodical, Vol. IV, No. 12, Supplementary page)

Comparison of Front Covers of the BSI Periodicals Vol. IV, No. 1 and 2
(Front Cover of the rest ten issues are the same with No. 1)



Back Cover of the BSI Periodicals Vol. IV, No. 1 - 12
(Describe the same extract for all periodicals)

Size, Inner Layout and Regular Sections of the Periodicals

Size of the periodicals is 18 cm × 23 cm and it is similar to the size of other magazines that published at that time. Concerning the pages of the periodicals, No. 1 to 12 of Vol. IV are over 100 pages for the thinnest issue and over 150 pages for thickest issue respectively. Number of copies for distribution are 3,000 copies for the fewest issue and 5,000 copies for richest issue. In comparison with its contemporary magazines like Shumawa, Ngwe Taryee, etc., inner layout of this periodical is lesser in describing illustrations and photographs to support the articles and short stories. But the editor decorates the inner layout of the periodicals with clear cut and attractive ways. For example, headings of the articles and name of authors are described in big sized bold letters. The headings and author names of short stories use to be described in illustrator's handwritings and one or two colour illustrations. Regular sections of the periodical are Editorial, Sub-editorial, Articles, Travelogues, Short Stories, BSI Detective Stories and Humours. Occasionally, Photo Essays on the special events of the BSI are also included in the periodicals. One peculiar thing about the regular sections, it does not include poetry section though the prewar magazines like Dagon, Thuriya and Myanmar Ah-swe and postwar magazines like Shumawa, Thwei Thauk and Ngwe Taryee use to include this section splendidly.

The Authors who wrote for this Periodical

As No. 1 of Vol. IV is the special new year issue, it can be seen that the famous authors like Zeya, Zaw Gyi, Min Thu Wun and Dagon U Hla Pe wrote articles and short stories in this issue. But the writings of outside authors could not be found in the following issues that published from February to December. In those issues, the inside persons of Special Investigation Administration Board and BSI senior staff wrote articles, short stories, travelogues and BSI

detective stories with the pennames of Letwé Min Nyo, Ireland Kyaw, Phoe Thar Aung, Mon Razu, Taw Pan Gale, Pay Si, Myet Hman, Moe Hnin, Myo Myint Yan Naung, etc. Sometimes they also wrote articles by using their original names. In No. 12 of Vol. IV, the honorary revelation which expresses the fact that who use which pen name in writing articles and stories for the periodicals is described.[1] With the exception of the writings of those inside persons, the writings of two famous authors of prewar Myanmar: Ledi Pandita U Maung Gyi (died in 1939) and Theikpan Maung Wa (died in 1942) are included in the periodicals too. The articles of Ledi Pandita U Maung Gyi which had been described in Dagon Magazine and those of Theikpan Maung Wa which had been described in Ganda Law Ka and Kyee Pwa Yei Magazines are reprinted in the periodicals. U Maung Gyi's articles urge the people especially the youth to maintain moral characters in conducting their professions. Theikpan Maung Wa's (ICS U Sein Tin) articles reveal his administrative experiences as a Sub-divisional Officer and travelogues in prewar days. As a commentary for the whole periodical, it can be said that it describes several sections excluding poetry and those sections aim not only at informing the endeavours of BSI to the people but also at entertaining the readers with the mixture of knowledge and aesthetic tastes. Of them, the writings on the endeavours of BSI and its historical events would be extracted and discussed.

Writings on the Endeavours of BSI and Upgrading the Capacity of its Staff

The Editorials and Sub-editorials of BSI periodical use to inform the people that the BSI is carrying out the task of protecting public properties and finances from the danger of dishonest persons. They also lay stress on the fact that the staff of BSI are applying precisely the authorities that vested to them in accordance with the provisions of the Special Investigation Administration Board and Bureau of Special Investigation Act. Sometimes, the Editorial reminds the BSI staff to pay attention to follow exactly the code of conduct that prescribed by the administration board in undertaking their duties.

In one Editorial, it mentions that Special Investigation Administration Board Chairman U Chan Tha wrote a series of articles in relations with administrative and political matters of the country by using the pen name Letya San Htar in the previous periodicals.[2] But in the periodicals that published in 1958, it does not find out Letya San Htar's such administrative and political writings. Instead, U Chan Tha uses another pen name: Letwé Min Nyo and wrote a series of articles about Myanmar literature, art and culture.

Among the regular sections of the periodical, ex-member of Special Investigation Administration Board U Pu (B.A., B.L) (later the director of Civil Service Board) wrote a series of articles named **"စ, သုံးလုံး ဥပဒေအလင်းပြ" (Elucidatory on BSI Act)** by using the penname of Moon Razu. In these articles, the author explained the provisions of BSI Act and Regulations in short and clearcut ways. According to these provisions, he also explained how the actions could be taken on the ones who made forgeries of government contract agreements, counterfeit import licenses and faked telegraph letters; as well as the ones who violated the trust of government and embezzled the public properties. He also explained how the responsible bodies of other countries

[1] *BSI Periodical,* Vol. IV, No. 12, Supplementary page which describes the list of honorary writers

[2] "Editorial", *BSI Periodical,* Vol. IV, No. 12, p. Supplementary. F

(i.e., in England and Germany) take actions on such felonies with comparative views.[1] These articles likely to aim at educating the BSI staff in taking actions on the dishonest ones by using effectively the authorities that vested to them in accordance with the provisions of the Act. Moreover, these articles reveal that how the dishonest persons attempted to misuse the public properties and finances with devious means in the early years of independence of the country.

In connection with such misuses of public properties and finances, Deputy Director of BSI Wunna Kyaw Htin U Par Kyin wrote BSI Detective Stories by using the penname of Myo Myint Yan Naung. Board Chairman U Chan Tha makes a remark that Myo Myint Yan Naung's detective stories based on true events that dealt with by the BSI staff in practical fields. In his detective story named "**ကြုံလေ ဘုံဗွေ**" **(An Experience that faced with in the Complex World of Existence),** Myo Myint Yan Naung explained how a gang of liars tried to misuse the public properties and finances by using counterfeit import licenses. He also explained how the BSI staff tried to investigate the case and made great effort to catch the gang members.[2] His other detective story named "**အောင်ဘာလေ**" **(Aung Bar Lay),** the author explained how a gang of liars that based in *Ranong* of Thailand tried to withdraw public finances of Myanmar by forging the lottery tickets that issued by the government of Myanmar. He also explains the persistent efforts of BSI staff to reveal this forgery case in order to protect the public finances, in four consecutive issues of BSI periodicals.[3] These BSI Detective Stories disclose the endeavours of BSI staff in protecting the public properties and finances as well as the seriousness of the danger of domestic and transnational gangs that tried to steal the public finances in post-independence Myanmar in 1950s.

The one who converted from colonial police service to BSI staff, U Tin Nyunt: retired BSI officer, wrote his memoirs named "**ကျွန်တော် မှတ်မိပါသေးသည်**" **(I still remember)** in No. 1, 2, 3, 5 and 6 of Vol. IV. with the penname, Pay Si. In these articles, the author wrote his firsthand experiences as a junior and mid-level police officer in colonial and postwar eras. He uses to inform the devious means of the felons and their misfortunes in facing with the law enforcers. He also reminds the law enforcement officers to use their intelligence and ability in dealing with the cases that assigned to them. His most important reminder is that the law enforcers must follow accurately their code of conduct in carrying out their duties.[4] By seeing this, it can be assumed that the retired BSI officer likely to give a take home message to his juniors about the importance of following the code of conduct in undertaking their tasks for the protection of public properties and finances.

A senior BSI officer, U Soe Nyunt wrote a series of articles under the name of "**အငြင်းပွားစာချုပ်စာတမ်း စစ်ဆေးခြင်းအကြောင်း**" **(Investigating the Controversial Contract**

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[1] Moon Razu, "စ,သုံးလုံးဥပဒေအလင်းပြ" "Elucidatory on BSI Act", *BSI Periodicals,* Vol. IV, No. 1, pp. 78 – 79, No. 2, pp. 87 – 88, No. 3, pp. 27 – 28, No. 4, pp. 49 – 50, No. 5, pp. 73 – 74, No. 6, pp. 95 – 96, No. 7, pp. 82 – 83, No. 8, pp. 60 – 61, No. 9, pp. 103 – 104, No. 10, pp. 108 – 109, No. 11, pp. 109 – 111, No. 12, pp. 103 – 105

[2] Myo Myint Yan Naung, "စ,သုံးလုံးစုံထောက်ဝတ္ထု၊ ကြုံလေ ဘုံဗွေ" "BSI Detective Story: An Experience that faced with in the Complex World of Existence", *BSI Periodical,* Vol. IV, No.2, pp. 116 – 134

[3] Myo Myint Yan Naung, "စ,သုံးလုံးစုံထောက်ဝတ္ထု၊ အောင်ဘာလေ" :BSI Detective Story: Aung Bar Lay, *BSI Periodical,* Vol. IV, No. 9, pp. 112 – 114, No. 10, pp. 71 – 83, No. 11, pp. 80 – 98, No. 12, pp. 89 – 102

[4] Pay Si, "ကျွန်တော် မှတ်မိပါသေးသည်" "I still remember", *BIS Periodicals,* Vol. IV, No. 1, pp. 85 – 89, No. 2, pp. 111 – 114, No. 3, pp. 116 – 123, No. 5, pp. 43 – 48, No. 6, pp. 41 – 46

Agreement) by using his original name. In these articles, he explained in details that how can technically examine the counterfeit contract agreements and forgery handwritings which included in those agreements. But he did not write these articles consecutive in the periodicals and those are found occasionally.[1] By seeing the detailed explanations and technical terms that used in his articles, the author may not intend to give knowledge to the general readers, but likely to educate the fellow staff of BSI who have to deal with the cases of such controversial contract agreement. U Soe Nyunt also wrote another article that named **"လက်ရေး၊ စက်ရေး လိမ်လည်ရေးခြင်းများ စုံစမ်းနည်း" (Investigating means for the forgeries with handwriting and typewriting)** with the penname of Theingi Kyei. Like his other articles, the author explained technically step by step how to investigate and reveal the forgeries that used counterfeit handwriting and typewriting in this article.[2] By seeing the writing style and expressions of U Soe Nyunt (Theingi Kyei), it can be assumed that these articles do not intend to general readers, but just aim at enriching the knowledge and qualification of the BSI staff for their practical works.

Another BSI senior officer: U Pe Han wrote articles about the administrative and religious matters of Konbaung period based on the royal orders with the penname of Myet Hman. The author describes in the introductory part of these articles that he found accidentally the palm-leaf manuscripts and parabaiks of these royal orders in his work trips as a BSI officer. He said, he believed that the instructions which include in these royal orders are still useful in the context of modern time and should be followed by law enforcers like the staff of BSI, police force and administrative department of independent Myanmar. Hence, he said, he wrote these articles with the purpose of knowledge sharing to the fellow staff. In his articles, the author explains about the royal orders of Konbaung period especially those of King Mindon that instructed the administrative and judicial officers to stick to their code of conduct in dealing with their duties.[3] In accordance with the introduction part of these articles, the author intends to urge the fellow officers of law enforcement field not only to follow the present laws but also to keep in mind the instructions of Myanmar kings in dealing with their tasks. In fact, such intention would be too difficult to be achieved in practice. Anyway, it should be acknowledged the good intention of the author.

The above-mentioned articles and detective stories reveal the fact that how BSI endeavoured for the protection of public properties and finances with great efforts. They also disclose the facts that the BSI Administration Board members and BSI senior officials paid attention to educate their staff to utilize precisely the authorities that bestowed to them by the

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[1] U Soe Nyunt, "အငြင်းပွားစာချုပ်စာတမ်း စစ်ဆေးခြင်းအကြောင်း" "Investigating the Controversial Contract Agreement", *BSI Periodicals,* Vol. IV, No. 1, pp. 25 – 29, No. 2, pp. 57 – 60, No. 12, pp. 67 – 69

[2] Theingi Kyei, "လက်ရေး၊ စက်ရေး လိမ်လည်ရေးခြင်းများ စုံစမ်းနည်း" "Investigating means for the forgeries with handwriting and typewriting", *BSI Periodical,* Vol. IV, No. 4, pp. 62 – 65

[3](a) Myet Hman, "မင်းတုန်းမင်းလက်ထက် မြို့ဝန်လိုက်နာမှုများ" "Rules had to be followed by Myowuns during the reign of King Mindon", *BSI Periodical,* Vol. IV, No. 3, pp. 89 – 94

(b) Myet Hman, "မင်းတုန်းမင်းလက်ထက် တရားမမှု ပြဋ္ဌာန်းပိုင်းခြားချက် ဥပဒေများ" "Prescriptions of Laws on the Civil Cases during the Reign of King Mindon", *BSI Periodical,* Vol. IV, No. 6, pp. 7 – 8

(c) Myet Hman, "မင်းတုန်းမင်းလက်ထက် ပြဋ္ဌာန်းသော ခရိုင်ဝန်တို့ စောင့်ထိန်းရန်ဥပဒေများ" "Laws that described to be followed by the District Officers during the reign of King Mindon", *BSI Periodical,* Vol. IV, No. 8, pp. 17 – 19

(d) Myet Hman, "မင်းတုန်းမင်းလက်ထက် ပြဋ္ဌာန်းသောဥပဒေ" "Law that prescribed during the reign of King Mindon", *BSI Periodical,* Vol. IV, No. 9, pp. 59 – 61

Act, to follow code of conduct in undertaking their duties, and to enrich their knowledge and upgrade their qualification for their practical use. By seeing those factors, moreover, it can be assumed that responsible persons of BSI tried their best to prove the negative predictions of the pessimists about their bureau were wrong. Though there are a number of other articles and stories in the referencing issues of BSI periodicals, these are likely to entertain the readers with aesthetic tastes and general knowledge. For instance, **Detective U San Ma Tu** stories wrote by Phoe Thar Aung (Administration Board Member (retired-Commissioner) U Aung Kyaw) are the adaptations of Sherlock Holmes and do not relate to the BSI's endeavours. **Travelogues** wrote by Taw Pan Gale (BSI Deputy Director U Htun Shein) are just the travelling experiences of the author and likely to extend the general knowledge of readers. Such writings would be excluded to discuss in this paper as they do not directly relate to the endeavours of BSI. In the next portion, the writings that reflect the history of BSI would be extracted and discussed.

The Writings that reflect the History of BSI

The whole speech of the Board Chairman U Chan Tha that delivered at the annual conference of the BSI (3 January 1958) could be seen in BSI periodical Vol. IV, No. 2. According to the information that expressed in Sub-editorial of the same issue, the newspapers just describe some extract from it as quotation.[1] Hence it can be said that the whole speech of BSI Chairman could be found in this periodical only. This speech reveals the brief history of BSI since its inception (1 September 1951) up to the end of previous year (31 December 1957). In his speech, U Chan Tha discloses the efforts of BSI to protect the public properties and finances as possible as it could though it faced with a number of difficulties in undertaking the tasks. He also reveals the classifications and exact numbers of cases that dealt with by the BSI within six and half years of its lifespan. These factors are important in the history of BSI. According to his speech, BSI deals with the cases in four categorizes as follows:

(a) cases of the ones who violate the Public Property Protection Act,
(b) cases of the ones who violate the Anti-Corruption Act,
(c) cases of the ones who violate the Foreign Exchange Regulation Act, and
(d) cases of the ones who violate the other Acts.

He also explains the six headings of BSI in listing these cases as follows:

(a) number of cases that reported to BSI,
(b) number of cases that prosecuted at the court of law by BSI,
(c) number of cases that punished by the court of law,
(d) estimated value of properties and finances that involved in the cases,
(e) estimated value of properties and finances that confiscated by BSI, and
(f) amount of money that fined by the court of law on the cases.

U Chan Tha also discloses the total number of cases, estimated value and amount of fine money under these six headings for the whole lifespan of BSI (from 1 September 1951 to 31 December 1957) as follows:

(a) total number of reported cases - 3,789
(b) total number of prosecuted cases - 1,211
(c) total number of punished cases - 812

[1] "Sub-editorial", *BSI Periodical*, Vol. IV, No. 2, pp. 14 – 15

(d) estimated value that involved in the cases - 140 million mmks
(e) estimated value that confiscated by BSI - 10 million mmks
(f) amount of fined money - 95,000 mmks

U Chan Tha said, the figures show that BSI could only take action on the cases that worth over 10 million kyats out of the reported cases that worth over 140 million kyats. By seeing these figures, he continued, the outsiders may judge that BSI could deal with a few cases out of a number of reported cases. But he urged the ones who want to criticize the BSI to keep in mind the fact that the bureau has only 165 senior and junior staff in dealing with all these cases. The government only had to spend 951,039 kyats per year for those staff. Hence, U Chan Tha said, it is cost-effective for the government to employ the BSI staff in protecting public properties and finances.[1]

The revelations of U Chan Tha in his speech disclose the endeavours of BSI in protecting public properties and finances in accurate figures. Moreover, his speech also reveals the fact that BSI had to deal with a great number of cases by a small number of staff. As a result, the bureau could only take actions on the cases less than 10% of reported cases. Nevertheless, he argued that BSI tried its best to deal with the assigned tasks under given situations. By studying U Chan Tha's speech, the readers could see the capacity and situation of BSI in its early history in brief.

Another notable writing about the BSI is the investigation on the statistics and on-ground situations of **နကရဖ (နိုင်ငံတော်ကောက်ပဲသီးနှံ ရောင်းဝယ်ရေးအဖွဲ့) (SAMB: State Agricultural Marketing Board).** This Na-ka-ra-pha was set up by the government as a statutory body for controlling domestic consumption and export of rice in post-independence Myanmar. As the stinks about the corruption of some staff of Na-ka-ra-pha leaked out, U Nu assigned BSI to investigate the case. After investigation, the BSI disclosed its findings and actions via press conference. It also described a quarterly report concerning this case in the periodical. According to the report, BSI investigated both on-paper and on-ground situations of Na-ka-ra-pha thoroughly. Investigations revealed the fact that Na-ka-ra-pha has the rice that valued over 150 million kyats on-paper, but it really has the rice that valued over 140 million kyats on-ground. The exact difference of value between on-paper and on-ground is 6.4 million kyats. Of this 6.4 million, the BSI is taking action on the cases that valued 1.8 million. The rest cases that valued 4.6 million would be taken actions soon.[2]

Like the BSI, in fact, the Na-ka-ra-pha was also a statutory body that highly authorized by the government. In this case, the former had to make investigations and take actions on the corrupted ones of the latter. By seeing this, it can be assumed that this case made the power and image of BSI increased. Consequently, it would be an important milestone in the history of BSI in its early years.

Another important writing about the BSI is **"စ,သုံးလုံး အမေးအဖြေ" (Question and Answer about BSI)** section. This section was described in Nos. 7 and 8 of Vol. IV of the periodical. In

[1] "The Speech delivered by Special Investigation Administration Board; Maha Thayei Sithu U Chan Tha, at the Annual Conference of BSI (1958), *BSI Periodical,* Vol. IV, No. 2, pp. 34 – 41

[2] (a) "စသုံးလုံးနှင့် သတင်းစာကွန်ဖရင့်" "BSI and Press Conference", *BIS Periodical,* Vol. IV, 4 pages in supplementary (page numbers are not described)

(b) "၁၉၅၈ ခုနှစ်၊ ပထမသုံးလပတ် စ,သုံးလုံး၏ လုပ်ငန်းဆောင်ရွက်ချက် အစီရင်ခံစာ" "The Report of BSI for the First Quarter of 1958), *BSI Periodical,* Vol. IV, No. 5, pp. 9 – 15

this section, one noticeable question is "who established the BSI for which purpose?" It is answered that BSI was established by Prime Minister U Nu with the purpose of reconstructing the corrupted moral pillar of the country. Another noticeable question is that "the staff of BSI would be loyal to whom?" It is answered that BSI staff must be loyal to the elected Parliament and the Cabinet formed by that Parliament. With the exception of these organs, the answer continues, the BSI staffs do not need to be loyal to anyone subjectively. One distinctive thing about this section, the same questions and answers are described repeatedly in two consecutive issues.[1]

If this section is looked at superficially, it can be assumed that the questions and answers intend to disseminate the basic facts about the BSI for the knowledge of general readers. But it should be noted that this section was included in the issues that published in mid-1958. This time coincided with the split of AFPFL government that stemmed from the dissensions between U Nu and U Kyaw Nyein. Under such circumstances, U Kyaw Nyein revealed his suspect that U Nu might utilize the BSI to suppress the political opponents.[2] Based on this background situation, it can be assumed that these questions and answers indirectly responded to the suspicious accusation of U Kyaw Nyein. Consequently, it can also be said that this section reflects the political weather of the country in late 1950s.

Last, but not the least, writing about the BSI history is the news of the retirement of its chairman. U Chan Tha who took charge of the BSI Administration Board as Chairman since its inception took retirement on 1 July 1958 while the country was in the political turmoil. The board expresses its special thanks to the retired chairman for his guidance and leadership in the Editorial of Vol. IV, No. 7 of BSI periodical.[3] In his place, U Aung Kyaw; retired Commissioner and Member of BSI Administration Board, was assigned as new Chairman by the Prime Minister.[4] Actually, U Chan Tha who was born in 1910 was only 48 years old when he took retirement in 1958. Moreover, he was in good health at the time of retirement. Though the BSI periodical did not express the reason for the retirement of its chairman, historical records reveal that U Chan Tha joined the Clean AFPFL led by U Nu soon after his early retirement.[5] By seeing these factors, it can be assumed that the political turmoil of outside world had impacted on the BSI more or less in this period.

Conclusion

Public Property Protection Police (PPPP) was upgraded as the Bureau of Special Investigation (BSI) in 1951 with the purpose of preventing the misuses of public properties and finances by the corrupted responsible persons. Its Administration Board started to publish the BSI periodical in 1954 in order to inform the people about the efforts of BSI in dealing with its assigned tasks effectively. Among these periodicals, the available issues that published in 1958

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[1] (a) "စ,သုံးလုံး အမေး အဖြေ" "Question and Answer about BSI", *BSI Periodical,* Vol. IV, No. 7, pp. 7 – 16

(b) "စ,သုံးလုံး အမေး အဖြေ" "Question and Answer about BSI", *BSI Periodical,* Vol. IV, No. 8, pp. 7 – 16

[2] *Bama Khint Newspaper,* dated 6 May 1958

[3] "ခေါင်းကြီး" "Editorial", *BSI Periodical,* Vol. IV, No. 7, pp. 1 – 11

[4] "မဟာသရေစည်သူ ဦးချမ်းသာအား နှုတ်ဆက်ဂုဏ်ပြုပွဲ"၊ "Honorary Farewell Ceremony to Maha Thareisithu U Chan Tha", *BSI Periodical,* Vol. IV, No. 8, Supplementary Ka - Za

[5] U Kyaw Win, U Mya Han, U Thein Hlaing, *၁၉၅၈ - ၁၉၆၂ မြန်မာ့နိုင်ငံရေး* (တတိယတွဲ) *(1958 – 1962 Myanmar Politics,* Vol. III), Yangon, Universities Press, pp. 10 – 11

(Vol. IV, No. 1 – 12) reveal the endeavours of BSI in protecting public properties and finances as well as part of its history that reflects the history of the country in post-independence period to some extent. The writings of these periodicals also disclose the facts that responsible persons of BSI paid attention to upgrade the knowledge and capacity of its staff to be able to deal with their tasks effectively. The former also laid stress on the fact that the BSI staff had to stick to the code of conduct in carrying out their duties. The figures that included in some writings unveil the amounts of public properties and finances that misused by the corrupted persons and the effectiveness of BSI in taking actions on those cases under giving situation. Lastly, these periodicals also expressed indirectly the fact that the political turmoil of the country in late 1950s had side-effects on the bureau more or less.

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MANAGEMENT OF THE ASSIGNMENTS OF EMPLOYEES ON IRRIGATION WORKS AT BAGO DISTRICT (1988-2010)

Win Win Cho*

Abstract

Bago District is situated in the southern part of the Republic of Union of Myanmar in Bago Region. It is a fertile district which is mainly based on agricultural cultivation. It is an area of heavy rainy season that the low land area of Bago District faces floods. Therefore, the Government of the Union of Myanmar constructed dams, embankments, sluice gates and canals for the development of agricultural sector and to prevent flooding in Bago District since 1988. In order to carry out the tasks for renovation and management of dams, embankments, sluice gates and canals that were already constructed in Bago District, Department of Irrigation organized the management on the assignment of staffs. The management on the calculation of labour forces during the interim period between 1988 and 2006 varies town by town in Myanmar as a whole. Started from 2006, headquarter in Yangon, Department of Irrigation, Ministry of Agriculture and Irrigation, the Government of the Union of Myanmar, therefore specified the method for calculating criterion on employee for the whole country. The methods for calculating criterion on employees consisted of calculating criterion for employee regarding irrigation system, sluice gates and distribution of water to paddy fields on summertime. Department of Irrigation calculated the criterion on employee for the whole country based on the method used during the colonial period. By this method, the assignment of staffs were calculated for *Zaungtu* Dam, *Shwe Pyay (3)* Reservoir, *Zalattaw* Reservoir, *Mazin* Dam, *Alainni* Dam, *Wagatoke* Dam, *Kodukwe* Dam, *Salu* Dam and *Shwelaung* Dam constructed in Bago Township. By the same method, the assignment of staffs were calculated for *Pyinpongyi* Dam, *Bawni* Dam, *Kawliya* Dam and Baida Dam situated in Daik-U Township and *Ye Nwe* reservoir located in Kyauktaga township. The aims of this research are to discuss the important part of assignment of staff in irrigation works and to analyze the calculation of labor standards for the assignment of staff regarding dams.

Keywords: employees, assignment of staffs and calculation of labour forces

Introduction

Bago District is formed with Kyauktaga, Nyaunglaybin, Daik U, Shwekyin, Waw, Kawa, Thanatpin and Bago Townships. Bago District is an area of heavy rain where the overflow of Bago and Sittaung rivers usually occur in rainy season that the low land areas of Bago District face with floods. The people in Bago District mainly conduct agriculture. Thus, the government of the Union of Myanmar laid down for the implementation of small and medium scales irrigation plans and constructed dams, embankments, sluice gates and canals for the development of agricultural sector. After building these infrastructures, Department of Irrigation conducted the irrigation works of water supply to the agricultural lands, of distribution of water by adjustment and of flood control and its managements on irrigation. In order to implement these irrigation works, the Department of Irrigation also carried out the tasks for renovation and management of dams, embankments, sluice gates and canals that were already constructed in Bago District. The management of Irrigation and Drainage Systems consists of the management to prevent the disasters at least that are monsoon flooding lands and flooding on wards and roads and the assignment of staffs for its management. The assignment of staffs plays an important part for

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renovation and management of dams, embankments, sluice gates and canals that are located in Bago District.

Aim and Objective

Aim and objective of this paper are to discuss the important part of assignment of staffs in irrigation works and to analyze the calculation of labor standards for the assignment of staff regarding dams.

Data and Method

This paper is based on the reports and list of the calculation on labour force requirement for dams, embankments, sluice gates and canals from the Department of Irrigation and Water Utilization Management. Moreover, people in charge of the Department of Irrigation have been interviewed and from them collected the data of the calculation of labour forces for the assignment of staff regarding dams. The research method used in the described study includes historical data analysis and policy guideline consideration.

Findings and Discussion

The calculation of criterion on employees regarding the preservation and conservation of dams, lakes and embankments during the interim period between 1988 and 2006 varies town by town in the whole country as well as regarding management on the assignment of employees for dams and embankments constructed in Bago District also differs town by town. Started from 2006, the headquarter in Yangon, Department of Irrigation, Ministry of Agriculture and Irrigation, the Government of the Union of Myanmar therefore defined the method for calculation of criterion on employee for the whole country. In calculating criterion for employee for the whole country, Department of Irrigation calculated based on the method used during the colonial period.[1] In calculating the criterion on employee uniformly, the management on the assignment of employees are that of calculation of criterion on employee concerning with dams and embankments, with sluice gates, with distribution of water to paddy field in summertime and with types of irrigation system.

Regarding the calculation of criterion on employee for dams and embankments, if the surface area of embankment is under five hundred thousand square feet, one person was assigned for one hundred thousand square feet. Supposing the surface area of the embankment is between five hundred thousand and ten hundred thousand square feet, one person was assigned for 1.5 hundred thousand square feet. If the surface area of the embankment is between ten hundred thousand and thirty hundred thousand square feet, one person was assigned for 2 hundred thousand square feet and it was also defined that a person was assigned for 2.5 hundred thousand square feet if the surface area of the embankment is over 30 hundred thousand square feet. Nevertheless, if the grassland was located at the downstream area of the embankment, the labour

[1] "ဆည်ကန်တာတမံ ထိန်းသိမ်းခြင်းနှင့်ပတ်သက်၍ အလုပ်သမားစံနှုန်းများ သတ်မှတ်ခြင်း"? (*The calculation of criterion for employees regarding the preservation and conservation of dams and embankments)*, Yangon, Department of Irrigation, Ministry of agriculture and Irrigation, Government of the Union of Myanmar, p. 1 (Hereafter cited as *the calculation of criterion for employees*)

force will be calculated as 1.25.[1] In calculating labour force for the embankment and salt-water embankment, if the embankment is under five feet in height, average one person will be assigned for three miles in length and one person was assigned for two miles in length, if the height of embankment was between five and ten feet in height. Three persons will be assigned for four miles in length at the embankment that is above ten feet in height. The specification of criterion for employee regarding the sluice gates constructed at the drainages, if the sluice gates were located at the distant area from the number of dwellings in a settlement, labours were organized for the whole year. In addition, if it was not far from the human dwellings, the labour will be appointed during the rainy season. For the purpose of water supply to the summer paddy fields, the requirement of labour force will be calculated based on the cultivated areas.[2]

The Irrigation Department defined two types of irrigation season and non-irrigation season in the specification of irrigation season for irrigation system for the whole country instead of water supply in the summer and rainy season. However, Director Offices at the respective region defined the irrigation season without specifying from the Headquarter in Yangon as time duration differs from one place to another. In calculating the requirement of labour forces in the irrigated areas for irrigation season in summer, the assignment of labour was made for the main canals and its branch of an irrigation canal that is over 200 cusecs[3] as five persons for four miles. If the branch of an irrigation canal is under 200 cusecs, one person was assigned for one mile. For the non-irrigation season in the rainy season, the assignment was made for the main canals and its branch of an irrigation canal that is over 200 cusecs as one person for one mile and the main canals and its branch of an irrigation canal that is under 200 cusecs as one person for three mile.[4] Moreover, Department of Irrigation conducted uniformity in specifying the criterion for employee for the whole country and it can be observed that the Department of Irrigation defined Irrigation season and non-irrigation season in the irrigated cultivation system without classifying summer and rainy season as the rainfall differs from one place to another.

By this method of calculation, Department of Irrigation assigned labours for nine dams and embankments located in Bago District. In studying the assignment of labour forces for the first constructed dam of *Zaungtu* situated at Bago Township, ten workers were assigned for the whole year and one person for water control gate, one person for business cleaning house security and one person who recorded water level were also appointed. For the irrigation system, fifty-eight person for irrigation season, twenty-nine person for non-irrigation season, one security for Byaiktaw –inn, one security for the irrigated station at the 7th and 8th branch of an irrigation canal and one security for business cleaning house at Phayagyi,one security for railroad irrigation canal and one security for the 6th branch of an irrigation canal were also assigned.[5]

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[1] "ဆည်ကန်တာတမံ ထိန်းသိမ်းခြင်းနှင့်ပတ်သက်၍ အလုပ်သမားစံနှုန်းများ သတ်မှတ်ခြင်း"၊ (*The calculation of criterion for employees regarding the preservation and conservation of dams and embankments)*, Yangon, Department of Irrigation, Ministry of agriculture and Irrigation, Government of the Union of Myanmar, p. 2 (Hereafter cited as *the calculation of criterion for employees*)

[2] *The calculation of criterion for employees*, p. 2

[3] A unit of flow (especially water) equal to one cubic foot per second.

[4] လူတွေ့မေးမြန်းခြင်း၊ ဦးဇော်မျိုးနိုင်၊ ဦးစီးအရာရှိ *(Personal* Interview with U Zaw Myo Naing, Chief Officer, Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township, on 16 April 2022

[5] "ဇောင်းတူရေလွှဲဆည်၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း" (Lists of the calculation on labour force requirement for Zaungtu sluice gate), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

The lists of calculation for required labored force and its assignment for the *Shwe pyay (3)* Dam, the second dam in Bago Township are five persons for the whole year, one security for business cleaning house, one person for security of water outlet and one person who recorded the water level or the annual rainfall. As there were 5.54 miles in length for the irrigation system, four labour for the irrigation season and two persons for non-irrigation were assigned according to the calculation of labour force requirement.[1]

According to the requirement of labour force for *Zalattaw* Reservoir, the third dam in Bago Township, four labour for irrigation season and two persons for non-irrigation season were to be assigned. By the calculation of labour force requirement for Zalattaw Reservoir, five labour forces for the whole year, one security for business cleaning house, one security for water outlet, one person who recorded the water level or rate of rainfall were to be appointed. In the irrigated system, nine labour for irrigation season and one labour for non-irrigation season were also to be assigned.[2]

The lists of calculation for labour force requirement and its assignment for *Mazin* Dam, the fourth dam constructed in Bago Township were six persons for the whole year, one security for business cleaning house, one security for water outlet, one person who recorded water level or the rate of rainfall. As there are 4.03 miles in length for the irrigated system of Mazin Dam, three persons for irrigation season and one person for non-irrigation season were to be assigned.[3]

The lists of calculation for labour force requirement and its assignment for *Alainni* Dam, the fifth dam situated in Bago Township were ten person for the whole year, one security for business cleaning house and one security for embankment.[4] In the irrigation system, twelve person for irrigation season and six person for non-irrigation system were to be assigned as there are 11 miles in length at the main irrigation canal and 7.14-mile in length at the branch of an irrigation canal. For the *Wagatoke* Dam that is the sixth Dam situated in Bago Township, the lists for calculation of labour force requirement and its assignment are fourteen person for the whole year, one security for the entrance to the embankment and one person for sluice gate.[5]

According to the calculation on labour force requirement and its assignment for *Kodukwe* Dam that is seventh dam in Bago Township, twenty-four seasonal workers, two security for a business cleaning house, one person who recorded the water level, one security at the station for annual average rainfall and four security for water outlet were to be assigned.[6] The lists of calculation on labour force requirement for *Salu* Dam that is eighth dam located in Bago Township were twelve workers for the whole year, fifteen workers for grassland cultivation area of the dam, one security for business cleaning house, one person who recorded water level or

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[1] *"ရွှေပြည် (၃) ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"* (Lists of the calculation on labour force requirement for Shwe pyay (3) Dam), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[2] *" ဇလတ်ထော်ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"*၊ (Lists of the calculation on labour force requirement for Zalattaw Reservoir), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[3] *"မဇင်းရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"* (Lists of the calculation on labour force requirement for Mazin Dam), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[4] *"အလိုင်နီရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"* (Lists of the calculation on labour force requirement for Alainni Dam), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[5] *"ဝါးကတုတ်ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"* (*Lists of the calculation on labour force requirement for Wagattoke Dam)*, Bago Township, Irrigation and Water Utilization Management Department, 2019, p. 1

[6] *" ကိုဒုကွဲရေလှောင်တမံ၏ လုပ်သားတွက်ချက်မှုစာရင်း"*၊ *(Lists of the calculation on labour force requirement for Kodukwe Dam)*, Bago Township, Irrigation and Water Utilization Management Department, 2019, p. 1

annual average rainfall and one security for diversion dam.[1] The lists of calculation on labour force requirement for *Shwelaung* Dam that is the last dam constructed in Bago Township are five seasonal workers, one security for business cleaning house , one security for water outlet, one security for embankment, one security on the camp across Yangon-Bago main road and one person who recorded the water level or annual average rainfall. Both nine workers for irrigation season and five workers for non-irrigation season are to be assigned for the irrigated system at *Shwelaung* Dam.[2]

The Ministry of Agriculture and Irrigation constructed four dams at Daik-U Township in Bago District. Among these four dams, lists of calculation on labour force requirement for the first constructed dam of *Pyinpongyi* in Daik-U Township were three workers for the whole year, one security for water outlet and water diversion cannel, one security for embankment. Moreover, one security for business clearing house and guesthouse and one person who recorded the water level or annual average rainfall were also appointed. For the irrigation system, twenty annual workers were assigned.[3] The list of calculation for required labored force and its assignment for the Bawni Dam, the second dam in Daik U Township are eighteen person for the whole year, one person for security of water outlet and one person for security of water diverson canal were appointed. In the irrigation system, forty-seven annual workers, one person for business clearing house and one security for Kadokeywama station were organized.[4] According to the lists of calculation on labour force requirement for the third constructed dam of *Kawliya*, seven workers for the whole year, one person for water diversion canal, one security for water outlet and two person who recorded the water level or annual average rainfall were appointed. Regarding the irrigation system, sixteen workers for the whole years, one security for Pwelay station, one security for guesthouse, one security for business cleaning house at water diversion dam and one person for Shansu station were required to be assigned.[5]

For the fourth dam situated at Daik-U Township, the lists of calculation on labour requirement for *Baida* Dam were five workers for the preservation season, one person for grassland cultivation area, one guard for meteorological station, one person who recorded the water level, two staffs for communication service at day and night, one security for water control tower, one security for water diversion dam, one security for business cleaning house and one person for the guesthouse. The lists of calculation on labour requirement for water diversion dam were three workers for water control gate on the northern part, one person recorded the water level and two staffs for communication service at day and night, one security for water diversion dam, one security for business cleaning house, four workers for opening valve of the water control gate and conservation and preservation for the dam and one cleaner for the compound of water diversion dam.

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[1] *"စလူရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"၊ (Lists of the calculation on labour force requirement for Salu Dam)*, *Bago* Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[2] *"ရွှေလောင်းရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"၊ (Lists of the calculation on labour force requirement for Shwelaung Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[3] *"ပျဉ်ပုံကြီး ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း" (Lists of the calculation on labour force requirement for Pyinpongyi Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[4] *"ဘောနီရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း"၊ (Lists of the calculation on labour force requirement for Pyinpongyi Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[5] *"ကောလိယရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊" (Lists of the calculation on labour force requirement for Bawni Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

For the irrigation system, thirty-seven workers were appointed for the branch of irrigation canal (I) from the main irrigation canal on the left and seventy workers for the small drains from the branch of the irrigation canal (I), the branch of the irrigation canal (3) and its small drains, the branch of the irrigation canal (4) and its small drains and twelve direct drains in the irrigation season. During the non-irrigation season, eighteen workers for the main irrigation canal and the branch of irrigation canal (I), and thirty-five workers for small drains from the branch of the irrigation canal (I), small drains from the branch of the irrigation canal (3), small drains from the branch of the irrigation canal (4) and 12 direct drains were assigned.[1] Moreover, temporary preservation labours[2] were also appointed in Bago Township according to the requirement of workplace. By the emergency requirement of workplace, one security for emergency water outlet at the sluice gate, two security for a building at the main drain and its branch of irrigation canal (I), one security for the main drain and its branch of irrigation canal (II), one security for the main drain and its branch of irrigation canal (III) and, one security for the main drain and its branch of irrigation canal (III) and one security for the main drain and its branch of irrigation canal were to be assigned. Moreover, one security for sluice gate at 12 direct drains were to be appointed according to the emergency requirement of workplace during the raining season.[3]

The lists of calculation on labour requirement for *Ye New* reservoir situated at Kyauktaga Township in Bago District, included nine seasonal labours for preservation season and twenty securities for business cleaning house, guesthouse, gate, store and rainfall station, sanitary workers, the staffs for communication service and one person who recorded the water level were appointed according to the requirement of workplace. The lists of calculation on labour force requirement for water diversion dam and other connected buildings were one guard for water control gate on the left and six security guard for water control gate on the right. In calculating the labour force requirement, one security for business cleaning house, one security for the entrance, one security for store, one person who recorded the rainfall and water level for the water diversion dam, one staff for communication service, one person for operating the generator for electricity and one postal worker were also appointed.[4]

In the irrigation system, twenty-three workers for the branch of irrigation canal (I) and the branch of irrigation canal (II) from the main canal on the left and fifty workers for the small drains from the branch of irrigation canal (I), (II) and (III) were to be appointed for the irrigation season. During the non-irrigation season, one person for the branch of irrigation canal (I) and small drainage (I) from the main canal on the left were to be assigned. Moreover, twenty-five workers for the small drains from the branch of irrigation canal (I), (II) and III were to be appointed. According to the requirement of workplace, six temporary preservation workers for the main canal, one person for the perseveration of small drain from the branch of irrigation canal

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[1] *"ဘိုင်းဒါးရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း ၊"* (Lists *of the calculation on labour force requirement for Baida Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 1

[2] Temporary preservation labours mean workers on daily wages for sanitary work regarding the dams and embankment.

[3] *လူတွေ့မေးမြန်းခြင်း၊ ဒေါ်နှဲ့နှဲ့မိန်၊ ပုံဆွဲ(၁)* (*Personal* Interview with Daw New New Sein, Drawing Officer (I)), Assistant Director Office, Department of Irrigation and Water Utilization Management, Hlegu Township, on 7 June 2022

[4] *ရဲနယ်ရေလှောင်တမံ လုပ်သားတွက်ချက်မှုစာရင်း* (*Lists of the calculation on labour force requirement for Yenwe* reservoir), Bago Township, Irrigation and Water Utilization and Management Department, 2019, p. 3 (Hereafter cited as *Lists of the calculation on labour force for Yenwe)*

(I) and one person for the branch of irrigation canal (I) and (II) were to be assigned.[1] By studying the management of labour force for the respective dam and embankment in Bago District, it can be studied that there were no specification for the irrigation season and non-irrigation season for *Wagatoke* Dam, *Kodukwe* Dam and *Salu* Dam located in Bago Township because of the absence of the irrigated system for the distribution of water during the summer season. Moreover, it can be seen that the appointed number of labour forces differed according to the size of the dam and sluice gate.

The ministry of agriculture and irrigation conducted the assignment of labour for the irrigation works. Moreover, the ministry of agriculture and irrigation opened the Irrigation Technology Centre at Bago Township for the development of technology concerning the irrigation work. In March 1988, the Japanese Government provided to construct this training centre, which was a memorandum of amity and cooperation between the Government of the Union of Myanmar and the Japanese Government. Started from 2005, the refresher course on irrigation technology were started to give training to the government officials and non-gazette government employees at this training centre. Sixteen refresher courses were taught at this training centre.[2] They are Introduction to ID, Administration, A-Code & D-Code, Surveying, Soil Mechanics, Concrete Technology, Hydraulics, Estimation, and Introduction to PC, Specification, Hydrology, Engineering Geology, Construction, Irrigation Practice, and Design Practice and report Writing. After attending this training course, all the employees from the Irrigation Department are allowed to get for their promotion. The duration of training course are defined from one month to two month according to the respective subject.[3] By opening the refresher course at the Irrigation Technology Centre at Bago Township, it led to improve the knowledge about the irrigation technology for the government officials and non-gazette government employees who served at the irrigation department. Moreover, the advanced irrigation technology from other countries can be studied in accordance with the times and benefits of the country will be improved.

Conclusion and Recommendation

In conclusion, the management and calculation of labor force requirements for dams, lakes, and embankments in Bago District, Myanmar have undergone changes over the years. Before 2006, there was a lack of uniformity in the calculation methods used by different towns in the country. However, since 2006, the Department of Irrigation, Ministry of Agriculture and Irrigation in Yangon has defined a standardized method for calculating the labor force requirements for the entire country.

The calculation of labor force requirements considers various factors, such as the surface area and height of the embankments, distance from dwellings, and the size of the irrigation system. Additionally, the labor force requirements are determined based on the irrigation season,

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[1] *Lists of the calculation on labour force for Yenwe*, p. 4

[2] *လူတွေ့မေးမြန်းခြင်း၊ ဦးမျိုးတင့်၊ ပုံဆွဲ (၁)* (*Personal* Interview with U Myo Tint, Drawing Officer (I)), Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township,on 5 May 2019

[3] *လူတွေ့မေးမြန်းခြင်း၊ ဦးဇော်မျိုးနိုင်၊ ဦးစီးအရာရှိ* (Personal Interview with U Zaw Myo Naing, Chief Officer), Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township, on 16 April 2020

which is classified as either irrigation or non-irrigation season, instead of the traditional classification of summer and rainy seasons.

The assignment of labor forces for specific dams and embankments in Bago District varies depending on the size and requirements of each project. The number of workers assigned ranges from a few individuals to larger groups, and additional personnel are appointed for tasks such as security, water control, and recording water levels or rainfall. The labor force requirements for the irrigation systems associated with the dams are also determined based on factors such as canal capacity and length.

The Ministry of Agriculture and Irrigation has taken steps to improve the management of labor force assignments for irrigation works. The establishment of the Irrigation Technology Centre in Bago Township has provided training opportunities for government officials and non-gazette employees to enhance their skills in irrigation technology. This center has offered various refresher courses covering different aspects of irrigation engineering.

The Department of Irrigation, under the Ministry of Agriculture and Irrigation of the Government of the Union of Myanmar, is responsible for conducting irrigation works, including water supply to agricultural lands, water distribution, and flood control management. These tasks involve the construction of dams, embankments, sluice gates, and canals. The Department of Irrigation used a calculation method inherited from the colonial period to determine the labor force requirements for the entire country. To manage the assignment of workers effectively, it is necessary to allocate workers for various tasks related to dams, embankments, water control gates, and summer water supply, as well as for the irrigation system. The number and types of workers required vary based on the size of the dam. Additionally, there are labor costs associated with planting grasslands downstream of the embankments, which may lead to a reduction in such plantations. In Bago Township, dams such as Wagatoke Dam, Kodukwe Dam, and Salu Dam were constructed to prevent flood disasters. Therefore, there was no need for labor force appointments for the irrigation system, as there was no such system in place for water distribution. The Irrigation Department defined two types of seasons for water distribution, namely irrigation season and non-irrigation season, considering the varying rainfall patterns in different areas. The establishment of the Irrigation Technology Centre has facilitated the study of advanced irrigation technology from other countries in accordance with the current time.

It is essential to continue promoting the standardization of labor force calculation methods across the entire country. This will ensure consistency and fairness in the allocation of labor resources for irrigation projects. Second, further training and capacity-building programs should be provided to irrigation officials and employees to enhance their knowledge and skills in irrigation technology. This will contribute to improved management and efficiency in the implementation of irrigation projects. Furthermore, it is important to regularly review and update the labor force requirements and assignment criteria for dams, embankments, and irrigation systems. This should consider factors such as changing weather patterns, technological advancements, and evolving agricultural practices.

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ကောလိယရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists *of the calculation on labour force requirement for Kawliya Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

ကိုဒုက္ခရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists *of the calculation on labour force requirement for Kodukwe Dam)*, Bago Township, Irrigation and Water Utilization Management Department, 2019

စလူရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (*Lists of the calculation on labour force requirement for Salu Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

ဆည်ကန်၊တာတမံ ထိန်းသိမ်းခြင်းနှင့် ပတ်သက်၍ အလုပ်သမားစံနှုန်းများ သတ်မှတ်ခြင်း၊ (*The calculation of criterion for employees regarding the preservation and conservation of dams and embankments)*, Yangon, Department of Irrigation, Ministry of agriculture and Irrigation, Government of the Union of Myanmar

ဇလတ်ထော်ရေလှော်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists of the calculation on labour force requirement for Zalattaw Reservoir), Bago Township, Irrigation and Water Utilization and Management Department

ဇောင်းတူရေလွှဲဆည်၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (*Lists of the calculation on labour force requirement for Zaungtu sluice gate)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

*ပျဉ်ပုံကြီးရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (*Lists *of the calculation on labour force requirement for Pyinpongyi Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

ဘောနီရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists *of the calculation on labour force requirement for Bawni Dam*), Bago Township, Irrigation and Water Utilization and Management Department, 2019

ဘိုင်းဒါးရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists *of the calculation on labour force requirement for Baida Dam*), Bago Township, Irrigation and Water Utilization and Management Department, 2019

မဇင်းရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (*Lists of the calculation on labour force requirement for Mazin Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

ရဲနွယ်ရေလှောင်တမံ လုပ်သားတွက်ချက်မှုစာရင်း (Lists of the calculation on labour force requirement for Yenwe reservoir), Bago Township, Irrigation and Water Utilization and Management Department, 2019

ရွှေပြည် (၃)ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists of the calculation on labour force requirement for Shwe pyay (3) Dam), Bago Township, Irrigation and Water Utilization and Management Department

ရွှေလောင်းရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists of the calculation on labour force requirement for Shwelaung Dam), Bago Township, Irrigation and Water Utilization and Management Department, 2019

ဝါးကတုတ်ရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက် တွက်ချက်မှုစာရင်း၊ (Lists of the calculation on labour force requirement for Wagattoke Dam), Bago Township, Irrigation and Water Utilization Management Department, 2019

အလိုင်နီရေလှောင်တမံ၏ လုပ်သားလိုအပ်ချက်တွက်ချက်မှုစာရင်း၊ (*Lists of the calculation on labour force requirement for Alainni Dam)*, Bago Township, Irrigation and Water Utilization and Management Department, 2019

လူတွေ့မေးမြန်းခြင်း(ဦးဇော်မျိုးနိုင်၊ ဦးစီးအရာရှိ၊ (Personal Interview with U Zaw Myo Naing, Chief Officer) Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township,on 16 April 2020

လူတွေ့မေးမြန်းခြင်း၊ ဒေါ်နှဲ့နှဲ့စိန်၊ ပုံဆွဲ(၁)၊ (Personal Interview with Daw New New Sein, Drawing Officer (I)), Assistant Director Office, Department of Irrigation and Water Utilization Management, Hlegu Township, on 7 June 2022

လူတွေ့မေးမြန်းခြင်း၊ ဦးမျိုးတင့်၊ ပုံဆွဲ(၁)၊ (Personal Interview with U Myo Tint, Drawing Officer (I)), Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township,on 5 May 2019 on 7 June 2022

လူတွေ့မေးမြန်းခြင်း၊ ဦးမျိုးတင့်၊ ပုံဆွဲ(၁)၊ (Personal Interview with U Myo Tint, Drawing Officer (I)), Assistant Director Office, Department of Irrigation and Water Utilization Management, Bago Township,on 5 May 2019

STUDY ON THE TWO WORDS: MYANMAR AND BAMAR IN HISTORICAL SOURCES (1084-1989 A.D)

Nan Hlaing*

Abstract

The terms, Myanmar and Bamar, are equivocal names in Myanmar. The two terms refer to the name of nation and name of nationality. Opinions of previous scholars are discussed in literature review. In this paper, over thirty historical sources—stone and bell inscriptions in Mon and Myanmar, epics (*pyo*, *mawgun*, and *egyin*), chronicles (*yazawun*, and *ayedawbon*), law, and 1943, 1947, and 1974 constitutions—are firstly collected and retrospection is diachronically done on the two terms. Examination is done how to use the two terms in the past. Finally, this paper draws a conclusion that the term Myanmar is historically formalized as the name of nation and the Bamar is derived from Mon. The term is adopted as a name of nationality when Do-Bama Asi-ayon was established in 1930. It promoted to the name of nation during the Japanese occupation period but the term Myanmar return to take place in the postwar onwards.

Keywords: etymology, Myanmar, Bamar, Inscriptions, epics, speech, Do-Bama Asi-ayon, constitutions

Research Methods: Heuristics, Hermeneutics and qualitative methods

Introduction

An attempt is made to understand on Myanmar and Bamar, equivocal name belonging to the names of nation as well as name of nationality. This discussion is also highlighted on the two terms discovered in historical sources. By collecting the sources, verification was made to the usage of the two terms. In this study, grounded theory is firstly used by using primary sources—stone inscriptions in Myanmar and Mon, bell inscriptions in Myanmar and Mon, an ink inscription, *pyiu*, (epics), *maukun:* (historical epics), *rājavaṁ* (Chronicles), *are:taupuṁ* (Struggles of Kingly Chronicles), speech, lyric of songs, newspapers, bank notes and postal stamps. Methodically, hermeneutic (interpretation of sources), heuristic methods (solving problem) and qualitative method.

In this study, the first motivation appears from General Ne Win's speech at the Seminar on Ethnic Culture of Myanmar held at the Meeting Hall of President's House, Yangon on 13 February 1981. In his speech, he took a discussion on autonyms, specific numbers of ethnic peoples, project to do on ethnic peoples and their originalities. At this seminar, he took a discussion as follows:

> …when *Dobama Asiayone* [We, the Burman Organization] took part in Myanmar nationalist movement, then, the term Myanmar changed to Bamar. We should carefully consider and do on the research questions: "How did the Myanmar appear?" And "How was the term Myanmar changed to Bamar?" it would be needed to collect the sources by academic departments especially History and Archaeology. This duty belongs to not only academic departments but also deals with the people of entire nation.[1]

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[1] *မြန်မာ့ဆိုရှယ်လစ်လမ်းစဉ်ပါတီ ဥက္ကဋ္ဌကြီး၏ခေတ်ပြောင်းတော်လှန်ရေးသမိုင်းဝင်မိန့်ခွန်းများ* (Anthology of Speech delivered by Chairman, BSPP), Vol. IV, Yangon, Headquarter of BSPP, 1983, pp. 323-338.

Secondly, motivation comes from the speech delivered by Nai Hongsar, Chairman of New Mon State Party (NMSP). He complains about the term Myanmar and pointed out that the term Myanmar, the name of nation, also refers to the Bamar nationality so that it makes exclusion to the other indigenous ethnic peoples of entire nation.[1] His compliance prompts to do this study. When the two terms are considered, the terms "Myanmar" and "Bamar" should be cleared.

1.1 Aim and Object

This paper is intended to give solution on the two equivocal terms, *Bamar* and *Myanmar*. It also aims to know the terms in historical sources of Myanmar and purposes to give those who want to know about the two terms in detail.

1.2 Literature Review

Lieut. Colonel A. P. Phayre was the first English scholar who paid attention on the words Myanmar and Bamar. He wrote about 'the History of the Burmah Race' in 1866[2] and discussed on the two terms. Etymologically, he thought that the word Myanmar is derived from the Pali word *brahmā*, signifying celestial beings. This idea had appeared since they became Buddhist. After studying by Phayre, some scholars took discussion on the two words, i.e.,

- Col. Henry Yule and A. C. Burnell who studied on the words Myanmar and Bamā in 1886, they had done on the two terms without Myanmar historical sources. Only by using the western sources, they studied on it.
- Hmawbi Sayar Thein, the first author to pay attention on the word Myanmar in 1910, like the Englishmen before his view, he also guesses at the word deriving from Pali.
- Taw Sein Ko, a scholar who thought about the etymology of Myanmar in 1913. He also accepted the view by Phayre which this autonym derived from '*brahmā'*.[3]
- U Kyaw Dun, a researcher who studied on the word Myanmar, and its etymology by emphasizing on Pāḷi point of view.[4]
- Prof. G. H. Luce in his 'the Peoples of Burma in the 12th—13the Century A.D' references with inscriptions about only the word of Mranma[5] but he did not make discussion on the two terms.
- Alankakyawswa Prof. Dr. Khin Aye, Myanmar Language Department, University of Yangon, also accepted the view.[6]

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[1] Nai Han Thar (2017) "ညီညွတ်သောတိုင်းရင်းသားလူမျိုးများ ဖက်ဒရယ်ကောင်စီက တင်သွင်းသောစာတမ်း" (The Paper submitted by United Nationalities Federal Council (Union of Burma)," *ပြည်ထောင်စုငြိမ်းချမ်းရေးညီလာခံ (၂၁) ရာစုပင်လုံ (ပထမအစည်းအဝေး) မှတ်တမ်း*၊ (Union Peace Conference, 21st Century Panglong, First Meeting, Record), Nay Pyi Daw: Ministry of Information, (241-244), p. 242.

[2] A. P. Phayre (1867) "On the History of the Burmah Race", *Transactional of the Ethnological Society of London,* Vol. V, London: Royal Anthropological Institute of Great Britain and Ireland, pp. 13-39.

[3] Taw Sein Ko (1913) *Burmese Sketches,* Yangon: British Burma Press, pp.19f.

[4] U Kyaw Dun (1933) "မြန်မာ ဟူသောစကားဖြစ်လာရင်း မူလအကြောင်း", *Journal of the Burma Research Society*, Vol. XXIII, Pt. 2, p. 86. Hereafter cited as Kyaw Dun: 1933.

[5] G. H. Luce (1933) "Note on the Peoples of Burma in the 12th—13th Century A.D.", *Census of India, 1931, Burma,* Pt. I, *Report,* Yangon: Government Printing, p. 296.

[6] Prof. Dr. Khin Aye (Maung Khin Min, Danubyu)'s leacture held at TEDxUM1, Yangon on 10 September 2019, https://m.youtube.com

Among the scholars, E. H. Parker also gave his view on the word Myanmar and its etymology which is against the view on the word deriving from *brahma* by origin. He viewed that the word Myanmar is *not* a loanword. It comes from provenance of Myanmar language.[1]

1.3 Research Questions

1. Does the word Myanmar refer to the country or nationality?
2. How was Myanmar used for the name of country and nationality in history?
3. When the word Bamar firstly appeared?
4. What pronunciation of the language belongs to the word Bamar?

Myanmar and its Etymology

Regarding with the terms *Myanmar* and *Bamā*, the *Dictionary of Myanmar* mentions that the word Myanmar refers to the ethnic peoples who ancestrally scatter and settle in Myanmar and the word Bamar is a pronunciation of the word Myanmar.[2] Either Myanmar or Bamar had two meanings in the previous times of 1989, and are referred to name of nation and name of ethnic peoples. In the Old Mon Inscription of 1084 AD erected by King Thiluiṅ Maṅ (Kyansittha), the word *jiñjeh mirmā*[3], the Myanmar singers, is mentioned.[4]

The earliest source of the word Myanmar is described in the Minister Siṅghasūr's Inscription of 1190 A.D in Myanmar. In this inscription he shows his offerings including a troupe of musicians. Among them, three musicians—Aiuw Sā, Aiuw Koṅ, and Aiuw Krī—are the Myanmar.[5] The Dhammarājaka Inscription of 1198 AD erected in the reign of King Narapatisithu (r. 1165-1211) also mentions a list of slaves including the Myanmar. It mentions as follows:

> …*mranmā* kwyan 500 (trans. 500 slaves who are the Myanmar)[6]

Likewise, the Thu Htay Muk Ku Pagoda Inscription of 1194 AD mentions as follows:

> …purhā kywan lhū so cañ sañ *mranmā* pantyā 13, kūlā kakhriy 5, ṇa ke1, ṇayok 1 miyā aui, davay 1, sā ṇcaliy 1, ṇa kroṅ 1, [7]
>
> (tran.) 13 musicians who are the Myanmar, 5 dancers who are Indians, Nga Ke, Nga Yauk, his wife O Dawei, his son Nga Salay, Nga Kyaung who had been offered to Buddhist monument.

Moreover, the Phwar Saw Inscription of 1241A.D mentions the offerings including slaves as follows:

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[1] E. H. Parker and H. M. Concul Kiungchow (1893) *Burma with Special Reference to He Relations with China,* Yangon: Rangoon Gazette Press, pp.22-23.

[2] *မြန်မာအဘိဓာန်အကျဉ်းချုပ်*၊ (A Brief Dictionary of Myanmar), Vol. III, Yangon: Myanmar Language Commission, 1979, pp.99, 198.

[3] မိၚမာ

[4] (a)Professor U Pe Maung Tin (edited and trans.), *လိက်တ္ဒအ်မန်-နန်သိဒ္ဓင်ကျာန်ယျတ် ကျန်စစ်သားမင်းကြီး၏ နန်းတော်မွန် ကျောက်စာ*၊ (Palace Building by King Kyansittha), Yangon: Ministry of Culture, 1957, p.10.

(b) U Chit Thein (ed. And trans.), *ရှေးဟောင်း မွန်ကျောက်စာပေါင်းချုပ်* (Anthology of Old Mon Inscriptions), Yangon: Archaeological Department, 1965, pp. 27,41.

(c) H.L. Shorto (1971) *A Dictionary of the Mon Inscriptions from the Sixth to the Sixteenth Centuries,* London: Oxford University Press, p.295.

[5] Nyein Maung: 1972: 50.

[6] Nyein Maung: 1972: 67, l. 29.

[7] Nyein Maung: 1972: 60.

…puhā lhū so kywan aiu sukrā samī aiu *Mranmā* ṇīma ma aut 3 yok

(trans.) Aiu Thaukkyar (Miss Friday), her daughter Aiu Mranmā (Miss Myanmar), her younger sister Ma Aut, the three slaves dedicated to the Buddhist monument[1]

The Htupayon Inscription of 1363 AD which was erected during the reign of King Thadominpyar (1364-67) mentions as follows:

…ava maṅ hu si thaṅ hin cow klaw tha kre ñā *Mraṁmā* rwā ti chaṁ rhi ma krwaṅ maṅ nhuaṅ 2 [nhac] lhyaṅ soṅ asyaṅ hu ran paṅ khluiw ruy cuiw tha muttama daway ra khiuṅ tan luiṅ nhuc tuiṅ tut khun syaṁ kywan ciuw khut pu chak tut ruy ma yut kliuw nhum ū thak khaṁ é

(trans.) the King of Inwa who is well known over Myanmar embracing *akre* (Lower Myanmar) and *añā* (Upper Myanmar), as well as who suppressed against enemies and ruled over Mottama, Dawei, Rakhine, Talaing (now Mon); and the Shan was paid homage.[2]

The Shwezigon Pagoda Bell Inscription of 1550 in Myanmar dedicated by King Hantharwaddy Hsinbyumyarshin mentions as follows:

…taluiṅ prañ tuiṅ niuṅ ṇaṁ *mraṁma* prañ tuiṅ niuṅ ṇaṁ alum[3]

(trans.) …entirety of two countries: Myanmar and Mon

2.2 Using the Word Myanmar in Historical Sources

The total number of thirty-three sources—inscriptions and epics mentioning the Myanmar and Bamar are also revealed as follows:

No.	Name of Inscriptions and Literature in Pali, Myanmar and Mon	Year / AD	Period/Reign
1	Bagan Palace Ceremony Inscription in Mon	1084	Kyansittha (r.1084-1113)
2	Minister Sighasū Inscription[4]	1190	Narapatisithu(r.1165-211)
3	Dhammarājika Pagoda Inscription[5]	1198	Narapatisithu(r.1165-211)
4	Thu Htay Muk Ku Pagoda Inscription[6]	1194	Narapatisithu(*r*.1165-211)
5	Pwar Saw Inscription[7]	1241	Kyazwar (*c*.1235-1249)

[1] Nyein Maung: 1982: 25.

[2] Nyein Maung: 1998: 129.

[3] ‘ရွှေစည်းခုံခေါင်းလောင်းစာ (Shwezigon Bell Inscription in Myanmar, Mon and Pali)’, *Report of the Superintendent, Archaeological Survey, Burma, 1953,* Yangon: Government Printing and Stationary Department, p.20.

[4] Nyein Maung: 1972: 50. …**မြန်မာပန်တျာကာ**။အိုင်္ဒသာ။အိုင်္ဒကောင်။အိုင်္ဒကြီ။ စည်သည်ကာ။ ငါဖုန်ရ။စည်သည် မိယာ

[5] Nyein Maung: 1972: 67. …**မြန်မာကျွန် ၅၀၀**။ ကုလာကျွန် ၅၀၀။အပေါင် ၁၀၀၀။

[6] Nyein Maung: 1972: 60. …**မြန်မာပန်တျာ** ၁၃။ကူလာကခြိယ်၅။ ငကော၁၊ ငယောက် ၁။မိယာ အိုအ်ဒဝယ်၁၊သာ စေလိယ်၁။ ငကြောင်၁၊ တေပါ၁၊

[7] Nyein Maung: 1982: 25, ll. 25... …ပုဟာလှူပါသော ကျွန် အိုသုကြာ။ သို့ အို **မြန်မာ**။ ငိမ မဥတ်အာ ၃ ယောက်။

6	Einya Kyaung Inscription[1]	1242	Kyazwar (*c*.1235-1249)
7	Thiripissayar Ayak Inscription[2]	1230	Kyazwar (*c*.1235-1249)
8	Htuparyon Inscription[3]	1363	Thadominpya (r.1364-67)
9	Awa Myo Nan Kyaung Inscription[4]	1398	Mingyi Swar Sawkai (r.1367-1400)
10	Tak Nwai Kyaung Monastery Inscription[5]	1442	Narapati I, aka, Tryaphya VI (r.1442-1468)
11	Kalyāṇī Inscriptions in Pali[6]	1476	Dhammaceti(r.1472-92)
12	*Gāthā Khrok Chay Pyiu* (Epic of Sixty Verses)[7]	1517	Shin Oun Ny (*b*. 1453-1528)
13	*Rājadhirāj Are:taupuṁ*[8]	1518-72	Tabinshwehtee(r.1531-50)
14	Shwezigon Bell Inscription[9]	1550	Bayinnaung(r.1554-1581)

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[1] Dr. E. Forchhammer (1892) *Inscriptions of Pagan, Pinya and Ava deciphered from the Ink Impressions found among the Papers of the Late,* Yangon: Government Printing, 1892, pp. 119. Hereafter cited as Forchhammer: 1892.
...စကုကျွန် **မြန်မာကာ** ။ငထုယ်သာ ငချတ်ခင်ဒ။သာငပုဒ။သာမြက်ရာဒ။ငချတ်ခင်ငီလေပဒ။ငီင။ငီငရုံဒ။ငယှန်ဒ၊သာငပုံဒ။ငီငစုံဒ။

[2] Forchhammer: 1892: 216, ll. 1-2. . …မဟာဒါနပတိပုရှာလှူသော ပုကံကျွန် ကုလာ **မြန်မာ** စုံ ၇၈ယောက်။ ဗောကလှပ်ကာ သာ ကျွန်ငါ ဝယ်သော ၃ဝကိပ် အပေါင်ကျွန် ၁ဝ၈။

[3] Nyein Maung: 1998: 129, ll. 3-6. …ရန်ဖက်ကင်သာ၊ အဝမင်ဟု သိတင်ဟန်စောဝ်၊ ဂ္ဂဝ်ထကြေညာ၊ မြံမာရွာတိ၊ ဆံရှိမကြွင်၊ မင် နှင်၂လျှင်၊ သောင်(အ)သျင်ဟု ရန်ပင်ချို့ဝ်ရုယ်၊ စိုဝ်ထ မုတ္တမ၊ ဒဝယ်ရခိုင်၊ တန်လိုင်နှစ်တိုင်၊ (တု)တ်(ခွန်)၊သျံကျွန် စိုဝ်ခုတ်၊ ပုဆက် တုတ်ရုယ်၊

[4] Forchhammer: 1892: 119, ll. 1-4. **…**နမောဗုဒ္ဓါယ၊ **မြံမာမင်**တိုတ် မညီညွတ်သောကြောင် ပြည်တဲချောက်ချာ ပျက်စိရုယ် သာသနာ ပျက်စီခရကာ သိကြာနတ်မင်သည် **…**နတ်မင်သည် စောင်မချင်သအာဖြင် ရန်ခပ်သိမ်ကိုဝ် ချိုဝ်ချယ်နိုင်ရုယ် **မြံမာပြည်** အကုန်ကို အစိုဝ်ရထသော ဖုန်တန်ခိုဝ် အသရိယ်။

[5] Forchhammer: 1892: 216, ll. 2-3. …သိရိတရိဘဝဏာတိတ်တျာပဝရပဏ္ဍိတဓမ္မရာဇာမေည်သော ဖုရျှင်မင်တရာ၏တူ တော် တမူလေည် ဖြစ်ခသော **မြံမ္မာပြေည်အလုံမ်စုံမ်** အစိုဝ်ရရုယ် အပြေည်ပြေည်မှကျော်စောခင်ရှာပြီထသော မင်ကြီးကျော်စွာ၏ ယောက်ဖတော်တမူလည်ဖြစ်ထသော

[6] …evaṁ Rāmañadese Sudhammanagarato Sāsanassas gantvā, **Marammadese** Pugāmanagare…
(a) Taw Sein Ko, 1892, *The Kalyāṇī Inscriptions recorded by King Dhammacetī at Pegu in 1476 A.D. Text and Translation,* Yangon: Government Printing, p.6.
(b) Kyaikkasan U Ācara and Thabyekan Sayardaw (1938) *မဟာကလျာဏီကျောက်စာ* (*The Mahā Kalyāṇī Inscriptions erected by King Dhammaceti*),Yangon: Pyi Kyi Mandaing Pitakat Press, p.27.

[7] Shin Oun Nyo, *ဂါထာခြောက်ဆယ်ပျို့* (Epic of Sixty Verses), ed. Shin Pyinnyarthiha and others, Yangon: State Pari yatti Sāsana Universty, 2003, p.75. …ပုဏ္ဏားး**မြန်မာ၊**ဗျာပါစင်းကြန့်ျ၊ ကြန်တန်ပျော့ဂ္ဂမ်းကမ်းယံပြုမြုံ၊ သထုံတလိုင်း၊ စဉ်တိုင်းဆက်သားကုလားပန်းသေး၊ရပ်ဝေးကျည်းလို၊သိန်းဃိုင်ဇ္ဈဗာလီဗောဓိပင်ကာ၊

[8] Banyar Dala, "ရာဇာဓိရာဇ်အရေးတော်ပုံကျမ်း" *မြန်မာမင်းများအရေးတော်ပုံ* (Struggle of Kings of Myanmar), Yangon: Yar Pyae Books, 2005, pp. 204.
…သည်နှစ်ယောက် အဖက်တန်သည်ဟုမွန်အမတ်၊ **မြန်မာ**အမတ်တို့ ဆိုကြကုန်၏။
…**မြန်မာ**မင်းသား မင်းရဲကျော်စွာလည်း မင်းပျိုမင်းလွင်၊ စိတ်လက်ခိုင်ကြံ့ ရဲရင့်လှသည်။
…သမိန်လောက်ဖျား **မြန်မာ**ကို ချီပင့်၍ **မြန်မာမင်း**နှင့်သမိန်လောက်ဖျား ညီညွတ်ပြီးလျှင် ချီလာသောအခါ အင်အားမရှိ နည်းလျက်ပင် **မြန်မာမင်း**ကို ဆင်နှင့် တိုက်ရ၍ ငါ နှစ်ခါ အောင်သည်။ (ibid, pp. 204,220,227.)

[9] *ASB, 1952-53,* p.20. …အဝမင် အမှုအမတ် ဆံမြင်နှင်တကွ လက်နက်တော်ဖြစ်သှ်၊ **မြံမပြည်တိုင်နိုင်ငံ** ထီဖြူဆောင်ဟူသမျှ လက်နက်တော် ဖြစ်၏။ ထိုသို့ကစ၍ ကုသိုလ် အဟောင်ပျက်လေပြီသုံကိုဝ် ပြုပြန်၏။ကုသိုလ်အသစ်လှ်မျာစွာ ပွာအောင်ပြုတော် မ မူ ပြန်၏။ ဥကလွန်လေသော မင်ကေရဇ်အမှုအမတ်တိုင်သှ် ဖုရာပစ္စည်၊တရာပစ္စည် တိုကိုဝ်စာသှ်ကိုလ် မစာနှင်ဟူ၍ လွှတ်တော်မူသှ်၊ တလိုင်ပြည်တိုင်နိုင်ငံ၊ **မြံမပြည်** တိုင်နိုင်ငံအာလုံမ်၊

15	Thak Taw Shae Pagoda Inscription[1]	1563	Bayinnaung (r. 1551-81)
16	*Thakhingyi Egyin*[2]	1574	Shin Myat Khaung (1538-1588)
17	*Yoedayar Mipayar Egyin*[3]	1578	Nawade I (1498-1588)
18	The *Zar Tar Daw Bon Yarzawin*[4]	1671 -72	Narawara Min(1671-1672)
19	The *Vilāsanī Maukun:*[5]	1756 - 1840	Navade, Lord of Wakmaswit
20	Shwe Mut Htaw Pagoda Inscription[6]	1764	Naungdawgyin Min (r.1760-63)
21	Nibban Hseik Oo Pagoda Inscription[7]	1764	Hsinbyushin Min (r.1763-1776)
22	Bagan Shwezigon Pagoda Inscription[8]	1768	Hsinbyushin Min
23	The *Salin Min Maung Paung Khyaung Egyin* composed by Shwe Daung Nandameit[9]	1771	Hsinbyushin Min

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[1] Nyein Maung: 1998: 135, ll.4-6. …ရန်ဖက်ကင်သာ၊ အဝမင်ဟု သိတင်ဟန်စောဝ်၊ကွဝ်ထကြေညာ၊**မြံမာရှာတိ၊** ဆံရှိမကြွင်၊မင်နှင်၂လျှင်၊ သောင်(အ)သျင်ဟု ရန်ပင်ရှိုဝ်ရယ်၊စိုဝ်ထ မုတ္တမ၊ဒဝယ်ရခိုင်၊တန်လိုင်နှစ်တိုင်၊(တု)တ်(ခွန်)၊သျှံကျွန် စိုဝ်ခုတ်၊ပုဆက်တုတ်ရယ်

[2] …ဗန်းမော်မိုးညင်း၊မကြွင်းအံ့ဘွယ်၊သုံးဆယ်စုံမှိုင်း၊တလိုင်း**မြန်မာ**၊မင်းတရားကို၊စကြာရွက်အုံး၊ခွန်ဆက်ရုံးသည်၊ (Shin Myat Khaung, *Thakhingyin Egyin*, para. 22.

[3] …**မြန်မာပြည်**ဇမ္ဗူ၊ထိန့်ဆူရိုက်ကြိုး၊ရန်ညွှန့်ချိုးသည်၊ရှင်ဘိုးတည့်ကျော်သွေး၊ ရပ်နီးဝေး။(Nawade, Yoedayar Mipayar Egyin, Tun Yi (ed.), *ချေင်းဟောင်းပေါင်းချုပ်*၊ (Anthology of *Egyin* Epics), Yangon: Yar Pyae Books, 2012, para. 20, p.250.

[4] *ဇာတာတော်ပုံရာဇဝင်* (Chronicle of Royal Horoscopes), ed. U Hla Tin, Yangon: Archaeological Department, 1960, pp.99f. This chronicle mentions the list of 101 Nationalities including the Mranmā (Myanmar).

[5] …အမရပူရ၊**မြန်မာ့**ကြင့်နန်း၊ဦးဆောက်ပန်းဟု၊ရွှေနန်းရတနာ၊စံထိုက်စွာသား၊မုဒ္ဒါသိဉ္စန၊ဘိသေကလည်း၊ (*Vilāsanī Maukun:*, para. 70.)

[6] Nyein Maung: 2013: 18. …အင်းဝပျက်ညှနော် မြေဲဘက် မုစ္ဆိုဘိုအရပ်တွင် အတံကြာ……**မြန်မာကျွန်တော်မျိုးအပေါင်**ကို စုရုံ ၍ ဖြိုနှင်တိုက် ပြီလျှင် ကောဇာသက္ကရာဇ် ၁၁၁၅ခု သာသနာတော် ၂၂၉၇ခု ပထမဝါဆိုလတွင် မုစ္ဆိုဘိုအရပ်ကို ကုန်းဘောင် ပြဉ် ရတနာ သိဃ်မြို့နန်ကျုံ ဗဟိုတံခါ နတ်ကွန် မဟာနန္ဒကံကြီရဠါနကို တပြိုင်နက်တခါတချိန်တ့်တဉ်၍ **မြန်မာဥစ္စန်ထွန်ရာ** သာသ နာတဉ်ရပ်မင်နေပြဉ်ကြီဖြစ်၏

[7] Nyein Maung: 2013: 24. …မဟာနဂရတိုင်း၊ ရာမညတိုင်း၊ မစ္ဆဂီရိတိုင်း စသဝ် တိုင်းကြီးတကာတို့ယေ့် ချက်ဖွိယ်။ သရိယ် ခေတ္တရာ၊ ပုဏ္ဏဂါမ၊ မြင်စိုင်းစသား ပင်းယစစ်ကိုင်း၊ပြည့်လှိုင်းစုံစွာ၊ ရတနာပူရမြတ်ဌာနဟု၊ **မြန်မာ့ပြည်ကြီး**

[8] Nyein Maung: 2013: 39, 59….ေ သြာင် သြာင်ချာဘုမ္မိမြေပုံသာထက် ရတနာသိဃ် ရွှေမြိုဝ်တ်ကြီး ရွှေနန်းကြီးတည်တ်မူရယ် ရွှေထီး ကနက်ဆောက်စိုက် စမွာယ်တ်မူသည် **မြမ္မာတိုင်နိုင်ငံ** အလုမ်ကိုဝ် သိမ်ကျုမ်တ်မူရယ်

…ရတနာပူရပြည်ကြီးသခင် လောကသရာဇူစေတီဒါယကာတ် မင်တရားကိုဝ် ရာမညတိုင် တလိုင်ဥရပ်ကိုဝ် လက်နက်ပြုရယ် မင်မူသဝ် ဟံသာဝတီမင်သည် တိုက်လံဖျက်ဆီ သိမ်ယူရယ် ရတနာပူရ **မြမ္မာတိုင်နိုင်ငံ** သာသနာတော် ညစ်နွမ်းရွှေ့လျှင် ပျက်စီးရှိလတ်သော်။

[9] …မြန်အောင်မြို့နန်း၊စံပယ်မြန်းက၊ ဆင်ကန်းတောတိုး၊ တလိုင်းဆိုးကြောင့်၊တောင်ရိုးခိုးကာ၊နေလေရှာသည်၊ **မြန်မာ**အများ၊ ရှင် စိတ်ထားဖြင့်၊ ရွှေဘဝါးတော်အောက်၊ဝင်လှာရောက်လျက်၊ သောက်သောက်ပြိုးပြွမ်း၊မှုတော်ထမ်း၏။ (Shwedaung Nandameit, *Salin Min Maung Paung Khyaung Egyin, Ballad* , Verse no. 32, edited by U Pe Maung Tin, Yangon: Myanmar Historical Commission, 1962, p. 13. Hereafter cited as Shwedaung Nandameit, 1771.)

…မွန်ရှမ်း **မြန်မာ၊**မြတ်သံဃာတို့၊ကယ်ပါစိမ့်ကြောင်း၊အခွင့်တောင်း၍၊အလောင်းမင်းထံ၊ မေတ္တာခံသော်၊ Shwedaung Nandameit, 1771, verse no. 42, p. 17.)

…စလင့်ပန်းကုံး၊ရွှေနားကျုံးလော့၊ယွမ်းသုံးဆဲ့ငါး၊ရပ်တပါးတွင်၊ကုလားဆပညာ၊ **မြန်မာသတ္တရ၊** မွန်းသုံးစုဟု၊ ဇမ္ဗူ့သပြေ၊ပင် မြစ်ခြေဦ၊ မိုနေကြရာ၊ သောင်းဒီပါဝယ်၊**မြန်မာ့ဦးစွန်း**၊ သည်ကထွန်း၍၊ (Shwedaung Nandameit: 1771: verse no. 56, p. 24.)

24	Wall painting, Shinpinpwintlan Pagoda, Hsin Kyoe Village, Yezakyo Township, Pakkhuku District	1797	Hsingu Min (r.1782-1819)
25	Royal Order of Myanmar (7 November 1806)[1]	1806	Hsingu Min
26	Maha Aung Mye Bon Thar Kyaung Inscription[2]	1823	Bagyidaw Min (r.1819-1846)
27	*Rājindarājamavaramaṇḍanī* (the Celebrated Great Chronicle)[3]	1829	Bagyidaw Min (1819-1837)
28	*Yoedayanaing Mawgun*(Epic for the Victory over Ayuthia)[4]	1853	Mindon Min (r.1853-1878)
29	Inscription erected at North of Pyinya City[5]	1881	Thibaw Min (r. 1878-1885)
30	*Dutiya Mahārājavaṁtaukrī:* (Second Great Chronicle of Myanmar)[6]	1898	Mandalay Time Press
31	Lieutenant-Governor of Burma[7]	1905	
32	*The Burma Act No. IX of 1920 The University of Rangoon Act, 1920*[8]	1920	
32	*Susodhitamahārājavaṁ*	1923	U Bi, Sayar Thein, Sayar

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[1] Than Tun (1986) *The Royal Orders of Burma (1598-1885)*, Vol. V, Kyoto: Southeast Asian Studies, pp.1025. **မြန်မာသံခံ**ပေသီကို တောင်ဘက်ဟိုက်ရေခါး ငါးစင်ရိုင်းရွာလပ်သည်ကို သနားတော်ခံစေမည် ဆက်သွင်းချက်အတိုင်းသင့်ပြီ၊

[2] Forchhammer: 1892: 402. ထေမြတ်တော်ပေါင်း ပျော်ကိန်းအောင်းသား ရွှေကျောင်းလွတ်တု ဇမ္ဗူဧဇ မြန်မာမှန်ပွင့် သောင်းမြင့်တံခွန် ဧတဝန်ကို မိုးစွန်ထိလော် ရွှေဘုံဆောက်၍ (IL no. 12-13.)

[3] Ariyāvaṁsa Ādiccaraṁsī Monrwe Zetawun Sayardaw, (1829) *ရာဇိန္ဒရာဇဝရမဏ္ဍာနီ (ခေါ်) မဟာရာဇဝင်ကျော်* (Rājinda rājavaramaṇḍanī, aka, the Celebrated and Great Chronicle), edited by Prof. Dr. Kyaw Swe Oo, n.d., M.A. Thesis, History, University of Yangon, pp.3,132,274,313.
…**မြန်မာမင်း**နှင့်**မြန်မာတပ်**အများဆုတ်ခွါကြောင်း **မြန်မာတတပ်**သာ ရှိကြောင်းကိုသာ စုံစမ်းစေသူတို့ သိမြင်ခဲ့၍ ယိုးဒယားမင်းကို လျှောက်သည်တွင် **မြန်မာတပ်**များ ဆုတ်ခွါဖို့ ရှိလေပြီးသည်ကို ငဖြို့ရင်းတွင် တပ်ငယ်တခုနှင့်**မြန်မာ**တို့ မလေးမစားနေပြန်သည်။ နေ ထွက်ရှိသလော။ မထီမဲ့မြင်နေသည်။**မြန်မာ**တို့ကို တယောက်မကျန် ဘမ်းယူပြီးလျှင် **မြန်မာမင်း** ဆုတ်လေရာ တပ်ခြေကြွေကို လိုက်၍ တိုက်ရမည်။ (ibid, p. 3)
…**မြန်မာ**အတီးအက၊ တလိုင်းအတီးအက၊ ထားဝယ်အတီးအက၊ တနင်းသာရီအတီးအက၊ ရှမ်းအတီးအက၊ ယွန်းအတီးအက၊ လင်းဇင်းအတီးအက၊ ယိုးဒယားအတီးအကများနှင့် တပ်တိုင်း စေ့အောင်ပွဲခံကြရသည်။ (ibid, p. 132)

[4] U Ponnya (1853) *ယိုးဒယားနိုင်မော်ကွန်း*၊ (Epic about Victory of Myanmar over Ayuthia), translated into English by Taung Goe, Yangon: Pyi Zone Publishing House, 2003, p.69, verse no. 22.14 **မြန်မာနိုင်ငံ** အရံထီးနန်း၊ ရှမ်းနှင့် ယွန်းကို၊ တစ်စွန်းတစ်စ၊ နှောင့်ယှက်ရ၍၊ မာနကိုးစား၊ ထင်ပိုးဝါးနှင့်။

[5] Forchhammer: 1892: 357, ll. 39. . ..ဇယတု။ ။**မြန်မာတိုင်းကြီး**နှင့်။မဟာမိတ်စစ်ဖြစ်ကြ၍ အင်္ဂလိပ်မင်းကထားသည်။ ကိုယ်စားလှယ်တော်။

[6] *ဒုတိယမဟာရာဇဝင်တော်ကြီး*၊ (Second Great Chronicle of Myanmar), Yangon: Seik Koo Cho Cho Books, 2015 Reprinted, pp.91, 94f. ဗမာနိုင်ငံ

[7] (a) It was an English designation in Myanmar. Its Myanmar equivalent is **မြန်မာ**နိုင်ငံတော်ကို စီရင်အုပ်ချုပ်တော်မူ သော ဘုရင်ခံမင်း (*Supplement to The Burma Gazette* (22 October 1927), Yangon: Government Printing, p. 1417.
(b)ဒေါ်ကြန် (၁၉၈၅)"ဗြိတိသျှခေတ်အုပ်ချုပ်ရေးဆိုင်ရာအခေါ်အဝေါ်များ"၊ (Myanmar Equivalents of British Official Designations) *နိုင်ငံသမိုင်းသုတေသနစာစောင်*၊ (Researches in Burmese History), No. 5, Yangon: Historical Research Department, p. 31.

[8] *၁၉၂၀ပြည့်နှစ်၊ **မြန်မာနိုင်ငံတော်ဆိုင်**ရာအက်ဥပဒေနံပါတ် ၉။ ၁၉၂၀ပြည့်နှစ်၊ ရန်ကုန်မြို့၊ ယူနီဗာစီတီသိပ်ံကျောင်းတော်ကြီး အက် ဥပဒေ*၊ Yangon: Govt. Printing, 1928.

	(Great Chronicle of Susodhita)[1]	Ko Ba Kyaw	
33	*Prime Minster's Speech delivered at the Burma Round Table Conference at St. James's Palace*[2]	1931	

Throughout the time of British colonial period, Department of Government Translation[3] used the word Myanmar (Burma in English) as an official vernacular term. Doubtlessly, the word Myanmar was a formal usage of Government of British.

2.3. The Bamar and its Prominence[4]

The earliest historical source of the word *Bamā* is found in the Shwezigon Bell Inscription of 1550 dedicated by King Bayinnaung. In this inscription in Mon, no. 11 line of this text mentions the word Bamā.[5] Also, the Mons call the Bamar Pemē or Bamay.[6] According to colloquialism of the Mons who had much earlier contact with the British than the Myanmar, Bamar is a pronunciation by the Mons and became prominent in the nineteenth century onward.

In regarding with the historical sources for Bamar, the term Bamar was popular when the Do-Bama Asi-ayon, meaning "We, the Bamar Association" and its slogans—the Land of Bamar is our nation; Bamar's language is our language; Bamar's speech is our speech; Love the Land of Bamar; Promote Bamar's language and pay respect on Bamar's mother tongue—were prominent in 1930. The term Bamar was given the name of this organization by nationalists. They understood the 'name of Bamar' deriving from Brahma, the God of Creator who created primeval human beings.

Accordingly, the name Bamar embraces not only the Bamar but also non-Bamar indigenous ethnic peoples descended from Brahma so that the Bamar and the ethnic peoples were the same in ancestor. It also means that they are blood relatives.[7] Otherwise, the word Myanmar refers to only the Myanmar ethnic people who was called the name of nation by autocratic rulers and the colonial rulers.[8]

The term Bamar was more prominent in the Japanese military occupation than the pre-war period. It appeared from an impact of encouragement of Japanese authorities who propagated anti-

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[1] **မြန်မာနိုင်ငံ**(State of Myanmar) **မြန်မာမြင်း** (Myanmar horse **), မြန်မာဗိမာန်**(Myanmar building) **မြန်မာကျွန်တော်မျိုး** (Myanmar slaves/ servants) *(Susodhitamahārājavaṁ)*, Vol. V & VI, Yangon: Yar Pyae Books, 2015 reprinted, pp. 466-470, 490, 509.

[2] **မြန်မာနိုင်ငံတော်**ဆိုင်ရာမျက်နှာစုံညီအစည်းအဝေး (the Final Session of the Burma Round Table Conference at St. James's Palace on the 12th January, 1932). (*နန်းရင်းဝန်ကြီးဏ်မိန့်ခွန်းများနှင့် မြန်မာပြည်ဘုရင်ခံမင်းကြီးဏ် မိန့်ခွန်းမှ ထုတ်နုတ်ချက်၊ Prime Minister's Speech,* Yangon: Printing and Stationery, 1932, p. 29.)

[3] စာတော်ပြန်ဌာန

[4] **ဗမာ**

[5] (a) ခလွာ **ဗမာ** ဂမိင်ကို တွော်င် ဗတာင် ဂေါအ်

(b) U Chit Thein, 1965, ရှေးဟောင်းမွန်ကျောက်စာပေါင်းချုပ်၊ (Ancient Mon Inscriptions), Yangon: Archaeological Department, pp. 106,216.

(*c*) bamā is Burmese. (H.L. Shorto, 1971, *A Dictionary of the Mon Inscriptions,* London: Oxford University Press, p.259.)

[6] (a) R. Hallidy (1922) *A Mon-English Dictionary,* Yangon: Ministry of Union Culture, 1955, Reprinted, p.328. Halliday mentions that ဗမာ Pemē. V. (1) to tend, to watch over, to herd; (2) to creep; (B) a Burman; adj. Burmese.

(b) interview with Nai Maung Toe, an elder Mon and expert in Mon Culture and History, 76 age, on 1 April, 2021.

[7] *ဗမာနိုင်ငံလုံးဆိုင်ရာ တို့ဗမာအစည်းအရုံးကြီး၊* (Do-Bama Asi-ayon), Yangon: Headquarter of Do-Bama Asi-ayon, 1959, p.5.

[8] Thakhin Thein Pe and Others (1974) *တို့ဗမာအစည်းအရုံးသမိုင်း* (History of Do-Bamar Asi-ayon), Yangon: Seikkoo Cho Cho Books, 2018 reprinted, p. 219.

British colonial rule and *burmanization*. They removed from some English identities, i.e., English named-streets, cities, markets and parks in Yangon and other towns of Myanmar. Japanese changed the names of thirty-seven places and renamed with the name of anti-British revolutionists and nationalists of Myanmar.[1] Then, Japanese military elite were closed to the Thirty Comrades who were the members of Do-Bama Asi-ayon. It was a cause to popular the term.

Stamps of this period give us to clarify. The title *bamā niun ṇaṁ tau* (State of Bamar) was pressed on the surface of stamps. When these stamps were made comparative study with the stamps of British Burma, the title *mranmā niun ṇaṁ* (State of Myanmar) was pressed on the stamps. In the *Constitution of Burma*, 1943, the terms *Bamā nuiṅ ṇaṁ tau* (Burma), *bamā amyui:sā:* (every Burmese national) and *bamābhāsā* (Burmese language) were written in Myanmar. The word Bamar (Burma in English) therefore was an official country name of this period.[2]

The word Bamar continued prominent in social life of Myanmar in the post Japanese occupation period. The *Proceedings of Burma Legislative Council*, *Records of Burma Parlia -ment in 1947* and the *Cakkūphrū Prajāt* mentions the word Bamar. At that time, the word *Bamar* was continued in Myanmar literature such as *Bamāpañ*[3] (Bamar nation or province), *Bamā tiuṅ sū pañ sā: myā:* (the people of Bamar),[4] *Bamā Niuṅ ṇaṁ* [5] (Bamar nation), *Bamā Lūmyiu:*(Bamar nationality),[6] *Bamā, kā kway re:*[7] (Burma Defense Service), *Bamā, tap ma tau*[8] (Burma Army), *Diu, Bamā chaṅ:rai sā: acañ: aruṁ:*[9] *Bamā prañ lut lap re:*[10] (Burma Independence), *Bamā Bhuraṅkhaṁ Maṅ:kri:*[11] (Governor of Burma), *Bamā cāpe*[12] (Burmese Literature),[13] When lyrics of patriotic songs (1930-1945) in Myanmar are studied, most of these songs were composed by YMB Sayar Tin, Nandawshae Sayar Tin, Myanmar Nyunt Sayar Tin, and Shwedaing Nyut. In these songs of them, Myanmar was mostly used as the name of nation, and Bamar referred to the name of ethnic people.[14]

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[1] Yoshinari TAKESHIMA (2007) "The *Burmanization* Policy in Burma under the Japanese Occupation", *Reconsidering the Japanese Military Occupation in Burma (1942-45),* Tokyo: Tokyo University of Foreign Studies, pp. 38-40.

[2] *ဗမာနိုင်ငံတော်အုပ်ချုပ်ရေးစည်းမျဉ်းပြဋ္ဌာန်းသောဥပဒေ၊ ဗမာသက္ကရာဇ် ၁၃၀၅* (Constitution of Burma, August 1st, 1943), the State, article 1,2, Fundamental Rights to Burmese Nationals, article no. 3-5, Language, Armed Forces article no. 3-4., Constituent Body, article no. 9.

[3] Zeyar Maung (1945) *စက္ကူဖြူပြဇာတ် (ခေါ်) မြန်မာ့နိုင်ငံရေးအခြေပြု၊* (Play about the *White Paper: Fundamental Play for Politics of Myanmar)*, Yangon: Mandalay: Hla Khin In Hsan Press, pp. 8-43. Hereafter cited as Zeyar Maung: 1945. **ဗမာ**ပြည်

[4] **ဗမာ**တိုင်းသူပြည်သားများ:

[5] ...**ဗမာ**နိုင်ငံ ကိုယ်ပိုင်အုပ်ချုပ်ရေး တောင်းဆိုမှုကို (*Zeyar* Maung: 1945: 20f.)

[6] Zeyar Maung: 1945: 28. **ဗမာ**လူမျိုး

[7] **ဗမာ့ကာကွယ်ရေး**

[8] **ဗမာ့တပ်မတော်**

[9] ဒို့**ဗမာ**ဆင်းရဲသားအစည်းအရုံး

[10] **ဗမာ**ပြည်လွတ်လပ်ရေး

[11] **ဗမာ**ပြည်ဘုရင်ခံကြီး

[12] **ဗမာ**စာပေ

(a) *Burma Legislative Council, Proceedings,* Vol. I, No. 7, 1946, Yangon: Government Printing, 1946, pp. 239,244f.
(b) *Burma Legislative Council, Proceedings,* Vol. I, No. 10, 1946, Yangon: Government Printing, 1946, pp. 379.

[13] Monywar Win Pe (1992) "ဇာတိမာန်တေး" (Patriotic Songs of Myanmar), *ဇာတိမာန်စာပေစာတမ်းများ၊* (Literature of Myanmar Nationalism), Vol. I, Yangon: Sarpebiman Books, 1992, pp. 196-223.

[14]Thutethi Maung Maung, *ခေတ်ဟောင်းဓာတ်ပြားသီချင်းပေါင်းချုပ်ကြီး၊* (Anthology of Old Myanmar Songs recorded in Gramophone), Yangon: Laminlay Books, pp.1369-1392.

When Constituent Assembly was held in 1947, the name of nation returned to the word Myanmar. However, nothing was found any significant discussion on the difference between Myanmar and Bamar. Some representatives, U Aung San, U Ba Cho, Thakhin Mya, and etc., did not pay attention to the ambiguous usage, the words Myanmar and Bamar when they took discussion on new constitution. However, the Bamar, a noticeable phrase, the Bamar who are majority of the people, is frequently used among their discussion. It therefore referred that the word Bamar meant the name of nationality and Myanmar also referred to the name of country.[1]

When the Constitution of Burma (Myanmar), 1974 was promulgated, the word Bamar was the name of nationality and Myanmar was the name of nation. The two words, are, therefore, used to tell in everyday use of the people. Likewise, Bamar is a name of nationality in the *Census of Burma, 1973.* During the State Law and Order Restoration Council (SLORC Regime), SLORC issued an order 2/89, and notification no. 5/9 on 18 June 1989 to clarify the two ambiguous names. According to it, the word Bamar refers to a name of nationality and Myanmar refers to all the nationalities.[2]

Conclusion

The term Myanmar is used since the Bagan period onwards. It is described in the stone inscriptions in Myanmar as well as classic literature of Myanmar, i.e. *pyiu*, *maukun:*,*ekhyaṅ*, *rājavaṁ*, and *are:taupuṁ* in Old Myanmar. The term Bamar firstly became prominent with the establishment of Do-Bama Asi-ayon and legalized in the Japanese occupation period. In fact, the word Bamar is a Mon pronunciation for Myanmar. The word Myanmar is written in Myanmar vernacular while the word Bamar is also mentioned in the Mon inscription of Bayinnaung's bell inscription dedicated at Shwezigon Pagoda, Bagan. In my opinion, founders of this organization had no willingness to use the term Myanmar, the former vernacular name of British Burma.

During the Japanese occupation period, the members of Do-Bama Asi-ayon also led to political role and anti-Anglo-American spirit was coincidently carried out by Japanese authorities. The word Bamar, therefore, continued as a popular usage in political role. However, it came to disappear since the Constitution of Burma, 1947. Myanmar, formal name of nation, continues to the present time. When SLORC took part as caretaker regime, Myanmar is promulgated to use the name of country and belongs to all the indigenous ethnic peoples. The word Bamar is also notified as the name of Bamar national. As the name of country, Myanmar has been used since the British colonial rule, the name Myanmar is now widely known.

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[1] *မြန်မာနိုင်ငံတော် တိုင်းပြည်ပြဂျလွှတ်တော်ညီလာခံမှတ်တမ်း*၊ (Proceeding Records of Constituent Assembly), Vol. 1, Part 4, (16 June 1947), Yangon: Government Press, pp.74.134.146,

[2] *လုပ်သားပြည်သူနေ့စဉ်သတင်းစာ*၊ (The Working Peoples's News Daily on 19 June 1989)

Appendix. I.

The wall-painting of Shinpinpwintlan Temple, A.D. 1797, Hsin Kyoe village, Yesakyo, Pakhukku district, Magwe Region

Envelope (1937)

Source: Steven Zwillinger, *a Catalog of Burmese Cachets (1937-1947)*

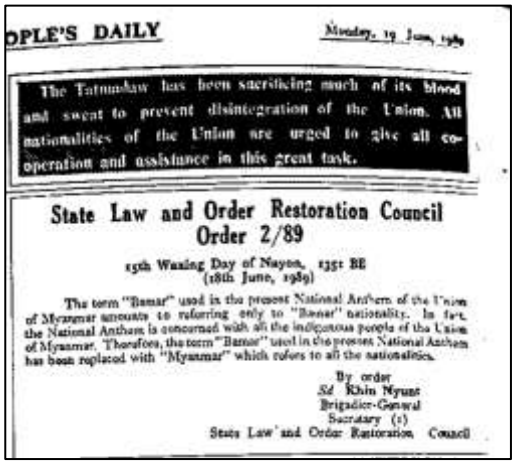
Appendix. II.

Bank notes during the Japanese Occupation Period

Source: http://burmaphilatelic.blogspot.com http://www.banknoteworld.com ats@atsnotes.com

Appendix. III.

Postage stamps of Myanmar period (1943-44)



Source: stampsofburma@gmail.com , ats@atsnotes.com

Appendix. IV.

Pwar Saw Inscription of 1241 A.D

Bayinnaung Bell Inscriptions

Source: photographed by Col.Aung Zaw Linn

Appendix. V.

The Constitution of Burma, 1943

緬 甸 國 家 基 本 法（緬文）

ဗမာနိုင်ငံတော်အခြေခံဥပဒေ

ဗမာသက္ကရာဇ် ၁၃၀၅ ခုနှစ်၊ ဥပဒေ အမှတ် ၁။

အုပ်ချုပ်မှု စီမံရေးအဖွဲ့အဖြစ်ဖြင့်၊ ယခုစည်းဝေးလျက်ရှိသောဗမာ့လွှတ်လပ်ရေး စီစဉ်ရေးအဖွဲ့၏ဥက္ကဋ္ဌနှင့် အဖွဲ့ဝင်များသည်၊ နိုင်ငံသူနိုင်ငံသားတို့၏ ဥပဒေပြုရန် အချုပ်အခြာအာဏာကို နိုင်ငံသူ နိုင်ငံသားတို့၏ ကိုယ်စားအသုံးပြု၍၊ အောက်ပါအတိုင်း စည်းမျဉ်း ဥပဒေတရပ်ကို အမိန့်ချမှတ်ပြုလုပ်လိုက်သည်။

အောက်ပါအစီအစဉ်တွင်ပါရှိသောစည်းမျဉ်းသည်၊ဗမာနိုင်ငံတော်၏ အုပ်ချုပ်ရေးစည်းမျဉ်း ဥပဒေဖြစ်ရမည်။

အစီအစဉ်။

နိုင်ငံးတော်။

၁။ ။ဗမာနိုင်ငံတော်သည်၊ လုံးဝလွတ်လပ်၍၊ အချုပ်အခြာအာဏာနှင့်ပြည့်စုံသော နိုင်ငံတော်ဖြစ်ရမည်။

၂။ ။ဗမာနိုင်ငံတော်သည်၊ မဟာအရှေ့အာရှတိုက် အတွင်းပွါးရေး နယ်ကြိုးတည်ထောင်ကြသော အချုပ်အခြာအာဏာပိုင် နိုင်ငံအစုဘသင်းတွင်၊ ဒေခြံးနိုင်ငံများနှင့် ဒေခွင့် အရေးတန်းတူရရှိ၍ ပါဝင်သော နိုင်ငံတခုဖြစ်ရမည်။

၃။ ။ဥပဒေပြုနိုင်၊ အုပ်ချုပ်နိုင်၊ တရားစီရင်နိုင်သော တန်ခိုးအာဏာများနှင့် အစိုးရ၏ တန်ခိုးအာဏာအားလုံးသည်၊ နိုင်ငံသားတို့ထံမှ သက်ဆင်းသဖြင့်၊ ရရှိသော တန်ခိုးအာ

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Personal Interview

Nai Maung Toe, an elder Mon and expert in Mon Culture and History, 76 age, on 1 April, 2021.

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ENVIRONMENT-FDI NEXUS: MYANMAR CASE*

Thidar Kyaw[1]

Abstract

This paper explains the nexus between Environment and Foreign Direct Investment with an analysis of the Pollution Haven Hypothesis (PHH), and evaluates the constraints shaping to the preservation of environment related to FDI in Myanmar. Myanmar is an enriched natural resources country, but it has limited, technology, infrastructure and manufacturing base. The launching of democratic reforms of the country in 2011 dramatically affected international investment communities and foreign investors began to intensely look at the country's enriched natural resources for their investment. Myanmar government has improved rules and regulations for investment projects and scrutinized practices of foreign investors in line with responsible investment and sustainable development of Myanmar. However, there are inevitably environmental impacts and degradation in some project areas. The paper, thus, raised a question: why Myanmar has faced the environmental security challenges from FDI although it has upgraded environmental laws and regulations under the changing context since 2011. An essential feature of the paper is that the enriched resources with poor environmental practices in Myanmar are attractive to resource seeking FDI and the condition has caused negative impacts on its environment. The analysis attempts to prove that economic growth with environmental sustainability in Myanmar depends on how environmental practices in carrying out investment projects comply with its regulations and laws.

Keywords: environmental issues, FDI, PHH, resource extraction, Myanmar's environmental rules

Introduction

Myanmar is a country with enriched natural resources but it has limited technology, infrastructure and manufacturing base. Since the 1990s, Myanmar has initiated the market-oriented economy and invited foreign investment to boost its economy. Various countries, such as China, Japan, Thailand and Singapore became major economic partners for imports, exports, and investment. The launching of democratic reforms of the country in 2011 dramatically affected the international diplomatic and investment communities. International community hailed reforms in line with the democratic transition. Consequently, western countries eased their sanctions and foreign investors began to intensely look at the country's enriched natural resources for commercial exploitation.

At the same time, Myanmar government has improved rules and regulations for investment projects and scrutinized the practices of foreign investors in line with responsible investment and sustainable development of Myanmar. However, there are inevitably environmental impacts and degradation in some project areas. Consequently, these impacts raised a question for foreign firms in Myanmar's resource extraction sector. Therefore, Myanmar government reviewed existing rules and regulations while approved new laws and environmental practices to prevent and protect environmental degradation from domestic firms and foreign direct investment projects. Under these laws and regulations, foreign investors have been required to comply with these environmental practices.

Based on the background, the paper is worth exploring why Myanmar has faced the environmental security challenges from Foreign Direct Investment (FDI) although it has

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upgraded environmental laws and regulations in the changing political context since 2011. While the literature focuses on the impacts of FDI on the environment in Myanmar, it lacks looking at the Pollution Haven Hypothesis (PHH) in this nexus. Thus, the objectives of the research are to explain the nexus between environment and FDI with an analysis of the Pollution Haven Hypothesis (PHH), and to evaluate the constraints to preserve environmental issues related to FDI in Myanmar. The paper intends to explore whether Pollution Havens Concept could be applied to FDI of Myanmar.

Accordingly, the paper is divided into five parts. The first part discusses the correlation between environmental-related issues and foreign direct investment. Then, Myanmar's environmental regulations is explained in the second part and foreign investment in Myanmar is assessed in the third part. The fourth part highlights the environmental impacts of foreign investment projects in Myanmar's resource extraction sector. Finally, constraints to maintaining and strengthening the environmental security in Myanmar are explored.

Nexus between Environment and FDI

Since the end of the Cold War, the trends of security threat gradually changed from inter-state war to non-traditional issues like environmental problems, intrastate ethnic conflicts and transnational crimes etc. However, all individual states and even the United Nations (UN) had no well-designed to address these threats. Among non-traditional security threats, environmental-related issues have been one of the most vulnerable to human society. Environmental insecurity would be challenges to the environment itself and the livelihoods of human beings. Therefore, addressing environmental problems has been raised the important questions for national and international security agenda.

The primary source of environmental insecurity is the effects of competition among states for their economic growth and development. Economic development has benefited to raise the living standards and improve the quality of life across the world. Consequently, foreign direct investment (FDI), a tool for development activities, has threatened environmental security in host countries mainly and the global community has been recognized the link in recent years. According to World Wide Fund in Nature (WWF) report in 1999, most FDI heavily relied on traditional ways of natural resource use and extraction, particularly focusing on agriculture, mineral and energy sectors. The third world countries have increasingly suffered a disproportionate amount of FDI flows into the natural resources sectors in recent years. This has led to accelerating all trends of environmental degradation such as resource scarcity, deforestation, loss of biodiversity and greenhouse gas emissions. Similar to all developing countries, Myanmar has accepted FDI for its economic development and these investment projects are mostly resources-based. Major investors have huge investment and development projects, focusing on natural resources. It is, therefore, critical to understand the interaction between FDI and its impacts on environment.

There is a key aspect of Micro-level analysis influenced to study the FDI-environment relationship in much of research effort to date. Micro-level analysis is that Pollution Havens Hypothesis (PHH) means "Impact of environmental standards on investment decisions by the firm". The Pollution Haven Hypothesis suggests that "foreign investment could be sensitive to weaker environmental standards. A possible asymmetry exists between foreign capital and local environmental standards".

PHH has three main dimensions of why FDI outflows to developing and poorest countries. Firstly, FDI locates or relocates heavy pollution industries to developing countries where there are less stringent environmental policies. Next, their waste of dumping the hazardous flows from developed countries into developing countries via industrial and nuclear energy production. Thirdly, FDI is mainly engaged in resource extraction sector in developing countries where there is no unrestrained extraction of fuel products, timber and other forest resources, etc. In brief, poor environmental regulations and practices, dumping the hazardous waste of industrial and nuclear energy production, and engaging in natural resources extraction in the host country are independent variables for developed countries' decision on their FDI outflows. Therefore, PHH means that if the firms chose their location for one of these variables, the host would face a considerable amount of environmental degradation due to the investments.

Environmental Regulations in Myanmar

Environmental regulations and governance in Myanmar were very weak for five decades until 2011. Myanmar heavily relied on natural resources to bring about its economic growth. After the State Law and Order Restoration Council came to power in 1988, the national economy was transformed from a socialist economy to a market-oriented economy. Economic recession since the Socialist government continued and sanctions led to a sharp drop in foreign assistance and export earnings. Then, the government initiated a market-oriented economy by attracting FDI through the Union of Myanmar Foreign Investment Law.

Along with investment promotion policy and development goals, the government engaged in some measures of environmental regulations and governance. In 1994, the National Environmental Policy which constituted environmental rules for the utilization, conservation, and prevention of degradation of its natural resources was approved. To follow the development of its national environmental policy, Myanmar drafted its Agenda 21 commitment in 1997. According to Agenda 21, Myanmar is required to undertake integrated management of natural resources and provide a blueprint to extend Sustainable Development Goals. Hence, National Sustainable Development Strategy was set up in 2009, integrating environmental considerations into national development in the future. Moreover, Myanmar established various relevant regulations and laws on environmental conservation. Furthermore, Myanmar has been a party to several international treaties relating to environmental protection and biodiversity conservation.

However, general policy proclamations in Myanmar failed to do the actual implementation. FDI was important to recover Myanmar's economy and investment sector, particularly from neighbouring countries due to economic sanctions by Western countries. However, most investment projects largely focused on the extraction of natural resources. Due to excessive use and unsystematic extraction of natural resources through investment projects, Myanmar has faced serious degradation in the environment and its eco system after a decade.

The 2010 General Election began the democratic transition in Myanmar and the winning Union Solidarity and Development Party (USDP) government assumed power in March 2011. The USDP government carried out reforms in the political, economic and administrative areas. Along with these reforms, the USDP government faced two critical conditions, which resulted in upgrading Foreign Direct Investments to comply with higher environmental standards. The first was that local communities and domestic environmental NGOs strongly opposed the

potential environmental and social impact of the Myitsone Hydropower Projects. Another situation was the increasing competitive investment climate in Myanmar due to strong interest from western democratic countries. Transnational corporations from western countries and international financial institutions started supporting Myanmar after lifting sanctions. These new transnational corporations sought to maintain higher environmental standards due to their businesses' reputation around the world. Consequently, the USDP government implemented seriously to undertake the higher environmental regulatory framework for FDI to respond the public pressure and to attract the new FDI.

The USDP government passed an Environmental Conservation Law in March 2012, and by-laws were issued in 2014. In order to support and operate the Environmental Conservation Law, the Environmental Conservation Rules in 2014 and Environmental Impact Assessment (EIA) in 2015 were established. The main function of EIA is to evaluate the environmental impacts of a proposed project from FDI at an early stage to mitigate damage to the environment and to ensure sustainable use of natural resources.

In 2016, the Ministry of Natural Resources and Environmental Conservation (MONREC) established the EIA Division under the Environmental Conservation Department (ECD) to supervise the review and approval of EIAs, Initial Environmental Examinations (IEEs), and Environmental Management Plans (EMPs). Moreover, the Directorate of Companies Registration and Investment (DICA) outlined stricter regulations in the stage of the proposal of investment and requested commitments from investors for responsible investment in the process of the investment agreement. Due to strict environmental rules for foreign investment projects, foreign investors are needed to comply with its environmental regulations and FDI policy. Moreover, it has encouraged responsible investment and more EIA restrictions, mid-term inspection and environment-friendly implementation of development projects are carried out. In 2019, environmental management and climate change strategy were announced.

Foreign Direct Investment in Myanmar

Myanmar has recognized that FDI provides income, direct employment and advanced technologies. The market-oriented policy has been practised and the Foreign Investment Law in November, 1988 was issued to attract FDI. Due to the western economic sanction up to 2010, most foreign investors in Myanmar were its immediate neighbours, Japan and ASEAN countries. Especially, Myanmar is a rich country in various types of natural resources: minerals and gemstones, oil and gas, timber and potential hydropower. Most foreign investments primarily focused on natural and energy resources sector although the FDI growth of Myanmar was not satisfactory compared to its neighbours.

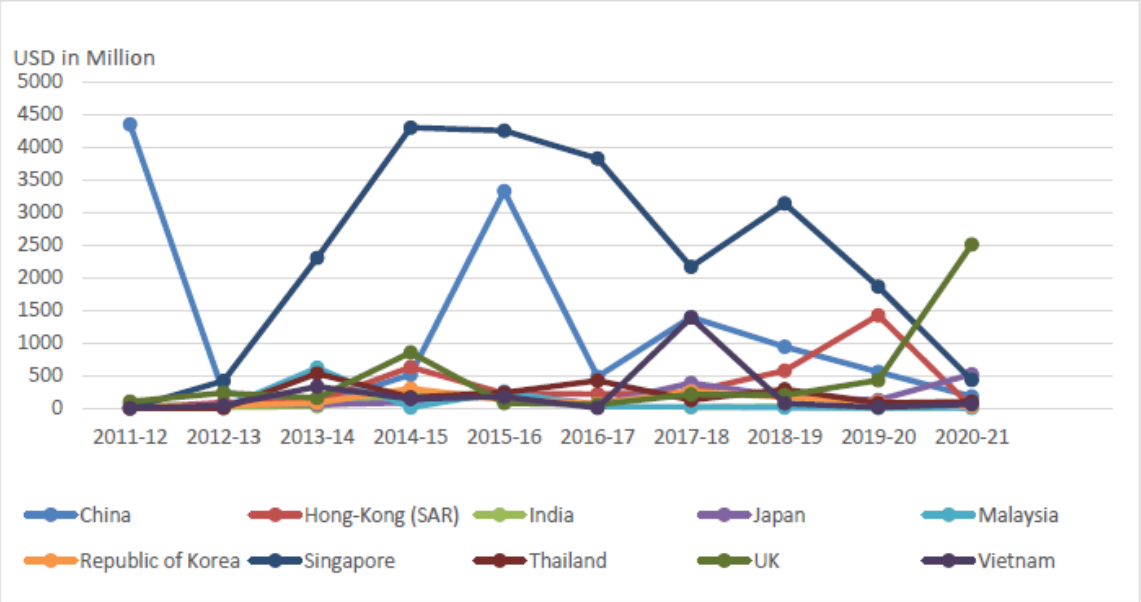

Figure 1: Top ten foreign investment countries and one region in Myanmar (2011-2021
Source: Directorate of Investment and Company Administration (DICA)

Moreover, Myanmar has been able to export raw materials and semi-finished products due to outdated infrastructure and technology. For example, Myanmar could not produce finished products of lumber and furniture and only export timber in log forms under market price. Subsequently, the country received low export income. At the same time, Myanmar has no choice but engaged more resource-based business and huge investment projects with mining, energy, and forest extraction sectors were widespread across Myanmar. Impacts of these projects brought about several environmental problems. Myanmar has faced with various environmental concerns that threaten sustainable development. Natural disasters, degradation of rivers, deforestation and soil erosion became evidence of serious environmental issues and environmental insecurity.

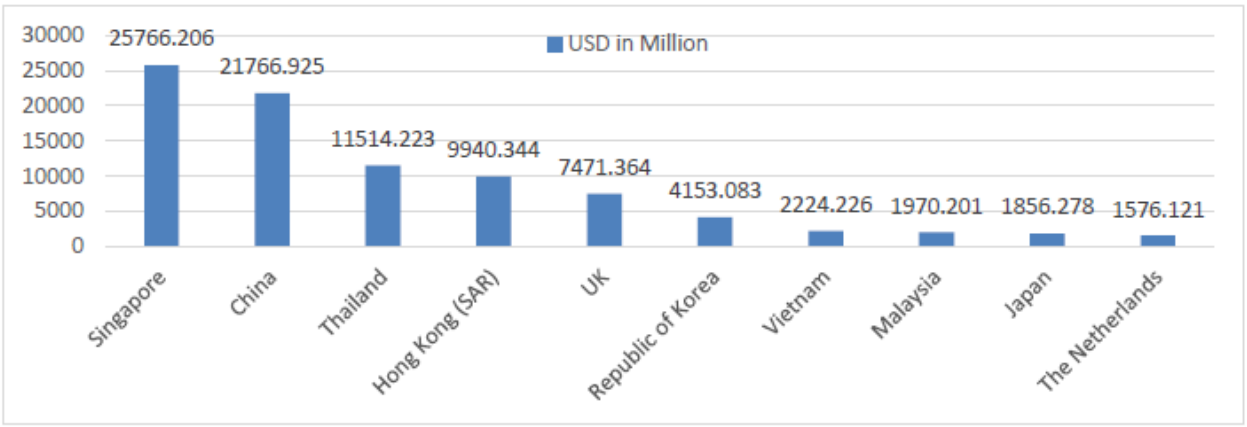

Figure 2: Top ten foreign investment countries and one region in Myanmar (2022)
Source: Directorate of Investment and Company Administration (DICA)

Since 2011, international investors have cast their eyes on Myanmar due to its potentially high growth of territorial and population size, geo-strategic location, endowed natural resources and future economic integration with neighbouring countries. However,

Myanmar government was aware of the previous lessons of environmental-related issues in the natural resources extraction sectors. Therefore, it attempted to implement a new trend of FDI: a shift from investments in natural and energy resources sector to manufacturing sector.

In the rapidly changing investment climate for Myanmar, the Directorate of Investment and Company Administration (DICA) under the Ministry of National Planning and Economic Development (MNPED) is the primary organization for promoting and facilitating for the responsible investment. DICA recognized eight sectors, which are Agriculture, Forestry, Mining, Livestock/ Fisheries, Transport, Hydropower, Oil and Gas, Hotel and Tourism, for promising investment opportunities. It expected manufacturing sector, agriculture sector and service sector to have a large employment and regional development impact.

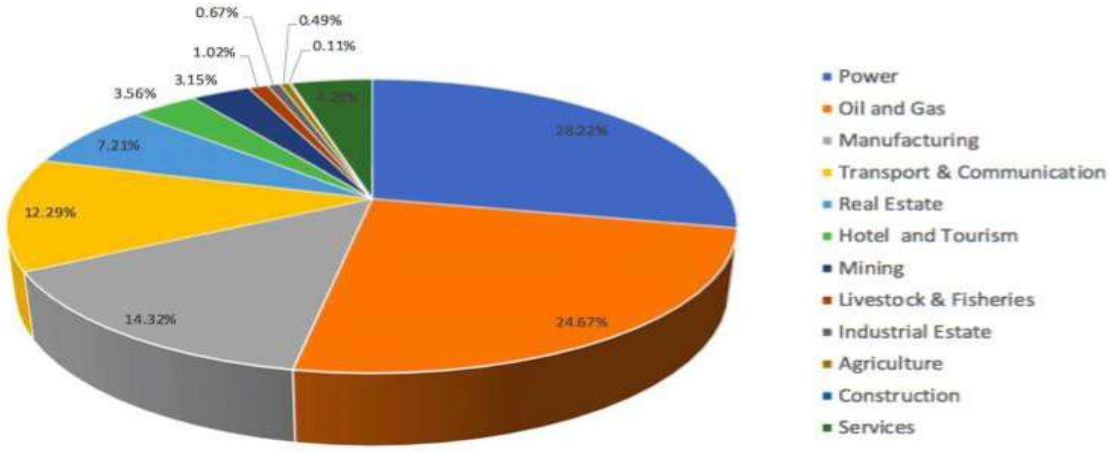

Figure 3: Foreign Investment by sectors in Myanmar

Source: Directorate of Investment and Company Administration (DICA)

Singapore, China and Thailand are the top three investors in Myanmar according to the Figure1 and 2. Singapore is the biggest foreign investor in Myanmar. It has mainly invested service sector with over 206 million dollars, followed by the manufacturing sector which attracted more than 114 million dollars and the construction sector with 65 million dollars in 2020. China has stood as the second largest investor in Myanmar after Singapore. Major investment sector of China in Myanmar is the power sector (over 63%), while investment in the oil and gas and mining sectors has covered 36% of total investment since 2011. The third largest investor, Thailand, has mainly occupied the power sector, followed by the oil and gas sector and the manufacturing sector. It shows that the investment trend of China and Thailand has focused on investment in resources extraction while Singapore has mainly covered in service sector.

Although Myanmar expected to move a new trend of FDI from the natural resources sector to the manufacturing sector, the resource extraction sector has still been a major foreign investment sector in the country. According to DICA, investment in the Power and Oil and Gas sectors have provided nearly fifteen three percent of total FDI, by over 28 percent and 25 percent respectively in 2021 as indicated in the Figure 2. Due to the large amount of FDI concentrating on resource extractive industries, Myanmar continued to face environmental and social costs in years to come.

Environmental Impacts of FDI in Myanmar

The nature of foreign investments supported the interests of foreign investors as well as the economic growth of Myanmar. However, these investments have a substantial impact on the environmental security of Myanmar. Because, most FDIs focused on the extraction and export of natural resources with paying little attention to the sustainability of their environmental impacts. National Commission for Environmental Affairs (NCEA) and United Nations Environmental Programme (UNEP) are ranking of Priority Environmental Concerns in Myanmar: forest resources, water resources, and quality status, land degradation, climate change, inadequate solid waste management, threat to biodiversity and impact of mining industry on the environment. Nevertheless, most of these environmental concerns in Myanmar are highly related due to the commercial exploitation of natural resources by foreign investors.

In the hydropower sector, China constantly stands as a primary investor in Myanmar. Most of the Chinese-funded hydropower projects provided benefits of electricity export abroad to mitigate its increasingly domestic energy demand. For instance, Myitsone Dam projects would be exported to China nearly 90% of the electricity. Besides, most of hydropower projects created deforestation and loss of biodiversity in their dam areas. Moreover, they have physically shrunk downstream water availability and destroyed environment-friendly river systems.

In the mining sector, a specific number of projects are difficult to calculate because they are less visible. For instance, Myanmar government agreed with Thai-owned company Myanmar Pongpipat Ltd (MPC) to operate Heinda Mine for tin extraction in July 1999 and renewed in 2009 and 2014. The Mine provided 1-2 tons every day exporting to Thailand, China and Malaysia. Although the company approved to respect the environmental laws of Myanmar in 2012, the local community has suffered deadly pollution impacts. The mine caused contamination of the local villagers' fields and the mine waste flowed directly into the local water sources. Hence, most mining projects polluted air and accumulated solid waste into streams that threatened the local community's health and underground water resources.

In the Oil and Natural gas sector, the construction of oil extraction and gas pipelines seriously damaged of coral reefs which are crucial habits for fish and marine life and harmed ecosystem such as wildlife poaching, forest and soil quality. For instance, Myanmar government approved natural gas export from Shwe Gas fields in Rakhine State to China and the project became one of the mega-project of Chinese FDI in 2007. The project is connecting the 771-km-long pipelines which started from the port of Kyaukphyu in Rakhine State to the Bay of Bengal through Magwe and Mandalay regions and northern Shan State to China. Although the company report claimed that it followed standard environmental rules and regulations, some areas in Rakhine and Shan States and Magwe Region have experienced soil erosion and landslides which are resulted from ecological problems due to the pipelines.

In addition, foreign investment in the agricultural sector has caused to land degradation and deforestation. Chinese small and medium size companies have invested in farmlands for fruits and vegetables which are transported directly to China. They converted forests into plantation for agricultural commodities like bananas and rubber. Besides, they used fertilizers heavily that destroyed farm land and caused air pollution, soil erosion and degradation of the underground water system. These activities have depleted the fertility of the soil and poisoned local communities' water supplies.

Constraints to preserve Environmental Security in Myanmar

Foreign investment in the resource-based extractive sector brought about negative impacts on environmental security in Myanmar. Myanmar government upgraded its environmental policy and regulations in line with international environmental standards, but the substantial progress of environmental security in Myanmar is questionable. The analysis pointed out some constraints under the existing circumstances.

The first constraint is the lack of efficient institutional capacity for environmental practices although Myanmar approved Environmental Conversation Laws and by-laws which constitutes the EIA process. The advantage of EIA procedures is a timely evaluation of the environmental impact of a proposed project to avoid environmental damage and to ensure sustainable use of the natural resource. However, a timely evaluation of the EIA process in foreign investment projects especially in natural resources sector is still challenging. According to the World Bank Group, only 6.9 percent of reports about the EIA process have been approved by the relevant department. Besides, an effective monitoring, evaluating and inspection process for the EIA reports is not in place due to a shortage of human resources. Furthermore, the actual reports for the EIA procedure have loopholes because of the weakness in technology applied to in environmental data as well as the weak of institutional capacity, corruption and lack of necessary administrative and legal structure.

The second reason is the weakness of the actual implementation process to comply with existing environmental policy proclamations. This has been linked with the former constraint of institutional capacity. Thus, although Myanmar approved the relevant environmental regulations, an effective implementation process and law enforcement are not yet placed due to the combination of corruption and ineffective monitoring, evaluating and inspecting regime. Consequently, some foreign firms in the resource seeking sector failed to follow Myanmar's environmental rules and regulations.

The third constraint is the lack of scientific data in Myanmar. The scientific data provides a list of environmental problems that are already or potentially threatening to the environment as well as society. Specifically, it further could support the systematic evidence-based environmental degradation measures for the relevant decision-makers as well as the foreign investment projects. However, government and also non-governmental organizations have not initiated an independent scientific study of the EIA compliance of foreign investment in the extractive sector to address uncertainties associated with the projects.

The final constraint is the issue of the "free-rider problem". Although most foreign investors announced their activities are following the environmental guideline after passing the Environmental Conservation Law in Myanmar, some failed to comply with these rules and regulations in practice. For example, the Kyaukphyu project consists of the industrial park and deep seaports on Made and Yanbye islands. The Government of Myanmar failed to conduct a Strategic Environmental Assessment dealing with the Kyaukphyu Project before the Environmental and Social Impact Assessment (ESIA). Although China International Trust and Investment Corporation (CITIC) has hired the Canadian company HATH to supervise the ESIA process on the Kyaukphyu Project, the ESIA process was only covered for the ports, not for Special Economic Zone. Likewise, some foreign investment projects have experienced taking advantages of the loopholes from Myanmar side such as institutional weakness and lack of

enforcement. In other words, some foreign investors can take a free-rider role if the environmental practices of Myanmar are imperfection in time.

Conclusion

Myanmar transformed its socialist economy and has practiced the market-oriented economy since the 1990s. It recognized the importance of foreign direct investment and trade for economic growth and capital. To attract foreign investment, it allowed all investors with flexible rules and regulations in big resources-based projects. After two decades, the country has been confronted with various environmental issues that threaten people's welfare and long- term sustainable development.

When Myanmar started democratization in 2011, it resumed cordial and active relations with various countries and most of international investors were willing to invest in the country. Consequently, Myanmar took a critical action to upgrade the relevant regulations for the environment to provide responsible investment and sustainable development. It issued Environmental Conservation Law, Environmental Conservation Rules and Environmental Impact Assessment (EIA) to prevent and protect the environment in 2012. Moreover, national policies for environmental management and climate change strategy were prepared after 2015. It has imposed green and responsible investment rules and regulations for foreign and domestic investors.

However, FDI in Myanmar has still impacts on priority environmental concerns of Myanmar such as forest resources, water resources and quality status, land degradation, climate change, threat to biodiversity and impact of mining industry on the environment. Because foreign investors have primarily concentrated on the resource extraction sector in Myanmar.

Myanmar has laws and regulations for environmental challenges but some constraints remain to be tackled. Lack of efficient institutions, the weakness of the actual implementation process, lack of scientific agenda and the free rider problem have yet to be resolved. Besides, its expectation of foreign investment to improve its development is one of the reasons why Myanmar could not ignore extractive investments. These circumstances brought about limited control of FDI extractive projects and their impacts on the country. Besides, the free rider role in foreign firms created innumerable adverse environmental and social challenges in Myanmar.

The analysis pointed out that Pollution Haven Hypothesis can be applied to study in Myanmar context. Firstly, Myanmar's natural resources have still attracted the continuous existence of most foreign investment in there. According to the DICA data, nearly sixty percent of FDI in Myanmar has heavily relied on the resource seeking sector. Next, the ineffective Myanmar's institutional capacity and practices, and a free rider position of some foreign firms are also the source of environmental insecurity. Thus, the enriched natural resources with poor environmental practices in Myanmar are attractive to foreign investors who are not responsible business firms and the condition causes negative impacts on its environment.

Nevertheless, Myanmar would continuously suffer numerous adverse environmental impacts from these irresponsible investors if it does not take lessons from the past and existing problems. The analysis attempts to prove that economic growth with environmental sustainability in Myanmar depends on how environmental practices in carrying out investment

projects comply with its regulations and laws. Nevertheless, Myanmar is needed to take serious on environmental aspects for future investment while attempting to minimize the numerous adverse impacts of resource seeking firms on its environmental security.

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MYANMAR-CHINA COOPERATION IN SOCIAL SECTOR SINCE 2011

Kywel Kywel Oo*

Abstract

Myanmar-China relations were rooted in history and the two countries maintained cordial relations throughout successive governments in Myanmar. China has continued its cooperation in Myanmar when Myanmar has been transitioned democratically since 2011. Along with reforms, Myanmar upgraded its policies for development cooperation and assistance in line with international standard. China extended social cooperation although it mostly focused on economic related relations in the past decades. Based on the background, the paper aims to explore China's cooperation to Myanmar especially in education, humanitarian and public health sectors since 2011. This paper focuses on the question that what extent Chinese cooperation affects Myanmar social sector development particularly in such three areas. It examines Chinese activities in scholarship program, provision of school facilities, disaster relief and public health emergency assistance in the Covid-19 pandemic in Myanmar.

Keywords: Assistance, Cooperation, Myanmar- China relations, Education, Humanitarian, Public Health, Development

Introduction

Myanmar-China relations officially started in 1949 after the People's Republic of China (PRC) was founded. Myanmar was the first country which recognized the PRC government. Since 1950s, they have shared the Five Principles of Peaceful Coexistence. China has been Myanmar's immediate neighbor, and big brother, based on good neighborliness and Pauk-Phaw friendship. It has been one of the top economic partners for decades. Its diplomatic support and economic ties contributed to overcome some barriers for development when Myanmar was isolated by international community after 1988. Both countries emphasized government-to-government relations but there was a changing trend in their relationship after 2011. They reviewed their cooperation approach and extended social cooperation in education, culture, public health to enhance people-to-people contacts.

Meanwhile, Myanmar government outlined more systematic approach and policy on development cooperation amid reforms. Based on the background, the objective of the paper is to explore China's cooperation to social sector especially in education, humanitarian and public health sectors of Myanmar from 2011 to 2020. This paper explores to what extent Chinese cooperation affects in these three areas after 2011. It is mainly approached by the analytical and qualitative method using both primary and secondary sources.

Myanmar-China Relations since 2011

Myanmar and China have had interactions among people throughout their long history. China has been a major trading partner, investor and donor of Myanmar for decades. Myanmar's Union Solidarity and Development Party (USDP) government led to diversify its foreign relations and normalized relations with western countries. It seemed to make balancing options in its foreign relations, particularly with China and the United States (US). It maintained friendly ties with China while tried to limit over-dependence on China. Myanmar has continued to keep

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the *Pauk-Phaw* relationship with China. In fact, the stand actually serves essence of Myanmar's foreign policy.

Under the USDP government, Myanmar-China relations were built on "comprehensive strategic cooperative partnership" in May 2011. However, after the suspension of the Myitsone Dam and other three projects, the relationship seemed to face with delicate interactions. China approached more with public diplomacy. It engaged more with new actors such as semi-officials, civil society organizations (CSOs), ethnic groups and non-state actors in Myanmar. Moreover, it started party to party relations between Chinese Communist Party (CCP) and different parties in Myanmar. In fact, it used dual track diplomacy for its role under democratic transition reforms in Myanmar while balancing the US and India in the region. Chinese government emphasized on people-to people-contact with people and community in Myanmar. Consequently, Chinese companies supported local people's welfare through providing free public health care services, building schools and compensating local villages for its projects.

Under the National League for Democracy (NLD) government, their bilateral relations continued based on "Five Principles of Peaceful Coexistence", and good neighborhood policy. Leaders of Myanmar government paid diplomatic visits and exchanged views on cooperation in various sectors. Myanmar also participated in Belt and Road Initiative (BRI) by concluding various agreements in both BRI Summits in 2017 and 2019. Chinese President, Mr. Xi Jing Ping, stated that China is ready to build a new type of international relations to promote high quality development of the BRI and Myanmar is one of the strategic countries for China's BRI projects. In January, 2020, Chinese President, Mr. Xi Jing Ping, visited Myanmar and proved their strategic partnership at the 70th Anniversary of diplomatic relations between two countries. Closer cooperation for development and BRI related investment showed their pleasant relations. After the Covid-19 broke out worldwide, China played active role in fighting the pandemic especially in Asian countries. Media and various scholars criticized as China's vaccine diplomacy, a kind of soft power influence throughout the world.

Myanmar's Approach and Policy for Cooperation Since 2011

Since 2011, Myanmar has been in democratic transition and its domestic reforms were carried in four parts. Democratic reforms were carried out in political, economic, social and administrative sectors. Along with democratic reforms in 2011, the USDP government renewed development policies which were based on national development plans and Sustainable Development Goals (SDGs). It designed short-term and long-term development plans for growth, stability and progress of social sector. The Government planned to improve development gap between urban and rural areas. Especially priorities were focused on public health and education in rural areas. The country reintegrated international community with extensive exchanges of diplomatic visits and meetings with various leaders especially with western countries. As a result, its international cooperation resumed actively and Myanmar government started to adjust foreign cooperation approach in line with changing reforms.

In 2012, President U Thein Sein chaired the Planning Commission and announced "Five Year Short- Term Plan" from 2012 to 2016. In June, 2012, the Government established three coordination bodies; the Foreign Aid Management Central Committee, Foreign Aid and Grant Management Working Committee and the National Economic and Social Advisory Council. In December, 2012, the First Myanmar Development Cooperation Forum was held and the "Naypyitaw Accord for Effective Development Cooperation" was accepted. The Forum proved

Myanmar's consideration on cooperating with donor countries and international organizations in accordance with the five principles of the Paris Declaration. At the forum, participants confirmed that the national ownership of the development process is fundamental and effective development cooperation has become essential.

In 2013, the Framework for Economic and Social Reform (FESR) was initiated and it highlighted that partnership with donors is important. It was a policy tool of the government to realize both the short-term and long-term potentials of Myanmar. It aimed to bridge the first 5-year plan of the larger 20-year strategy to make national policies more focus on the SDGs. In 2015, the Aid Information Management System (AIMS) was formed. Under the NLD government, the Development Assistance Cooperation Unit (DACU) was established. DACU took responsibilities for systematic management of development assistance which was needed to be effective, efficient, coordinated and nationally focused implementation. The Government discouraged the aid brokering, and encouraged budget support, which promoted to ensure alignment of development assistance with national and sectorial plans. At the same time, it boosted the project- based assistance, and prioritized innovative approaches to service delivery that has potential for wider partnership with government entities.

The first Myanmar Development Assistance Policy (DAP) was adopted in 2018 to guide the assistance delivery, highlighting sectors for priority investments and strengthening effective and inclusive partnerships in development. In 2020, the second DAP was issued, and established on the Global Partnership for Effective Development Cooperation (GPEDC) which encourages development assistance to be in line with Myanmar's national planning and budgeting process, results- driven, innovative, mutual accountable, transparent and commitment for effective and inclusive partnerships. As a host country, Myanmar practiced national cooperation and assistance guidelines which were based on international guidelines.

Chinese Cooperation in Education, Humanitarian and Public Health Sector

Myanmar- China official cooperation started when China gave a loan commitment to Myanmar in 1961 under the Economic and Technical Cooperation Agreement. In 1978, China emphasized on domestic economic development. In 1990s, it emerged as the leading supporter to Myanmar successive governments. Myanmar also needed its supports under sanctions and economic development. During the mid-1990s, China used foreign cooperation and assistance programs as a strategy to access the natural resources from developing countries. China announced that its cooperation was no string attached but seemed to be complemented with its national interests such as the recipient's strategic location, rich in natural resources, recognition of One China Policy at the international community and preferred the undemocratic states. China supported Myanmar successive governments diplomatically and economically. Its cooperation was given based on its "Eight Principles of Foreign Aid." Its cooperation mostly focused on loan, grants and development projects in economic and business areas for industry, infrastructure development, transportation and energy from 1988 to 2011.

Myanmar and China have exchanged social relations particularly in cultural sector since 69 AD. Historical evidences showed that exchanges of artists from ancient kingdoms of Myanmar visited China to perform music, acrobatic and magic shows. Their social relations up to 1990s were based on cultural exchanges including cultural shows, youth exchange, sports, language training, and concerts. The visits of Buddha's sacred tooth relics in 1955, 1994, 1996 and 2011 highlighted the special milestone in their cultural relations. Due to China's renew

policy on Myanmar, its cooperation in cultural sector expanded with exchanges between journalists, writers, artists and youths. At the same time, broader cooperation in social sector was emphasized on education, public health and humanitarian sectors.

After 2011, Chinese cooperation for Myanmar included two ways as direct provision to Myanmar government and through local community and private sectors. Chinese government discussed cooperation programs with the ministries concerned of Myanmar and provided directly for implementation. Chinese non-governmental organizations (NGOs) also took part in social cooperation. Besides, Chinese social cooperation programs through business community were in the form of social responsibility for local community in project areas. Education, humanitarian and public health sectors to local communities were provided by Chinese firms in Myanmar.

(i) China's Cooperation in Education

In the educational assistance sector, the Chinese Ministry of Education (MOE) is providing scholarships to students from developing countries. Moreover, in 2013, the China Foundation and Poverty Alleviation (CFPA) team was sent to Myanmar which gave assistance in four areas; public health care and education, livelihood development and humanitarian aid, supporting non- profit organizations (NPO) partners and public advocacy. To combat poverty alleviation, education is the foundation and the CFPA found that higher education quality in Myanmar needed to extend students more public training classes for the future. The Chinese Embassy in Myanmar also offered facilities to schools and universities. It provided one thousand and five hundred computers to Yangon and Mandalay universities in 2013.

Under the CFPA Education Program, there are four running programs. They are Moving Forward Program, New Great Wall Scholarship Program, School Dormitory Building Program and Domestic Panda Pack Project and Small Package, Big Love Program. The first program is a development-oriented philanthropic project for the educational development for children in poverty-stricken areas and fair education in urban and rural areas through social care and development by cooperating with local education sectors such as primary schools in local areas. The second program is for high school and undergraduate students who have financial difficulties aiming to cultivate self-reliant talents. The third program is to improve schools' facilities in poverty-stricken areas and the last one is launched by the CFPA, China-Post and CCTV-6 under the guidance of State Council Leading Group Office of Poverty Alleviation and Development.

In 2015, the CFPA was officially registered as the international non-governmental organization (INGO) at the Myanmar Ministry of Home Affairs (MOHA). Starting in 2016, the CFPA Myanmar has implemented Pauk-Phaw scholarship, Panda Pack, Computer Lab, China-Myanmar Friendship Scholarship and school infrastructure in twelve states and regions. In total, one thousand and three hundred students have received Pauk-Phaw scholarship till 2020 and each student received USD 300 per year. Starting in 2016, a pilot project was proposed and assisted fifty students from four universities in Yangon, six universities in Mandalay and two universities in Rakhine State.

Furthermore, the China-Myanmar Friendship Scholarship was given to high performing, low income five hundred and thirty-eight students in Myanmar as cooperation between the Chinese Embassy in Myanmar and the CFPA. Up to 2019, twenty schools throughout eight regions were given assistance, four hundred and seven students received scholarships and one hundred and seventy-six students with bursary under this project. The "Friends for Silk Road"

was founded in 2015 by China Foundation for Peace and Development (CFPD) and the Myanmar Alingyaung (Brightness) Foundation to improve Myanmar's education environment. Under this program, eighteen schools have been built and ten standard teaching buildings in ten rural schools were built in line with Myanmar MOE's standards.

In 2017, the Panda Pack Project has donated to 37,760 primary students in six states, including Shan, Rakhine, Kachin, Yangon, Bago and Sagaing regions. For 2019-2020 academic year, the CFPA Myanmar Office donated 100,000 school bags and stationaries to students in fifteen townships from Yangon. On 19th June, 2019, "Myanmar Love Package Project" by the CFPA was launched to promote quality education for Myanmar primary students in poverty-stricken and marginalized areas in cooperation with local partner, Shan State Women's Affairs Organization (SSWAO), in line with "Myanmar's Education for All" Campaign.

In 2016, the China-Myanmar Friendship Schools Program was launched in cooperation between Myanmar government and the Chinese Embassy in Myanmar. This program offered Myanmar graduate students to study in China and ten schools have been built. In 2019, the Lancang-Mekong, International Vocational Institute, was built by the collaboration between the Chinese companies and Myanmar University of Yunnan Province to improve the human resource's quality through training, maintain friendly relations from generation to generation by the more comprehensive cooperation. As part of Myanmar International Bicycle Project, the CFPA and Less Walk jointly donated one thousand bicycles to students in need in Myanmar for 2019-2020 academic year.

In 2020, the CFPA Myanmar Office established a lab classroom with forty new brand computers to narrow the digital divide for the university students in Dagon University. Moreover, it provided Information and Communications Technology (ICT) education training on certified market-driven short courses with KMD Institute. Up to 2020, the CFPA Myanmar Office has raised funds and materials around USD 3.3 million, benefitting 78,276 people in Myanmar. After the political changes in Myanmar in 2021, China continued its education assistance by the Panda Project in Shan State to the local community directly from Alibaba Group.

(ii) China's Cooperation in Humanitarian Activities

In humanitarian support sector, Chinese humanitarian assistance goes bilaterally rather than multilateral ways intending to strengthen relations with countries in Global South and Asia Pacific region, enhance China's image as a responsible state and for commercial and economic benefits. In humanitarian sector, China focused on disaster relief and rehabilitation, supports for internally displaced persons (IDPs), and refugees.

On 11th April, 2011, Chinese Ambassador to Myanmar, Mr. Li Junhua, donated USD 50,000 cash to Myanmar Red Cross Society (MRCS) for the relief and recovery efforts for the major earthquake in northeastern part of Myanmar. On 31st December, 2013, China assisted three hundred and fifty sets of integrated housing and one million USD in cash for the resettlement of homeless people and victims in quick-hit northern Myanmar. In February, 2014, the Red Cross Society of China provided 10,000 sets of humanitarian assistance boxes, with rice, cooking oil, emergency medicine and materials to the IDPs in the northernmost Kachin State.

Since 2015, the Chinese Embassy in Myanmar encouraged its companies for community assistance in flooding regions and gave commodities and equipment to local organizations. According to Chinese Ambassador, Mr. Chen Hai, Chinese humanitarian assistance is a part of the China-Myanmar Economic Corridor (CMEC). For 2015 Myanmar's floods, Chinese

assistance went through official government and non-governmental organizations. After Myanmar government announced the Emergency Relief Plan, Chinese government became the first government with quick aid to the flooding areas. The Chinese Ministry of Commerce, the Chinese Embassy in Myanmar, the Chinese Chamber of Commerce in Myanmar and the Chinese People's Liberation Army provided official assistance to Myanmar government. Moreover, many Chinese non-governmental organizations such as Chinese-funded enterprises and the China-Myanmar Friendship Association delivered assistances. The China-Myanmar Friendship Association supported with China's Blue Sky Rescue Team as a first international rescue force for disaster relief work in Myanmar. It carried out the task in cooperation with rescue workers from Myanmar Army, Fire Brigade and Police Team.

China provided humanitarian support to refugees in both Myanmar and Bangladesh. In 2017, Chinese Ambassador to Myanmar, Mr. Hong Liang, gave two hundred million kyats for Rakhine State as a government-to-government assistance. In September 2017, China sent two hundred prefabricated houses for displaced persons and donated USD 150,000 to the Myanmar Ministry of Social Welfare, Relief and Resettlement. In June and November, 2018, Chinese humanitarian assistance went to the IDPs in Kachin State. Likewise, China contributed one thousand units of Assembled Board Houses and two hundred million kyats for refugees. Sometimes, the Association of Southeast Asian Nations (ASEAN) cooperated with Chinese government to give humanitarian assistance to civilians in Myanmar.

(iii) China's Cooperation in Public Health

China's cooperation in public health became very significant during the Covid-19 pandemic in developing countries. This study will mainly focus China's cooperation on Covid-19 pandemic issue in Myanmar. On 23rd March, 2020, the first Covid-19 case was detected in Myanmar and China started medical supports including training, provision of test kits, laboratory materials, masks, and gloves. In April, 2020, Myanmar government announced the Covid-19 Economic Relief Plan (CERP) to combat the consequences of Covid-19. At the same time, China sent medical teams through multilayered engagement framework from the Chinese government and its business community to Ministry of Health and Sports (MOHS) and military in Myanmar. Chinese private companies such as State Power Investment Corporation (SPIC), Yunnan Energy Investment Group (YEIG) and Union Resources and Engineering Company Limited (UREC) gave assistance for the combat of Covid-19 in Myanmar to different ministries. In addition, the Chinese Embassy in Myanmar provided assistance in kind and cash to the MOHS and Myanmar military. Moreover, Chinese provincial government and organizations along the border areas gave assistance to Myanmar friends.

On 8th April 2020, the Chinese medical expert team including twelve members arrived Yangon and donated 5.3 tons of medical supplies to assist in Myanmar's combat to Covid-19. China's Covid-19 vaccine is called "Sinopharm" which is the most used vaccine in Myanmar. Moreover, the Chinese Embassy in Myanmar actively coordinated with Myanmar domestic medical experts in its battle of Covid-19. Furthermore, Chinese military medical team from the Chinese People's Liberation Army (PLA) provided assistance to Myanmar military to build a Covid-19 testing laboratory at the No.1 Defense Services General Hospital in Mingalardon Township, Yangon. As China has experiences of combatting the epidemic, it truly contributed a great effort to Myanmar for combating the spread of virus.

In 2021, China offered the vaccines and oxygen supply during the severe third wave of Covid-19 in Myanmar. On 5th October, 2021, Myanmar MOHS announced its cooperation of vaccine sharing program with China. In May, 2022, the Chinese Embassy stated that China donated Covid-19 vaccines and syringes which could help Myanmar to fill and boost the vaccination rate and the Chinese Covid-19 vaccines were used for the children from five to twelve years old. The mobile laboratory vehicles were supported and used at the border check points. To shape a shared future between the two countries, China has provided fifty-three million doses of Covid-19 vaccines, including test kits, medical supplies, medical equipment and other necessary things. Since the first outbreak of Covid-19 pandemic, China is the first country which helped Myanmar in large amount to effectively control and prevents the spread of Covid-19. China's supports in prevention and control of Covid-19 are considerably affective and helpful based on the two countries' Pauk-Phaw friendship. Besides, the cooperation in public health sector is encouraged by President Mr. Xi Jing Ping's will to shape the China's Health Silk Road and for stronger bilateral relations.

Conclusion

In the 21st Century, cooperation is the main component of Chinese foreign policy as a soft power tool with two main interests, helping the recipient countries and shaping its image in the world profile. Like all forms of cooperation in international politics, cooperation between states is not simple but based on their own objectives. Naturally, cooperation especially with powerful states is always attached with strings to fulfill their foreign policy goals. Various sources commented that Chinese cooperation is likely to link on its national interests.

It can be analyzed that China-Myanmar relations has still continued to be motivated by economic, diplomatic, geostrategic and maritime interests after 2011. With Myanmar democratic reforms, China understood that it should extend to people to people relations rather than only government to government relations. Moreover, cooperation and social assistances were strongly encouraged to enhance people-to-people contact. Therefore, its cooperation level in social sector has improved since 2011 to promote its image in Myanmar for economic benefits. Simultaneously, Myanmar improved its development cooperation and policy which were based on SDGs and national development plans. It sets out its own regulations and principles founded on the GPEDC and the 2011 Busan Partnership and preferred nationally-owned, effective and efficient assistance.

If analyzed, the China- Myanmar cooperation in education, humanitarian and public health activities have become significant in social sector development. For the education sector, the CFPA is the main operating Chinese non- governmental agency which functions the programs, by working together with local partners and Myanmar government in line with Myanmar's "Education for All" process. Its supports focused on the school building and assisting the needy students in rural areas. Concerning with the humanitarian assistance, Myanmar government had already announced that providing the human needs is the ultimate responsibility of a state and delivering and allocating supports can be accomplished through the collaboration between the Myanmar government, local CSOs, NGOs and the Chinese enterprises, aligning with Myanmar Sustainable Development Plan (MSDP) and fulfilling government's objectives according to 2018 and 2020 DAPs. These cooperation and provisions are through private or official procedure under the guidelines of the DAP Umbrella.

In reality, Chinese official assistance went mostly directly to government ministries. In Myanmar, controlling Covid- 19 pandemic has become very crucial since its own public health infrastructure and human resource have been limited. To tackle the pandemic, China has assisted the Myanmar government in great efforts. Public health cooperation was motivated by a will to help its close partner in time of the pandemic. But there can be other possible objectives for its role to smooth its strategic aims and BRI projects, and improve its image at the international arena. It would argue that Chinese cooperation in education, humanitarian and health sectors is partially significant in Myanmar's progress in the past ten years although it is not fully covering overall development needs. Nevertheless, Chinese aid is a catalyst to Myanmar's social development to some extent with scholarships, school facilities, exchanges, disaster relief, supports for vulnerable people, and public health emergency assistance in the Covid-19 pandemic.

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APPLICATION OF CURTAIN GROUTING IN UPPER PAUNGLAUNG DAM*

Aye Lwin[1]

Abstract

Upper Paunglaung dam is a 98 m high Roller Compacted Concrete (RCC) gravity dam on Paunglaung River. The main types of dam foundation rocks are meta-sandstone and granite. During the construction of dams, it is necessary to carry out the curtain grouting in order to ensure the seepage cut-off and reducing uplift pressure beneath the dam foundation. Single row curtain grouting with split-spacing method was used in Upper Paunglaung dam. Geological condition and geological model of dam foundation were made in order to get proper grouting design and grouting methods. Trail and final grout mix design was made based on the results of material used in grouting. Single grout mix with a water/cement (W/C) ratio of 0.8~0.75:1 (by weight) as a "stable grout mix" was used for all grouting stages. Based on the geological condition of dam foundation, upstage stage and downstage method were used in curtain grouting. Grout curtain efficiency is one of the most important factors to control seepage flow beneath the dam body to ensure its safety concerns. Hence, all grouting data were analysed in order to know the grout curtain efficiency of dam foundation and then correlation between Lugeon values and cement take. According the results, the correction between Lugeon values and cement take shows poor correction, however, the grout curtain efficiency was achieved 94% in average after grouting. In this paper, the application of curtain grouting in Upper Paunglaung dam and grout curtain efficiency are discussed.

Keywords: dam, geological model, curtain grouting, grout mix design, grout efficiency,

Introduction

The Upper Paunglaung dam was built on Paunglaung River located on about 42 km (26 miles) east of Pyinmana, Pyinmana Township, Dekhinathiri District, Naypyitaw Union Territory. The dam site is located at latitude 19° 45' 17" N, longitude 96° 35' 54" E (U TM 2186257.62 m N, 247931.90 m E) and referred to map index as UTM 1996-09 of 1:50000 scale UTM topographic map. Purpose of the dam construction is to produce electricity and installed capacity is of 140 MW. Location map of Upper Paunglaung dam site is shown in Figure (1).

The main rock types of Upper Paunglaung dam foundation are meta-sandstone and granite. Geotechnical investigation was made to know geological conditions of dam foundation and then detail geological mapping was made during the dam excavation in order to know acceptable rock class of dam foundation. Geological model was made to provide for considerations of proper grouting design. Based on the geological condition of dam foundation, upstage stage and downstage method were used in curtain grouting at Upper Paunglaung dam.

During the construction of dams, it is necessary to carry out the curtain grouting in order to ensure the seepage cut-off and reducing uplift pressure beneath the dam foundation. Single row curtain grouting with split-spacing method was used in Upper Paunglaung dam. Curtain depth at Upper Paunglaung dam was ranged from 40 to 60 m. There are 27 blocks and 2 sub-blocks at left abutment (LA) and right abutment (RA) from left to right for Upper Paunglaung RCC dam construction. Curtain grouting was performed inside the foundation gallery.

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* Best Paper Award Winning Paper in Geology (2022)

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Materials used in grouting were tested to obtain grout mix properties. Based on the results of trial grout mix, proper grout mix design was chosen as a final grout mix design. Single grout mix with a water/cement (W/C) ratio of 0.8~0.75:1 (by weight) as a "stable grout mix" was used for all grouting stages during the dam construction. The correlation of Lugeon vs. cement take and grout curtain efficiency were also attempted.

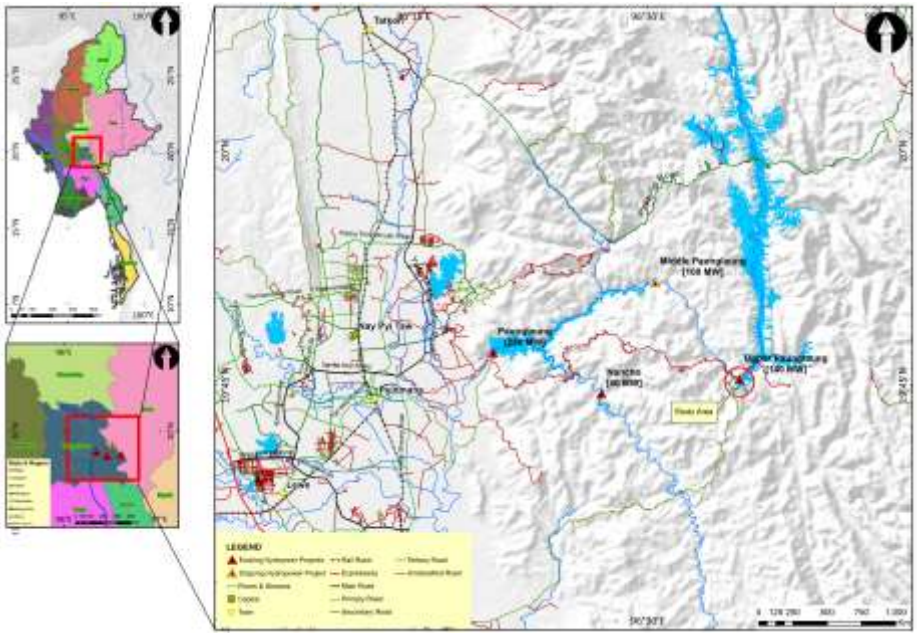

Figure (1) Location map of Upper Paunglaung dam site

Regional Geology of the Study Area

The Upper Paunglaung dam site area consists of Carboniferous-Permian rocks of the Mergui and Mawchi Series, and Ordovician rocks of the Pindaya Group and Mesozoic Granite (DGSE, 2008). The rock sequence is illustrated in Table (1). The Carboniferous rocks are composed mainly of sandstone, siltstone, and mudstone, which are slightly metamorphosed. The Ordovician rocks of Pindaya Group are thick-bedded to massive limestone. The Mesozoic granite exposed in the dam site area is mainly Padat Chaung granite. The granite outcrops are found on the left banks of the Upper Paunglaung dam site and along the Paunglaungnge Chaung and Padat Chaung.

Table (1) Stratigraphic succession of the study area

Formation/Group	Symbol	Age	General Lithology
Quaternary	Q_2	Holocene	Recent/younger Alluvium: River deposit, slope-wash deposit,
	Q_1	Pleistocene	Older Alluvium: Unconsolidated, terrace deposit, residual soil, saprolite
Mergui Group	CP	Carboniferous - Permian	Siltstone, shale, meta-sandstone
Pindaya Group	O	Ordovician	Siltstone, thick bedded to massive limestone
Igneous	Gr2	Mesozoic - Tertiary	Granitic rocks

The major Panlaung Fault runs in the eastern part of the dam site area. It is trending nearly NNW–SSE in direction and is passing through the reservoir area. It is about 5.0 km away from the dam site. Another fault is the Padat Chaung Fault, inferred to be a low-angle fault or thrust fault (Mitchell, 2018). It is trending in the N-S to NNW-SSE direction. It is about 2.2 km away from the west of the dam site. The regional geological map of the study area is shown in Figure (2).

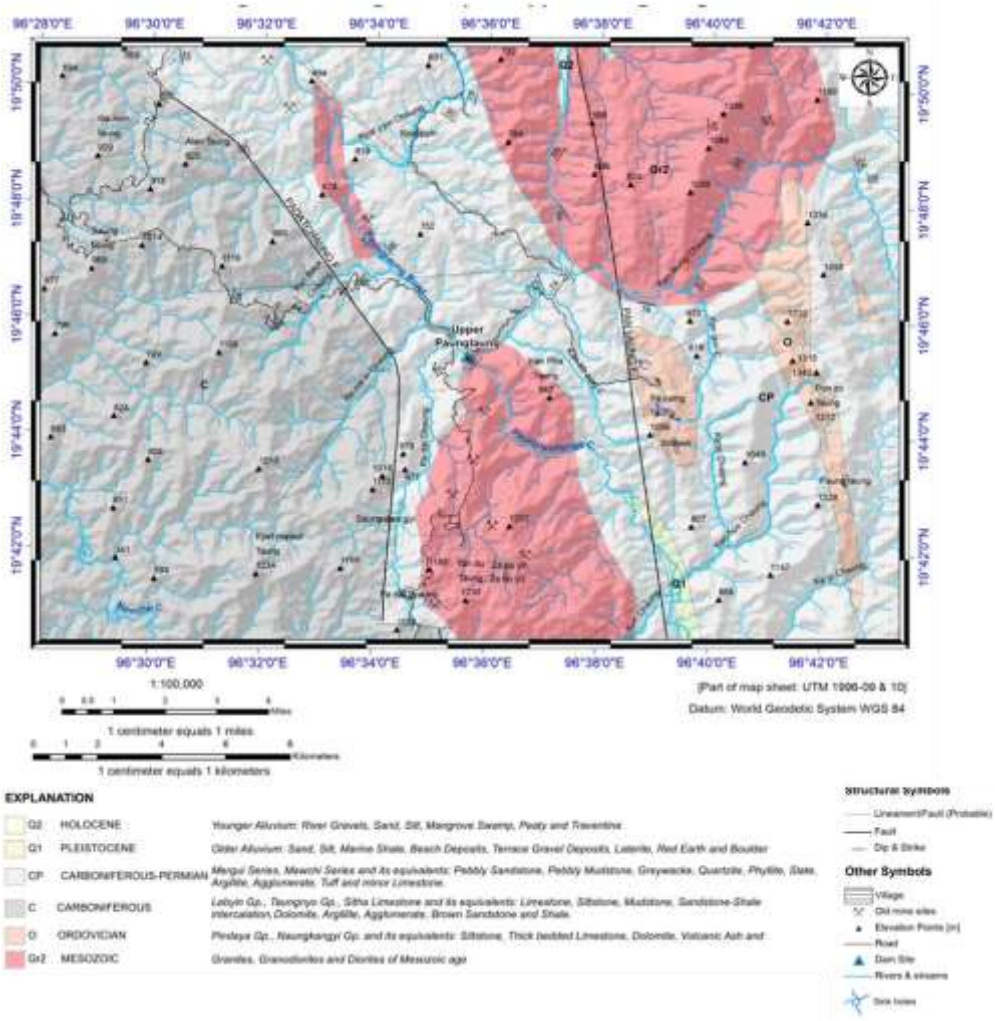

Figure (2) Regional geological map of the study area (After DGSE, 2008)

Dam Foundation Geology

The main rock types of dam foundation are meta-sandstone and granite. According to the drilling investigation results, through the dam alignment and dam foot print area, the thickness of overburden soil and decomposed rock cover is about 29 m. The evidences of the drill hole results show that the dam alignment can be subdivided into the following zones:

- **Left bank, above dam crest** (from EL. 396 m asl to 441 m asl, BH-14, BH-22 and BH-26): Overburden top soil composed of residual soil and decomposed met-sandstone is about 40 to 42 m in thickness. The fresh bedrock is found at elevation of variable depth (EL. 356-398 m asl) below a maximum 6 m thick layer of weathered meta-sandstone.

- **Left bank, dam abutment** (from EL. 312 to 372 m asl, ABH-1, ABH-2, ABH-4, ABH-5, BH-30, and BH-32): The overburden is reached from 7 to 29 m in depth. Weathered zones are variable in thickness of 1 to 7 m and fresh rock levels are ranged from EL. 312 to 360 m asl.
- **River section** (BH-2, ABH-14 and BH-24): River deposits is maximum 4 m thick below EL. 297 m asl. Granite bedrock is found at between EL. 286 m asl (BH-2), 293 m asl (ABH-14) and meta-sandstone is at 283 m asl (BH-24) in deep river section. Bedrock condition depicts that the contact of granite and meta-sandstone is found at the river section.
- **Right bank** (BH-3, BH-12 and BH-13): Overburden thickness is to 13 m. The thickness of weathered zone layer varies from 1 to 20 m and in the dam foot print area is to 13 m. The bedrock is meta-sandstone in drill holes at the right bank.

The overburden soil at the left abutment is thicker than the right abutment of the dam and the bedrock level of the left abutment is deeper than the right abutment.

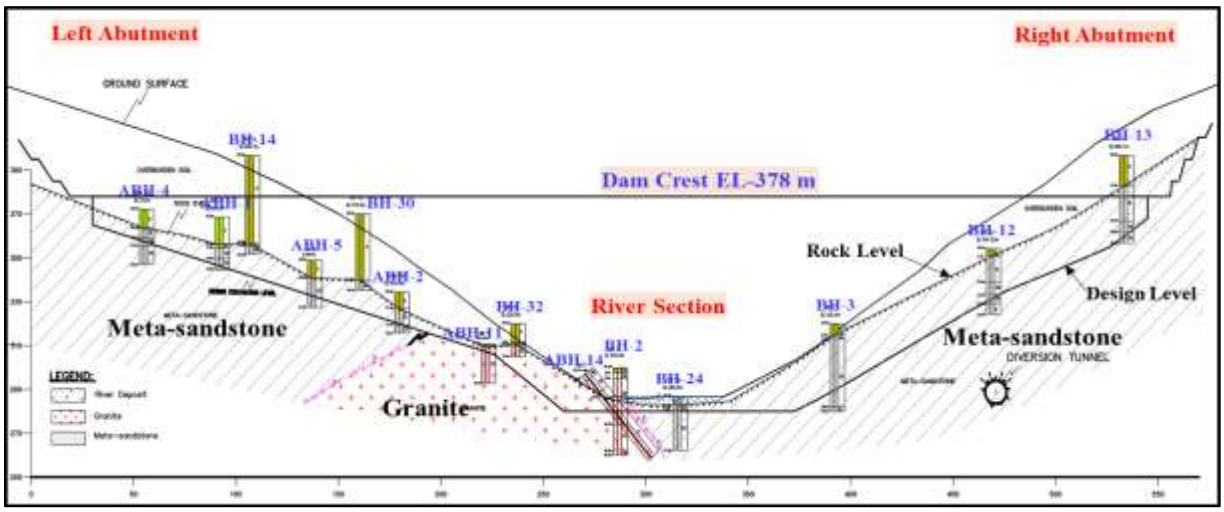

Figure (3) Geological profile along the dam axis

Permeability of Dam Foundation

Water pressure tests were carried out during the drilling investigation. Accordance with the results of water pressure tests, the permeability of dam foundation is ranged from about 2.0 to 8.0 Lu.

Rock Classification of Bedrock

Bedrock condition of dam foundation was classified on the basis of the criteria developed by Central Research Institute of Electric Power Industry (CRIEPI), Japan.

By using CRIEPI rock mass classification, meta-sandstone occurred CL to CH class at left bank and CL to B class at right bank. Granite occurred CH to B class at the left bank. The foundation of Upper Paunglaung dam can be classified into four (4) categories of CH-B, CM, CL, and D in good order. Basically, the acceptable rock class for dam foundation must be higher than CM rock class according to CRIEPI rock mass classification. Therefore, the design excavation level of the dam foundation was made based on the results of bedrock condition.

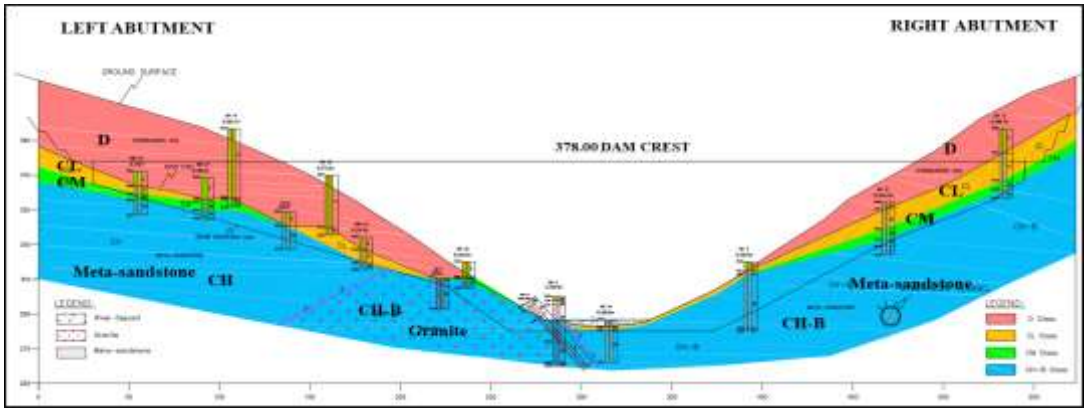

Figure (4) Rock class profile of Upper Paunglaung dam foundation

Geological Model of Dam Foundation

Excavation for the dam foundation was generally executed down to the required dam foundation rock class (CM) level. Based on the geological and geotechnical investigation results, the geological model of dam foundation is summarized as three different foundation conditions as follows:

(A) **Good quality meta-sandstone, slightly weathered** (grade CH), characterized by grey color; appears on the major part of the dam footprint

(B) **Slightly to moderately weathered meta-sandstone** (grade CM) of grey to brownish color; on the D/S part of the footprint, approx. El. 310-335 on the left abutment and approx. El. 295-320 on the right abutment respectively

(C) **Good quality granite** (grade CH), in the left abutment below El.315 m asl.

During the dam foundation excavation, geological mapping of the entire dam foundation including all lithologies, discontinuities and their orientations, and overall competency of the foundation on which the RCC dam was to be built and to be made actual dam geological model and dam foundation treatment.

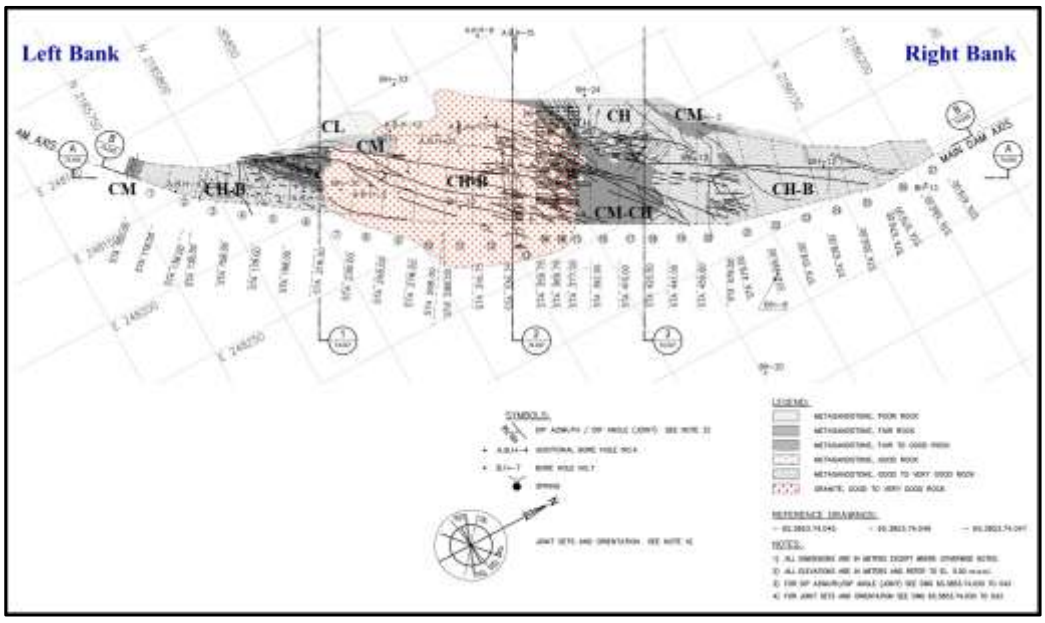

Figure (5) Foundation geological map of Upper Paunglaung dam

Objectives

This research mainly focus to choose proper curtain grouting design and methods based on geological conditions of dam foundation and grout materials. Hence, geotechnical investigation, dam foundation geology, geological model, material testing and grout mix design were carried out prior to carry out the curtain grouting works to correlate grout curtain efficiency related to geological condition with Lugeon values and cement or grout takes.

Methodology

Data collection and reviews of geotechnical investigation, dam foundation geology and geological model were mainly based on consultancy project reports and relevant data of Colenco Power Engineering Co., Ltd. (2005) and Geology Branch, Department of Hydropower Implementation (DHPI) (2008), ICOLD (2015), Frei, H.R. & Voborny, O. (2011) and Voborny, O. (2010 & 2011). CRIEPI Rock Mass Classification (Kikuchi K., Saito K., 1982) was used to classify dam foundation rock class.

Grout materials and grout mix trials were performed on site using the actual grout mixing equipment with OPC cement. Lugeon permeability and cement or grout take of respective grout holes were recorded during the curtain grouting process. The grouting data were collected from Geology Branch, Department of Hydropower Implementation (DHPI). Grouting reviews and analysis were made by using the publications of Bruce, D.A. & George C.R.F. (1982), Ewert, F.K. (1985), Houlsby, A.C. (1990), ISRM (1996), Kutzner, C. (1996), Nonveiller, E. (1989), Rafi, J.Y. (2013), Warner, J. (2004), Weaver, K.D. & Bruce, D.A. (2007) and Fell, J.R. et. al. (2015). Water pressure test was performed to know Lugeon and their jointing system of underlying rocks by using the document of Quiñones-Rozo, C. (2010).

Curtain Grouting

Curtain grouting was executed at the Upper Paunglaung dam during the construction to attain the objective of reducing the permeability of the foundation rock mass and seepage control beneath the dam foundation. The grouting works were performed inside the foundation gallery. There are 27 blocks and 2 sub-blocks at left abutment (LA) and right abutment (RA) from left to right for Upper Paunglaung RCC dam construction. Total work volume of curtain drilling and grouting was 18,032 m and 9,732 m. The quantity of grout holes were 198 holes – there were primary 48 holes, secondary 48 holes, tertiary 95 holes, quaternary 3 holes and check hole 4 holes. Of which, the numbers of exploratory primary pilot holes were 30 holes as cored holes.

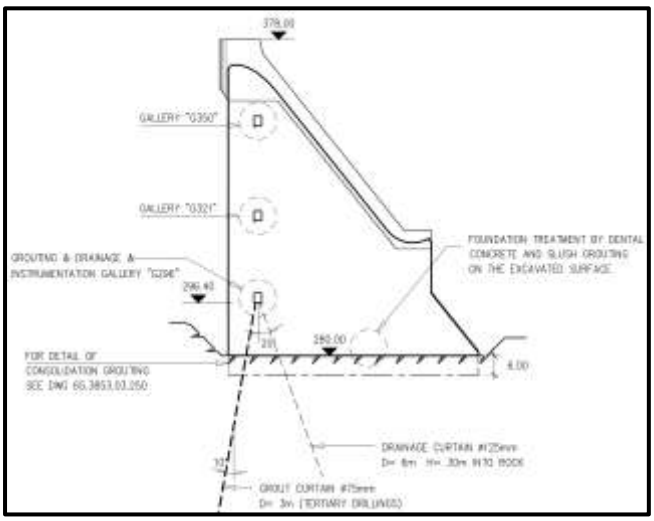

Figure (6) Curtain grouting location at Upper Paunglaung dam

Grout Curtain Depth

Curtain depth at Upper Paunglaung dam was ranged from 40 to 60 m. There were three portion of curtain depth as 60 m depth of all grout holes in river section, 50 m depth in middle portion (lower abutment) and 40 m depth in upper portion of both abutments along the dam axis.

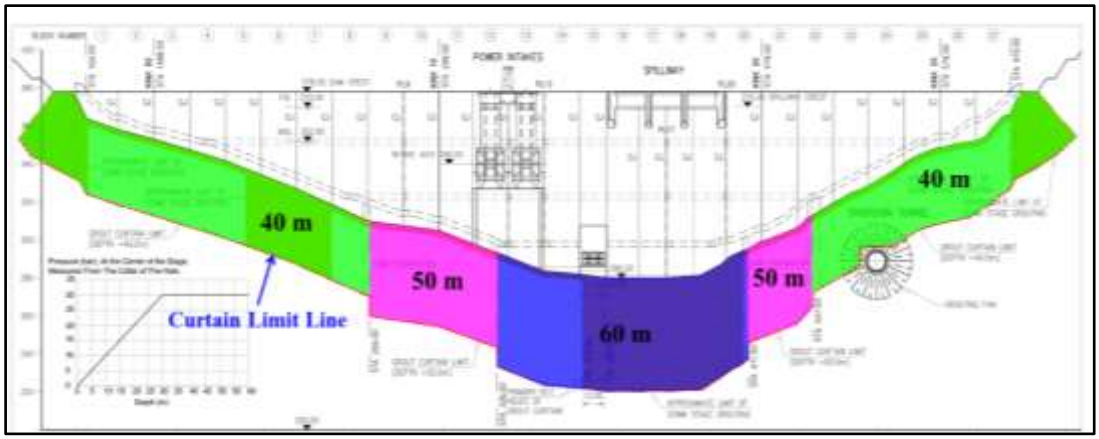

Figure (7) Different grouting depth of curtain grouting at Upper Paunglaung dam

Grouting Methods

Based on the geological condition of dam foundation, upstage stage and downstage method were used in curtain grouting at Upper Paunglaung dam. Downstage grouting method was especially used where contact zone of granite and meta-sandstone in the river section, middle portion of left bank and abutment wing section including interface of dam concrete and foundation rock contact. Then, the upstage grouting was commonly used in the good rock condition except weak zones, contact zone and interface of dam concrete and foundation rock.

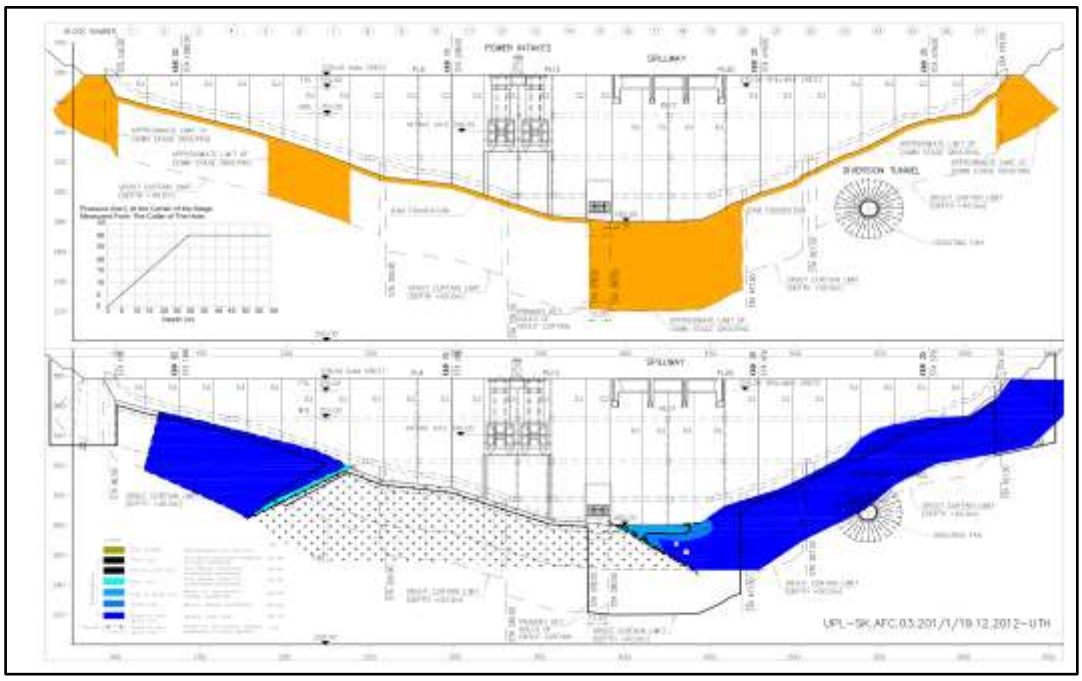

Figure (8) Grouting methods based on geological condition and curtain depth (downstage – orange colour)

Grouting Pattern

Single row curtain grouting with split-spacing method was used in Upper Paunglaung dam. The spacing of grout holes from primary (P) to secondary (S) and secondary (S) to tertiary (T) hole was 3.0 m based on a spacing of 12.0 m for primary holes.

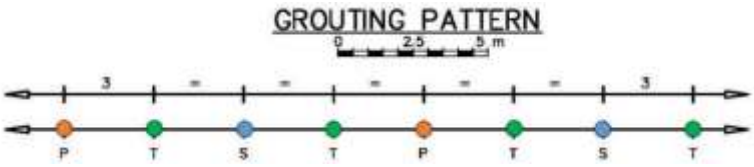

Figure (9) Split-spacing curtain grouting pattern

Arrangement of Boreholes

Direction and spacing of boreholes are of major importance for successful grouting. To determine the optimal direction of boreholes, the average orientation of the joints to be grouted must be assessed. Thus, the curtain grouting at Upper Paunglaung dam was comprised of systematic primary, secondary, and tertiary holes (spaced respectively 12, 6 and 3 m) with a 10° upstream inclination with respect to the vertical for a better intersection with the main nearly vertical joints of the rock mass.

Effective Grout Width or Thickness of Grout Curtain

The spacing of bore holes (s) is optimized using the expected distance the grout will travel or its reach (R_e). Expected grout travel reach (R_e) and effective grout width (d) of a single row of grout holes can be estimated as follows:

$s = R_e.\sqrt{3}$ (ISRM, 1996) ……. Equation (1)

The expected grout travel reach (R_e) from Equation (1) can be written as

$R_e = \frac{s}{\sqrt{3}}$ (ISRM, 1996) ……. Equation (2)

ISRM (1996) stated that the effective grout width (d) of a single row of grout holes is 1.33 R_e.

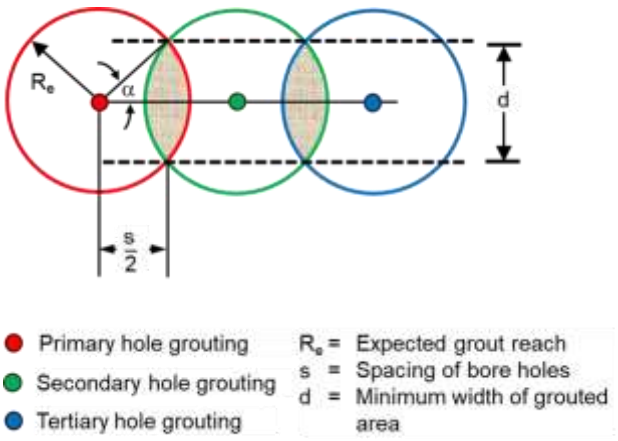

Figure (10) Geometry of borehole alignment

According to above-mentioned facts, the grout curtain was designed with the grout travel reach (R_e) of **1.7 m** and grouted area width (d) of **2.3 m** to deal with the water flow infiltration, making a consistent reduction of the permeability of the foundation rock.

Grouting Pressure

According to rule of thumb of Normal Swedish Practice, the grouting pressure is 1.0 bar/m (4.5 psi/ft) depth. Thus, the grouting pressure were established by calculating the depth to the centre of the stage from the collar of the grout hole in the foundation gallery as shown in Figure (11).

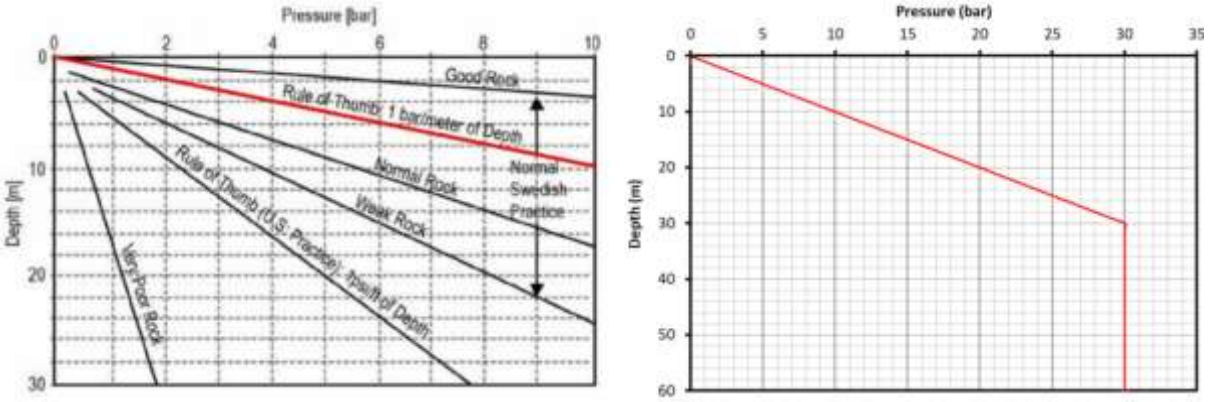

Figure (11) Curtain grouting pressure: Rule of thumb (left) and Upper Paunglaung dam (right)

Curtain grouting pressure was used by 1.0 bar/m depth up to 30 m depth and constant pressure was used for successive depths. Actual grouting pressure (PG) at the borehole mouth was increased in steps of 1.0 bar/m depth measured from the foundation level to the middle of the stage being grouted, starting at 1.0 bar for the top stage up to the respective maximum pressure limit (PL). In case, there were indication of near surface displacements, the pressure steps of 1.0 bar/m were to be lowered to 0.5 bar/m. Ultimate PL never exceed 30 bars as shown in Figure (12).

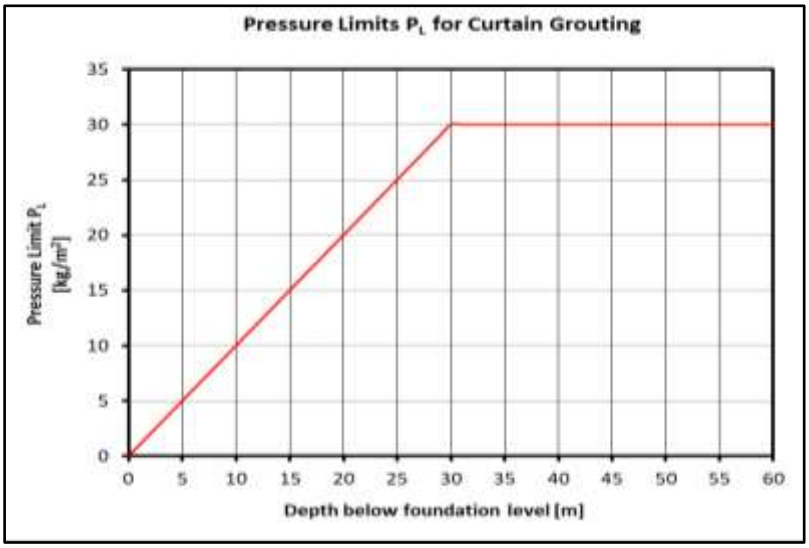

Figure (12) Pressure limits for curtain grouting at Upper Paunglaung dam

Grout Materials

Water and cement are commonly used in dam foundation grouting. Characteristics of grout materials were tested for curtain grouting at Upper Paunglaung dam.

(i) Water

The water to be used for drilling, flushing, testing, and grout mixing has to be clear potable water free of silt or sand. Silty/clayey will be very detrimental to the efficiency and durability of the grout.

(ii) Cement

The cement used for grout mixes is fresh Ordinary Portland cement (OPC) free of lumps. The cement used for pressure grouting has to be Blaine value of at least 3,500 cm^2/g with a maximum of 1.5% retention of cement particles retained on the ASTM sieve no. 200 (0.075 mm or 75 □m) sieve.

Taungphilar cement was used in curtain grouting at Upper Paunglaung dam. Blaine values of the cement are ranged from 3,107 to 4,632 cm^2/g, and average value was 3,673 cm^2/g. Average initial setting time and final setting time of the cement were 2 hr. 39 min and 3 hr. 38 min.

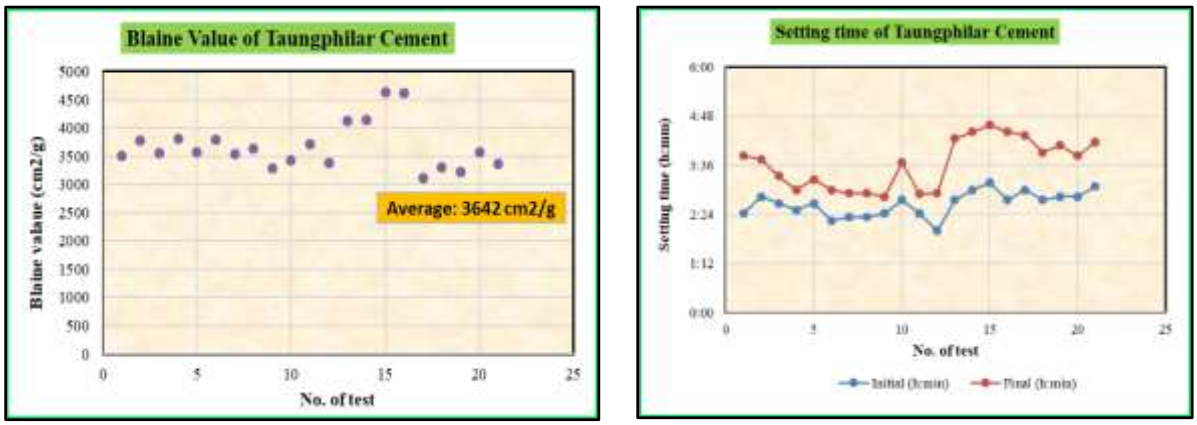

Figure (13) Blaine value and setting time of Taungphilar cement

Trial Grout Mix Design

Single grout mix was attempted to use for the curtain grouting at Upper Paunglaung dam. Grout mix trials were performed on site using the actual grout mixing equipment and with Taungphilar cement. The grout mix is used by fresh Ordinary Portland Cement (OPC), Taungphilar cement having special ordered from Taungphilar cement Factory, Naypyitaw. Blaine (fineness) value is of about 3,900 to 4,100 cm^2/g for curtain grouting at Upper Paunglaung dam. The tests were carried out as follows:

- Grout mixer efficiency test: For this test, a 1:1 w/c grout mix was used and with time zero starting the point when all the cement had been added, the grout mix was taken sample from the same point in the mixer drum at 30 sec intervals for a max time of 3 min (180 sec) and the density of each of the 6 no. of samples measured. The results were plotted for density vs. time and the optimum mixing time to be selected.
- Grout sedimentation/decantation tests
- Grout density test – using a "mud balance"
- Grout flow tests – using ASTM C939 flow cone to measure efflux time
- Grout compressive strength using 50 mm cubes

The above tests were carried out on grout mixes with the following w/c ratios 2:1, 1.5:1, 1:1 and 0.8:1 by weight.

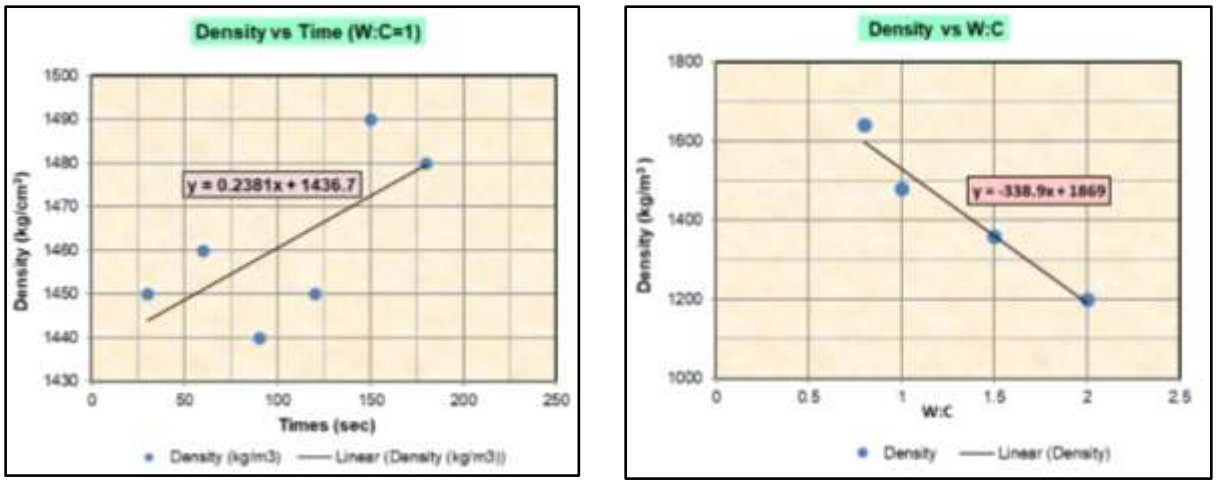

Figure (14) Trial grout mix results: Density vs Time & W/C ratio for curtain grouting

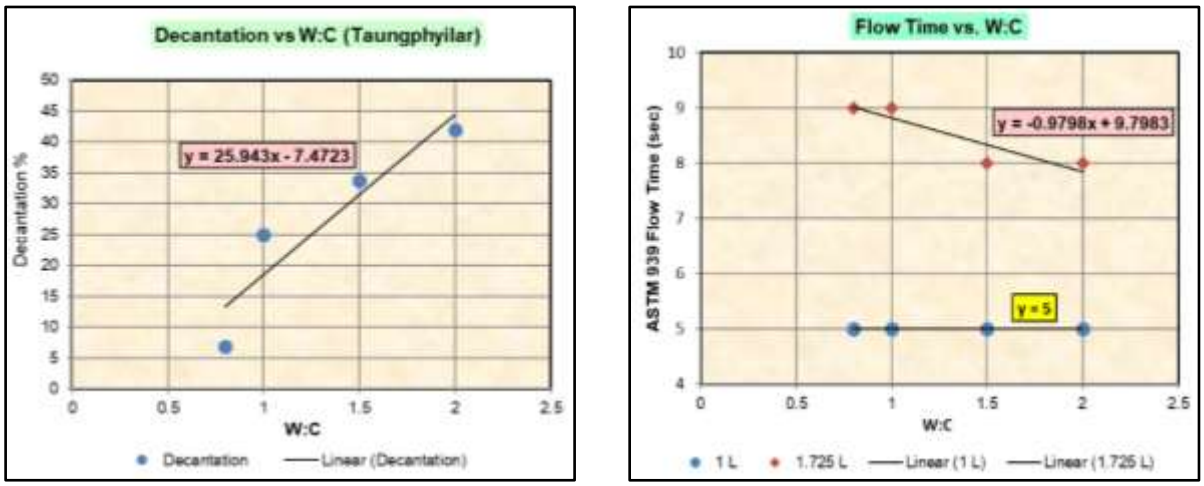

Figure (15) Trial grout mix results: W/C ratio vs. Decantation and Flow time for curtain grouting

Final Grout Mix Design

From the point of view of trial grout mix results, only unique mix was taken into account for the entire curtain grouting process. Thus, a single grout mix with a water/cement (W/C) ratio of 0.8~0.75:1 (by weight) as a "stable grout mix" was used for all stages regardless of the measured Lugeon value for the stages.

Target Lugeon

Based on the depth range measured from the RCC dam concrete and rock interface, the target Lugeon values for the curtain grouting was zoned at Upper Paunglaung dam. In the river section and middle portion (lower abutment), the target Lugeon values were defined ≤ 3 Lu for depth ≤40 m; ≤ 5 Lu for the depth between >40 m and ≤ 50 m; and ≤ 8 Lu for the depth > 50 m. In the upper abutment sections, the target Lugeon values were defined ≤ 5 Lu for the depth ≤ 40 m.

Grout Take Criteria

Deere (1976) created a simple classification system that is convenient to use for this purpose and for statistical purposes. According to

Table (**2**) grout take or cement take consumption classification (Deere, 1976), additional or quaternary/quintenary holes were decided to conduct where the grout takes are "moderate" or "greater" for the grouting stages. Target grout take consumption of curtain grouting at Upper Paunglaung dam was defined as 25 kg/m of grout hole.

Table (2) Cement take classification (after Deere, 1976)

Classification	Symbol	Actual grout takes (kg/m)
Very Low	VL	0 – 12.5
Low	L	12.5 - 25
Moderately Low	ML	25 - 50
Moderate	M	50 - 100
Moderately High	MH	100 - 200
High	H	200 - 400
Very High	VH	> 400

Lugeon Testing

The Lugeon tests were carried out the "downstage" technique. Table (3) describes the conditions typically associated with different Lugeon values, as well as the typical precision used to report these values.

Table (3) Condition of rock mass discontinuities associated with different Lugeon values (after Quiñones-Rozo, 2010)

Lugeon range	Classification	Hydraulic conductivity range (cm/sec)	Condition of rock mass discontinuities	Reporting precision (Lugeons)
<1	Very Low	$<1\times10^{-5}$	Very tight	< 1
1 - 5	Low	1×10^{-5} - 6×10^{-5}	Tight	± 0
5 - 15	Moderate	6×10^{-5} - 2×10^{-4}	Few partly open	± 1
15 - 50	Medium	2×10^{-4} - 6×10^{-4}	Some open	± 5
50 - 100	High	6×10^{-4} - 1×10^{-3}	Many open	± 10
> 100	Very High	$> 1\times10^{-3}$	Open closely spaced or voids	> 100

Water Flushing

Before testing of any stage, the section was thoroughly washed with clean water under pressure to remove all drill cuttings, rock chips, clay, slurry, and other debris. Flushing was carried out under surcharge pressure; the water flow was unrestricted and enough velocity to scour all the drilling detritus. This is particularly important those stages drilled with percussion drilling was being used.

Testing Procedure

Most of the Lugeon water pressure tests were carried out by using Japanese method. Consecutive tests of five (5) minutes were applied. The pressure is increased in three (3) to five (5) steps from the lowest pressure to the peak pressure and reduced again in steps to the lowest pressure. The pressure pattern was used as 2.0 kgf/cm^2 ⇔ 4.0 kgf/cm^2 ⇔ 6.0 kgf/cm^2 ⇔4.0 kgf/cm^2 ⇔ 2.0 kgf/cm^2.

Refusal Criteria

The grouting of any stage was considered as complete when one of the following conditions was achieved:

- If sudden stoppage occurs after three attempts when starting grouting of a stage.
- If grout takes decrease gradually and stop suddenly after one hour of normal grouting operation with any of the mixes and if the grouting pressure is near to the pressure limit P_L
- When the grout take for the stage is at a rate of less than 0.5 liter/m/min at the specified pressure for 15 minutes or more.

Controls of Curtain Grouting

All grouting contractor performed the following routine quality control tests during grouting operation to confirm the consistency of the grout:

- Temperature of mixing water and grout mix by thermometer
- Bleeding of grout by graduated cylinder (ASTM C940)
- Viscosity of grout by marsh cone funnel (API RP 13-B1) and Flow Cone (ASTM C939)
- Density of grout by mud balance (API RP 13-B1)
- Initial and final setting time by vicat needle (ASTM C191) or field cup test.
- Compressive strength test of grout samples in site Laboratory (ASTM C109/C109M-99).

The real time grouting process was continuously recorded by using digital grout flow meter. The parameters controlled for each stage are as follows:

- Actual working pressure P_G and duration of application [from t_1 to t_2]
- Actual grout flow rate “q”
- Total grouting duration T [based on begin and completion of a grouting stage]

Further, the volume “V” of grout mixed [in terms of kg of cement] and pumped to the particular stages in a grout hole was registered at the grout mixing plant. The overall grouting progress and the grout takes were recorded continuously by using digital grout flow meter and manual registered as double checking method.

During the curtain grouting operation, Lugeon test and grout injection were recorded by using digital grout flow meter with SD card and the records were manually registered.

Figure (16) Curtain grouting inside the foundation gallery at UPL dam

Data Analysis of Curtain Grouting

There are 27 blocks and 2 sub blocks at left abutment (LA) and right abutment (RA) from left to right for Upper Paunglaung RCC dam construction. Curtain grouting was performed inside the foundation gallery. Single row curtain grouting and split spacing method including both upstage and downstage methods were used in Upper Paunglaung RCC dam.

There are three curtain grouting zones such as upper portion (left and right abutments) and middle portion (lower abutment of left and right) and river section based on geological condition, grout curtain depth and hydrostatic pressure of impounded water. The results of all grout holes in respective dam blocks of those three zones were analyzed.

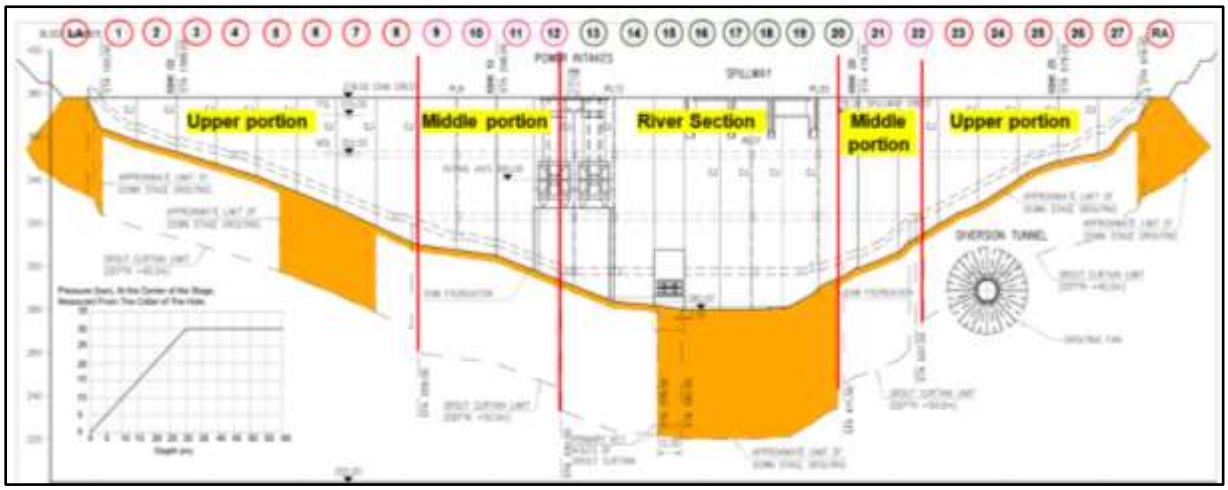

Figure (17) Curtain grouting zones along the dam axis

In curtain grouting at Upper Paunglaung RCC dam, grout mix design of water/cement (W/C) ratio of 0.75~0.8:1 (by weight) as a “stable grout mix” as well as “thick grout mix” was used. Lugeon values and cement takes of each grout hole order were recorded during the grouting process. Curtain grouting pressure was used by 1.0 bar/m depth up to 30 m depth and constant pressure was used for successive depths.

According to Quiñones-Rozo (2010) classification, discontinuity condition of Upper Paunglaung dam foundation rock mass based on the Lugeon results of primary holes shows that

average 86% of dam foundation rock mass is "very tight to tight" condition with open discontinuities.

It is difficult to predict the grout penetration because it depends not only on the apertures of discontinuities/fractures, roughness and interaction with other sets of fractures, but also on the grout viscosity, pressure, and duration etc. Bozovic (1985) and Ewart (1985) concluded that the correlation between cement or grout take and Lugeon value is very weak.

In Upper Paunglaung dam, water was injected solely through applied pressure ranging from 2.0 to 6.0 bars during Lugeon permeability testing. For dam foundation grouting, curtain grouting pressures ranging from 1 to 30 bars were utilized. The maximum grouting pressure is five times the maximum pressure of the Lugeon test. Water and grout mix differ in fluid type and properties. The aperture of discontinuity conditions in the dam foundation rock mass varies from very tight to tight. A thick grout mix with a W/C ratio of 0.75~0.8:1 (by weight) was used in the grout mix design. These conditions reflect the relationship between cement or grout takes and Lugeon values for each grout hole order, as shown in Figure (18). The figure reveals that the Lugeon values and grout takes for each grout hole order are widely scattered, indicating a very poor correlation. Thus, it is not possible to establish a direct correlation, and predicting grout penetration based on Lugeon values becomes difficult. It is worth noting that Lugeon values prior to grouting may not provide a general indication of the cement takes during grouting. The finding aligns with the conclusions of Bozovic (1985) and Ewart (1985), who also determined that the correlation between cement or grout take and Lugeon value is very weak.

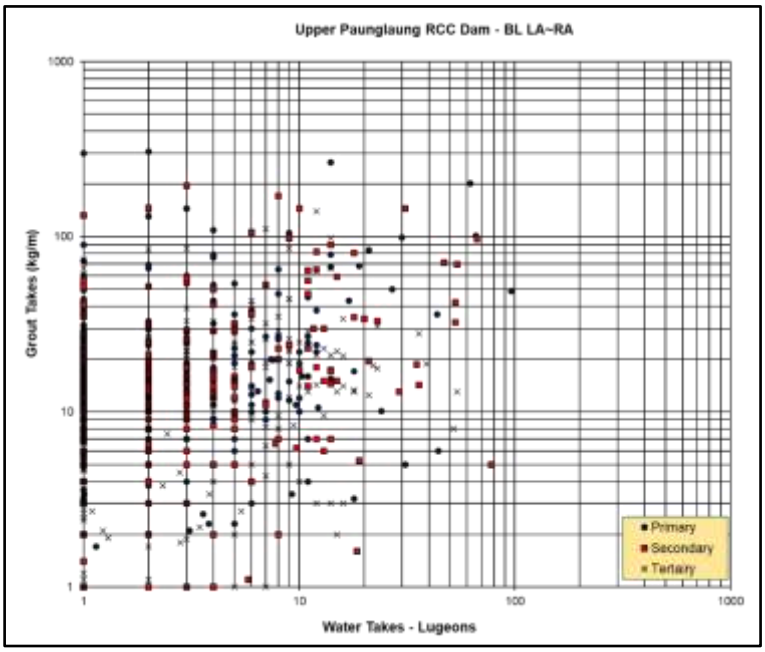

Figure (18) Grout take vs Lugeon value (all blocks)

The grout curtain efficiency was analyzed using frequency distribution analysis. In this analysis, the Lugeon values before and after grouting were considered from the results of the 1st order (primary) holes to the highest order holes. Grout takes before and after grouting were considered from the results of the 2nd order (secondary) holes to the last highest order holes. The analysis results reveal the grout curtain efficiency in the Upper Paunglaung dam, which is presented in Table (4). This table displays the frequency (%) of Lugeon and cement or grout take

results before and after grouting, indicating the achievement of the target criteria for Lugeon values and cement or grout takes in each grouting zone and respective grout curtain depths.

Table (4) Efficiency of curtain grouting of each grouting zone

No.	Zone	Depth Range (m)	Before Grouting	After Grouting	Before Grouting	After Grouting
			Lugeon	Lugeon	Cement Take	Cement Take
1	Upper Portion (Left Abutment)	≤40 m	80%	95%	85%	95%
2	Middle Portion (Left Abutment)	≤40 m	91%	96%	81%	100%
		40-50 m	90%	96%	81%	100%
		>50 m	100%	100%	100%	100%
3	River Section	≤40 m	37%	84%	81%	89%
		40-50 m	89%	90%	81%	95%
		>50 m	100%	97%	71%	89%
4	Middle Portion (Right Abutment)	≤40 m	77%	86%	86%	83%
		40-50 m	83%	100%	67%	92%
		>50 m	100%	100%	67%	100%
5	Upper Portion (Right Abutment)	≤40 m	95%	91%	84%	90%
	Target Achievement Percent (Average)		**86%**	**94%**	**80%**	**94%**

Conclusion and Discussion

Curtain grouting was carried out in Upper Paunglaung dam construction. In this study, geological condition and geological model of dam foundation were made to ensure proper grouting design and grouting methods including determination of borehole inclination, hole arrangement and hole spacing, grouting depth and stage length, as well as grouting pressure. Then, the grout materials were tested to obtain grout mix properties and grout mix trials were made on site. Based on the results, proper grout mix design was chosen as a final grout mix design. Thus, a single grout mix with a water/cement (W/C) ratio of 0.8~0.75:1 (by weight) as a "stable grout mix" was used for all grouting stages. Considering the geological condition of the dam foundation, both the upstage and downstage methods were used in curtain grouting.

Target Lugeon values for the curtain grouting were established based on the depth range measured from the interface between the RCC dam concrete and the rock. The curtain grouting was conducted in accordance with the grouting specification. All grouting data were analysed in to evaluate the efficiency of the grout curtain in the dam foundation and to determine the correlation between Lugeon values and cement takes. According the analysis results, the correction between Lugeon values and cement take shows poor correction, however, the grout curtain efficiency was achieved 94% in average after grouting. Therefore, the application of curtain grouting in Upper Paunglaung dam was successfully completed.

Acknowledgement

I would like to express my respectful gratitude to Dr. Day Wa Aung, Professor and Head, Department of Geology, University of Yangon for giving opportunity to summit this research paper. I also would like to thank my supervisor, co-supervisor, all my teachers and colleagues for their encouragement that helps smooth preparation in this research paper.

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SEDIMENTARY FACIES ANALYSIS OF EARLY EOCENE UNITS IN THE NORTHERN MINBU BASIN

Kyaw Khaing[1] and Day Wa Aung[2]

Abstract

The present study mainly focuses on the Sedimentary facies of Clastic sedimentary rock mainly on the sandstones of Early Eocene. Early Eocene unit exposed in the northernmost part of the Minbu Basin, Tilin Township, Magway region. The study attempts to determine their depositional environment. The study area mainly consists of Tertiary Clastic Sedimentary rocks. The strata can be classified into two major stratigraphic units such as (1) Laungshe Formation (Early Eocene) and (2) Tilin Formation (Early Eocene). The stratigraphic sections of the study area were measured by Jacob staff methods. The lithology, texture, sedimentary structure, fossils content and tectonic deformation will be checked and recorded. Lithologically, Laungshe Formation is mainly composed of thinly laminated dark grey to bluish grey shale intercalated with thin to medium-bedded sandstones. Tilin Formation is mainly composed of sandstone. Early Eocene units are divided into nine lithofacies. Based on the lithofacies and characteristics, at least (3) lithofacies associations can be established in the Early Eocene clastic strata of the research area. These are (1) Prodelta association (2) Delta front association and (3) Delta top association. Based on sedimentary lithofacies and facies association, the depositional environment of Laungshe Formation is shallow marine environment and the depositional environment of Tilin Formation is deltaic environment. Thus, the depositional environment of Early Eocene units is deltaic to shallow marine environment.

Keywords: Facies, Prodelta, Delta, Depositional Environment

Introduction

The research area, northernmost part of the Minbu Basin, is located at 16 km east of Tilin, Magway region. It lies between latitudes 21˚ 36′ N and 21˚ 44′ N and longitudes 94˚ 09′ E and 94˚ 17′ E in UTM-No 2194-02 and 2194-06. The location map of the study area is shown in figure (1). The research area is a mountainous and forested region and the ranges are running north-south direction. Because of the sandstone dominant and shale dominant formation, this area shows ridge and valley topography. It lies between Pondaung range and the eastern flank of the Chin hill. The strata can be classified into two major stratigraphic units such as (1) Laungshe Formation (Early Eocene) and (2) Tilin Formation (Early Eocene).

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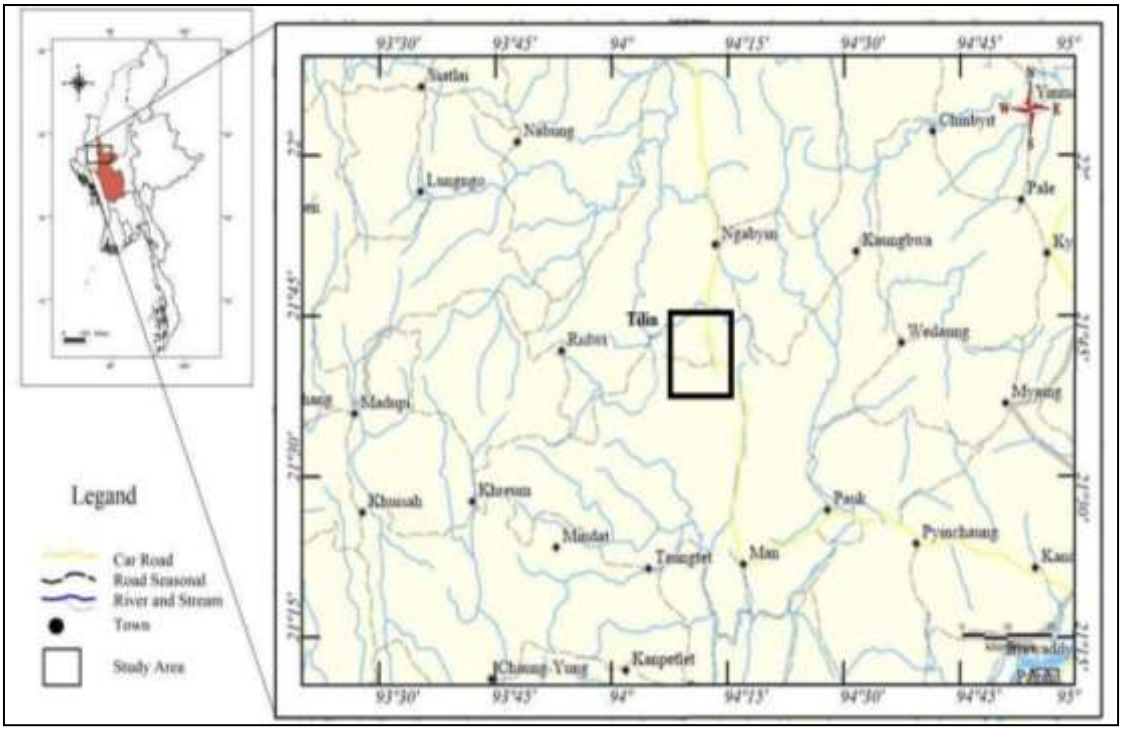

Figure (1) Location map of the study Area

Methodology

Field method-detailed sedimentological measurement was carried out from stream sections and road cuttings. The stratigraphic sections of the study area were measured by Jacob staff methods. The field work is to collect require stratigraphic record from the outcrops of the study area for the establishment of the detail stratigraphic framework and to collect samples for laboratory analysis. The lithology, texture, sedimentary structure, fossils content and tectonic deformation will be checked and recorded.

Geological Background

The present study area is situated in the northern part of the Minbu basin in Central Cenozoic Belt where Mesozoic and Tertiary rocks exposed. The Minbu Basin is bounded on the east by a major strike-slip fault, Sagaing Fault and on the west by western ranges. The regional trends of the mountains run generally north-south with slight variations in some places.

The Minbu Basin is bounded by a couple of 20˚ N and 22˚ N uplifts. Structurally, Minbu Basin is a south plunging Syncline (Salin Syncline), measuring approximately 200 km in length, north south oriented and about 70 km in width.

The name “Laungshe Shale” was first introduced by Cotter (1915) after Laungshe village (20˚ 02′ N - 94˚ 03′ E) for a sequence of thin bedded claystones, siltstone underlying the Tilin Sandston. It comprises the alternating beds of sandstone and shale or clay which are ranging in Early Eocene age. They are generally north-south trending. In 1969, Aung Khin and Kyaw Win used the name “Laungshe Formation” as a formal lithostratigraphic unit.

Laungshe formation is mainly composed of thinly laminated dark grey to bluish grey shale intercalated with thin to medium-bedded sandstones. The lower boundary between Paunggyi Formation and Laungshe Formation observes the comformable contact. The upper boundary with overlying Tilin Formation is comformable. It is gradational contact along most of its extent. This formation was considered as Early Eocene age on the basic of fauna contents.

The name "Tilin sandstone" was first introduced by Cotter (1915) after Tilin village (20˚ 45′ N - 94˚ 06′ E) for a sequence of grey to yellowish brown sandstones and some thin bedded clay which exposed in the area between Milestone 75 and 81 on the Pakokku-Tilin road. They are generally north-south trending. In 1969, Aung Khin and Kyaw Win used the name "Tilin Formation" as a formal lithostratigraphic unit.

Although Tilin Formation is mainly composed of sandstone, it seems to be subdivided into two members; a lower and upper according to sand/shale (clay) ratio. The lower boundary between Laungshe Formation and Tilin Formation observes the comformable contact. It is fairly sharp boundary along car road from Anayban to Kyin village. The upper boundary with Tabyin Formation is transitional contact. The faunal assemblages and its stratigraphic position indicate the Early Eocene age for this unit.

Sedimentary Lithofacies Analysis

A number of good outcrops of Early Eocene units are situated especially along Tilin-Pakokku car road sections. The stratigraphic section of Early Eocene Formations is measured along the Tilin- Kyin- Pauk car road sections. The lithology, texture, sedimentary structures, fossils contact and tectonic deformation were checked and recorded during measurement (Graham, 1988). Base on stratigraphic measured section, Early Eocene Formations are 2114m thick. Based on the characteristic of sedimentary units which include thickness, sedimentary structures, grain sizes and types, colour and biogenic contact of the sedimentary rock, the lithofacies of Early Eocene units are classified. Early Eocene units are divided into nine lithofacies. Measured sections are described in figure (2).

Thin-lenticular bedded sandstone facies

This facies is well developed in the lower and middle parts of Tilin Formation. It is consists of dark grey in the weathered surface, dark brown and yellowish brown in the fresh surface, fine to coarse grained and very thin to thin bedded sandstone (figure 3). Pelecepods fossils are locally occurred in this facies. Sedimentary structures are characterized by liguide ripple (figure 4), mud crack, burrow structure, parallel lamination, cross bedding, lenticular bedding, concretion, load cast, flute cast and mud pebble. Recorded maximum thickness of this facies is upto 13 meters. The upper boundary is gradational contact to very thin to thin bedded shale facies.

This facies reflects the seaward of the distributary mouth bar in seaward sloping margin of the delta front environment where the sedimentation rate is high. The sedimentary structures association in the deposit of this facies such as cross bedding, ripple mark and lenticular bedding are interpreted to the deposit of delta front area. The repeated occurrence of the definite sequence of the sedimentary structures indicates the seasonal layering (Reineck and Singh., 1980). The dimension of the sand beds of this facies show the sheet like deposit, which means the delta front sheet sand. Thus, this facies can be interpreted as delta front environment.

Massive sandstone facies

This facies is well exposed at the upper part of Tilin Formation. It is consisted of medium to coarse grain and massive sandstone (figure 5). In this outcrop, this sandstone appears grey in weathered surface, greenish grey in fresh surface well marked. The sedimentary structures such as parallel lamination and mud pebble (figure 6) are noted. Sandstone with mud pebble at the base on erosional surface is overlain upon the bluish grey shale with erosional contact.

Figure (2) The explanation of the stratigraphic column of Early Eocene Units

Figure (3) Brown, fine to medium grained and very thin- to thin-bedded sandstone of Laungshe Formation

Figure (4) Current ripples developed in thin bedded sandstone at the lower and middle part of Tilin Formation

Massive bedding and medium- to coarse-grained indicated that very high energy channel area. This facies is generally interpreted to have been formed in channel environment.

Figure (5) Grey, medium- to coarse-grained, massive sandstone facies of the Tilin Formation

Figure (6) Mud pebble in massive sandstone of the Tilin Formation

Mudstone facies

This facies is well developed in the middle part and upper part of Laungshe Formation and lower part of Tilin Formation. Mudstone facies is consists of light brown in the weathered surface, light grey in fresh surface (figure 7). Mudstone is intercalated with light grey shale. These facies contain abundance horizontal burrow structures (figure 8). The average thickness of this facies is 14 m thick. The upper contact is sharp to very thin to thin bedded sandstone facies.

Horizontal burrow structure indicated low energy and quite water environment. The very fine to fine-grain composition and laminated structure of this facies is indicative prodelta deposition. Laterally extensive shale and mudstone lamination is deposited in prodelta (Reineck and Singh, 1980).

Figure (7) Light brown, thin-bedded mudstone of Laungshe Formation

Figure (8) Horizontal Burrow structure in brown, thin-bedded mudstone of Laungshe Formation

Grey shale facies

This facies is widely distributed throughout the whole unit of Laungshe Formation and Tilin Formation. It is mainly consists of dark grey in weathered surface, light grey in fresh surface, very thin to thin bedded shale (figure 9). Thin and parallel laminated structure are characterizes in shale bed. Mud concretion, caliche and gypsum plates (figure 10) are found in this facies. The thickness of this facies is varies from 10 meter to 15 meters. The upper boundary is gradational contact to sandy shale facies.

Very fine grain interpreted that suspension sediments deposited in low energy area such as prodelta of shelf. This facies is interpreted to be of prodalta or shelf environment. Thick finer sediments and intercalated marl band show quite water, low energy condition. The fine- grained muddy sediments are the prodelta deposits, which are closely related to prograding deltaic system (Reineck and Singh, 1980).

Figure (9) Dark grey, very thin- to thin-bedded shale of Laungshe Formation

Figure (10) Gypsum plates intercalated in dark grey, very thin to thin bedded shale of Laungshe Formation

Carbonaceous or coaly shale

This facieses well developed at the middle part of Tilin Formation. It contains coaly shale with thin siltstone and dark grey to black carbonaceous (figure 11). In this facies, coal layer apparent 20 cm in the embedded in brownish shale is well marked. The coal layer is thinning to eastward at the measure section.

The formation of coal is in the swamp, flood basin of the area where the thick accumulation of plant remains formed into the coal layer. The siliciclastic input is very least in this and also represent to the emergent of the area. Therefore, this facies is interpreted to be deposited in a swampy environment or delta top.

Sandstone intercalated with thinly shale

It is well developed at the lower and middle part of Tilin Formation. It is consisted of fine to medium grained, thin to medium bedded sandstone (figure 12) dark grey in the weathered surface, dark brown and brown in the fresh surface. Sandstone is intercalated with grey and dark brown, thinly bedded shale. Leaf imprint are observed in this facies. Mud pebbles and ripple marks occur in this sandstone. The maximum thickness of this facies is 9 meters. The lower contact is gradational contact to medium bedded sandstone. The upper boundary is sharp with very thin to thin bedded shale.

This facies includes several exclusive features of tidal deposits. Sandy sediments in parallel stratification are observed in intertidal zone of tidal influence coastal regions (Nichols, 1999, 2009). This facies is interpreted as forming from alternating flood-ebb tidal current with intervening slack-water suspension fallout in tidal flood area (Miall, 2000).

Figure (11) Carbonaceous or coaly shale of the Tilin Formation

Figure (12) Grey, fine- to medium- grained and thin to medium bedded sandstone intercalated with dark brown shale

Swaly cross stratified sandstone facies

This facies is well exposed at lower and middle part of Tilin Formation. It is consisted of fine to medium grain, thin to medium bedded sandstone (figure 13). Plecepods fossils fragment occurs in this facies (figure 14). Sedimentary structures are characterized by mud concretion, parallel lamination and mud crack. The maximum thickness of this facies is 3 meter. The lower boundary is gradational contact to very thin to thin shale facies. The upper contact is gradational to very thin to thin sandstone facies.

This facies was deposited in shallow marine subtidal area under storm condition. This facies developed lower the delta front deposits and covered by medium to thick bedded sandstones of mouth bar deposits. Swaly cross stratification is believed to form as a result of combined flow that is the action of both waves and a current (Nichols, 2009). Base on bedding character, this facies is the lower part of mouth bar deposits in the delta slope environment (Reading, 1996) or lower subtidal depend upon storm period.

Figure (13) Swaly cross stratified sandstone facies of Tilin Formation.

Figure (14) Fossils fragment collected from shale intercalated with sandstone facies

Sand and shale interbedded facies

This facies is well exposed at the middle part of Tilin Formation. It is consisted of fine grained and thin bedded sandstone, reddish brown in weathered surface, light grey in fresh surface. Sandstone mostly possessed laminated nature alternate with grey shale (figure 15). The thickness of this facies is 2.5 meter. The lower contact is gradational to very thin to thin bedded sandstone. The upper contact is sharp to medium bedded sandstone facies.

Sharp contact between sandstone and shale layers is the typical features of tidal process and identified as tidal rhythmic (Reineck ad Singh, 1980). The sand-shale interbedded can be interpreted by the deposition of tidal current and slack water conditions respectively during flood and ebb current activities (Nichols, 1999, 2009).

Thick-bedded sandstone facies

This facies is well developed in the upper part of Tilin Formation. It is composed of dark grey in the weathered surface, dark brown and yellowish brown in the fresh surface, thick to very thick bedded and fine to medium grained micaceous sandstone. Sedimentary structures such as by very low angle cross bedding and parallel lamination (figure 16) are noted. Thickness of this facies is ranging from 0.5 to 21 meter. The lower contact is gradational with very thin to thin bedded shale facies. The upper boundary is sharp to massive sandstone facies.

This facies is vertically associated with the bedded shale facies and massive sandstone facies. Sedimentary structures contained in this facies indicate the where influence high-energy current such as planar cross-bedding. The sedimentary structures pointed to tidal condition in this facies. The lithology characters and sedimentary structures interpreted that this facies is the deposits of high energy current in tidal flat in subtidal sand body,

Figure (15) Sand and shale interbedded facies of the Tilin Formation

Figure (16) Thick to very thick bedded sandstone showing parallel lamination in the Tilin Formation

Facies Associations

In clastic facies analysis, individual facies are process related and are usually not environmentally specific. Facies associations are environmentally specific. Therefore, in clastic facies analysis, individual processes (facies) are needed to be combined together into facies associations to define environment. Based on the lithofacies and characteristics, at least (3) lithofacies associations can be established in the Early Eocene clastic strata of the research area. These are (1) Prodelta association (2) Delta front association and (3) Delta top association.

Prodelta facies association

The prodelta facies association consists of grey shale facies and mudstone facies in the study area. The prodelta is the area of low energy environment, where thick accumulation of finer particals settles out from suspension.

In the study area, this facies association occupies the lower and middle part of the Laungshe formation and lower part of Tilin Formation of the eastern part of the study area. This lithofacies association is mainly composed of lamination shale, thin- to medium-bedded mudstone, and very fine- to fine-grained sandy shale. Thin and horizontal laminated structures are common in the sediments of this association. Very fine- to fine-grained of suspended materials and marine fauna of this lithofacies association indicated prodelta deposits (Reading, 1996; Blatt *et al*, 1980).

Delta front facies association

Delta front facies association mainly consists of thick-bedded sandstone, thin-lenticular bedded sandstone and sandstone intercalated with thinly shale. In the study area, Laungshe Formation and the lower and middle part of Tilin Formation mostly occupy the delta front sheet and sand-mud alternate bedding. These facies associations are always developed over the sediments of prodelta association. This lithofacies association includes fine- to medium-grained, thin- to thick-bedded sandstone intercalated with shale. Medium- to thick-bedded sandstones are characterized by thickening upward bedding and coarsening upward grain. Cross bedding are occurred in these sediments. The lithologic and bedding character of this association is representation as the coarsest grains are deposited at the mouth bar and finer away from mouth.

Based on these characters, the sediments of this association are deposited in delta front environment (Nichol, 1999, 2009).

Delta top facies association

Delta top facies association mainly consists of sand and shale interbedded facies, massive sandstone facies and carbonaceous coaly shale facies. In the study area, this facies association occupies the upper part of Laungshe formation and Tilin Formation of the eastern part of the study area. The deposition of cross -bedded sandstone with mud drape is typical delta deposits which is always association with coal of swampy area.

This lithofacies association contains massive sandstone, and alternated layer of thin-bedded sandstones and very thin- to thin-bedded shale. The coarsest material is the evidence of fluvial processes is the representative of river channel deposits in delta top setting (Reading, 1996). Sand-shale alternation also showed ebb-flood currents with intervening slack-water suspension deposition in delta top environment (Nichols, 1999, 2009).

Depositional Environment

The lithofacies associations and their possible environments have been discussed. The interpretations are in agreement with those mentioned by Walker *et al* (1992), Reineck and Singh (1980), and Reading (1996). The environments are classified into three major groups; prodelta, delta front and delta top.

The lower part of Laungshe Formation is started the beginning of channel deposition in continental shallow shelf during regression by the occurrence of very coarse grained sediments. These regressive sediments are followed by the very fine grained sediment of shale, mudstone and transgression was started. This sequence is the evidence of world-wide sea level rise during the early Eocene. These fine grained sediments are deposited in prodelta environments. The prodelta sediments are covered by the delta front sediments of thin-bedded sandstones, thickening upward sandstone intercalated with shale and coarsening upward mouth bar deposits. The fining away and downward sediments are deposited in delta front environment. These trangressive sediments are developed in the middle part of Laungshe Formation. The marine transgression is terminated by the redeposition of delta front sediments and prodelta sediment successively. The upper portion of Laungshe Formation is characterized by the deposition of prodelta sediments. Based on sedimentary lithofacies and facies association, the depositional environment of Laungshe Formation is shallow marine environment.

The Tilin Formation is started the occurrence of coarsening upward delta mouth bar deposits underlain by the very fine grained suspended loads of prodelta deposits of Laungshe Formation. The medium-bedded sandstone intercalated with mud layers also found under the coarsening upward sandstones in the lower part of Tilin Formation. Based on the lithologic characters such as coarsening and thickening upward positions and sedimentary structure of this sediment, the lower part of Tilin Formation is deposition as the upper part subaqueous mouth bar in delta front environment. These delta front sediments are followed by the fining upward sandstones of distributary channel deposits in the lower delta top environments. It showed the regression sea level. Very fine grained sediments, mudstone and shale covered on the fining

upward sandstones in the Tilin Formation. They are suspended loads deposited in delta top environment during flood time (Nichols, 1999). In the middle part of Tilin Formation, prodelta deposits, very fine grained shale are intercalated with fining upward sandstone are represented in the lower part of delta front. These intercalated layers of sandstones are represented the transgression event. These alternation sequences are continued to the upper part of Tilin Formation except the minor occurrence of flood plain deposits, suspended loads. Thus, the depositional environment of Tilin Formation is deltaic environment. Based on sedimentary lithofacies and facies association, the depositional environment of Early Eocene units is deltaic to shallow marine environment.

Conclusions

The research area is a mountainous and forested region and the ranges are running north-south direction. The strata can be classified into two major stratigraphic units such as (1) Laungshe Formation (Early Eocene) and (2) Tilin Formation (Early Eocene). Laungshe formation is mainly composed of thinly laminated dark grey to bluish grey shale intercalated with thin to medium-bedded sandstones. Although Tilin Formation is mainly composed of sandstone, it seems to be subdivided into two members; a lower and upper according to sand/shale (clay) ratio. Early Eocene units are divided into nine lithofacies. The prodelta facies association consists of grey shale facies and mudstone facies in the study area. Thin and horizontal laminated structures are common in the sediments of this association. Very fine- to fine-grained of suspended materials and marine fauna of this lithofacies association indicated prodelta deposit. Delta front facies association mainly consists of thick-bedded sandstone, thin-lenticular bedded sandstone and sandstone intercalated with thinly shale. This lithofacies association includes fine- to medium-grained, thin- to thick-bedded sandstone intercalated with shale. Medium- to thick-bedded sandstones are characterized by thickening upward bedding and coarsening upward grain. Cross bedding is occurred in these sediments. Delta top facies association mainly consists of sand and shale interbedded facies, massive sandstone facies and carbonaceous coaly shale facies. This lithofacies association contains massive sandstone, and alternated layer of thin-bedded sandstones and very thin- to thin-bedded shale. Sand-shale alternation also showed ebb-flood currents with intervening slack-water suspension deposition in delta top environment. Based on sedimentary lithofacies and facies association, the depositional environment of Early Eocene units are deltaic to shallow marine environment.

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PETROGENESIS AND TECTONIC SETTING OF GRANITES OF THE HERMYINGYI-TAUNGPHILA AREA, DAWEI SN-W REGION, SOUTHERN MYANMAR

Kyaw Swa Win[1], Aung Zaw Myint[2], Htay Win[3]

Abstract

Hermyingyi-Taungphila area is located in the central granite range of the Dawei Sn-W region. In the study area, the greisen-bordered quartz veins are hosted by a Paleocene granite and Mergui Group. The granite samples have high A/CNK [molecular proportion of Al_2O_3/ ($CaO+Na_2O+K_2O$)] values, ranging from 1.47 to 4.34, which is greater than 1.1 and reveals the S-type. The granite is highly siliceous (SiO_2 = 75-80 wt.%), peraluminous, calc-alkaline, and strongly fractionated. It possesses the enrichment of Cs, Rb, Th, U, K, and La and the depletion of Ba, Sr, and Eu, indicating magma is mainly derived from the lower continental crust. The tetrad REE patterns with strong negative Eu anomalies (Eu/Eu*- 0.01-0.04) and $(La/Sm)_N$ (0.6-0.9) are consistent with the characteristics of a highly fractionated or evolved magmatic-hydrothermal system. Combined with previous geochronological data, the present geochemical data provides that the granites were formed at a collisional setting.

Keywords: Greisen-bordered quartz veins, granite, Hermyingyi, Taungphila, Sn-W mineralization, tetrad REE patterns

Introduction

Sn-W deposits are widely distributed in the Dawei Sn-W region, Tanintharyi Region, Southern Myanmar (Figure. 1b). Hermyingyi, largest primary Sn-W deposit of the Dawei region, is situated at the northern edge of the central range in which the greisen-bordered quartz veins are hosted by the Paleocene granite and Permo-Carboniferous metasediments of Mergui Group. In this research, we studied the geochemistry of Hermyingyi and Taungphila granites to determine their petrogenesis and tectonic setting.

Geological Setting

Regional Geology

There are three granite ranges in the Dawei district: the Coastal Range, Central Range, and Frontier Range (Brown and Heron, 1923) (Figure. 1b). They occur as a part of the Western Granite Province of Southeast Asian Sn-W belt (Figure. 1a) (Cobbing et al., 1992). Most of the Sn-W deposits and prospects are spatially associated with the granites of the Paleocene age (Aung Zaw Myint et al., 2017, 2021; Li et al., 2018) and metasedimentary rocks of the Carboniferous to early Permian Mergui Group. Hermyingyi, Wagone, Bawapin, Pagaye, and Putletto are primary deposits and Heinda is a tin placer deposit, are located in the Central Range (Bender, 1983; Aung Zaw Myint et al., 2021).

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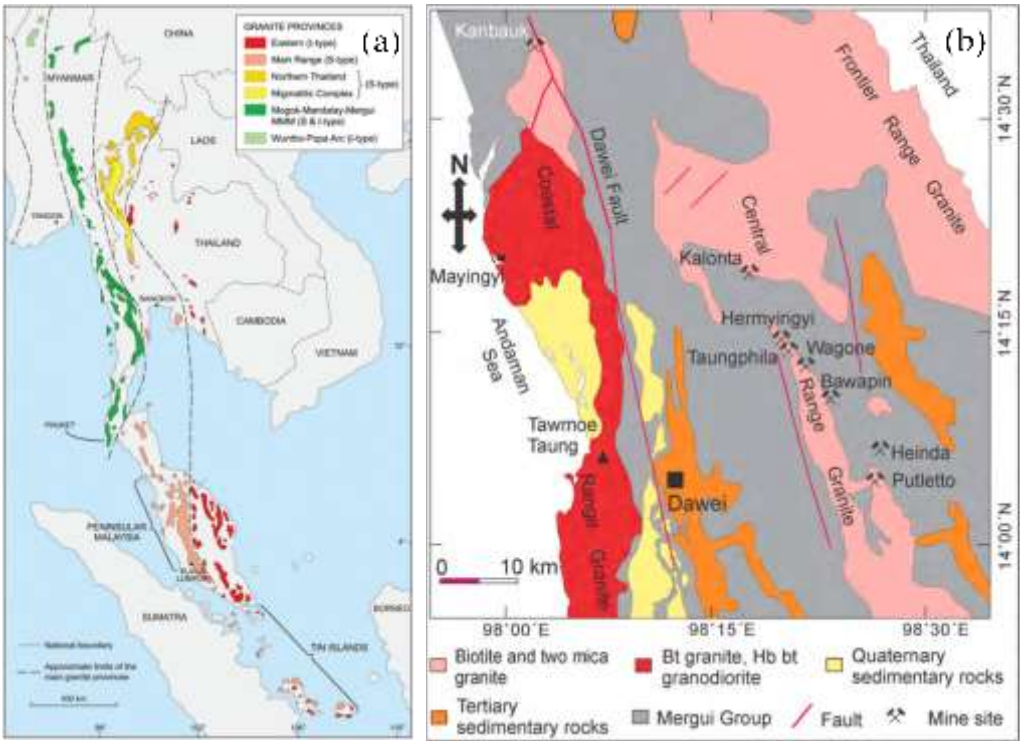

Figure. 1. (a) Southeast Asian Granite Belts (Cobbing et al.,1992, Gardiner et al., 2014) (b) Regional geological map of Dawei Sn-W District (Aung Zaw Myint et al., 2021)

Geology of the Hermyingyi-Taungphila Area

The granites from Hermyingyi and Taungphila area have medium- to coarse-grained and mainly composed of quartz, plagioclase, orthoclase, alkali feldspar (perthite), biotite and muscovite. The biotite and muscovite granites at Hermyingyi and Taungphila have been dated as LA-ICP-MS U-Pb dating of zircon ages of 61.44 ± 0.6 Ma (Li et al., 2018) and 68.8 ± 0.1 Ma (Jiang et al., 2017), respectively. Mergui Group consists of quartzite, greywacke, phyllite, sandy phyllite, and sandy mudstone.

Hermyingyi Sn-W deposit comprises three worksites: namely No (1) adit, West Cave adit, and A1 adit. Gugyi adit and Megyi adit are located in the Taungphila area. The quartz veins trend N-S with vertical inclination (80° to 90°) to the East. Veins have a maximum length of 500 m and thickness ranging from a few centimeters up to 1 m. The veins cut the granite and overlying Mergui Group. Greisenization, the most distinct hydrothermal alteration of the area, represents by an assemblage of quartz-muscovite, indicating the high temperature, post-magmatic alteration of rocks by volatile-rich solutions associated with the cooling of granitic intrusion. Ore veins contain mainly cassiterite and wolframite associated with sulfide minerals of molybdenite, pyrite, arsenopyrite, sphalerite, chalcopyrite, bismuthinite, galena, and covellite.

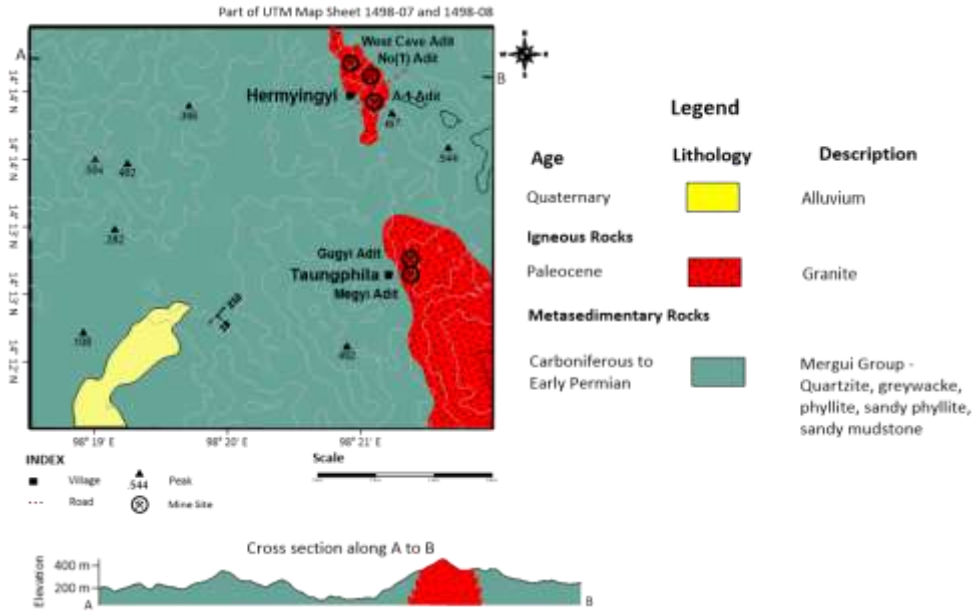

Figure. 2. Geological Map of the Hermyingyi-Taungphila area (Kyaw Swa Win, 2022)

Materials And Methods

Total 15 samples of granite from Hermyingyi and Taungphila area, 9 samples from 3 worksites of Hermyingyi area and 6 samples from 2 worksites of Taungphila area, were analyzed by inductively coupled plasma atomic emission spectroscopy (ICP-AES) for major elements and inductively coupled plasma mass spectrometry (ICP-MS) for trace elements at ALS Testing Services Co. Ltd, Laboratory in Stafford, Queensland, Australia.

Geochemistry

Major and Trace Elements

Geochemical data indicate that the granite samples have a high content of SiO_2 (75.1-80.1 wt. %) associated with Na_2O (0.08-4.02 wt. %), MgO (0.01-0.06 wt. %), Al_2O_3 (11.25-13.8 wt. %), P_2O_5 (0-0.01 wt. %), K_2O (2.79-5.48 wt. %), CaO (0.01-0.67 wt. %), TiO_2 (0.02-0.05 wt. %), MnO (0.07-0.32 wt. %), and Fe_2O_3 (0.88-2.17 wt. %). Loss on ignition (LOI) is very low (0.62-3.39%) that unveiling low volatile contents. The A/CNK [molecular proportion of Al_2O_3/ ($CaO+ Na_2O+K_2O$)] values range from 1.51 to 4.64 and they are greater than 1.1 referring to the peraluminous (Figure. 3a). They plot in the filed of high-K calc-alkaline in the SiO_2–K_2O diagram (Figure. 3b).

They have high content LILE (large ion lithophile elements) of Rb (711-1285 ppm) and moderate concentration HFSE (high field strength elements) of Y (48-200 ppm), U (7.88-25.7), Th (23.5-40.8) with depletion of Hf (4.6-9). They exhibit low Nb/Ta ratios (2.22-4.45), Zr/Hf ratios (11.47-17.92) and high Rb/Sr ratios (66.45-1435.71), Y/Ho ratios (20.6-41.93).

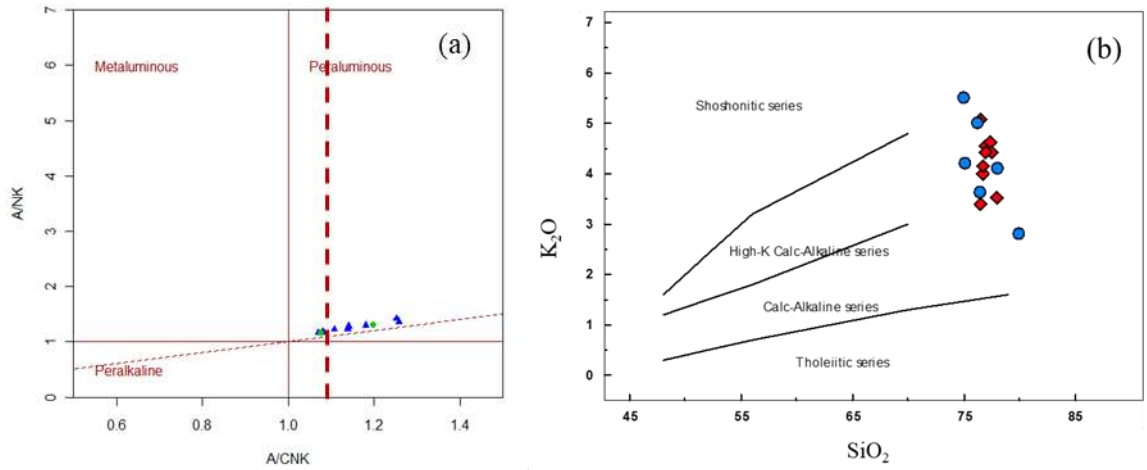

Figure.3.(a) A/NK (molar $Al_2O_3/[Na_2O+ K_2O]$) versus A/CNK (molar $Al_2O_3/ [CaO+Na_2O+ K_2O]$) diagram (Shand, 1943) (b) SiO_2 versus K_2O diagram (Peccerillo and Taylor, 1976) for granite samples in Hermyingyi-Taungphila area

Rare Earth Element (REE) Geochemistry

All granite samples are characterized by the tetrad REE patterns with deep negative Eu anomalies (Eu/Eu* = 0.01 to 0.04) (Figure. 4). The total REE content varies widely, from 91.35 to 176.47 ppm in the Hermyingyi area and 69.08 to 251.27 ppm in the Taungphila area, respectively. The granite samples from Hermyingyi and Taungphila area are similar REE patterns (Figure. 4). In the Hermyingyi-Taungphila area, $(La/Yb)_N$ varies from 0.15 to 0.61 and $(La/Sm)_N$ from 0.6 to 0.99.

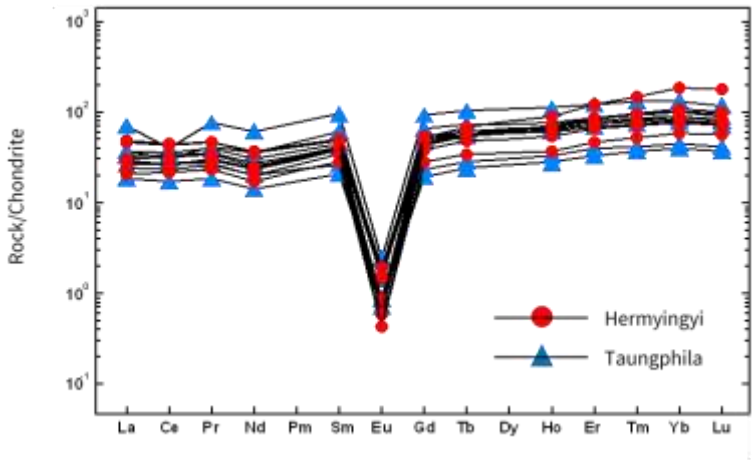

Figure. 4. Chondrite-Normalized REE pattern of the Hermyingyi and Taungphila granites (Sun and McDonough, 1989)

Discussion

Petrogenesis

The REE patterns of the Hermyingyi and Taungphila granites exhibit the tetrad effect and it indicates late magmatic differentiates with strong hydrothermal interactions or deuteric alteration, in highly evolved mineralized granites (Jahn et al., 2001) (Fig. 4). This tetrad effect is accompanied by non-CHARAC (charge-and-radius-controlled) trace element behavior (Fig. 5a). Such behavior occurs typically in highly evolved magmatic systems which may be regarded as

transitional between a pure silicate melt and an aqueous fluid (Bau, 1996). A distinct positive correlation between Nb/Ta and Zr/Hf indicates the geochemical condition during the magmatic to the hydrothermal stage (Figure. 5b).

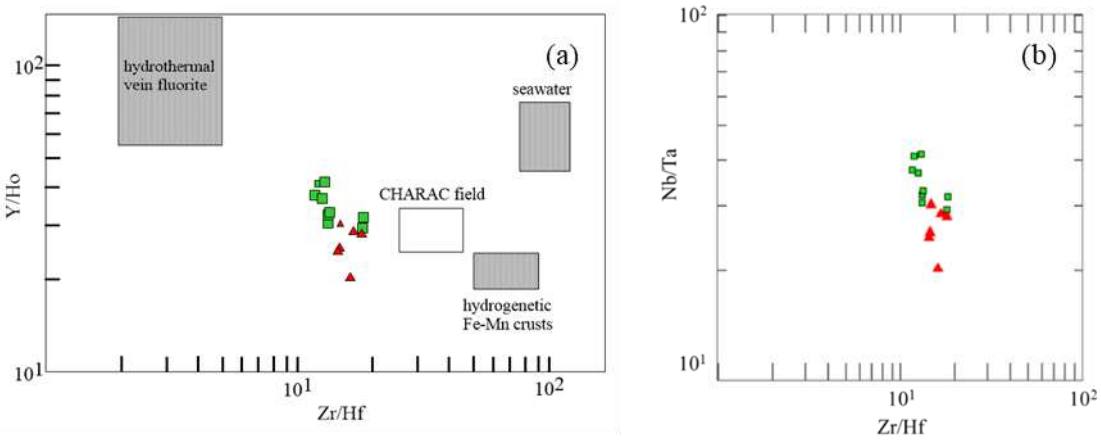

Figure. 5. (a) Y/Ho and Zr/Hf variation diagram of the Hermyingyi-Taungphila granites showing non-CHARAC trace element behavior (Bau, 1996) (b) Zr/Hf and Nb/Ta variation diagram showing the behaviour of HFSEs during magmatic-hydrothermal activity

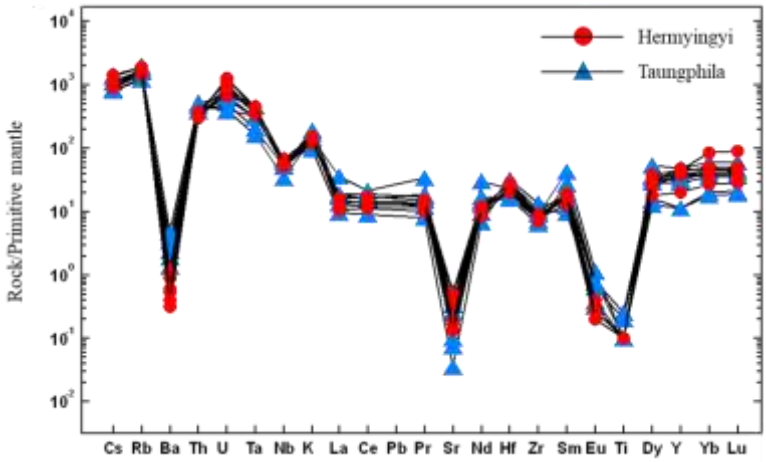

Figure.6. Chondrite-Normalized trace element abundances for Hermyingyi and Taungphila granite (Sun and McDonough, 1989)

The Hermyingyi and Taungphila granites have low ratios of Nb/Ta (2.22-4.45), Zr/Hf (11.47-17.92) and Th/U (1.02-5.03), all of which are consistent with continental crustal derivation (Singh et al., 2017).

Primitive-mantle normalized spider diagram of trace elements (Figure.6) show enrichment of large ion lithophile elements (LILE, e.g., Cs, Rb, Th, U, K, La) and depletion of high field strength elements (HFSE), such as Ba, Sr, and Eu, revealing that the magma is derived from the lower continental crust (Li et al., 2014). Large increases of Rb, Nb, Y, Lu and HREE and decreases of Sr, Ba, Ti, and LREE are associated with higher Si content (Li et al., 2018). All granite samples are presented by the tetrad REE patterns with distinct negative Eu anomalies (Eu/Eu* = 0.01-0.04) (Figure. 4) and low LREE fractionation [$(La/Sm)_N$ = 0.6-0.9] indicate the S-Type granite characteristics (Sha and Chappell, 1999).

Tectonic Setting

The granites from the Hermyingyi-Taungphila area plot syn-collisional granites in the Rb vs. (Y+Nb) and R1-R2 diagram (Figure. 7a & b) and it can be said these granites emplaced at the syn-collisional setting during Paleocene. The tectonic setting of Sn-W mineralization in Myanmar was linked to plate-margin magmatism. Cretaceous to Eocene magmatism in Myanmar developed both proximally in association with a subduction-zone volcanic arc and distally within the back-arc region, showing different granite-type affiliations in N-S-striking magmatic belts (Wang et al., 2014; Gardiner et al., 2015; Jiang et al., 2017).

After the Early Cretaceous collision in West Myanmar and the Sibumasu-Tengchong area (Metcalfe, 2013; Liu et al., 2016), low-angle subduction of the Neo-Tethyan oceanic lithosphere caused the development of an Andean-type magmatic arc with Late Cretaceous- Paleocene (100–50 Ma) felsic magmatism in the Western Granite Province (Mitchell et al., 2012; Jiang et al., 2017; Gardiner et al., 2018; Zhao et al., 2017; Fang et al., 2018; Aung Zaw Myint et al., 2021). Roll-back of the Neo-Tethyan oceanic slab probably plays a key role to produce the crustal derived melts that underwent high degrees of fractional crystallization and subsequent fluid exsolution (Jiang et al., 2017; Li et al., 2018; Mao et al., 2020), which finally formed most of the Sn-W (-Mo) deposits in the Western Granite Province. Late Cretaceous to Paleocene event is characterized by the formation of many large-scale deposits, including Hermyingyi, and medium to small-scale deposits and displays an assemblage of quartz and pegmatite veins, greisens, and skarns (Aung Zaw Myint et al., 2021).

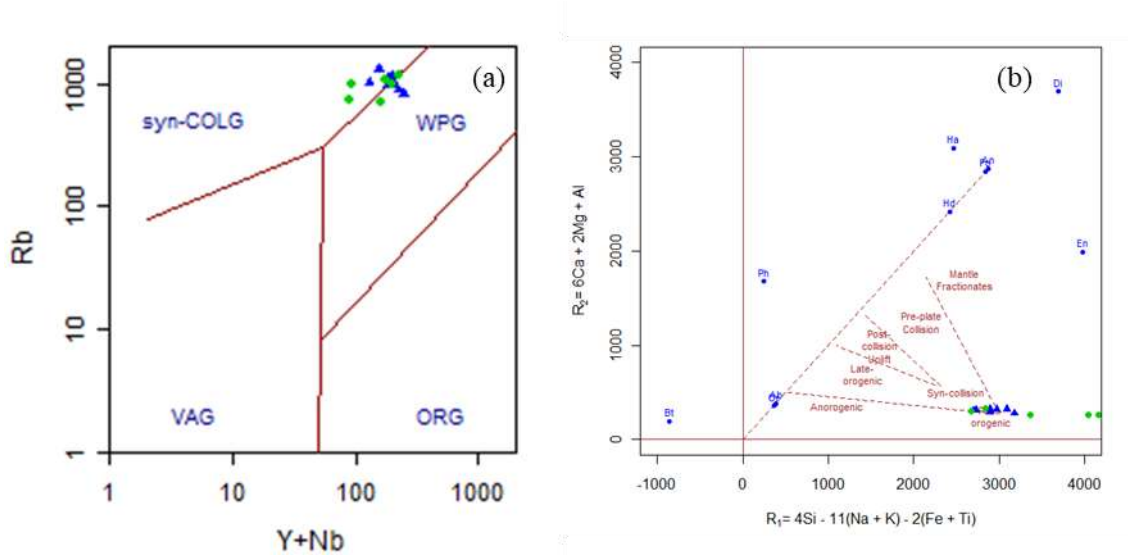

Figure. 7.(a) Rb-(Y+Nb) discrimination diagram (Pearce et al., 1984) (b) R1-R2 diagram (Batchelor & Bowden ,1985) showing the tectonic affinities of Hermyingyi-Taungphila granites

Conclusion

Geochemical signatures of the granites from the Hermyingyi-Taungphila area indicate that the magma is mainly derived from the partial melting of continental crust. The tetrad effect of REE pattern and non-CHARAC trace element behavior indicate Hermyingyi and Taungphila granites are originated from the highly fractionated and highly evolved magmatic systems. The

Hermyingyi-Taungphila granites were emplaced at a syn-collisional setting between Sibumasu and Indian plate during Paleocene.

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PETROGRAPHY AND GEOCHEMISTRY OF VOLCANIC ROCKS IN THE WIN GYI AREA, WUNTHO-BANMAUK GOLD REGION, MYANMAR

Than Tun Win[1], Aung Zaw Myint[2], Htay Win[3]

Abstract

Win Gyi area is located in the south-eastern part of Wuntho Massif and characterized by the lithologic units of (i) plutonic rocks of Kanzachaung Batholith, (ii) volcanic rocks of Mawgyi Volcanics, and (iii) volcanoclastics and volcanic rocks of the Mawlin Formation. Gold mineralization in the study area is mainly confined to the andesitic unit of Mawgyi Volcanics and, hence, we study the petrography and geochemistry of Mawgyi Volcanics to determine petrogenesis and tectonic setting. Mawgyi Volcanics mainly consist of porphyritic andesite and basalts. A geochemical study indicates that the volcanic rocks possess of SiO_2 (48.5- 57.9 %), Na_2O (1.21-6.55%), K_2O (0.13-0.5%), MgO (4.5-7.18%), Fe_2O_3 (9.27-11.2%), and TiO_2 (0.74-1.08%), mostly show calc-alkaline characteristics. Chondrite-normalized REE patterns and primitive mantle-normalized spider diagram reveal that the volcanic rocks are derived from slab-derived fluids, resulting from partial melting of the metasomatized mantle wedge. The volcanic rocks were formed by the subduction of the Neo-Tethyan oceanic lithosphere to the Eurasia plate during Cretaceous.

Keywords: Wuntho-Banmauk segment, Mawgyi Volcanics, Win Gyi area, petrogenesis, tectonic setting

Introduction

Wuntho-Banmauk Gold Region is located in the Popa-Loimye magmatic arc of Myanmar. This region is famous for the Kyaukpazat gold deposit, Shangalon porphyry-like copper-gold deposit, and other gold and copper occurrences. The Win Gyi area is one of the high-grade gold occurrences in the Wuntho-Banmauk Gold Region (Fig. 1). Gold-bearing quartz veins are hosted by the Mawgyi Volcanics. There was no systematic record regarding the geochemical characteristics of the Mawgyi volcanics. Thus, we conduct the petrography and geochemistry of the volcanic rocks of Mawgyi Volcanics to determine their petrogenesis and tectonic setting.

Geological Background

Popa-Loimye magmatic arc is related to the later tectonic events associated with the subduction of the Neo-Tethys oceanic lithosphere (Cobbing et al., 1992; Gardiner et al., 2018). The Popa-Loimye magmatic arc comprises Cretaceous to Oligocene dioritic to granodioritic rocks, Cretaceous to Miocene volcanic rocks, and Quaternary basalts (Gardiner et al., 2018; Mitchell, 2018). Win Gyi area is located in the southeastern part of Wuntho Massif (Noetling, 1894), also known as the Wuntho-Banmauk segment of the Popa-Loimye magmatic arc (Mitchell and McKerrow, 1975). Wuntho-Banmauk segment is built up with (i) plutonic rocks of Kanzachaung Batholith and Pinhinga Plutonic complex, (ii) volcanic and volcanoclastic sediments of Maingthon dacite, Mawlin Formation, Mawgyi Volcanics, and Shwedaung Formation, and (iii) sedimentary units of Kangon Formation, Ketpanda Formation, and Wabo

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Chaung Formation (United Nations, 1979). The origin of Mawgyi Volcanics (105- 93Ma) coincident with the formation of many Neotethyan supra-subduction zone ophiolites and intraoceanic arcs along orogenic strikes in the eastern Mediterranean, Middle East, Pakistan, and Southeast Asia (Zhang et al., 2022).

The geology of the Win Gyi area is represented by the lithologic units of (i) plutonic rocks of Kanzachaung Batholith, (ii) volcanic rocks of Mawgyi Volcanics, and (iii) volcanoclastics and volcanics rocks of Mawlin Formation (Fig. 1). Mawgyi Volcanics are widely exposed in the Win Gyi area.

Analytical Methods

Fifty samples of igneous rocks were collected from the environs of the Win Gyi for petrography and geochemical analysis. Among them, six fresh samples of volcanic rocks are analyzed with X-Ray Fluorescence Spectrometry (XRF) at the Geological Department, Yangon University. At ALS, Australia, five samples are analyzed with Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) for major and minor oxides. Then, four samples are analyzed with Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) for trace elements and Rare Earth Elements. The whole rock geochemical data are listed in Table (1) and (2).

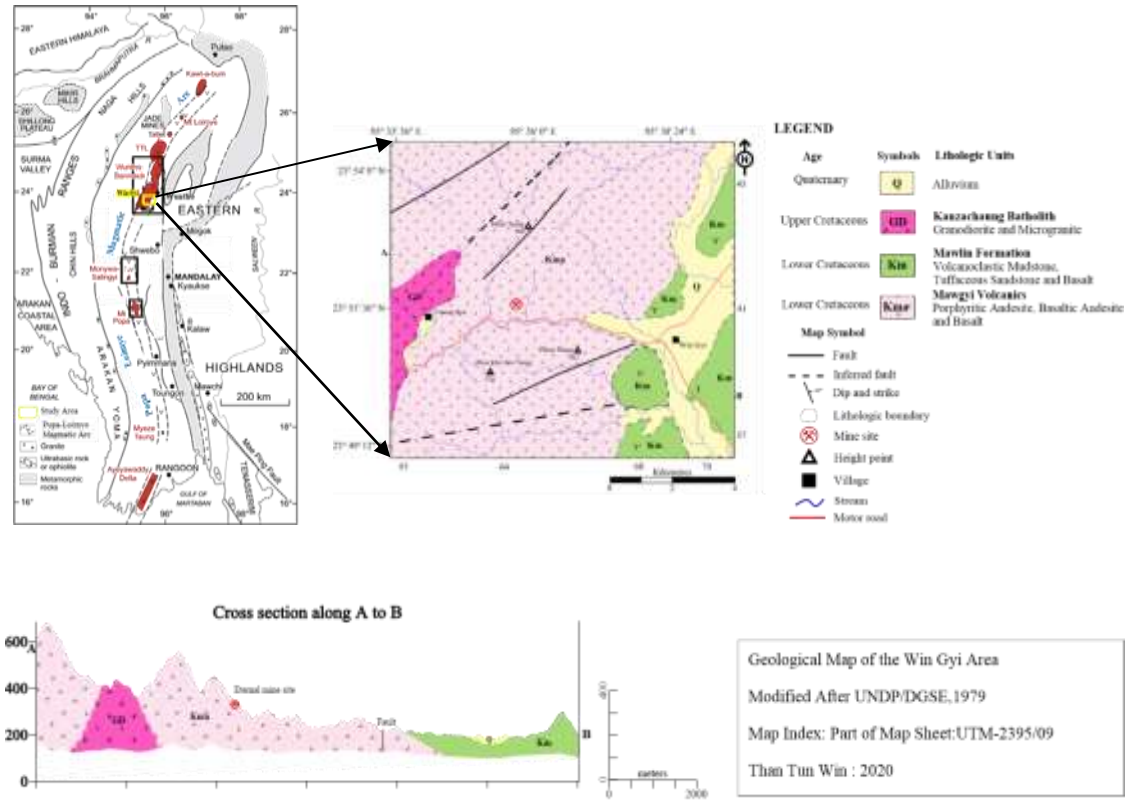

Figure 1 Popa-Loimye magmatic arc, (Mitchell and McKerrow, 1975) and geological map of the study area

Petrography

Porphyritic Andesite

It is well exposed in the north and northeastern part of the study area, displaying dark-brown to light grey, fine-grained, porphyritic, massive, and highly weathered (Fig. 2a). It is composed essentially of feldspar, pyroxene, and hornblende. It comprises 25% of phenocrysts (plagioclase, pyroxene, and quartz) and 75% of groundmass (plagioclase, epidote, and opaque minerals). The penetration-twinned plagioclase phenocrysts, 0.2 to 0.7 mm in diameter, are embedded in the groundmass (Fig. 3a). Alteration minerals are epidote, chlorite, sericite, and actinolite. Some plagioclase phenocrysts are altered partially to sericite. The large phenocryst of euhedral orthopyroxene is altered to strongly pleochroic actinolite, which shows yellowish-green, long prismatic form, and nearly parallel extension (Fig. 3b). Chlorite occurs as radial aggregates (Fig. 3c).

Basalt

It is well exposed in the southern part of the study area (Fig. 2b). It essentially consists of feldspar, pyroxene, and hornblende. It comprises 80% of groundmass (glassy matrix, feldspar laths, pyroxene, and opaque minerals). The plagioclase phenocrysts, 0.3 to 0.5 mm in diameter, are embedded in the groundmass (Fig. 3d). Pyroxene occurs as subhedral to anhedral micro-phenocrysts and high interference color (Fig. 3d &3e). Some plagioclase laths show flow texture (Fig. 3f).

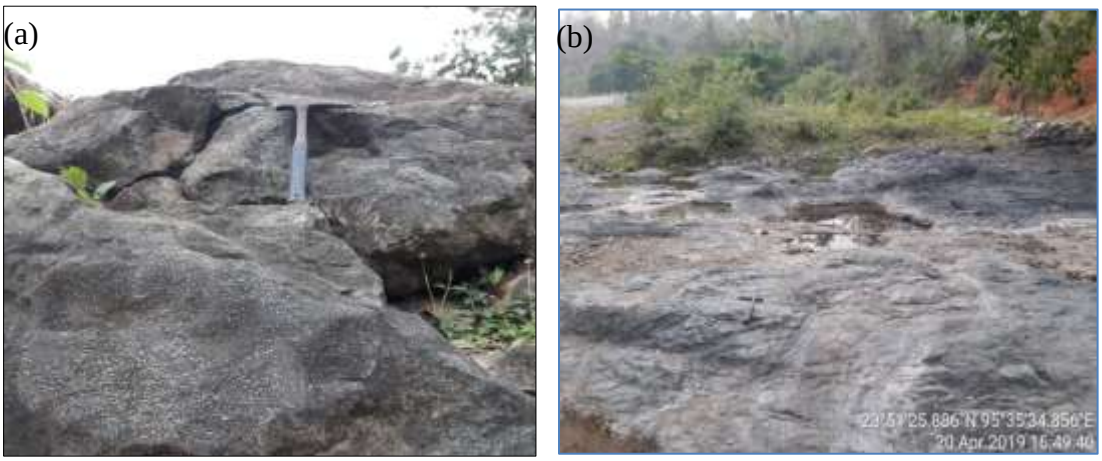

Figure 2 Field exposures of Mawgyi Volcanics (a) Nature of porphyritic andesite exposed near the mine site, (b) Basalt exposed at stream bed of Kyauk Kyi Chaung

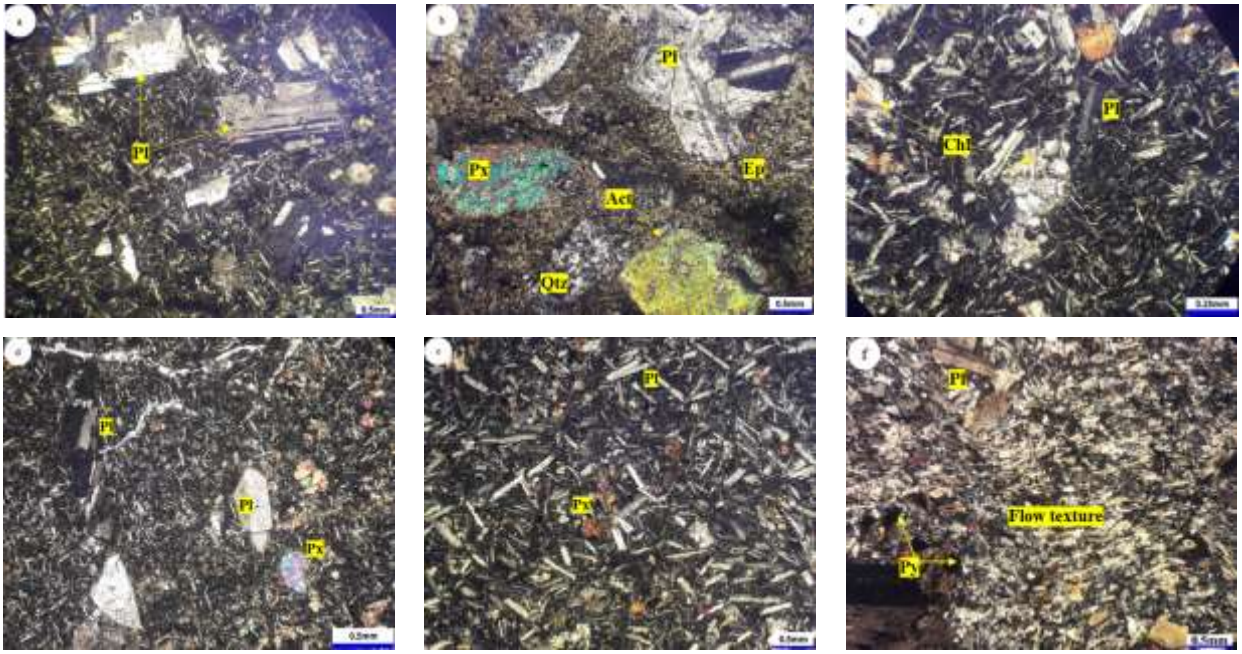

Figure 3 Photomicrographs showing the mineral composition of (a, b, c) Porphytic andesite, (d, e, f) basalt of the Mawgyi Volcanics. Abbreviation; Qtz, quartz; Pl, plagioclase; Or, orthoclase; Bt, biotite; Hb, hornblende; Ep, epidote; Act, actinolite; Px, pyroxene; Chl, chlorite; Py, pyrite

Geochemical Characteristics

Major Elements Geochemistry

The chemical composition of Mawgyi volcanics show SiO_2 (48.5- 57.9 %), Al_2O_3 (15.6-18.6%), Na_2O (1.21-6.55%), K_2O (0.13-0.5%), CaO (3.7-9.35%), MgO (4.5-7.18%), MnO (0.18-0.74%), Fe_2O_3 (9.27-11.2%), and TiO_2 (0.74-1.08%). The abundances of Al_2O_3, Fe_2O_3, and MgO are negatively correlated with the value of SiO_2. CaO, Na_2O, and K_2O do not markedly increase with SiO_2, and TiO_2 is slightly positively correlated with SiO_2. All volcanic samples belong to the basalt, basaltic andesite, andesite, and basaltic trachy andesite (mugearite). Most of the samples show a subalkaline/ tholeiitic nature (Fig. 4a). The volcanic rocks are better classified using the AFM diagram of (Irvine and Baragar, 1971) shown in figure (4c) within the field of calc-alkaline series except for three samples that fall in the tholeiitic series.

Table (1) Major elements (wt %) concentration in the volcanic rocks of Win Gyi area

Method	**ICP-OES**					**XRF**					
Sample No	**E-002**	**E-065**	**E-066**	**E-068**	**E-089**	**E-067**	**WG-002**	**WG-003**	**WG-018**	**LPK-4**	**WG-001**
SiO_2	50.9	51	54	54.2	48.5	48.8	53.7	53.6	55.5	53.2	57.9
Al_2O_3	16.95	18.6	15.65	15.6	17.8	15.8	16.1	16.1	16.2	17.3	17.4
Fe_2O_3	9.38	10.25	12.2	10.85	11	12.5	10.1	11.2	8.49	9.27	10.1
CaO	4.45	7.76	4.62	3.7	9.35	6.44	5.29	7.11	12.9	14.4	5.25
MgO	5.6	6.23	4.96	4.73	5.01	7.53	7.18	6.96	4.5	4.72	5.03
Na_2O	5.19	4.55	5.01	6.55	3.91	1.54	2.85	1.63	5.69	1.21	2.31
K_2O_3	0.49	0.13	0.2	0.09	0.22	0.45	0.57	0.186	0.49	0.335	0.4
TiO_2	0.79	0.73	0.97	0.74	1.08	1.16	1	1.05	0.992	0.98	1.61
MnO	0.18	0.18	0.2	0.2	0.25	0.73	0.141	0.209	0.063	0.097	0.34
P_2O_5	0.09	0.06	0.13	0.05	0.14	0	0	0	0	0	0
LOI	3.7	1.7	2.62	1.98	1.03	0	0	0	0	0	0
Total	97.72	101.2	100.56	98.69	98.3	95	96.931	98.045	104.825	101.5	100.34

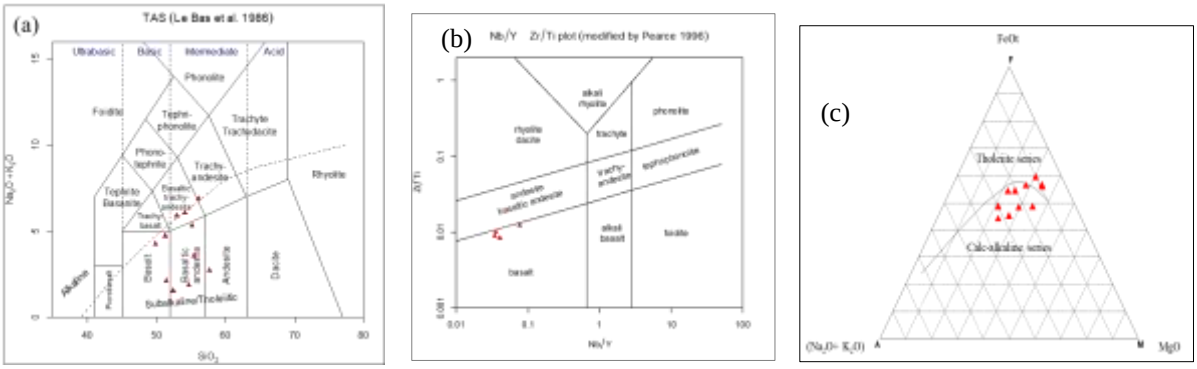

Figure 4 (a) TAS (total alkalis ($Na_2O + K_2O$) and silica (SiO_2)), diagram (Le Bas et al, 1986),
(b) Nb/Y vs. Zr/Ti variation diagram (Winchester & Floyd, 1977; Pearce, 1996),
(c) AFM diagram (Irvine and Baragar, 1971) for the volcanic rocks of the Win Gyi area

Table (2) Abundances of trace and rare earth elements in the Mawgyi Volcanics

Sample	Ba	Ce	Cr	Cs	Dy	Er	Eu	Ga	Gd	Hf	Ho	La	Lu	Nb	Nd	Pr	Rb	Sm	Sn	Sr	Ta	Tb	Th	Tm	U	V	W	Y	Yb	Zr	Yt
E-002	47	16	70	0.27	4.56	2.9	0.78	12.8	4.01	2.01	0.95	5.7	0.46	1.8	10.3	2.86	5.2	3.04	1	158	0.8	0.68	1.31	0.43	2	272	8	23.6	2.48	58	1
E-065	32	7.7	90	0.63	2.91	1.9	0.65	15.6	2.47	1.2	0.64	3.2	0.28	0.6	5.8	1.2	2	1.88	1	128	0.1	0.43	0.7	0.3	0.19	360	4	17.4	1.83	39	12
E-066	40	11	50	0.28	4.26	2.83	0.92	16.8	3.6	1.9	0.95	4.4	0.4	0.8	8.6	1.72	5.5	2.62	1	187	0.2	0.66	0.93	0.39	0.3	378	2	22.5	2.52	58	22
E-068	45	5.8	40	0.17	2.84	1.9	0.77	12.2	2.46	1.1	0.63	2.1	0.25	0.6	4.9	0.88	1.3	1.84	1	112	0.1	0.42	0.33	0.25	0.08	349	4	14.8	1.71	37	29

Trace and Rare Earth Elements Geochemistry

Nb/Y vs. Zr/Ti diagram indicates that volcanics are mainly basaltic composition (Fig. 4b). The degree of fractionation of an REE pattern can be expressed by the ratio of the normalized concentration of a light REE (La or Ce) divided by the normalized concentration of a heavy REE such as (Yb) or the trace element (Y). The ratio of the HREE (Yb) divided by the LREE (La) would be a good indicator of the slope of the REE diagram. Volcanic samples display slight enrichments of light rare earth element (LREE) with $(La/Yb)_N$ ratios of (0.99–1.16) and $(La/Sm)_N$ ratio of (0.8-1.17). The $(Tb/Yb)_N$ ratios (1-1.16) show slight fractionation of HREE. The Eu anomalies (Eu/Eu* = 0.66–1.18) show weakly negative and positive anomalies (Fig. 5a). Primitive mantle-normalized spider diagram of Mawgyi volcanics shows high Ba/Th values (36.18 - 45.3), high Ba/La ratios (8.32-21.33), and low Th/Nb ratios (0.55-1.17) (Fig. 5b).

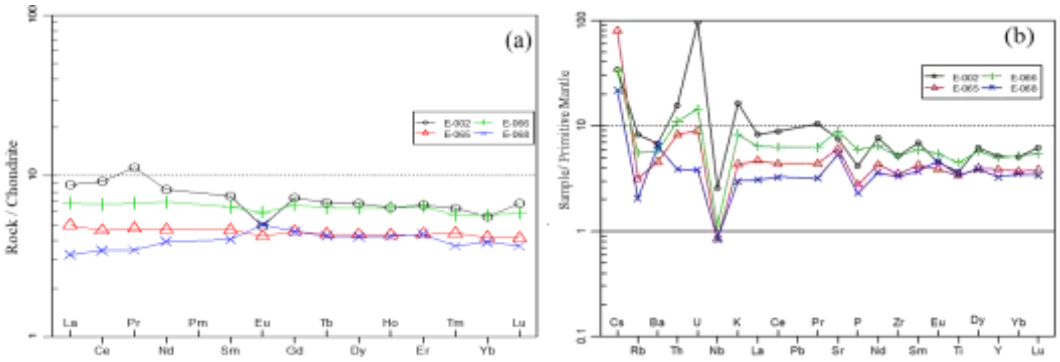

Figure 5 (a) Chondrite normalized REE diagram (Sun and McDonough, 1995) and, (b) Primitive mantle-normalized spider diagram (Sun and McDonough, 1989) of Mawgyi Volcanics

Discussion

Petrogenesis

Volcanics rocks from the Win Gyi area contain MgO (4.5-7.53 wt%), Cr of (40-90 ppm), and Ni (0.00-29.2 ppm) that are lower than the values of mantle-derived primary melts (i.e., MgO > 8 wt%, Cr > 1000 ppm, and Ni > 400 ppm; Best, 2003). The Mawgyi Volcanics display a slight variation from andesitic to basaltic composition. They mostly belong to the medium-K, calc-alkaline series with a few plotting in the tholeiite field. In the REE spider diagram, the HREE portion of all the curves is shown relatively flat indicating no relation with deep fractionation processes. The LREE-enriched patterns with weakly negative Eu anomalies resemble subduction-related aqueous fluids or melts (Pearce et al., 1992, Pearce and Peate, 1995). Primitive mantle-normalized spider diagram shows enrichments in LILE (Cs, K, and Sr) and depletion of HFSE (Nb, P) are compatible with arc-type magmas and their mantle sources were likely affected by slab-derived fluids/melts (Hawkesworth et al. 1993; Pearce and Peate 1995). High Ba/Th (36.18-45.3) values, high Ba/La (8.32-21.33), and low Th/Nb (0.55-1.17) ratio indicate their mantle sources were mainly metasomatized by the slab-derived fluids (Hawkesworth et al. 1993; Pearce and Peate 1995; Kesselet al. 2005). In addition, high Ba/Th values indicate the addition of hydrous fluids from shallow levels of subducted oceanic crust (Elliot, 2003). Thus, the Mawgyi volcanics were likely formed by the magma generated from the slab-derived fluids, which may be mixed with hydrous fluids.

Tectonic Setting

According to the triangular plot of Zr/4, 2×Nb, and Y (Meschede, 1986), the volcanic rocks from the study area fall within the N-type MORB and volcanic arc basalts field (Fig. 6a). By using Cr versus Y plot (Pearce, 1996), volcanic samples of the study area are located in the volcanic arc basalt (VAB) field (Fig. 6c). The Nb/Yb versus Th/Yb diagram (Dilek and Furnes, 2011) diagram shows Mawgyi Volcanics fell within the field of oceanic arc (Fig. 6b).

Based on the geochemical data, the parent magma of the volcanic rocks was generated from a subduction-related fluid metasomatized mantle source. It was probably related to the high-angle subduction of the Neo-Tethyan oceanic lithosphere to the Eurasia plate.

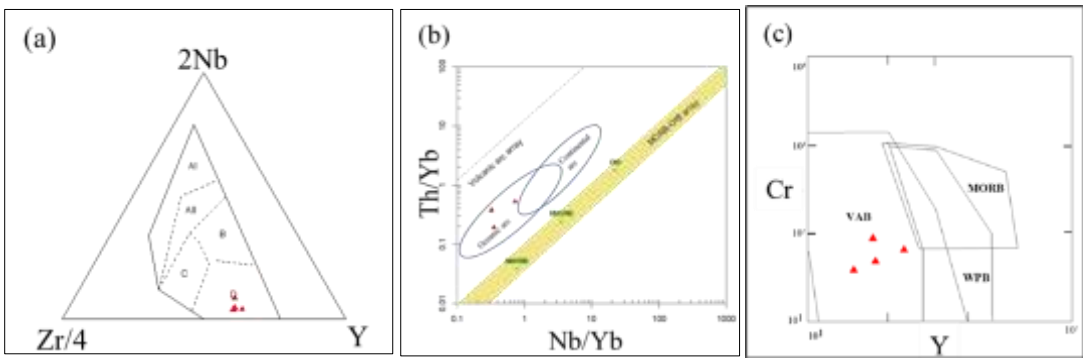

Figure 6 (a) Zr-Nb-Y diagram for basalts, (Meschede, 1986), (b) oceanic arc and continental crust (Dilek and Furnes, 2011), (c) Cr-Y discrimination diagram for basalts (Pearce, 1996)

Conclusions

A combination of petrographic study and geochemical data indicate that the volcanic rocks of the Mawgyi Volcanics have a slight variation in composition, ranging from basalt to andesite. Chondrite-normalized REE patterns and primitive mantle-normalized spider diagram reveal that the volcanic rocks are derived from partial melting of the metasomatized mantle wedge by slab-derived fluids. The present study suggests volcanic rocks are likely related to the subduction of the Neo-Tethyan oceanic lithosphere to the Eurasia plate during the Cretaceous (~110-90 Ma).

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GEOLOGY AND GOLD MINERALIZATION AT THE SHWEGYAUNG – MANKAT AREA, SOUTHWESTERN PART OF BANMAUK TOWNSHIP, SAGAING REGION, UPPER MYANMAR

Lwin Ko Zin Win[1], Moe Min Soe[2]

Abstract

The Shwegyaung-Mankat area is situated within Banmauk Township, Katha District, Sagaing Region. It is involved Wuntho Massif Uplift bordered on the west by Chindwin Basin and on the east by Sagaing Fault. The geology of this area is predominantly occupied by Hpyu Taung Metamorphics, Shwedaung Formation, Mawgyi Andesite, Mawlin Formation, Kanza Chaung Batholith Group, and Wabo Formation. Gold mineralization associated with volcanoclastic rocks of Lower Cretaceous, mineralized quartz veins in fracture zone of Hpyu Taung Metamorphics, and intrusive rocks of Kanza Chaung Batholith Group. Gold-bearing quartz veins from the research area are characterized by sheeted veins, massive, veinlets and fracture-filling textures. Base on geological setting, structure control, alteration minerals, hosted rock and mineralization style, the research area is expected to be epithermal related low-sulfidation gold mineralization. Mineralized quartz veins hosted in Mesozoic age of volcanic, metamorphic, and intrusive rocks. Evidence of mineralized veins structure and ore texture, the mineralization style of research area is considered to be low-sulfidation epithermal deposit. The age of mineralization is probably post Paleozoic time.

Keywords: Mawgyi Andesite, Hpyu Taung Metamorphics, Kanza Chaung Batholith, Epithermal, Low-sulfidation, Gold mineralization

Introduction

Location, Size and Accessibility

Shwegyaung-Mankat area is situated within Banmauk Township, Katha District, Sagaing Region in northern Myanmar. It lies about 4 km southwestern part of Banmauk Town and falls in topographic maps index no. 83-P/15 and 83-P/16 on a scale 1 inch to 1 mile (1 : 63360). It is bounded by Latitude 24º 11′ 29" to 24º 24′ 33" N, and Longitude 95º 46′ 33" to 95º 54′ 29" E. The area covers approximately 264 square kilometers in extent.

In this area can be reached directly using Mandalay-Myitkyina motor road and railway line, transit of Indaw to Banmauk Townships (Fig-1).

Materials and Methods

The research work was conducted using the following instruments; One inch topographic map references, Aerial photographs, Landsat TM images, Brunton compass, Geological hammer, G.P.S, Stereoscope, Tape, Digital camera and Computer.

Tape and Compass Traverse method was applied in the field. The data measured was plotted in the field on base map sheet. Representative samples were collected by using the G.P.S and Geological hammer. Recording detail locations and lithology in the field notes and taking the photos. Slope and other geological structures were measured by Brunton compass.

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Regional Geology

Regional geologic setting

Regionally, the present research area is covered with the Mesozoic and Cenozoic rock units ranging from Pre-Upper Triassic to Post-Oligocene in age. In this area, the Mesozoic and Cenozoic rock units are extensively exposed (Fig-2).

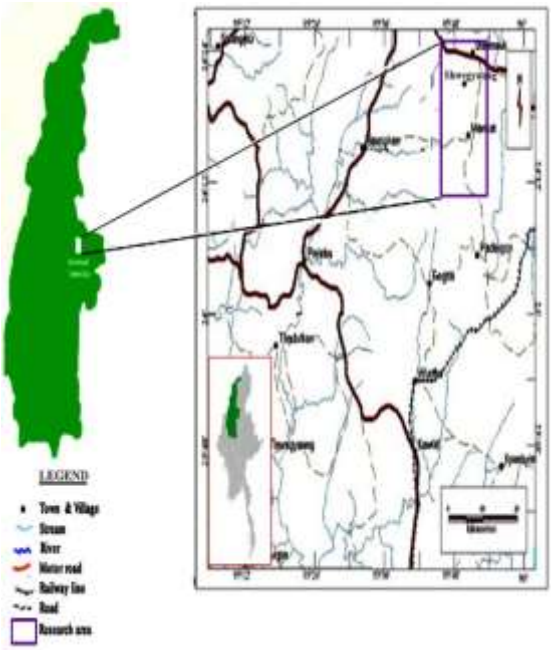


Figure: (1) Location and accessibility map of research area

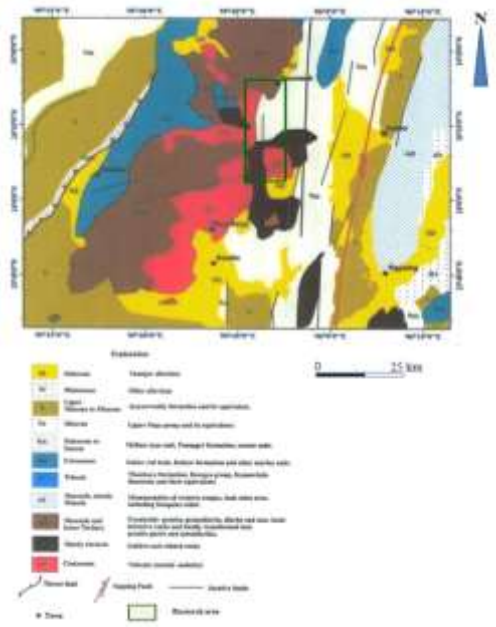


Figure: (2) Regional geological map of research area (MGS, 2014)

Area Geology

During the field works, (114) samples of rock and ore were collected from the research area for various observations and analysis in laboratory, (48) samples of rock and (66) samples of ore were collected for petrographic study as well as geochemical analysis, (34) mineral samples from mineralized quartz veins, and (16) samples of altered wallrock were collected for petrographic study. There are (22) samples of rock from the shear zones of andesite, dacite, diorite and granodiorite were also collected for petrographic study.

Stratigraphy

Stratigraphically, the research area consists of rock units ranging from Pre-Upper Triassic to Quaternary in age. Investigated area is mainly composed of the succession of seven stratigraphic rock units. This seven stratigraphic rock units from oldest to youngest are described in table (1).

The research area is mainly composed of volcanic rock unit, andesite, locally called Mawgyi Andesite (Lower Cretaceous), plutonic rock unit of Diorite in Kanza Chaung Batholith Group (Upper Cretaceous) and sedimentary rock unit of Wabo Formation (Oligocene to Miocene).

Distribution of major rock units

Regionally, the Mesozoic and Cenozoic rocks are exposed in present research area (Fig-3).

Table (1): Stratigraphic succession of rock sequences exposed on the research area (After UNDP, 1979)

Rock Sequence	Age
Alluvium	Quaternary
^^^^^^^^^^^^^^^^^^^^	
Wabo Formation	Oligocene to Miocene
^^^^^^^^^^^^^^^^^^^^	
Kanza Chaung Batholith Group	Upper Cretaceous
Mawlin Formation	Lower Cretaceous
Mawgyi Andesite	Lower Cretaceous
^^^^^^^^^^^^^^^^^^^^	
Shwedaung Formation	Upper Triassic
Hpyu Taung Metamorphics	Pre-Upper Triassic

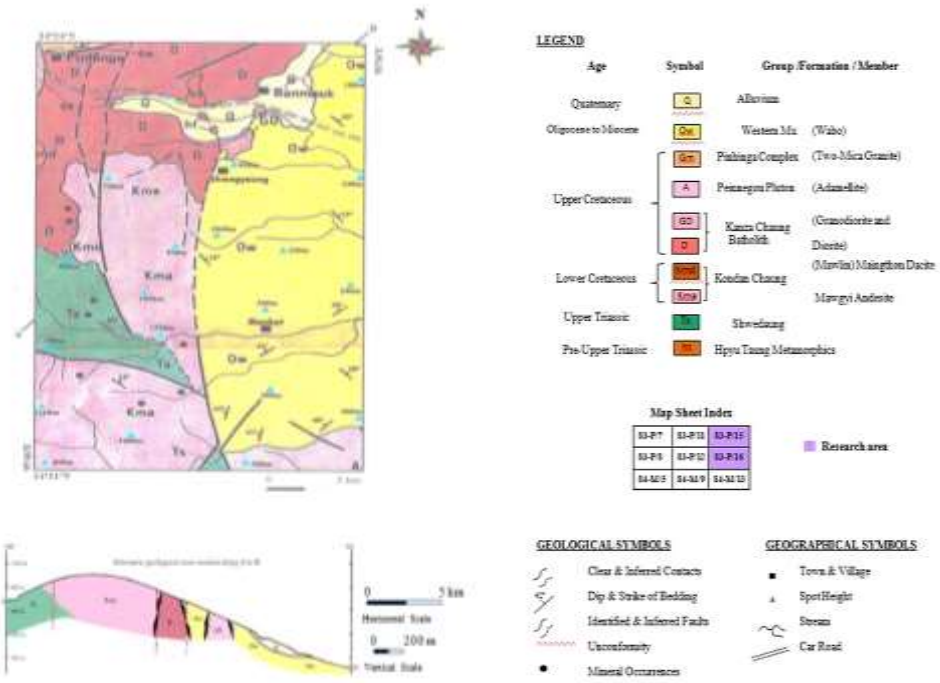


Figure: (3) Geological map and cross-section of research area (Lwin Ko Zin Win, 2023)

Geological structure

The research area lies between Wuntho Massif at the west and still active Sagaing Fault at the east. So, the geological structures of this area is very complex. Mainly, attitude of beds, fold, fault, foliation, joint and unconformity can be found as the geological structures.

Fold

There are no major anticlinal and synclinal folds in the research area. However, small scale minor contoured folds and drag fold in the schist (Fig-4).

Fault

Nankan-Banmauk valley is a fault trough controlled by two major faults as Taungchaung Fault on the east, and Chutkon-Legyin Fault on the west. Gold deposits are related by fault system. Mineralizations of Banmauk area generally occur as N-S, NNW-SSE and E-W trend (Fig-5).

Figure: (4) Minor contoured fold in the quartz schist

Figure: (6) Base-metals mineralizaiton in Kanza Chaung Batholith Group

Mineralization

Host lithology

Gold mineralization is confined with the andesite, schist and diorite rocks, and veins are mostly of fissure-fillings type. The mineralization trend NNW to SSE direction, and the dips are almost vertical. This veins thickness are varies from 10 to 350 mm. Gold ore deposits in research area are hosted in the Kanza Chaung Batholith (Wuntho Massif). The mineralized gold veins are predominantly occur hosted in andesite and diorite body. In many places, the veins are follow fracture-filling textures. Some mineralized quartz viens are recognized in the fracture zone of metamorphic rocks and diorite body. Auriferous quartz veins are found as the fracture-filling textures in diorite body. In research area, the quartz gold veins are injected into the andesite and diorite bodies as hydrothermal breccia and fracture-filling form. Generally, gold and base-metals mineralizaiton are mainly found in andesite and diorite occur along the faulted contact zone and dipping of fault is N 70º E (Fig-6).

Gold mineralization in Wuntho district

The gold mineralization in Wuntho district is largely confined to the Banmauk-Wuntho inlier. Here, it is found principally as Au-bearing quartz veins (or) Quartz-carbonate veins, which are exploited in small scale mines at gold grades of 20 to 100 g/ton Au (Mitchell et al., 1999), and lie within the Upper Cretaceous granodiorite locally extending into the schist and volcanic country rocks (United Nations, 1978 and Khin Zaw, 1990). Similar gold veins are also found father north in the Mabein district within Tagaung-Myitkyina Belt, and here Mitchell et al.

(1999) make reference to the epithermal Au-bearing veins are found within strongly silicified host rocks of Upper Oligocene to Lower Miocene mudsone and sandstone. Low-sulfidation epithermal gold quartz veins are also reported from the south of Shangalon (Ohn Thwin, 2004).

Gold mineralization in Shwegyaung-Mankat area

The research area have five prospects. In these prospects are mainly used underground mining method (adit, inclined and vertical shaft). They are Kanbat (KB) and Legyin (LG) adits, Thahtaymaw (THM) and Nansamsar (NSS) inclined, and Shwekyin (SK) shafts. The total depth of KB-1 adit is approximately 760 m and KB-2 adit is about 160 m from mine portal which locates 680 and 720 m above from the sea level. The main adit is 225º trend. In these adits, gold-bearing quartz vein generally N-S and NE-SW dipping. Gold-bearing quartz vein is hosted in andesite. The total depth of THM inclined is approximately 850 m and NSS-2 inclined is about 140 m from the mine portal which locates 430 and 350 m above from sea level, which inclined to 305° trend. In these inclined, gold-bearing quartz is hosted in the contact between mudstone and andesite can be observed at 25 m. Gold-bearing quartz vein is hosted in andesite. The total depth of SK-1 and 2 shafts are approximately 500 m from the mine portal which locates 770 m above from sea level. This prospect has four levels, in each level spacing nearly 130 m from the mine portal. In this prospect, gold mineralization is mainly hosted by andesite. The gold-bearing quartz veins trend nearly N-S with steep dipping 50º to 60º and thickness is about 0.1 to 1.5 m (Fig-7).

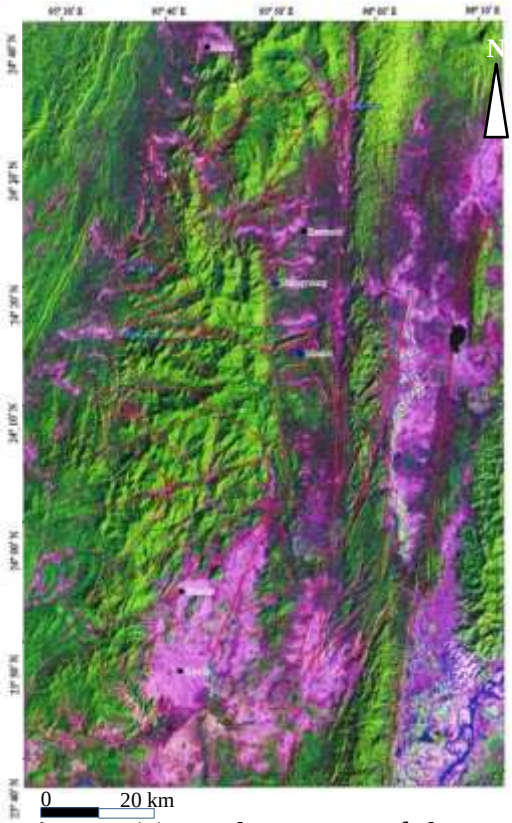
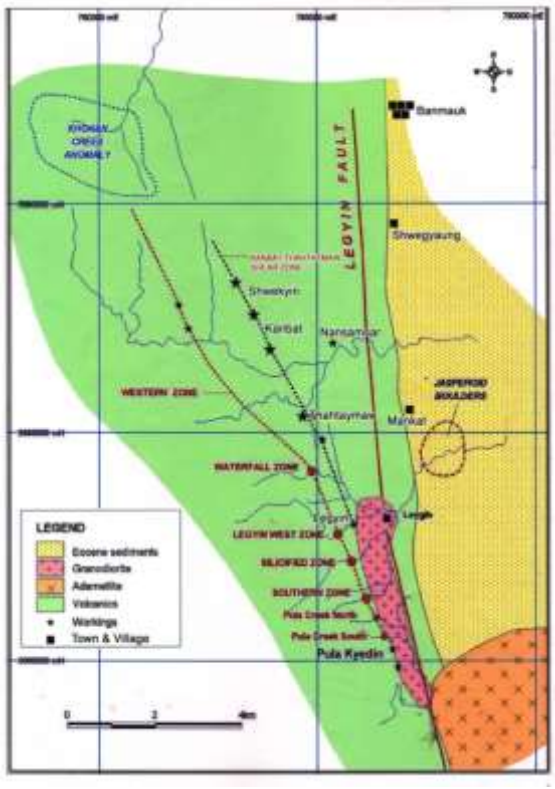


Figure: (5) Landsat image of the research showing area and its environ



Figgure: (7) Plan view map of research area geology and main prospects (Lwin KoZin Win, 2023)

Gold mineralization of the research area is characterized by sheeted vein, stockwork, massive and small veinlets. Mostly, mineralized veins are occurred along the fault and breccia zones. The vein trends have two directions: nearly N-S direction, and NNW-SSE direction. According to the field observation, the mineralization gold-bearing quartz veins are massive,

sheeted, veinlets and fracture-filling types. The thickness of vein is 0.1 to 0.5 m (Fig- 8 a, b, c, d), (Fig- 9 a, b, c, d, e, f) and (Fig- 10 a, b, c, d).

There are two mineralization zones of gold-bearing massive quartz vein occur in this research area. They are - (1) Massive quartz veins occur in Kanbat adit. It is trending NW-SE, and its dipping ranges from 38º to 65º. The thickness of vein is 0.12 to 0.3 m, and (2) Stockwork form and quartz veinlets are occur in Shwekyin worksite. It is nearly N-S trending, and its dipping ranges from 55º to 59º. The thickness of vein is 0.15 m (Fig- 11 and 12).


Figure: (8 a and b) Massive quartz vein underground adit in Kanbat mine (1)


Figure: (8 c and d) Shear plane and breccia zone of underground adit in Nansamsar mine (2)



Figure: (9 a, b, c and d) Massive and laminated quartz vein in gold-bearing quartz vein of underground adit in Thahtaymaw mine


Figure: (9 e and f) Small quartz veins are inclining various angle


Figure: (10 a and b) Massive and laminated quartz vein in Shwekyin prospet (1)


Figure: (10 c and d) Gold-bearing quartz vein of underground adit in Shwekyin prospet (2)

Figure: (11) Massive quartz vein occur in Kanbat range

Figure: (12) Massive form and quartz veinlets occur in Shwekyin

Ore Samples were collected from many worksites of the research area, which is vertical pit (or) shaft, inclined and aditing by the timbering supported. In this research area, gold mineralization occurs in two settings. They are - (1) Massive vein type gold-bearing quartz vein hosted in andesite, and (2) Stockwork type gold-bearing quartz located in diorite shows the nature of mineralized quartz veins occur in research area (Fig- 13 a, b, c and d).

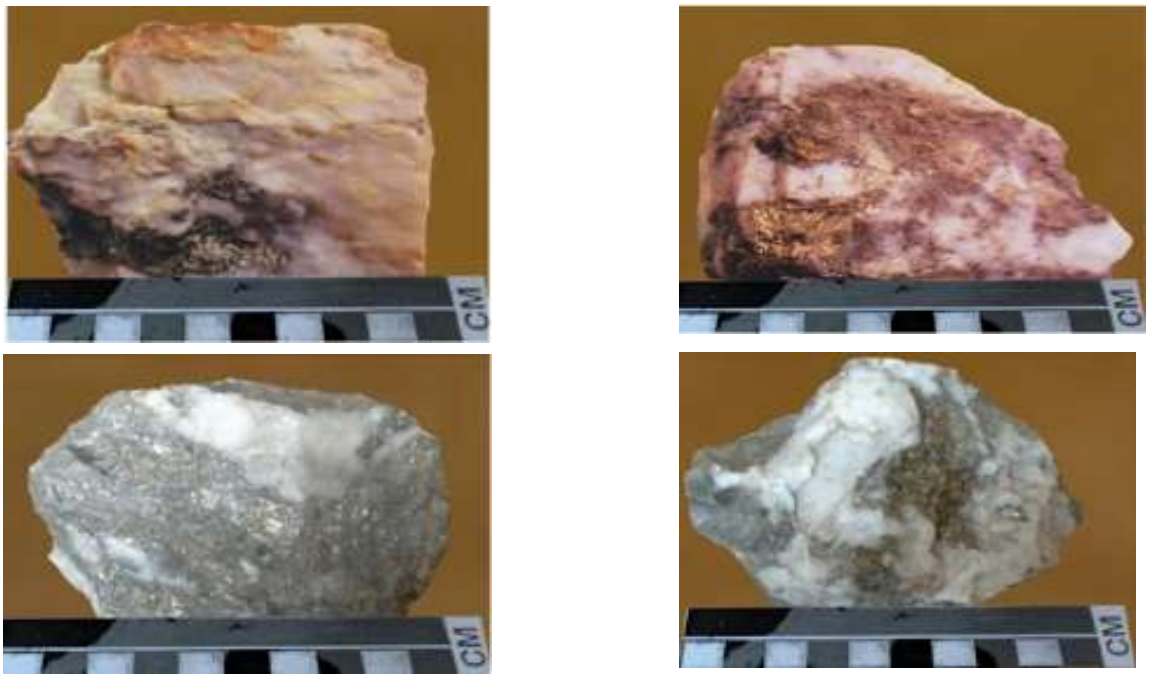


Figure: (13 a, b, c and d) Nature of gold mineralized quartz veins in research area

Figure: (14 a, b, c and d) Nature of gold-bearing quartz veins occur in andesite

The field study and microscopic examination of research area show that the rocks are moderate to intensely alter. In some samples, the alteration is highly intense that primary textures have been destroyed and the original lithology cannot be determined. Strongly altered rocks are adjacent to auriferous quartz veins are typically enriched in the sulfide minerals. The hypogene sulfide minerals are pyrite and chalcopyrite. It is possible sources of mineralization associated with the hydrothermal fluids in this area (Fig- 14 a, b, c and d).

Results and Discussions

Lithologic control

The mineralization zone occurs in volcanic rock of the andesite, metamorphic rock of the schist, and plutonic rock of the diorite. These rocks are often occur strongly altered near the fault zone, and gold-bearing quartz vein occur as the stockwork, sheeted, massive and small veinlets. The intrusive bodies may be carried up the heat source of hydrothermal fluids along the fracture. The quartz vein is giving a variable thickness, from as little as 0.05 m and as much as 0.3 m. Immediately, near surrounding the quartz vein, host rock is strongly altered with localized the chlorite development. Brecciation and fracturing of the host rocks are ground preparation for quartz vein associated with the gold deposition.

Structure control

The research area is situated between Sagaing Fault to the east and Wuntho Uplift to the west, the various deformations and magmatism has subjected to the rocks. There are two mineralization zones of gold-bearing massive quartz veins occur in research area. Mineralized zone lies within along the major fault zone, and gold content is rich in the shear zone between quartz veins and host rocks. It is suggested that time of mineralization approached to the development of intrusion related and this area can be more favorable to development the fracture zone.

Possible age of mineralization

This research area is located between Sagaing Fault to the east, and Wuntho Uplift to the west. The possible age of mineralization is mainly noticed the two points. They are- lithologic and structural controls. The mineralized quartz veins are mainly hosted in Mesozoic age of volcanic rock (Lower Cretaceous andesite), metamorphic rock (Pre-Upper Triassic schist), and intrusive rock (Upper Cretaceous diorite). They are considered to be found together as the hydrothermal process. According to the veins type, ore texture, major fault trending system, age of mineralized host rocks, and style of mineralization is probably later than the hosted rocks.

Therefore, the age of mineralization in Shwegyaung-Mankat area is probably post Paleozoic time.

Type of mineralization

The type of mineralization of research area is based on the geological setting, structure control, alteration minerals assemblage, hosted rock and mineralization style. The research area is expected to be many features typical of epithermal related low-sulfidation gold mineralization.

Conclusion

Shwegyaung-Mankat area is located about 4 km southwestern part of Banmauk Township, Katha District, Sagaing Region. The research area lies in northern continuation part of the Wuntho Massif and it is the northern segment of CVL so called Inner Volcanic Arc. Wuntho Massif lies in the Inner Burman Tertiary Basin (Central zone) which is one of the major geotectonic units of Myanmar.

Geologically, this research area is occupied by Hpyu Taung Metamorphics, Shwedaung Formation, Mawgyi Andesite, Mawlin Formation, Kanza Chaung Batholith Group, and Wabo Formation. According to the field observation, megascopic and microscopic studies, and XRF analysis, the rock units can be classified as andesite, dacite, diorite and granodiorite. Gold mineralization associated with volcanoclastic rocks of Lower Cretaceous, mineralized quartz veins in fracture zone of Hpyu Taung Metamorphics (quartz schist), and intrusive rocks of Kanza Chaung Batholith Group.

Gold-bearing quartz veins are characterized by sheeted veins, stockwork, massive, small veinlets and fracture-filling types. Mineralized quartz veins are mainly occurred along the fault and breccia zones. The vein trends have two directions are nearly N-S and NNW-SSE directions. There are two mineralization zones of gold-bearing massive quartz vein; (1) Massive quartz vein occur in Kanbat adit. It is trending NW-SE, and its dipping ranges from 38º to 65º. The thickness of vein is 0.12 to 0.3 m, and (2) Stockwork form and quartz veinlets occur in Shwekyin worksite. It is nearly N-S trending, and its dipping ranges from 55º to 59º. The thickness of vein is 0.15 m.

Type of mineralization of research area is based on the geological setting, structure control, alteration minerals assemblage, hosted rock and mineralization style. The research area is expected to be low-sulfidation epithermal deposits gold mineralization. Mineralized quartz veins are mainly hosted in andesite, schist, and diorite rocks. The veins type, ore texture and style of mineralization in Shwegyaung-Mankat area is probably later than the hosted rocks. Therefore, the age of mineralization is probably post Paleozoic time. Evidence of mineralized veins structure and ore texture, the mineralization style of research area is considered to be low-sulfidation epithermal deposits. It can be concluded that economic potential of minerals cannot be evaluated in this stage because of the lack of drill hole data.

Acknowledgements

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CHEMICAL ANALYSIS OF GROUNDWATER FOR DOMESTIC USES AND IRRIGATION WATER IN BAGO TOWNSHIP, BAGO REGION

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Abstract

The research area, Bago is situated on the Eastern Part of the Bago Yoma. The topography of the research area is slight moderate plain and its gently slope towards the east. This area is about 228.712 square kilometer. The sources of water supply are water from tube well and reservoir. The main aquifer in western part is Irrawaddy Formation and in the eastern part it is Alluvial Aquifer. The yield of Irrawaddy is 500 to 2000 gallons per hour. pH falls between 6.5 to 7.7. TDS falls in 50-340 ppm. Total salinity is low and electrical conductivity (E.C) is always not more than 530 μ mho/cm. Iron content is rising up to 3 ppm. The results analyzed by KURLOV'S METHOD, SSP% method, SAR method MAR method, RSBC method, TDS and PIPER method can be classified the water types, drinking water, domestic use and Irrigation water. According to the above these methods and WHO Drinking Water Standard, the groundwater of the research area is suitable for the drinking water, domestic uses and Irrigation water.

Keywords: pH, TDS, groundwater, SAR method and PIPER method

Introduction

The research area is lying about 10 m to 20 m above sea level. Population of Bago City is dense. The population is about 435,000 (census 2019). It lies on the bank of the Bago River. The city area is situated bank of the Bago River and the eastern extremity of the Bago Yoma.

Location and Size

Bago Township is situated in the southern part of the Bago Region. The research area lies between North Latitudes 17° 25' 00" to 16°35' 30"and East Longitudes 96° 25' 00" to 96° 32' 00". The area coverage is about 228.712 km^2 (figure 1).

Purpose of Research

The purpose of research includes the following:

(1) To obtain groundwater that is truly representative of the geologic formation.
(2) To investigate the chemical quality of the water.
(3) To research the characteristics of aquifer based on aquifer function.

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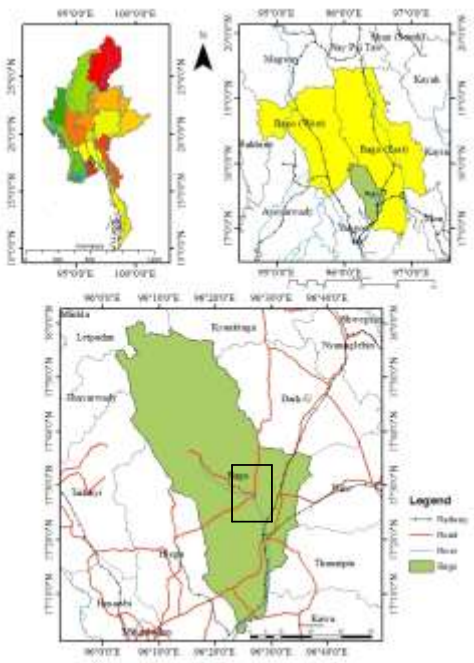


Figure (1) Location map of the research area

Methods of Research

Before commencement of the field work, the author visits to exit wells gathering of available data, such as relevant, topographic maps, meteorological data and chemical data of groundwater in research area. These collected data are examined systematically and then they are reviewed and analyzed in the Water Resources Utilization Department in Yangon. During the field, the measurements of water level, well depth, the position of wells by G.P.S are made.

Topography

The research area is located at the East of the Pegu Yoma anticline where Miocene to Pliocene rocks crop out. The research area is an elevation of between 30-60 feet above sea level. The research area is bounded by Waw, Payagyi, Daike-U, Hlegu and Tanatpin townships. The research area is sloping to the gently east. The eastern parts of the research area are the tidal affected area.

Drainage

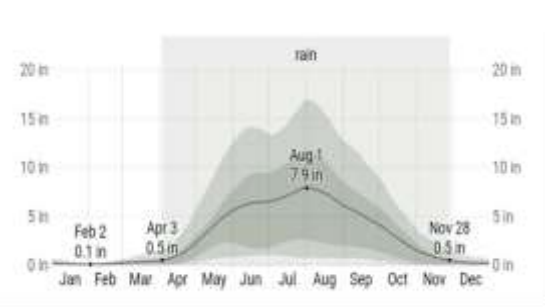
Tidal action also takes place in the stream channel in the eastern part of the area. The main river is the Bago River. The drainage pattern of the area is coarse dendritic or tree-like pattern (figure 2). Drainage pattern is important because the part of the drainage pattern indicate changes in under groundwater condition, type of rock and geologic structure.

Climate

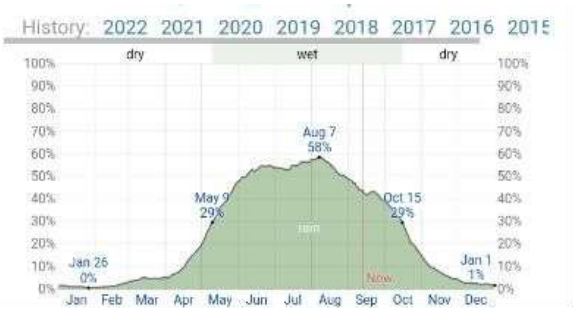
The research area, the wet season is oppressive and overcast, the dry season is muggy and partly cloudy and it is hot year-round. Over the course of the year, the temperature typically varies from 64°F to 100°F. Bago experiences extreme seasonal variation in monthly rainfall. The rainy period of the year lasts for 7.8 months from April to November, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Bago in August with an average rainfall of 7.4 inches. It receives more than 126 inches of rain per annum. When the temperature

is high; there is more evaporation and transpiration which reduces the amount of water in the river. The data recorded from the Kaba-Aye Meteorological Station. The weather graphs are shown in figure (3A, B, C and D).

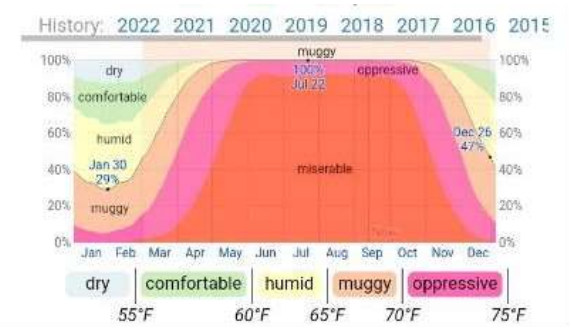
Figure (2) Drainage map of research area



A. Rainfall



B. Precipitation



C. Humidity

D. Temperature

Figure (3) Climate condition of the research area A. Mean Rainfall, B. Mean Precipitations, C. Mean annual Humidity and D. Mean Temperature

Regional Geologic Setting

Bago (Pegu) Region occupies the southernmost on land segment of the Central Myanmar Belt. It is bordered on the north by Magway and Mandalay Regions, on the east by Kayin and Mon States, on the south by Yangon and Ayeyarwady Regions, and on the west by Rakhine State. Except for the low hills of the Bago (Pegu) Yoma, running north-south across the center of the Region, the foot hills of the Eastern Highlands Province in the eastern part and those of the WR in the west, Bago Region is composed mostly of flat alluvial plains. Except for the small

northwestern part, the Bago Region has not received enough geological investigations as much as it deserves. It is probably because Bago Yoma, known to be underlain almost entirely by Miocene clastic sedimentary rocks, is considered less attractive of for the economic mineral potential. Generally, people are more interested in the reported economic mineral occurrences or in areas where there have been some local mining activities. Moreover, the Bago Yoma is very thinly populated and thickly wooded, hence it was largely reserved forest area. It is hardly accessible for the rigorous geological field work although it is surrounded by fairly thickly populated agricultural flat lands. The northwestern part of Bago Region, however was intensively investigated because of its oil potential. The geology of Bago Region is in fact interesting and is unique because the Region embraces the southern segment of the Western Ranges (WR), the southern segment of the Central Myanmar Belt (CMB) and a narrow western part of the Eastern Highlands Province (EHP). Therefore, the geological succession of the Bago Region is composed of a mixture of some rock units of the WR, the CMB and a few of the EHP.

Geological Structure of the Research Area

Sagaing fault is a major tectonic structure that cuts through the central Myanmar, broadly dividing the country into a western half moving north with the India plate and an eastern half attached to the Eurasian plate. The Sagaing fault moves at an average of 18-20 mm each year. The Sagaing fault is a right-lateral Strike Slip fault (dextral fault, meaning that an observer on one side of the fault would see the other side moving to his right during an Earthquake. The Sagaing fault is running nearly in N-S direction in the western part of the research area. (Deym 1968; Win Swe, 1972; Curray et.al.,1979). The research area lies among the Sagaing Fault, Kyaukkyan Fault and Papun Fault. Sagaing Fault is situated in the west of the research area, Kyaukkyan Fault and Papun Fault are in the east. The earthquake risk of the research area is mainly caused by the movement along the Sagaing Fault which is a right-lateral strike-slip fault that runs north-south along the eastern flank of Bago Yoma. High magnitude events indicate that the Sagaing Fault is the principal source of seismic hazards in Myanmar. The Regional Geological Map is shown in (figure 4).

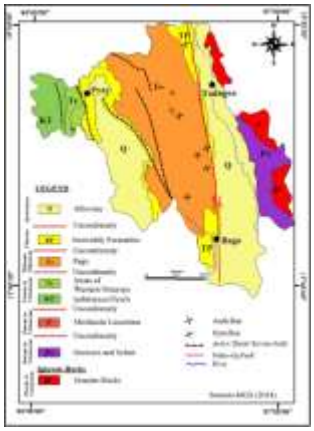


Figure (4) Regional Geological Map of the Bago

Hydrogeologic Characteristics of Research Area

Collection of Data

One-inch topographic map was used in collection of the water samples of the area under investigation. The collected samples were analyzed at Health Department. Tube-wells data were

collected from the Water Resources and Utilization Department (W.R.U.D) and Ministry of Agriculture and Irrigation Department. There are two main types of lithology and aquifer, i.e. there are Alluvial Aquifer and Irrawaddy Formation. According to lithologic logs the water bearing horizons consist of yellow and blue coloured sand, sand with clay and gravel. According to well logs data the aquifer type is confined type. The depth of aquifer is ranging from 19ft to 70ft from the ground surface. The groundwater chemical analysis of the research area is shown in Table No. (1).

Table 1. Chemical analysis of the research area

Tube Well No.	TDS	EC	pH	Na	k+	Ca2+	Mg2+	Fe2+	Cl-	SO4=	HCO3-	Aquifer Types
1	340	530	6.74	17	0.6	11.2	22.1	2.5	64	66.2	54	Alluvial
2	210	330	6.76	16	0.5	14.4	8.64	3	56	25.9	36	Alluvial
3	95	150	7.22	16	1	8.24	3.36	2	26	17.1	18	Alluvial
4	50	70	6.75	8.2	0.9	1.6	1.44	0	14	3.84	12	Irrawaddy
5	165	250	7.3	144	3.8	42.7	9.62	1	0	20	11.52	Irrawaddy
6	90	130	6.5	17	4.4	4.81	1.44	0.3	15	11.5	20	Irrawaddy
7	170	260	6.7	38	4.2	9.62	3.84	0.2	20	46.1	46	Irrawaddy
8	235	360	6.8	22	4.9	12.8	5.28	0.2	25	76.8	40	Alluvial
9	70	110	6.6	4.1	1.4	1.6	2.4	0.12	15	15.4	16	Alluvial
10	110	160	6.6	21	2.6	7.21	2.4	0.5	19	23	30	Irrawaddy
11	230	350	6.7	36	4	16.8	8.16	0.2	74	30.7	40	Alluvial
12	320	490	6.7	18	2.5	54.5	11.4	0.3	69	61.4	30	Alluvial
13	160	240	6.6	25	3	10.4	6.72	0.15	39	23	40	Irrawaddy
14	230	350	7.7	24	2.7	14.4	2.4	0.13	21	88.3	24	Alluvial
15	110	160	6.8	17	3.8	7.21	3.84	0.35	25	19.2	24	Alluvial

Aquifers

The Irrawaddy aquifer found the western part of the research area. The alluvial aquifer mainly composed of the easter part of the research area. Irrawaddy rocks mainly composed of siltstone, clay, shale and sandstone which generally dipping towards the east and the south with a very low angle. Yield of the tube-wells vary from place to place is depending on the well's size, thickness of aquifer, well's design and well's development. The southern part of the research area, the depth reaches up to 480 feet. The water bearing horizon of Irrawaddy Formation is encountered at the depth ranging between 60 feet and 530 feet. In the research area, well no. T5 with the depth yields 2000 gallons per hour from the depth 480ft.

Chemical Composition of Groundwater

The collected samples are analyzed at the Water Resources and Utilization Department (W.R.U.D) and Ministry of Agriculture and Irrigation Department, the cations and anions and TDS, EC, pH, total alkalinity and total hardness.

Classification by KURLOV'S (1928) Method

The Kurlov's formula is written by using ionic concentrations that are expressed in milliequivalent percent (meq/l). The highest amount of ion is expressed first and lesser ion in second and so on. The anions are written above the line and cations are written below the line. The degree of mineralization (m) is placed in front of the format while pH, temperature, Fe^{++} etc., is placed behind. Based on Kurlov's Method, the chemical classification of groundwater types in the research area shows 1. Chloride -Sulphate- Magnesium, 2. Chloride-Sodium-Calcium-Magnesium, 3. Chloride-Sulphate-Sodium-Calcium, 4. Chloride-Bicarbonate-Sodium, 5. Sulphate-Bicarbonate Sodium, 6. Sulphate-Sodium-Calcium, 7. Chloride-Sulphate-Sodium-Magnesium, 8. Chloride-Sulphate-Bicarbonate-Sodium, 9. Chloride-Sodium, 10. Chloride-Sulphate-Calcium, 11. Sulphate-Sodium-Magnesium, and 12. Chloride-Sulphate-Bicarbonate-Sodium.

Classification of Piper Diagram

This method is proposed by Piper (1944) and by Hill (1940). This method of tri linear diagram is widely use to depict chemical data and show the relative concentrations of the major cations (Ca^{+2}, Mg^{++} and K^{+}) and anions (CO_3^{-},HCO_3^{-},Cl^{-} and $SO_4^{=}$). Cations are plotted on the left triangle and anions on the right triangle. Piper diagram are show in figure (5). Kurlov's method and Piper method are compared the result of the research area in groundwater types, which in table (2).

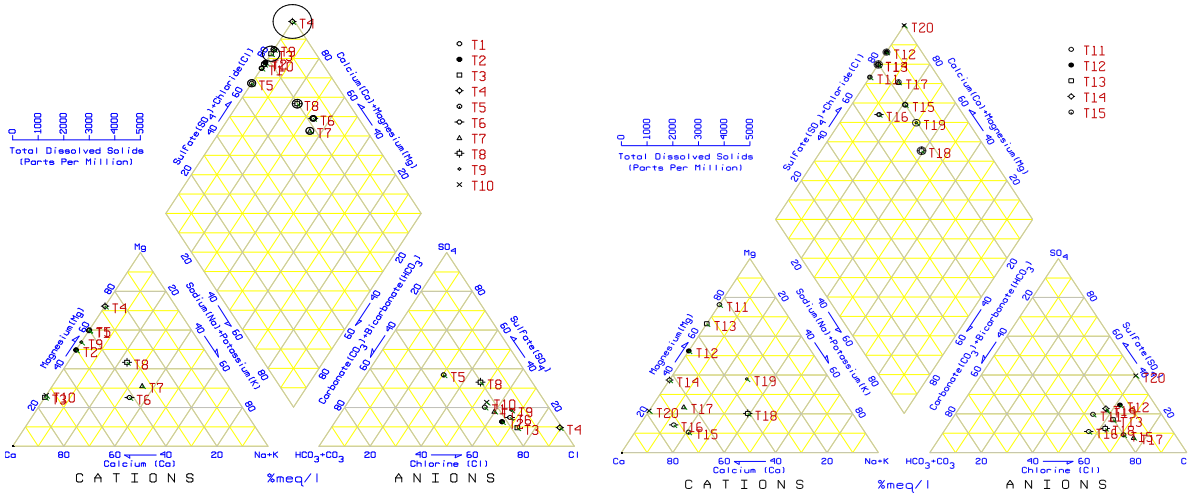


Figure (5) Classification of the Piper diagram, after Piper (1944) and by Hill (1940)

Table 2. Compares ion with Kurlov's (1928) Method and Piper Method

Tube Well No.	Kurlov's Method	Piper Method
T_1	Cl SO_4 Mg	Ca Mg Cl
T_2	Cl Na Ca Mg	Ca Mg Cl
T_3	Cl SO_4 Na Ca	Ca Cl
T_4	Cl HCO_3 Na	Mg Cl
T_5	SO_4 HCO_3 Na	Ca Mg HCO_3 Cl SO_4
T_6	Cl HCO_3 Na	Ca Mg Na Cl
T_7	SO_4 HCO_3 Na	Ca Mg Na SO_4
T_8	SO_4 Na Ca	Ca Mg Na SO_4 Cl
T_9	Cl SO_4 Na Mg	Ca Mg Cl SO_4
T_{10}	Cl SO_4 HCO_3 Na	Ca HCO_3 Cl
T_{11}	Cl Na Ca	Ca HCO_3 Cl
T_{12}	Cl SO_4 Ca	Ca Mg Cl SO_4
T_{13}	Cl HCO_3 Na	Mg Cl
T_{14}	SO_4 Na Mg	Ca HCO_3 Cl
T_{15}	Cl SO_4 HCO_3 Na	Ca Cl SO_4 HCO_3

Chemical Analysis of the Groundwater

Chemical Analysis is important to specify the actual characteristic of groundwater. Determination of pH, total dissolved solids, T.D.S, electric conductivity E.C, dissolved cations of Na^+, K^+, Ca^{++}, Mg^{++} and Fe^{++} and dissolved anions of CO_3^-,HCO_3^-,Cl^- and $SO_4^=$ are made in the laboratory.

In groundwater resources evaluation, the quality of groundwater is as important as its quantity. The chemical and physical constituents of groundwater determine its usefulness for municipal, commercial, industrial, agricultural and domestic water supplies.

The chemical composition of groundwater also indicates the geologic history of rocks, groundwater recharge and discharge, movement and storage. In recent decades, exploitation of groundwater has increased greatly, mainly for irrigation purpose because most of the areas have little access rainfall. Groundwater of the research area is being used from shallow tube wells and deep tube wells. Poor quality of water adversely affects the human health and the plant growth.

Purified water is free from disease producing chemical constituents and microorganisms that are dangerous to health, majority of the rural people do not have potable water for domestic use. Groundwater is applied to rural water supply system without proper treatment for drinking water and irrigation water. Groundwater may also be contaminated by weathering of rocks and applying fertilizer for agriculture purpose.

Major Cations

Cations, which commonly contained in tube-wells including iron Fe^{++} cations have been determined. Common cations are Sodium Na^{+}, Potassium K^{+}, calcium Ca^{++} and Magnesium Mg^{++} are represent shown in figure (6,7,8 and 9).

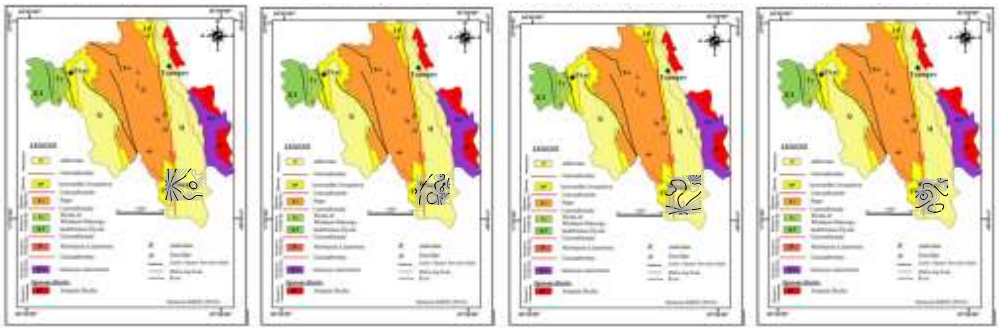


Figure (6,7,8 and 9) Distribution map of the Major Cations in research area.

Major Anions

Anions are playing a vital role in quality determination of groundwater. Only major anions of Carbonate (CO_3^{-}), Bicarbonate (HCO_3^{-}), Sulphate ($SO_4^{=}$) and Chloride (Cl^{-}) ions should be taken into account are represent shown in figure (10,11 and 12).

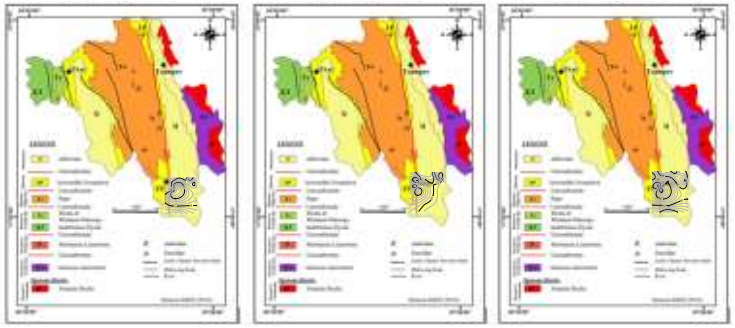


Figure (10,11 and 12) Distribution map of the Major Anions in research area.

Domestic Purposes for Water Quality

The pH values of water samples are ranging from 6.5 to 7.7. It is found that all of pH values fall in the W.H.O guideline for drinking water of 6.5 to 8.5.

The electrical conductivity (E.C) of groundwater samples is ranging from 70 to 530 µmhos/cm. It is observed that most of the samples do not exceed the W.H.O standard of 1500 µmhos/cm.

TDS concentration is ranging from 50 ppm to 340 ppm. Total dissolved solid values fall in fresh water quality range that is not more than 1000 ppm. The groundwater is fresh water according to H.A Gorrell classification.

Sodium concentration is more than 50 ppm that makes the water salt taste and health problems. Sodium concentration of the research area is ranging from 8.5 ppm to 144 ppm. Sodium concentration of all samples from younger alluvial aquifer falls in maximum permissible limit of 200 ppm as W.H.O guideline.

Calcium concentration is ranging from 1.6 ppm to 54.51 ppm and does not exceed the W.H.O standard of 200 mg/L.

The value of iron in the research area is ranging from 0.0 ppm to 3 ppm. W.H.O guideline indicates a permissible iron value of 0.3 ppm. Some water samples of the research area are exceeded the W.H.O limit.

Bicarbonate concentration in the research area is ranging from 11.52 ppm to 54 ppm. W.H.O standard recommends a concentration of 200 ppm for potable water. Water quality in three tube wells in the research area exceeds W.H.O. standard.

The concentration of sulphate in the research area is ranging from 3.84 ppm to 88.84 ppm. One tube well exceeds W.H.O. standard. High sulphate tends to form hard scale in boilers and plumbing units. For drinking water, sulphate concentration should not exceed 250 ppm because the water will have a bitter taste and can produce laxative effect at higher level. The water quality shows the domestic uses and drinking water of water quality in the Table No. (3).

Table 3. WHO standard guideline for the drinking water in research area

Characteristics	Guideline value		The range obtained from groundwater	Remark
	Desirable	Max Permissible		
Calcium	75 mg/l	200 mg/l	1.6-54.51 mg/l	Good
Magnesium	30 mg/l	150 mg/l	1.44-22.8 mg/l	Good
Sodium	0- mg/l	200 mg/l	4.13 –144 mg/l	Good
Potassium	0- mg/l	200 mg/l	0.6 –4.86 mg/l	Good
Sulphate	0- mg/l	400 mg/l	3.84 – 88.32 mg/l	Good
Chloride	200 mg/l	600 mg/l	0 –74 mg/l	Good
Iron	0.5 mg/l	1.5 mg/l	0 – 3 mg/l	Poor
TDS	0- mg/l	1000 mg/l	50 – 340 mg/l	Good
pH	6.5	8.5	6.5 – 7.7	Potable
EC	0-micro mho/cm	1500 micro mhos/ cm	70–530 micro mhos/cm	Good

Agriculture purposes for Groundwater Quality

Agriculture is the basis of the Myanmar economy. The research area is situated in the eastern part of the Bago (Pegu) Yoma. It is one of the most productions of paddy in the country.

Suitability of irrigation water depends upon many factors including the quality of water, soil type, salt tolerance, characteristics of the plants, climate and drainage characteristics of soil. Groundwater always contains small number of soluble salts dissolved in it. To assess the quality of water for irrigation, sodium plays a significant role. A high percentage of Na in water tends to

break down the soil structure, the soil becomes more plasticity and this will be restricted water movement to root zone.

The quality of water for irrigation is classified by Sodium Adsorption Ratio (SAR), Magnesium Adsorption Ratio (MAR), Soluble Sodium Percentage (SSP or Na %) and Residual Sodium bicarbonate (RSBC). The respective values of all water quality parameters are summarized in each table. The results were compared with standard parameter in each case for each type of groundwater.

Sodium Adsorption Ratio (SAR)

Sodium Adsorption Ratio (SAR) is most commonly used to assess suitability of irrigation water. The SAR measures sodicity in terms of the relative concentration of sodium ions to the sum of calcium and magnesium ions in water sample Figure. 5. Sodium concentration in water effects deterioration of the soil properties reducing permeability. SAR is calculated using the following formula:

$$S.A.R. = \frac{Na +}{\sqrt{Ca + 2 + Mg2 + /2}}$$

Where, the ionic concentrations are expressed in meq /L. The result of the Sodium Adsorption Ration (SAR) is shown in Figure. (13) and Table No. (6).

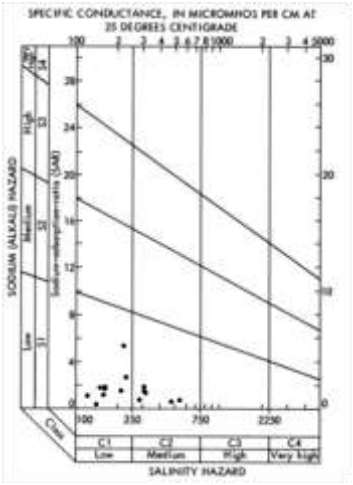


Figure (13) Sodium Adsorption Ration (SAR)

Magnesium Adsorption Ratio (MAR)

Magnesium content of water is considered as one of the most important qualitative criteria in determining the quality of water for irrigation. Generally, calcium and magnesium maintain a state of equilibrium in most water. More magnesium in water will adversely affect crop yield as the soil become more saline, Raghunath, H. M., (1987). The values of magnesium adsorption ratio of each aquifer are tabulated in Table (6).

$$\text{M.A.R.} = \frac{\text{Mg2} +}{\text{Ca2} + + \text{Mg2} +} \times 100$$

The value of magnesium adsorption ratio of research area is ranging from 21.52 to 76.77 %. Acceptable limit of the magnesium adsorption ratio is 50 %.

Residual Sodium Bicarbonate (RSBC)

The concentration of bicarbonate and carbonate influences the suitability of water for irrigation purposes. The high RSBC water has high pH. Therefore, land irrigation with such water becomes infertile owing to deposition of sodium carbonate (Eaton, F.M 1950). The method of classification based on Residual Sodium Bicarbonate (After Eaton, F.M 1950) is showed in Table No. (4).

$$RSBC = HCO_3 - Ca \quad meq/L$$

The residual sodium carbonate values of water samples ranging from - 0.03 to 1.8 RSBC is expressed in meq/L units. The result of the Residual Sodium Bicarbonate (RSBC) is shown in Table No. (6).

Table 4. Classification based on Residual Sodium Bicarbonate (After Eaton, F.M 1950)

Residual Sodium bicarbonate	Classification
< 1.25	Excellent
1.25 – 2.5	Good
2.5 - 3	Fair
> 3	Poor

Soluble Sodium Percentage (%)

Sodium concentration plays an important role in evaluation of groundwater quality for irrigation because sodium causes an increase in the hardness of the soil as well as a reduction in its permeability. The sodium percentage (Na %) is calculated using the formula given below:

$$SSP = \frac{(Na + \ + \ K+)}{Ca\ 2 + \ + Mg2 + \ + \ Na + \ + \ K +} \times 100$$

The methods of classification of groundwater based on Na% (Wilcox,1955) is shown in Table No. (4). The result of the SSP% are shown in Table No. (6).

Table 5. Classification of Groundwater based on Na % (Wilcox, 1955)

(Na %) Percentage of Sodium	Classification
< 20	Excellent
20 - 40	Good
40 -60	Permissible
60 - 80	Doubtful
> 80	Unsuitable

Table 6. Summary Table for various methods of irrigation water quality in Research Area

Tube Well No.	EC	SAR	MAR	RSBC	SSP%
1	530	0.67	76.44	0.33	24.10
	Good	Good	Unsuitable	Excellent	Good
2	330	0.82	49.70	-0.13	33.13
	Good	Good	Suitable	Excellent	Good
3	150	1.19	40.21	-0.12	51.20
	Good	Good	Suitable	Excellent	Permissible
4	70	1.13	59.75	0.12	65.70
	Good	Good	Unsuitable	Excellent	Doubtful
5	250	5.15	27.09	-1.94	68.53
	Good	Good	Suitable	Excellent	Doubtful
6	130	1.79	33.05	0.09	70.79
	Good	Good	Suitable	Excellent	Doubtful
7	260	2.62	39.70	0.27	68.92
	Good	Good	Suitable	Excellent	Doubtful
8	360	1.31	40.43	0.02	50.13
	Good	Good	Suitable	Excellent	Permissible
9	110	0.48	71.21	0.18	43.81
	Good	Good	Unsuitable	Excellent	Permissible
10	160	1.70	35.44	0.13	63.42
	Good	Good	Suitable	Excellent	Doubtful
11	350	1.77	44.43	-0.18	52.14
	Good	Good	Suitable	Excellent	Permissible
12	490	0.57	25.64	-2.23	18.74
	Good	Good	Suitable	Excellent	Excellent
13	240	1.50	51.54	0.14	52.23
	Good	Good	Unsuitable	Excellent	Permissible
14	350	1.50	21.52	-0.33	54.31
	Good	Good	Suitable	Excellent	Permissible
15	160	1.28	46.76	0.03	55.67
	Good	Good	Suitable	Excellent	Permissible

Results and Outcomes

The research area is underlain by Recent to Pliocene age. It is mainly composed of yellow to red, fine to coarse sand, gravel, yellow to red of lateritic soil and yellowish clay. The main aquifer is Irrawaddy aquifer and Alluvial aquifer. The specific yield of the groundwater is 1000 to 2000 gallons per hour for 4 inches diameter well and the depth of water bearing horizon is ranging from 40 ft to 270 ft in Irrawaddy aquifer. The yield of alluvial aquifer is up to 600 gallons per hour for 4 inches diameter well and the depth of water bearing horizon is ranging from 40 ft to 90 ft. The concentration of hydrogen ion (pH) is between 6.5 and 7.7. Mostly, total dissolved solids are always less than 340 ppm in the research area. Total salinity is low and electrical conductivity (E.C) is not more than 530 μ mho/cm. The concentration of Chloride ion is widely distributed in most of the water of the studied region and the amount present in groundwater relative higher than other anions. The results analyzed by KURLOV'S METHOD, SSP% method, SAR method MAR method, RSBC method, TDS and PIPER method can be classified the water types, drinking water, domestic use and Irrigation water. If high amount of Iron concentration, which can be reduced of amount with aeration methods and sand filtering methods. According to the KURLOV's Method and Piper Method, Water Types can be classified by 12 water types. According to the above these methods and WHO Drinking Water Standard, the groundwater of the research area is suitable for the drinking water, domestic uses and Irrigation water.

Acknowledgement

We wish to express our sincere thanks and gratitude to our supervisor Dr. Maung Thin, (Retd.) Rector, Dagon University, for his supervision guidance, critical reading of the manuscript and offering many valuable suggestions throughout the course of the research.

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A STUDY ON PETROCHEMICAL ANALYSIS OF GRANITIC INTRUSION AT ME'NETAUNG AREA, HOPONG TOWNSHIP, SOUTHERN SHAN STATE

Mya Moe Khaing[1], Nang Sandi Lwin[2], Min Han Nyein[3], Nway Cherry Win[4]

Abstract

The research area lies between latitude 20° 34′ 00″ to 20° 45′ 00″ north and longitude 97° 15′ 00″ to 97° 22′ 30″ east, which is situated about 21 km, southeast of Hopong township, Southern Shan State. The intrusive igneous rocks are granites and muscovite-biotite granites. The granitic rocks show chemical composition (weight percent) of SiO_2 (70.35-74.20), Al_2O_3 (13.69-16.59), TiO_2 (0.21-0.39), Na_2O+K_2O (7.85-9.31), Fe_2O_3+MgO (1.72-3.74), MnO (0.03-0.05), CaO (0.56-0.80) and P_2O_5 (0.20-0.30). Petrochemically, P (K-(Na+Ca)) - Q (Si/3-(K+Na+2Ca/3)), R_1-R_2, normative (Ab - Or - An) and TAS diagrams indicate that the granitic rocks from the research area belong to the granite field. In the molar Na_2O-Al_2O_3-K_2O and B-A plot diagrams show that granites and muscovite-biotite granites are predominantly peraluminous. AFM diagram indicates that the granitic rocks belong to the calc alkaline series. From the result of K_2O Vs Na_2O diagram, granites and muscovite-biotite granites of the research area involve S-type. Normative data plot of Quartz-Albite-Orthoclase diagram shows that the granitic rocks lie within 2kb and 10 kb during crystallization. According to ternary plot of Quartz-Anorthite-Orthoclase diagram exhibits that the majority of all granitic rock samples were formed between 0.5kb and 5kb. It can be interpreted that the granitic rocks were consolidated under the low pressure condition. Due to the relationship between differentiation index and temperature, the liquidus temperatures are 720°C for granites and muscovite-biotite granites. From the schematic depth-temperature diagram, it is indicated that the granitic rocks from the research area crystallized at the depth of 26 km. The granitoid rocks of the research area are Orogenic granitoids. Therefore, the granitic rocks were formed on the continent relation to the subduction of an oceanic plate beneath the continent. R_1-R_2 binary (millication) diagram indicates the granitic rocks of the research area correspond to syn-collision zone.

Keywords: granites, muscovite-biotite granites, S-type, liquidus temperatures, depth of crystallization

Introduction

Location, size and accessibility

The research area lies between latitude 20° 34′ 00″ to 20° 45′ 00″ north and longitude 97° 15′00″ to 97° 22′ 30″ east, which is situated about 21 km, southeast of Hopong town. It is bounded by grids no 87 to 02 and 92 to 23 in one-inch topographic map No. 93 H/6 and H/5 and it covers 414 square km. The Taunggyi-Mong Pong car road passes through the northern part of the research area. It can be accessed by car and motorcycle from Hopong throughout the year. The location map of the research area is shown in Figure. 1(A).

Drainage system

In the research area, the common drainage systems vary from trellis to dendritic patterns. The distinct stream of the research area is Samphu, which generally flow from south to north,

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which are parallel to general strike of the rock units. The drainage map of the research area is shown in Figure. 1(B)

(A) (B)

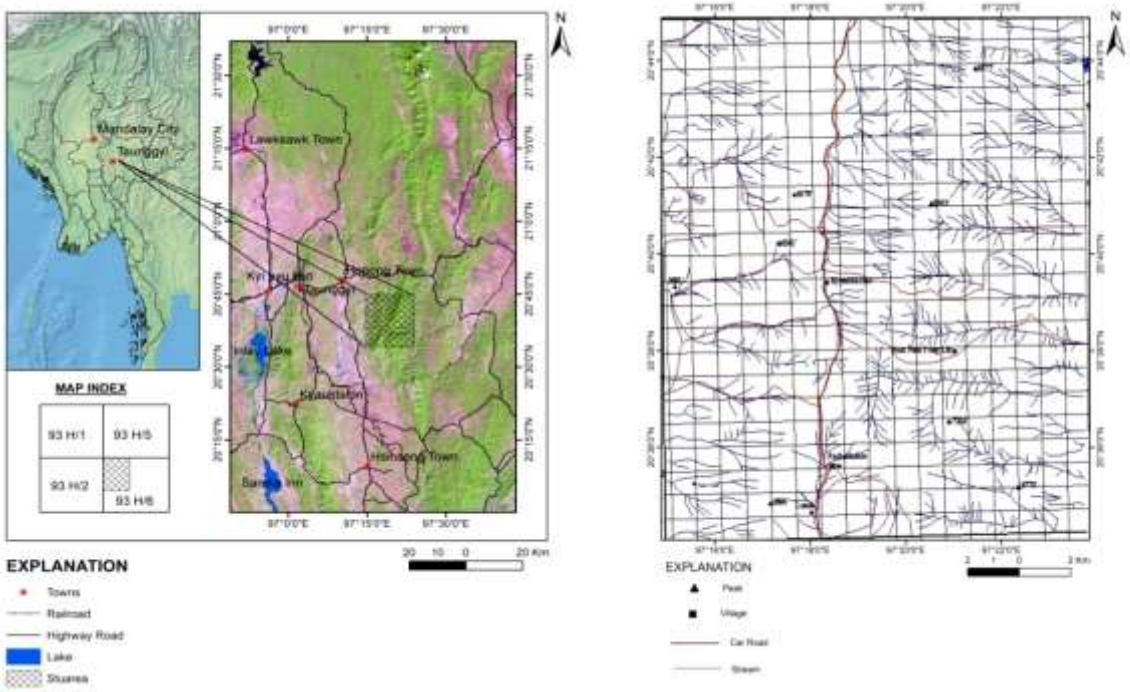

Figure 1. (A) Location map of the research area and its environs

(B) Drainage map of Me'netaung area, Hopong Township (Source: one-inch map)

Regional Geologic Setting

The research area is located in Eastern highland that elevated more than 914 m above sea level. Regional geological map of the research area is shown in Figure 2. Ordovician rocks (Lokepyin Formation, Wunbye Formation, Nan on Formation, Tanshauk Member), Silurian rocks (Linwe Formation, Wabya Formation), Plateau Limestone Group (Nwabangyi Dolomite Formation, Thitsipin Limestone Formation) and Molohein Group are cropped out at the southern part of Loi Samphu ranges. There is a large anticline plunging to the south. Metamorphic rocks and intrusive igneous rocks are exposed in the northern part, especially at the peak of Loi Samphu.

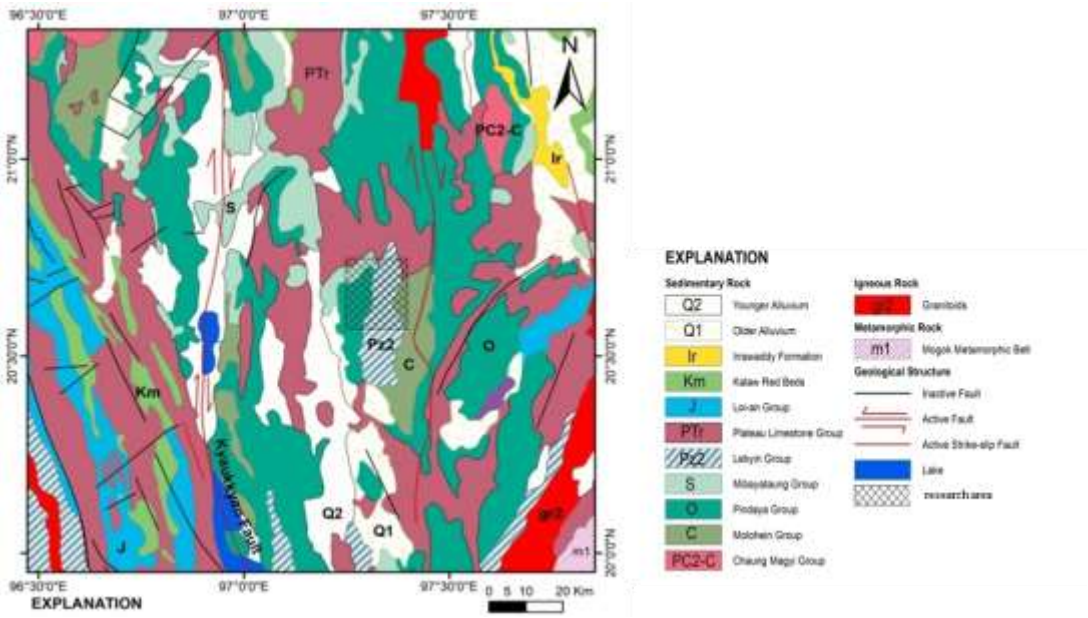

Figure 2. Regional geological map of the research area (Source: Myanmar Geosciences Society, 2014)

Purpose of Investigation

- To determine petrochemical characteristics of granitic rocks
- To interpret the genetic types of granitic rocks
- To describe condition during crystallization of the granitic rocks

Materials and Methods

The major oxide and trace elements abundance were determined by X-ray fluorescence spectrometry. The representative granitic rock samples including 3 granites and 4 muscovite-biotite granites from the research area were selected for analysis and were sent to DSSTRC (Defense Service Science and Technology Research Centre) in Pyin-Oo-Lwin Township, in Table. 1&2. The analyzed data are shown in Table. 2. Standard C.I.P.W norms and C.I.P.W norms with biotite and hornblende were calculated according to the rules of Hutchison (1975) is displayed in Table. 3. Thornton and Tuttle Differentiation Index (TTDI or DI, Differentiation Index) can be used as an indicator of bulk composition which was calculated from the standard C.I.P.W norms. These results are exhibited in Table.3. Triangular plots of some analyses results were carried out by Tridraw 2.6 software. For Differentiation Index diagram, Major oxides and Trace elements variation diagrams, Ternary diagrams, Binary diagrams and Triangular plots diagrams were drawn by using SPSS-17.0 software, GCD kit 3.0, Tridraw software and Microsoft excel.

Results and Findings

Geology of the Me' netaung Area

The stratigraphic succession of the research area, in ascending order is Chaung Magyi Group (Pre-Cambrian), Molohein Group (Late Cambrian), Lokepyin Formation, Wunbye Formation, and Nan-on Formation of Pindaya Group (Early to Middle Ordovician), Linwe Formation and Taungmingyi Orthoquartzite Member of Mibayataung Group (Silurian),

Devonian Unit (Early Devonian) , Carboniferous Unit (Carboniferous), Plateau Limestone Group (Early Permian to Middle Triassic), Loi-an Group (Jurassic) and Alluvium (Holocene). The intrusive igneous rock is porphyritic biotite granite (Late Triassic to Early Jurassic). The geological map of the research area is shown in Figure 3.

Petrochemical Analysis of Granitic Rocks

The granitic rocks of the research area are granites and muscovite-biotite granites. The granites, muscovite-biotite granites show chemical composition (weight percent) of SiO_2 (70.35-74.20), Al_2O_3 (13.69-16.59), TiO_2 (0.21-0.39), Na_2O+K_2O (7.85-9.31), Fe_2O_3+MgO (1.725-3.74), MnO (0.03-0.05), CaO (0.56-0.804) and P_2O_5 (0.20-0.30).

In Harker's variation diagram, CaO, Na_2O, K_2O, TiO_2, Al_2O_3, MgO and P_2O_5 are negatively correlated with SiO_2. FeO_t are positively correlated with SiO_2. Plots of selected trace elements of Cr and Zr are positively correlated with SiO_2, Figure. 4. Plots of trace elements Mg, Rb versus SiO_2 show decreasing of those elements with increasing of SiO_2 contents. Differentiation Index (DI) of the igneous rocks in the area varies from 93.141 to 95.381. Standard CIPW normative corundum ranges from 2.693 to 4.267. Total alkali content (Na_2O+K_2O) ranges from 7.85 to 9.31. TAS diagram after Cox et. al. (1979), Figure.5 (A) indicates four groups of igneous rocks and the dividing line between alkaline and subalkaline magma series. The granitic rocks from the research area belong to the subalkaline affinity. TAS diagram of Middlemost (1994), Figure.5 (B) exhibits granites and muscovite-biotite granites fall in the granite field.

According to the P (K-(Na+Ca)) – Q (Si/3-(K+Na+2Ca/3)) diagram of Debon and Le Fort, (1983), Figure.6 (A), the granitic rocks in the research area fall in the granite field. R_1= 4Si-11(Na+K) – 2(Fe+Ti) and R_2= 6 Ca+ 2Mg+ Al, (R_1-R_2) diagram of De La Roche et. al (1980) classification diagram indicated that the granites and muscovite-biotite granites confined to the granite field, in Figure.6 (B). B-A plot diagram from (after Villaseca et al, 1998) show granites and muscovite-biotite granites are predominantly peraluminous, Figure. 7.

In the AFM diagram, FeO_t - (Na_2O+K_2O) - MgO shows that the decrease of MgO with a rise of FeO_t during the initial stage of differentiation. In the later stage of differentiation, there is an increase of alkali (Na_2O+K_2O) with a depletion of FeO_t is shown in Figure. 8. SiO_2-Na_2O+K_2O - FeO_t+MgO diagram, Figure. 9 show the rise of SiO_2 and depletion of FeO_t+MgO during the entire process of magmatic differentiation. K_2O - Na_2O - CaO ternary diagram, Figure. 10 exhibits that the enrichment of CaO during the initial stage of differentiation with addition of Na_2O. There is an increase of K_2O which is subsequently replaced by Na_2O in the late stage of magmatic evolution.

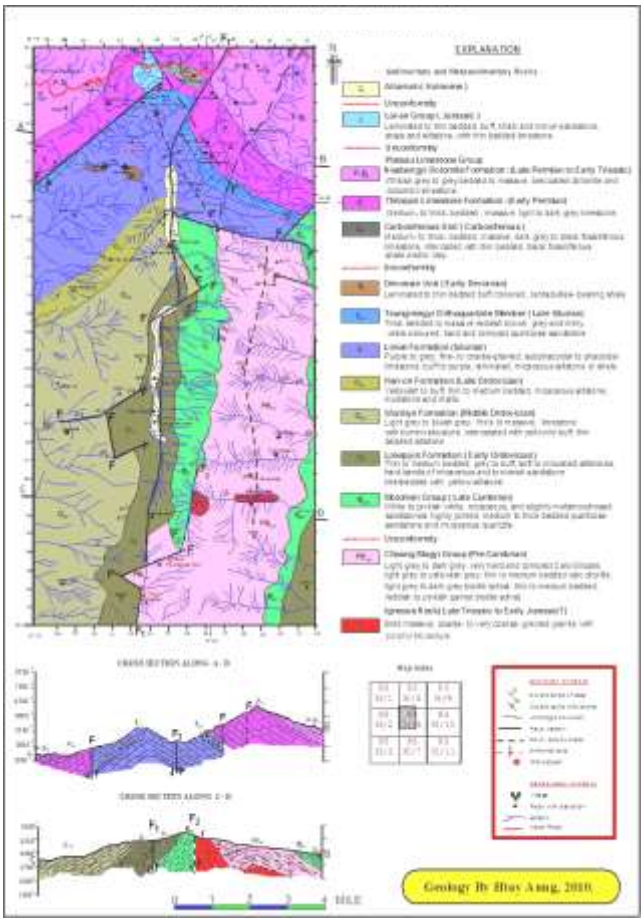

Figure. 3 Geological Map of the Me'netaung area (Source: Htay Aung, 2010)

Table. 1 Analyzed samples and locations of the granitic rocks of the research area

Samples	Rock Types	Locality
mmk-1	Granite	N 20˚37′32″E 97˚20′42″
mmk-2	Granite	N 20˚37′32″E 97˚20′43″
mmk-3	Granite	N 20˚37′35″E 97˚20′41″
mmk-4	Muscovite-biotite granite	N 20˚37′32″E 97˚20′42″
mmk-5	Muscovite-biotite granite	N 20˚37′34″E 97˚20′44″
mmk-6	Muscovite-biotite granite	N 20˚37′32″E 97˚20′47″
mmk-7	Muscovite-biotite granite	N 20˚37′33″E 97˚20′46″

Table.2 Major oxides (wt. %) and trace elements (ppm) abundances of the granitic rocks from the research area

Sample No	**mmk-1**	**mmk-2**	**mmk-3**	**mmk-4**	**mmk-5**	**mmk-6**	**mmk-7**
Types	**granite**	**granite**	**granite**	**muscovite-biotite granite**	**muscovite-biotite granite**	**muscovite-biotite granite**	**muscovite-biotite granite**
SiO_2	74.2	73.25	73.56	71.38	71.64	70.35	70.83
TiO_2	0.23	0.247	0.21	0.39	0.35	0.247	0.22
Al_2O_3	13.69	13.9	14.56	15.00	14.93	16.59	16.18
Fe_2O_3	1.865	2.00	1.679	3.18	2.88	1.99	1.722
MnO	0.03	0.028	0.03	0.05	0.05	0.032	0.03
MgO	0.34	0.402	0.29	0.56	0.48	0.387	0.33
CaO	0.79	0.804	0.62	0.62	0.56	0.645	0.59
Na_2O	2.61	2.76	2.74	2.71	2.91	3.278	3.18
K_2O	5.24	5.29	5.89	5.54	5.82	5.93	6.13
P_2O_5	0.22	0.205	0.24	0.30	0.28	0.271	0.27
Total	99.23	98.93	99.83	99.73	99.89	99.72	99.482
A/CNK	1.588	1.569	1.574	1.691	1.607	1.683	1.629
A/NK	1.743	1.726	1.687	1.818	1.710	1.821	1.732
Ba	0.06	1.67	0.06	-	-	-	-
Cu	-	0.011	-	-	-	-	-
Zn	0.0067	0.0077	0.0061	0.0119	0.0099	0.0069	0.0065
Mg	0.21	0.24	0.18	0.34	0.29	0.23	0.20
Fe	1.31	1.40	1.18	2.22	2.01	1.39	1.20
Sr	0.004	0.038	0.004	-	-	0.003	0.003
Sb	0.036	-	0.049	-	-	-	-
Ca	0.57	0.58	0.44	0.44	0.40	0.46	0.46
P	0.097	0.089	0.107	0.129	0.123	0.118	0.188
Mg	0.21	0.24	0.18	0.34	0.29	0.23	0.20
Ti	0.136	0.105	0.128	0.232	0.208	0.148	0.134
Al	7.248	7.36	7.71	7.93	7.90	8.78	8.56
Na	1.94	2.05	2.04	2.01	2.16	2.43	2.37
K	4.35	4.39	4.892	4.60	4.83	4.93	5.09
Zr	0.0129	0.0117	0.0114	0.0182	0.0177	0.0142	0.0118
S	0.03	0.49	0.07	0.08	0.06	0.01	0.02
Rb	0.0517	0.0447	0.0481	0.0577	0.0561	0.0485	0.0494
Tl	0.136	0.148	0.128	0.232	0.208	0.148	0.134

Table. 3 Standard CIPW norm and standard CIPW norm with biotite and hornblende of the granitic rocks in the research area

Standard CIPW norm

Sample no.	mmk-1	mmk-2	mmk-3	mmk-4	mmk-5	mmk-6	mmk-7
Quartz	37.681	35.603	34.058	33.186	31.345	27.471	27.84
Corundum	2.837	2.693	3.13	4.147	3.499	4.267	3.857
Orthoclase	31.205	31.608	34.863	32.82	34.42	35.134	36.395
Albite	22.256	23.613	23.223	22.988	24.643	27.809	27.289
Anorthite	2.501	2.679	1.51	1.119	0.95	1.433	1.168
Hypersthene	0.853	1.012	0.723	1.398	1.196	0.966	0.826
Ilmenite	0.065	0.061	0.064	0.107	0.107	0.069	0.064
Hematite	1.88	2.022	1.682	3.188	2.882	1.995	1.73
Rutile	0.198	0.218	0.177	0.335	0.294	0.212	0.187
Apatite	0.525	0.491	0.569	0.712	0.664	0.644	0.643
Sum	100	100	100	100	100	100	100
D.I	93.979	93.517	95.274	93.141	93.907	94.682	95.381
C.I	3.099	3.388	2.017	2.098	1.788	2.11	1.747

D.I - Differentiation Index of Thornton and Tuttle (1960)

C.I - Crystallization Index of Poldervaart and Parker (1965)

Standard CIPW norm with biotite and hornblende

Sample no.	mmk-1	mmk-2	mmk-3	mmk-4	mmk-5	mmk-6	mmk-7
Quartz	38.46	36.505	34.741	34.427	32.412	28.359	28.61
Corundum	3.126	3.005	3.392	4.547	3.84	4.572	4.13
Orthoclase	30.353	30.605	34.129	31.456	33.254	34.165	35.561
Albite	22.209	23.561	23.178	22.936	24.598	27.748	27.235
Anorthite	1.69	1.805	0.776	-	-	0.569	0.398
Ilmenite	0.065	0.06	0.064	0.107	0.107	0.068	0.064
Hematite	1.876	2.018	1.679	3.181	2.877	1.991	1.727
Apatite	0.524	0.49	0.568	0.711	0.663	0.642	0.641
Sphene	0.568	0.612	0.515	0.786	0.668	0.606	0.541
Sum	100	100	100	100	100	100	100

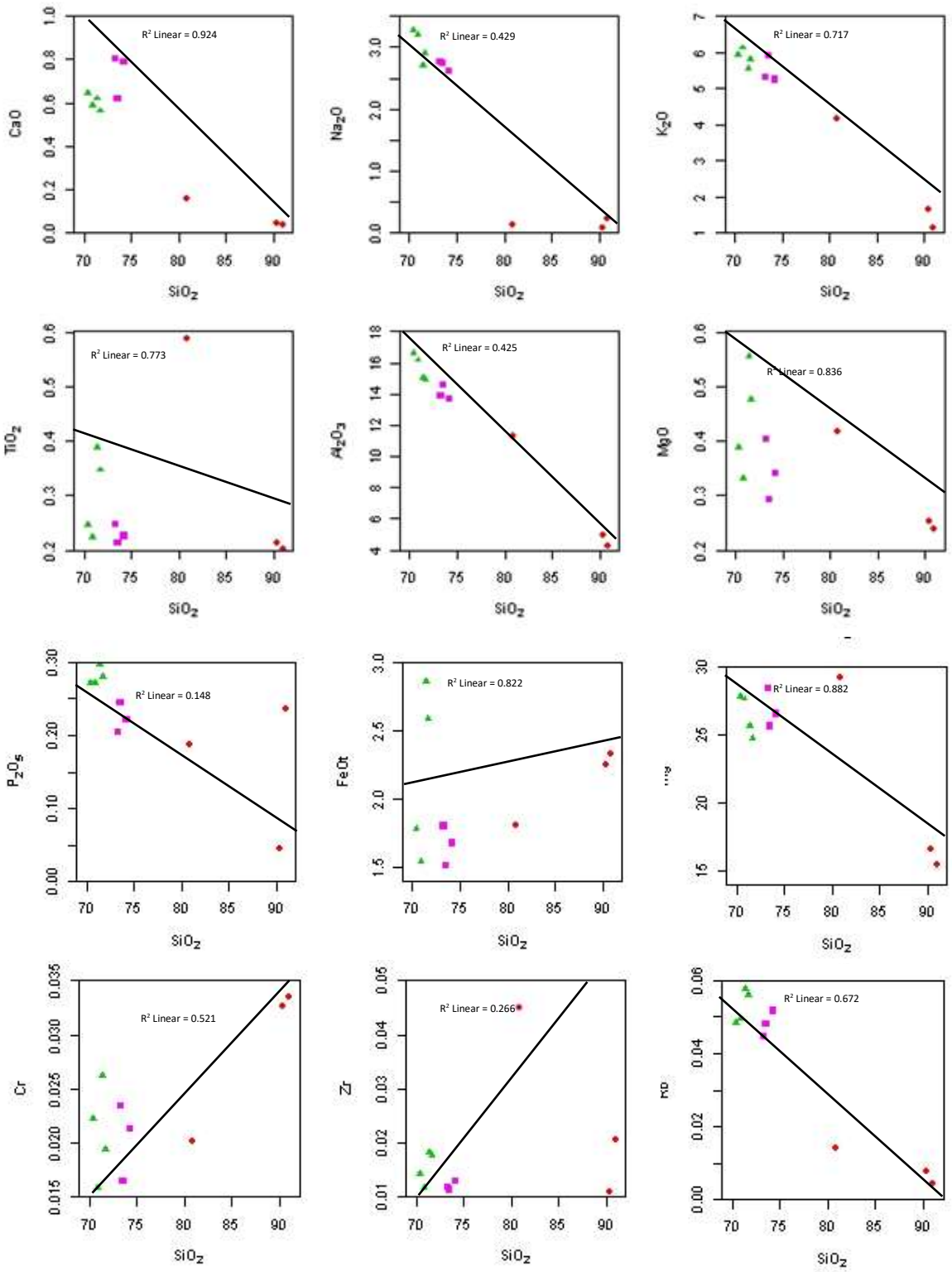

Figure 4. Harker's variation diagrams illustrating major oxide Vs SiO_2 of the granitic rocks from the research area. Symbols as in Table (2)

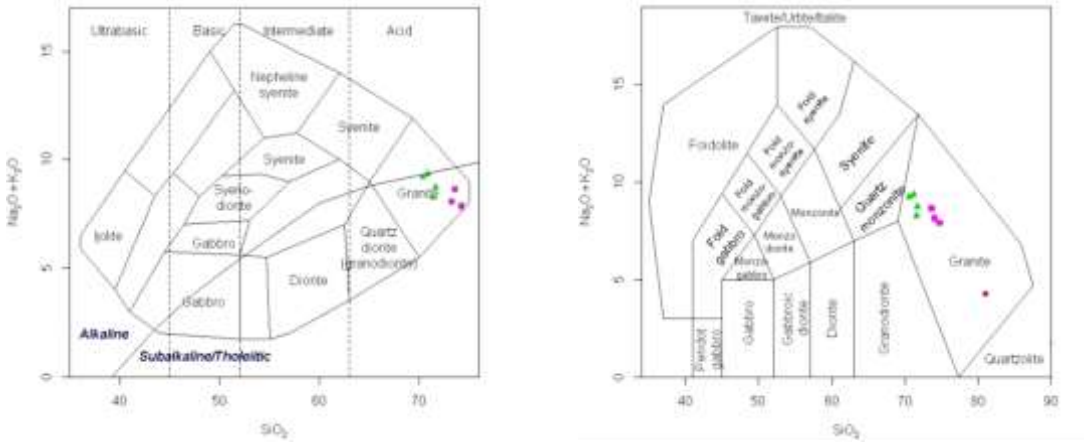

Figure 5. (A) TAS diagram of Cox et. al. (1979) showing subalkaline series of the research area, Symbols as in Table (2)
(B) TAS diagram of Middlemost (1994), granitic rocks fall in the granite field

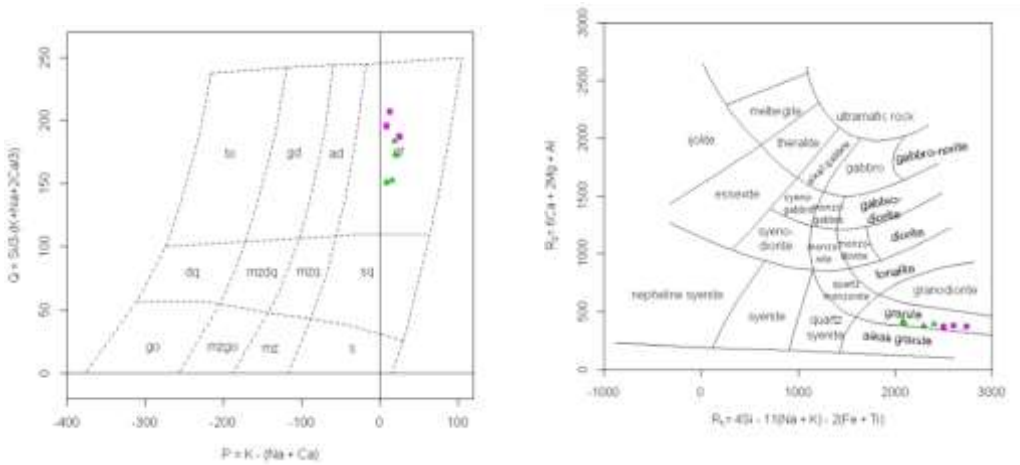

Figure 6. (A) P-Q (Debon and Le Fort, 1983) diagram showing the igneous rocks of the research area. Symbols as in Table (2)
(B) R_1-R_2 multication classification diagram for the igneous rocks of the research area (after De la Roche et. al. 1980), Symbols as in Table (2)

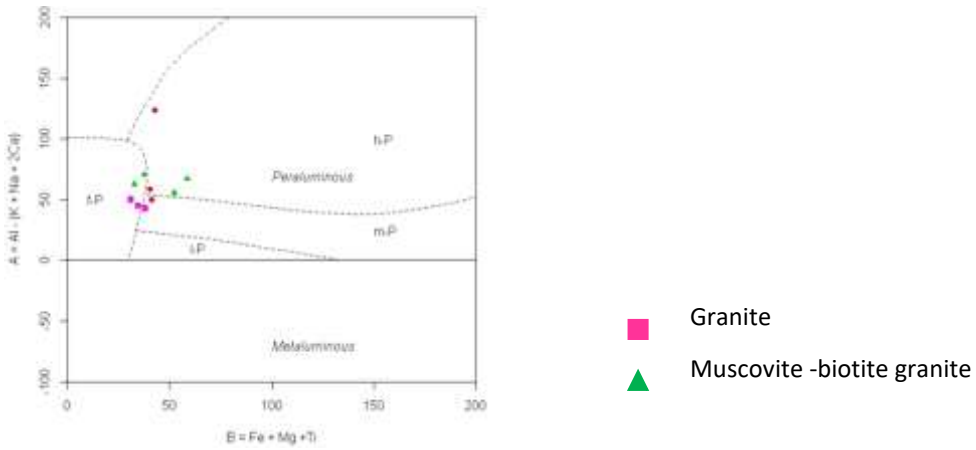

Figure 7. A = Al - (K + Na + 2Ca) Vs B (Fe + Mg + Ti) diagram showing the peraluminous and metaluminous characters of granitic rocks of the research area (B-A plot modified by Villaseca et al, 1998), Symbols as in Table (2).

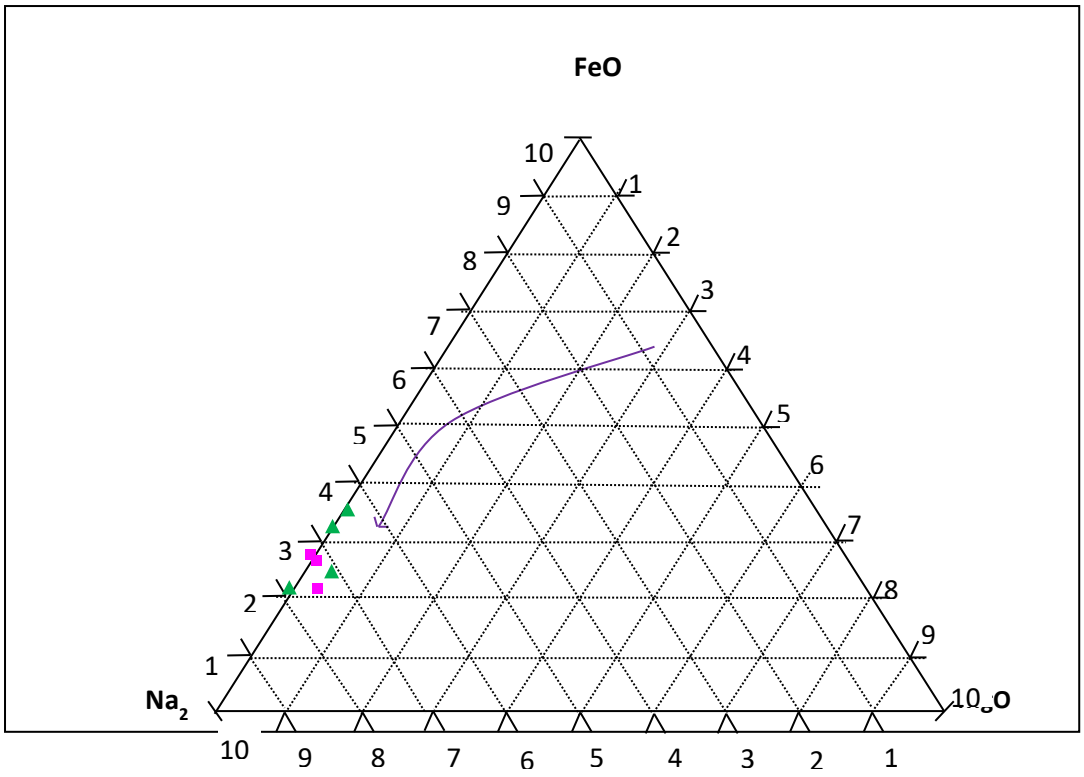

Figure 8. FeO_t - Na_2O+K_2O - MgO (AFM) diagram explains magmatic differentiation within the series (after Hine et. al, 1978). Evolutionary trend is indicated by the arrow. Symbols as in Table (2)

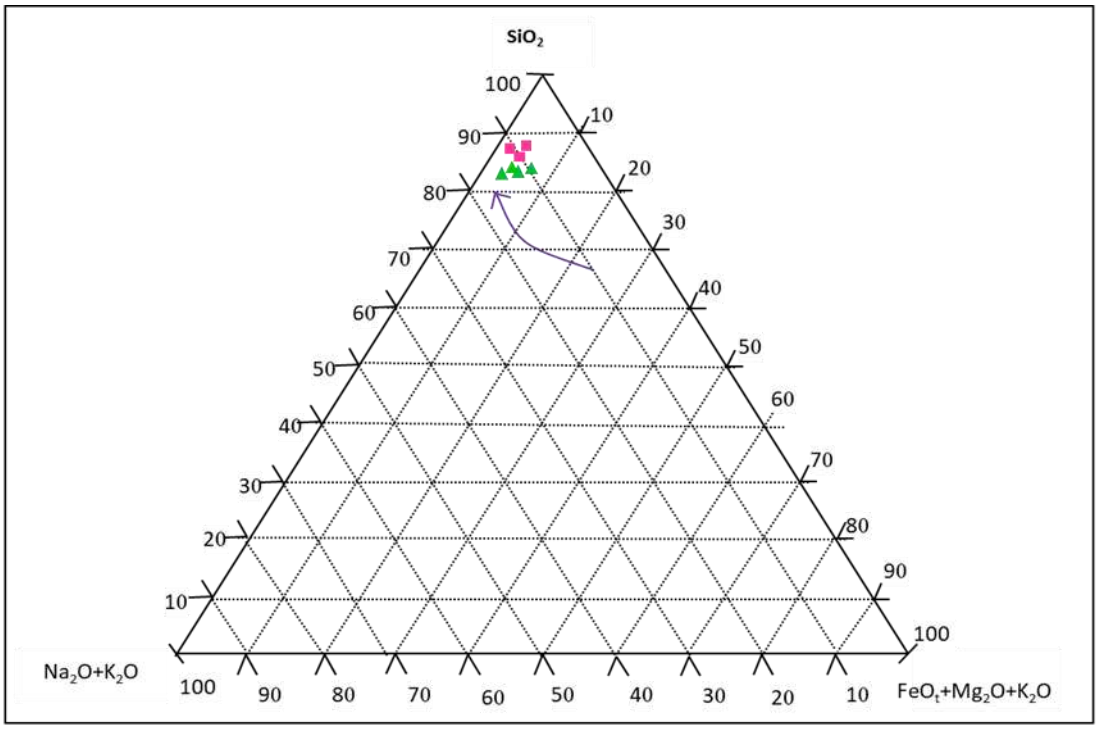

Figure 9. SiO_2 - Na_2O+K_2O - FeO_t+MgO diagram shows the evolutionary trend of the igneous rocks differentiation (after Le Maitre, 1989). Differentiation within the series is indicated by the arrow. Symbols as in Table (2)

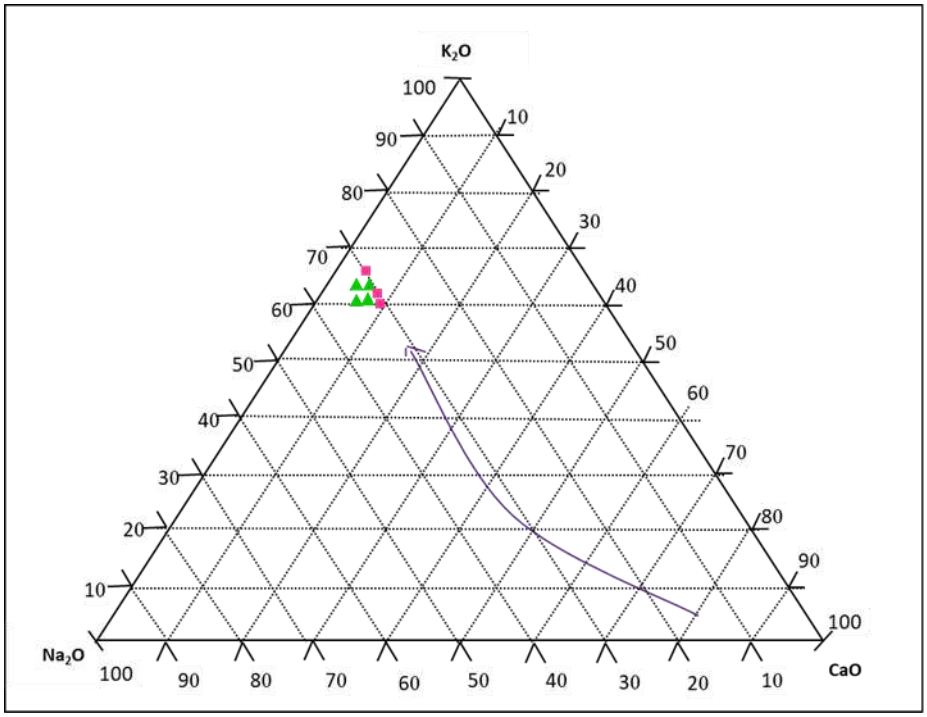

Figure 10. K_2O-Na_2O-CaO ternary diagram exhibits magmatic differentiation of the granitic rocks in the research area, (after Chappell and White, 1974). Evolutionary curve is indicated by the arrow. Symbols as in Table (2)

Genetic type of granitic rocks

Major elements characteristics of the granitic rocks have been used as a key for the interpretation of the origin of granite. The granitic rocks from the research area are predominantly peraluminous. Molecular Al_2O_3/Na_2O+K_2O, A/NK>1.1, A/NK value is 1.687 - 1.821 and Molecular Al_2O_3/ CaO $+Na_2O+K_2O$, A/CNK> 1.1, A/CNK value is 1.569 - 1.691. Some muscovite-biotite granites are relatively high in sodium, Na_2O normally $>$ 3.2% with approximately 5% K_2O and three granites and two muscovite-biotite granites are low in sodium, Na_2O normally$<$ 3.2%. The normative corundum ranges from 2.693 - 4.267. Lack of normative magnetite is characteristic of S-type. From the result of K_2O Vs Na_2O diagram, the granitic rocks of the research area involve S-type is exhibited in Figure.10. Two mica granites are considered as sedimentary protolith of S-type. Above these facts, the granitic rocks in the research area are S-types granite according to Chappell and White (1974). The relatively high quartz content, in the range of (27.471-37.681wt %) of this S type granite can be considered that this granite was derived from the quartz rich sedimentary rocks. It may be formed from the supracrustal origin (Chappell and White, 2001). Rb-Ba-Sr diagram, Figure.11 shows that two granites and four muscovite-biotite granites are fitted in strongly differentiated granite and only granite from the research area is fitted as low Ca granite (El Bouseily and El Sokkary, 1975).

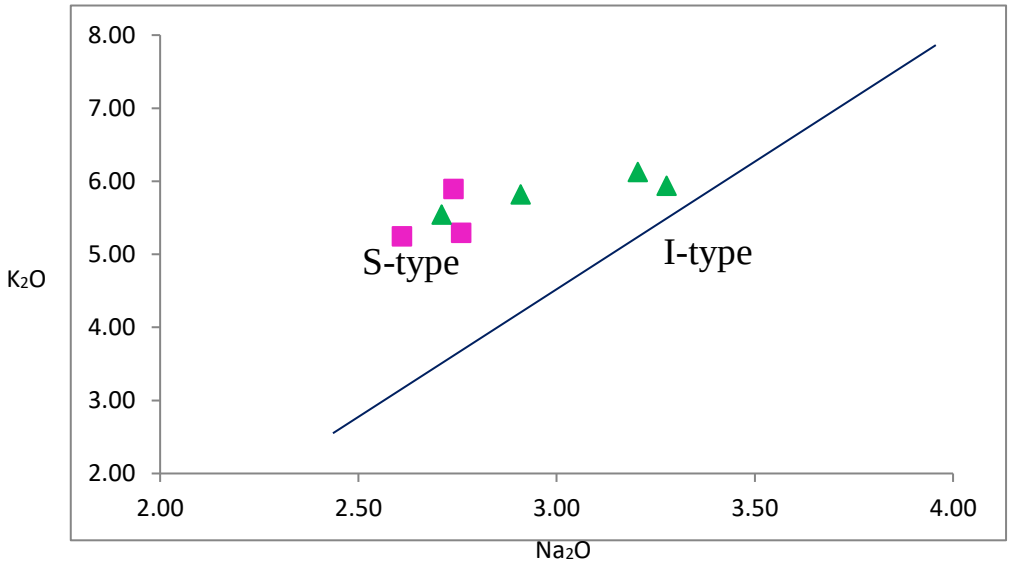

Figure 11. K_2O Vs Na_2O diagram for the granitic rocks of the research area, (after Chappell and White, 1983)

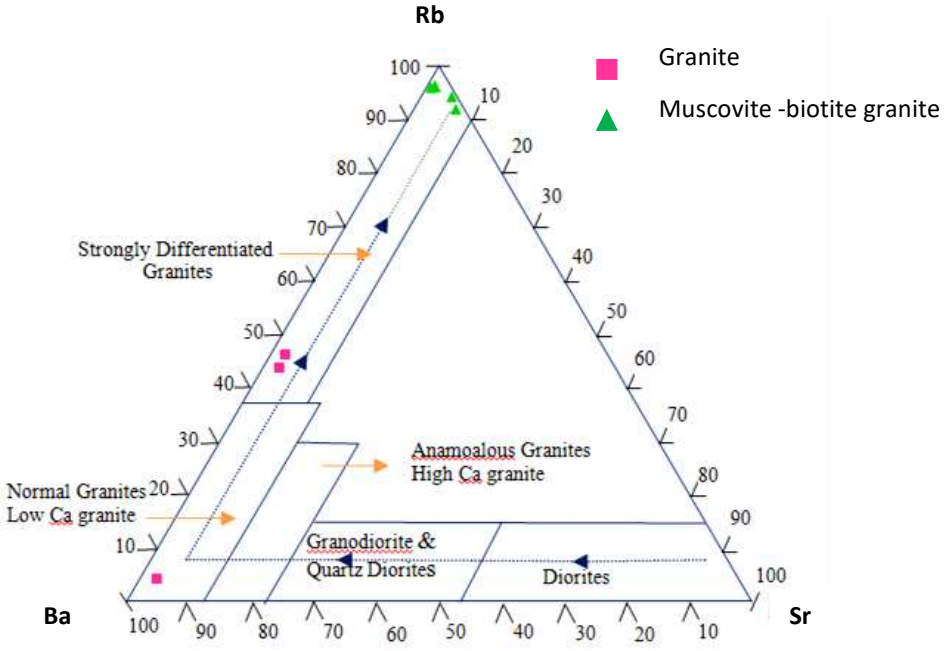

Figure 12. The different fields of the ternary relation Rb-Ba-Sr on some investigated igneous rocks. Arrow indicates differentiation trend. (after EL Bouseily and EL Sokkary, 1975)

Condition during Crystallization of the Granitic Rocks

Normative data plot of Quartz - Albite - Orthoclase diagram after Tuttle and Bowen (1985), H_2O saturated liquidus field boundaries in the system for various water pressures. This diagram, Figure.12 (A) indicates that the granitic rocks in the research area lie within 2kb and 10 kb during crystallization. Ternary plot of the normative weight percent composition of Quartz-Anorthite-Orthoclase (after Tuttle and Bowen, 1958), Figure.12 (B) exhibits that the majority of all granitic rock samples were formed between 0.5kb and 5kb. It can be suggested that the granitic rocks from the research area were consolidated under the low pressure condition. If the igneous rocks were assumed as crystallization at minimum pressure of 2kb, their liquid temperature can be estimated from the diagram showing the relationship between differentiation

index and temperature at 2 kb water pressure. From this diagram, the liquidus temperatures are 720˚C for granites and muscovite-biotite granites, Figure.13. Depth of the crystallization of the granitic rocks can be expressed from the schematic depth-temperature diagram (after Marmo, 1956) in Figure.14. Generally, it may be suggested that granites and muscovite-biotite granites crystallized at the depth of 26km.

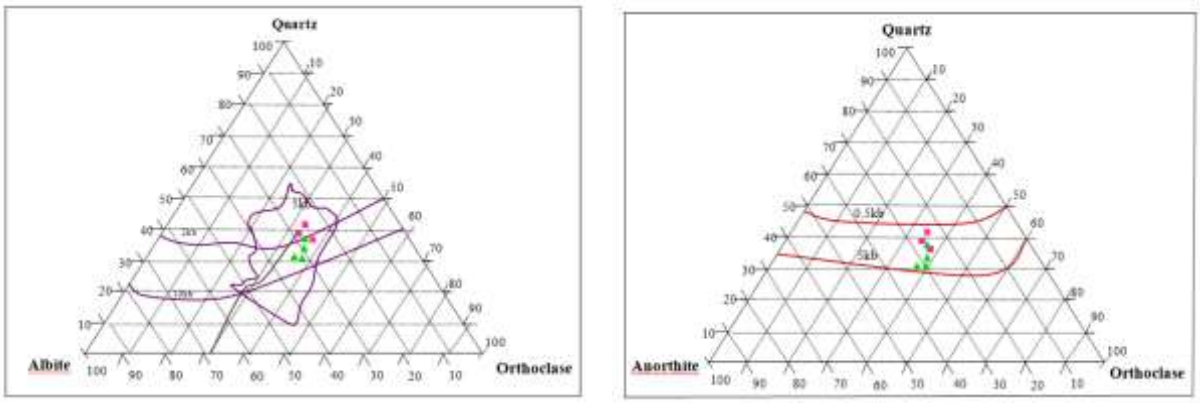

Figure 13. (A) Normative data plot of Quartz-Albite-Orthoclase ratio exhibits the granitic rocks in the research area have water pressure within 2kb and 10kb (after Tuttle and Bowen, 1985). Symbols as in Table (2)

(B) Ternary plot of the normative Quartz-Anorthite-Orthoclase shows the granitic rocks were formed between 0.5kb and 5kb water pressure (after Tuttle and Bowen, 1985). Symbols as in Table (2)

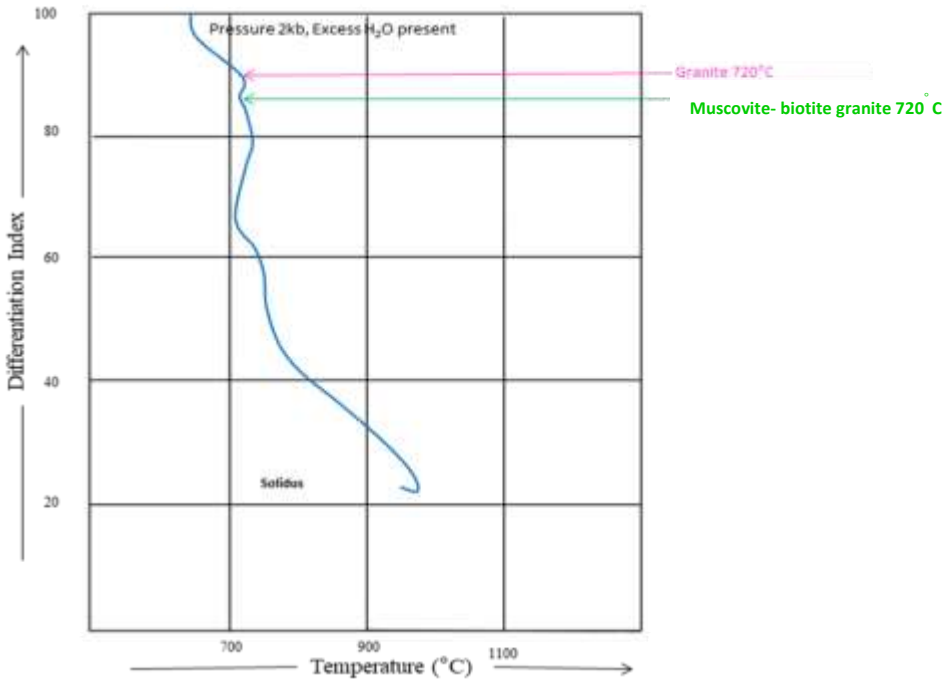

Figure 14. Temperature-differentiation index diagram for the igneous rocks of the research area, at 2 kb water pressure (after Piwinskii and Wyllie, 1970)

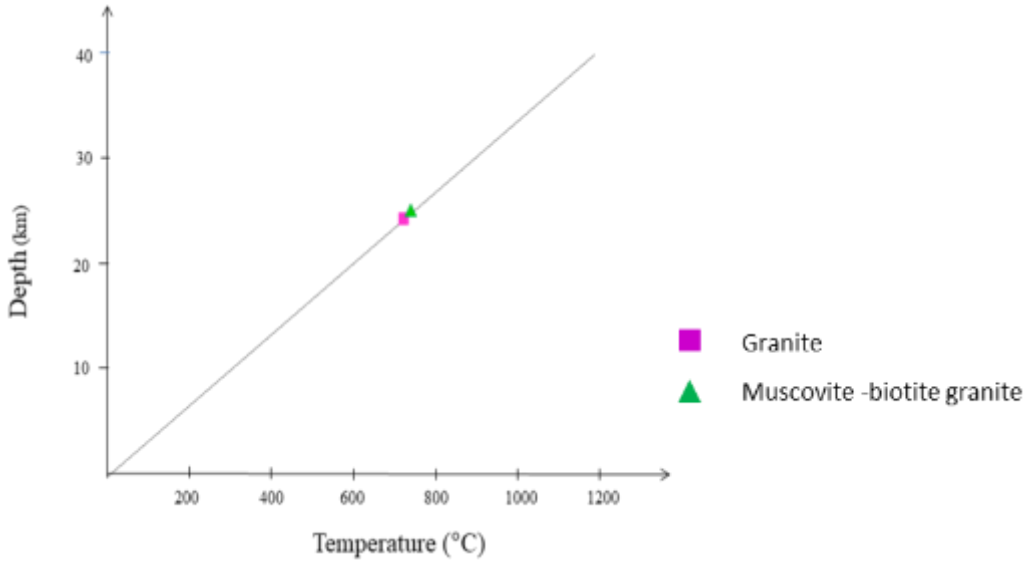

Figure 15. Schematic depth-temperature relation diagram for the igneous rocks of the research area, (after Marmo, 1969)

Tectonic Discrimination of the Granitic Rocks

The configurations of tectonic environments for the granitic rocks of the research area were made by using Maniar and Piccoli (1989) classification schemes. They classified the granitoid rocks by tectonic setting as follows:

Orogenic Granitoids (a) Island arc Granitoid (IAG)

(b)Continental arc Granitoid (CAG)

(c)Continental collision Granitoid (CCG)

(d) Post orogenic Granitoid (POG)

Anorogenic Granitoids(e) Rift-related Granitoid (RRG)

(f) Continental epeirogenic uplift Granitoid (CEUG)

(g)Oceanic Plagiogranite (OP)

In plots of M/AFM (MgO/Al_2O_3+FeO+MgO) versus F/AFM (FeO /Al2O_3 +FeO +MgO) and C/ACF (CaO /Al_2O_3 +CaO + FeO) versus F/ACF (FeO/Al_2O_3+CaO+FeO) variation diagrams show the granitic rocks of the research area fall within the IAG+CAG+CCG field. is exhibited in Figure.16 (A&B). According to SiO_2 Vs Al_2O_3 diagram (after Maniar and Piccoli, 1989), Figure.17(A) showing the environment of the granitic rocks from the research area fall within the IAG+CAG+CCG field. Again in the Shand's Index diagram, Figure.17(B) exhibited that plots of the granitic rocks fall in the CAG and CCG field. According the above mentioned data, it can be safely considered that the granitoid rocks of the research area are Orogenic granitoids. Therefore, the granitic rocks were formed on the continent relation to the subduction of an oceanic plate beneath the continent. Batchelor and Bowden (1985) used to discriminate the tectonic setting of granite, according to R_1-R_2 binary (millication) diagram, Figure.18 indicates the granitoid rocks of the research area correspond to syn-collision zone.

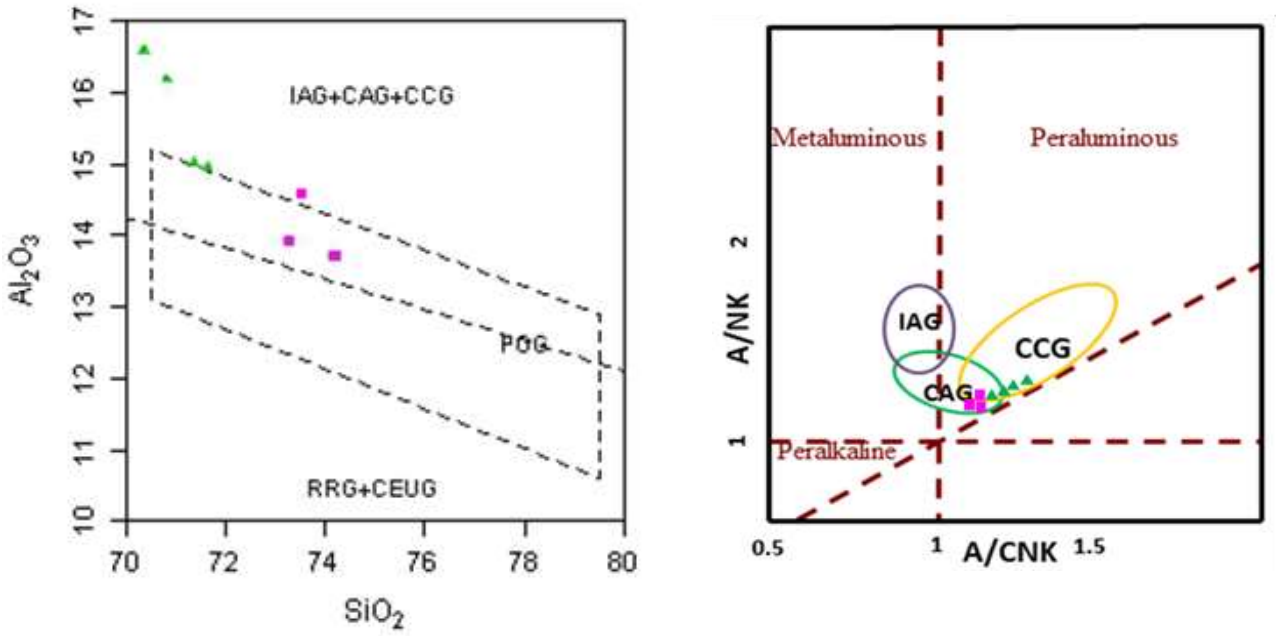

Figure 16. (A)AFM diagram showing the environment of the granitic rocks from the research area fall within the IAG+CAG+CCG field (after Maniar and Piccoli, 1989)

(B) ACF diagram showing the granitic rocks of the research area fall within the IAG+CAG+ CCG field (after Maniar and Piccoli, 1989)

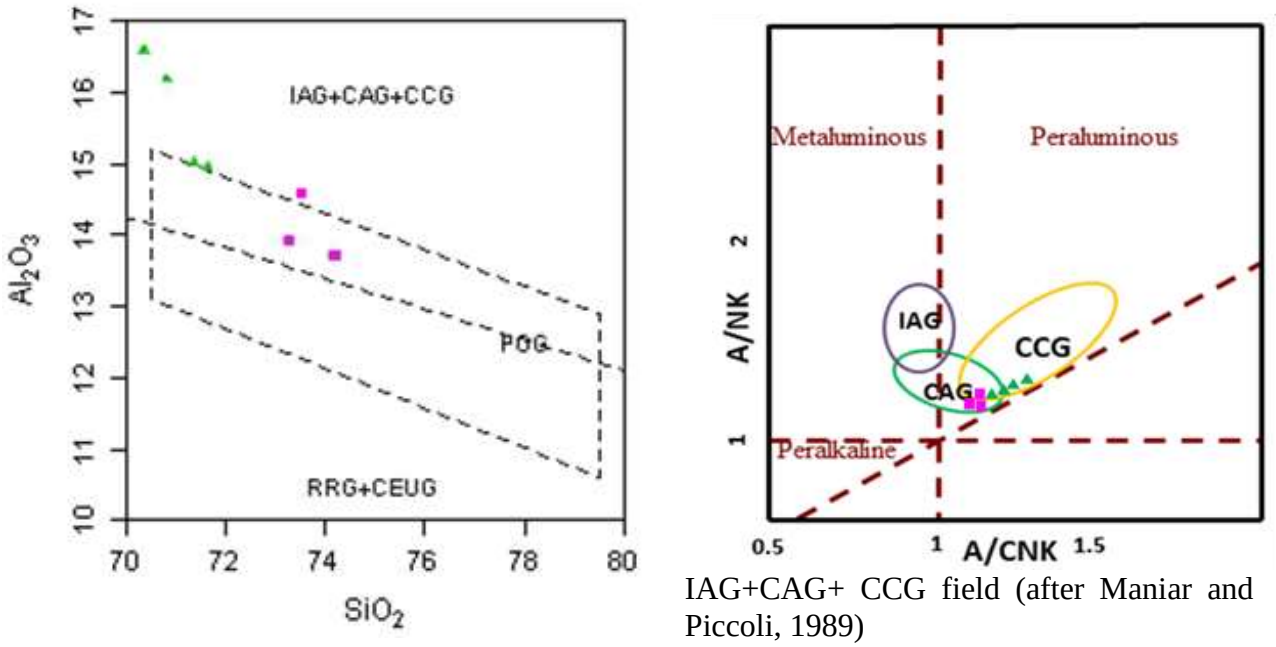

Figure 17. (A)SiO_2 Vs Al_2O_3 diagram showing the environment of the granitic rocks from the research area fall within the IAG+CAG+CCG field (after Maniar and Piccoli, 1989)

(B) Shand's Index diagram for granitic rocks of research area, which fall within the CAG and CCG field

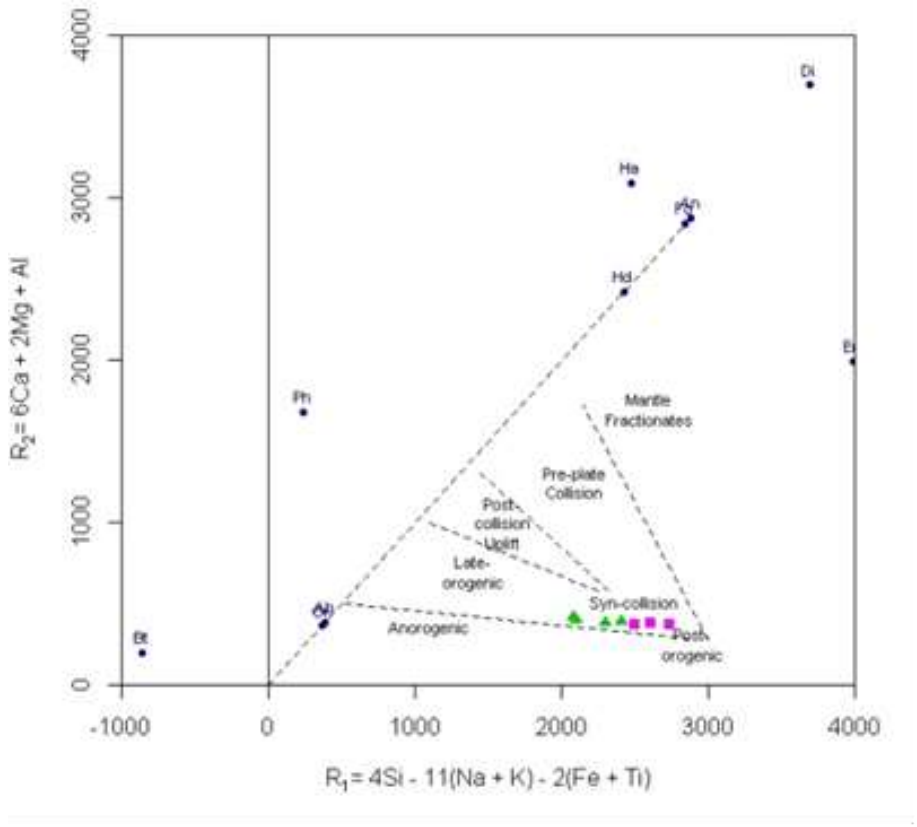

Figure 18 R_1-R_2 binary (millication) diagram showing the discrimination of the tectonic setting of granitic rocks (after Batchelor and Bowden, 1985)

Conclusion and Discussion

The research area is situated about 21km, southeast of Hopong township, Southern Shan State. The intrusive igneous rocks are granites and muscovite-biotite granites. Petrochemically, P - Q, R_1-R_2, normative (Ab - Or - An) and TAS diagrams indicate that the granitic rocks belong to the granite field. Na_2O-Al_2O_3-K_2O and B-A plot diagrams show that granites and muscovite-biotite granites are predominantly peraluminous. Two mica granites are considered as sedimentary protolith of S-type. K_2O Vs Na_2O diagram indicates that granites and muscovite-biotite granites involve S-type, it formed from the supracrustal origin. Quartz - Albite - Orthoclase diagram indicates that it lies within 2kb and 10 kb. According to ternary plot of Quartz-Anorthite-Orthoclase diagram exhibits that the majority of all granitic rock samples were formed between 0.5kb and 5kb. It can be suggested that the granitic rocks from the research area were consolidated under the low pressure condition. From differentiation index and temperature diagram, the liquidus temperatures are 720˚C for granites and muscovite-biotite granites. Depth of the crystallization of the granitic rocks can be expressed from the schematic depth-temperature diagram, it may be interpreted that granites and muscovite-biotite granites crystallized at the depth of 26km. In plots of M/AFM Vs F/AFM, C/ACF Vs F/ACF and SiO_2 Vs Al_2O_3 diagrams show the granitic rocks of the research area fall within the IAG+CAG+CCG field. Again, in the Shand's Index diagram, the granitic rocks fall in the CAG and CCG field. According the above mentioned data, it can be safely considered that the granitoid rocks of the research area are Orogenic granitoids. Therefore, the granitic rocks were formed on the continent relation to the

subduction of an oceanic plate beneath the continent. R_1-R_2 binary (millication) diagram indicates the granitic rocks of the research area correspond to syn-collision zone.

Acknowledgements

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ESTIMATION OF REMAINING OIL RESERVES ON 2700 FT SAND (PYAWBWE FORMATION) CD FAULT BLOCK, MANN OIL FIELD

Tin Myint Oo[1], Day Wa Aung[2] and Thet Tun[3]

Abstract

Reserves estimation is heavily affected by technical uncertainty. The underground oil reserves estimation methods can be grouped in three groups. There are Analogy Method, Volumetric Method and Performance Method. Performance Method includes Material Balance Method, Decline Curve Analysis and Reservoir Simulation. In early stages of development, reserves estimates are restricted to the Analogy and Volumetric calculation. As production and pressure from a field become available, Decline Curves Analysis and Material Balance calculation, become predominant methods of calculating reserves. These methods greatly reduce the uncertainty in reserve estimates; however, during early depletion, caution should be exercised in using them. Decline Curves relationships are empirical, and rely on uniform, lengthy production periods. It is more suited to oil wells, which are usually produced against fixed bottom-hole pressure. Analysis on these methods, however provide quality assurance, for estimating hydrocarbon reserves. Different estimation methods may yield significantly different results, and reconciliation of the differences may be difficult. If there are wide differences, application of two or more methods may reveal the need for future investigation. Comparison of the reserves estimates with actual results on a post mortem basis will provide valuable learning point. The comparison must include quantitative assessment of basis and accuracy of estimate.

Keyword: reserves, material balance, decline curve, volumetric and simulation

Introduction

The Mann anticline is located in the Minbu District, Magway Region, between latitude 18° 10′ to 18° 18′ and longitudes 94° 45′ to 95° 0′, covering about 10 square miles (6400 arces). The Mon Chaung is the northern boundary and the Sabwet Chaung is the southern boundary. The area north of latitude 18° 14′ is a flat plain with average elevation of 140 ft above sea level covered by alluvium. The area between latitudes 18° 14′ and 18° 10′ is a fairly rugged terrain with average elevation of 250 ft covered by Miocene to Oligocene rocks.

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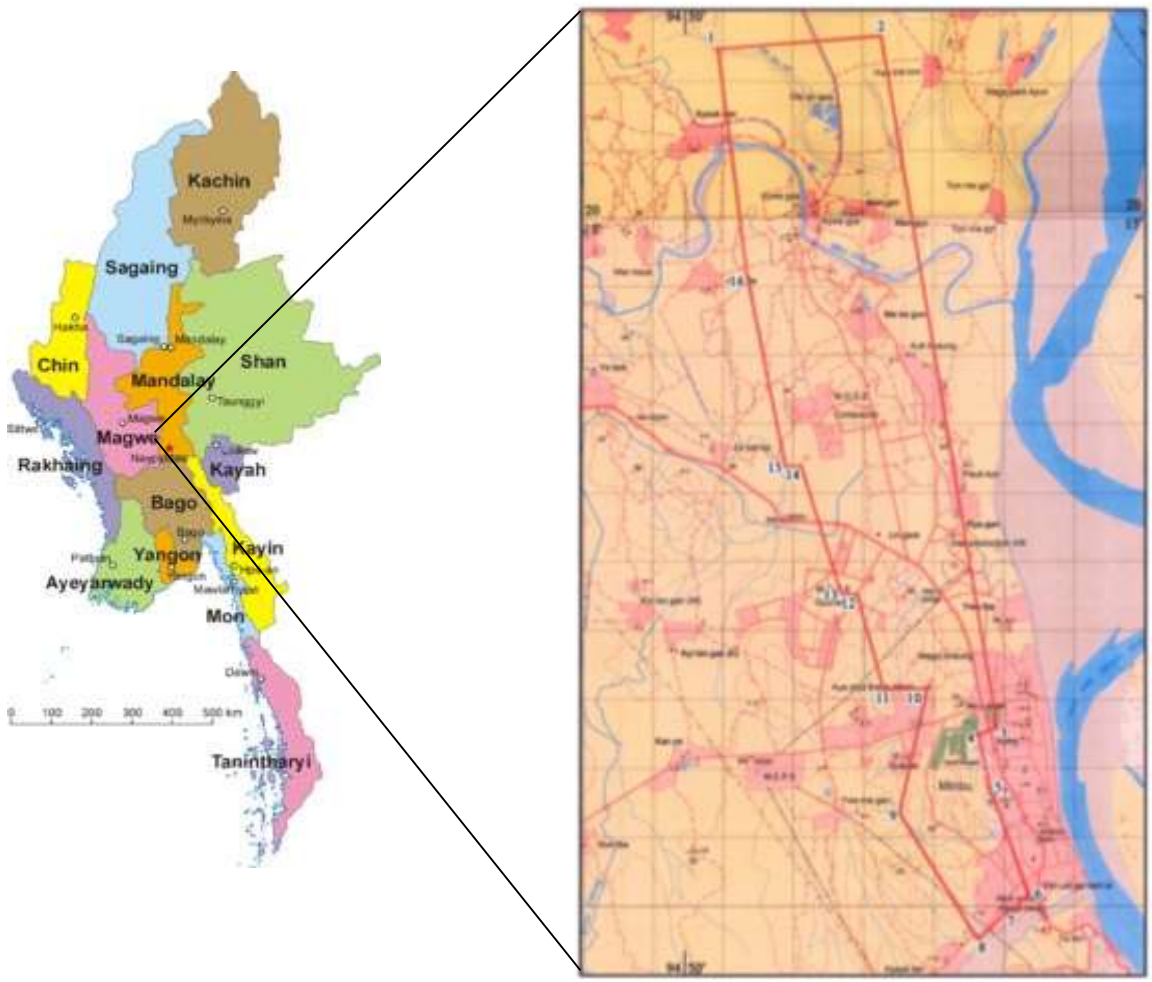


Figure (1) Location map of the study area

Geology of Mann Oil field

The Mann anticline occupies northern crestal area and northern plunging area of the Minbu anticline. The Minbu anticline is an asymmetrical, elongated anticline continuing from the Tagaing-Chaungtha structural trend through Peppi, Palanyon, and Htaukshabin to Minbu with the NNW-SSE trend. The Minbu-Taggaing- Chaungtha anticlinal structure trend is the first line of structure reference to the Salin Syncline developed on the east flank of Salin Basin shown in figure. The Sabwet Chaung fault located at the latitude 18° 10′ divided Minbu anticline into two anticlines namely Mann anticline and Htaukshabin anticline.

Mann anticline is a broad-crested, asymmetric, cross and crest ally faulted anticline bound to the east by the west hading thrust. The dips are as high as 70° on the west flank and rarely exceed 30° on the east flank. The nose of the anticline and most of the crestal area have dips in the range 10° -15°.Geological map of the Mann anticline is shown in figure.

The Minbu Structure is thrusted in the east flank hading toward west, there are both longitudinal and cross fault. It is rise from the Salin syncline around Latitude 20° 21' N and terminates in the Peppi area, a distance of 30 miles. The northern plunging end of this structure (where Mann oil field is situated), which is to aboard, gentle and stable anticline, under cover of the alluvial and Irrawaddies was discovered by gravity and seismic surveys. To the south a number of structural highs are present along the trend on which 6 small oil fields; Shwelinban,

Taukshabin, Palanyon, Yethaya, and Peppi are siturated. A west ward hading thrust is present along the eastern flank of the structure to the south of Sabwet Chaung. To the south, the Minbu structure is in continuation with the Tagaing-Chaungtha structural trend. Minbu structure consist of four oil and gas fields Peppi, Htaukshabin, Tabin and Mann. Mann is latest one of the largest oil field discovered by MOGE in 1970.

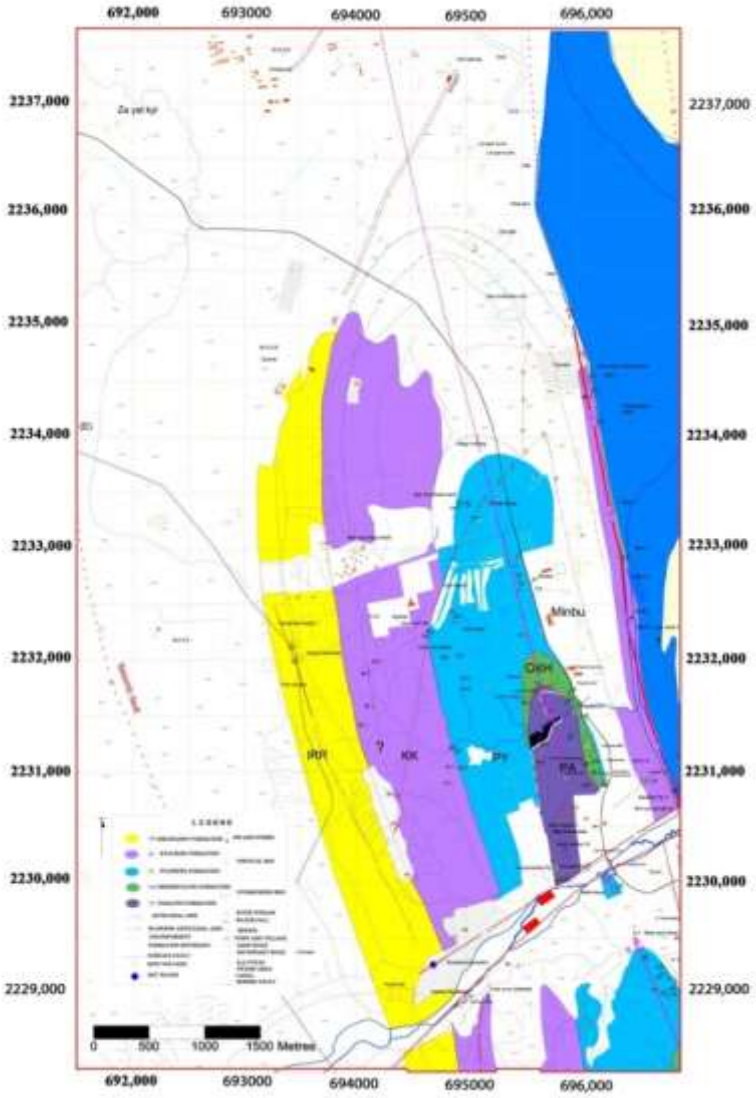


Figure (2): Geological map of Mann anticline (source: MPRL E&P,2009)

Well log correlation to Pyawbwe Formation

The Pyawbwe Formation of Early Miocene age has been described as open marine / deeper shelf deposits (Stuart et al., 1992). They also state that the non-marine to paralic environments grade southwards through delta front and prodelta environments. Mann Field is located in a mid-outer neritic environment according to Stuart et al. (1992). Within the sequences, Stuart et al. (1992) describes the occurrence of a basal Sequence Boundary, a Transgressive System Tract and a Highstand System Tract.

The Pyawbwe Formation is characterized by a series of prograding and aggrading log characteristics. The progrades are subtle, and it is often not possible to recognize a general

increase or decrease in prograde thickness and sand content. This is especially true for the lower portion of the formation. A significant break in lithological characterisation occurs at the top 3200'sand. Generally, the sequence below the 3200'sand is less mud prone and consists of a series of sands and shales, according to the serrated log pattern. The succession on top of the 3200'sand shows a higher mudstone content. The top 3200'sand is a very significant marker horizon and characterises a break in sedimentation character (also observed in core). It is believed to form a major break in sedimentation in the entire area and is definitively a sequence boundary and showing a change in depositional setting in the delta environment.

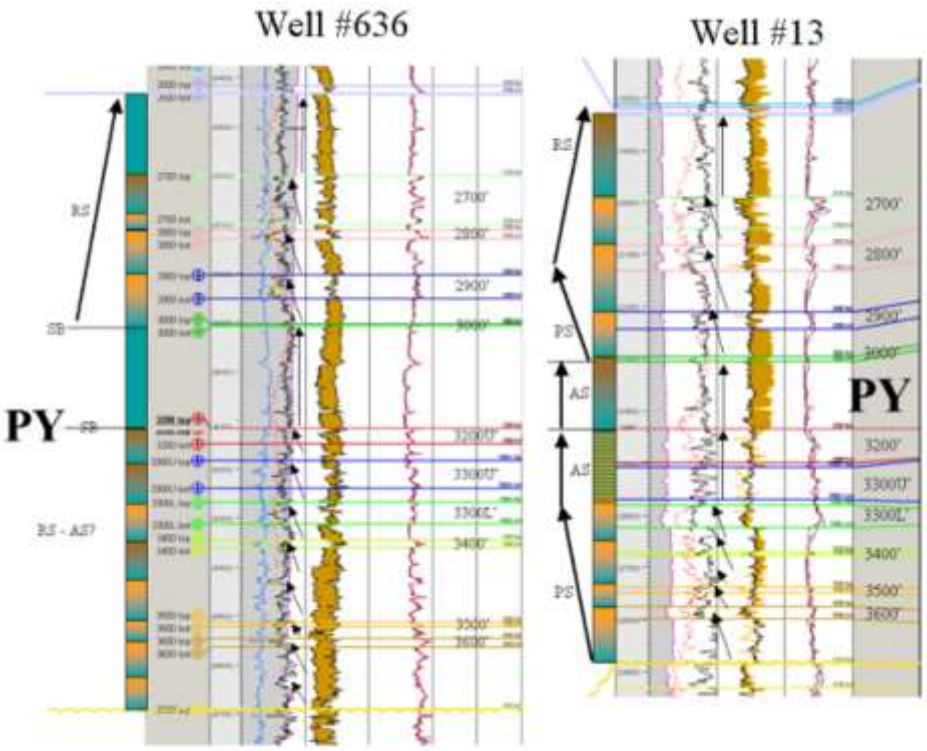


Figure (3): Wells M-636 and M-13, sequences in Pyawbwe Formation. (SB = Sequence boundary, PS = Progradational seq., AS = Aggradational seq., RS = Retrogradational seq.)(source: MRRL.E&P,2009)

The base of Pyawbwe is characterized by a regional unconformity. From core, the location of this regional unconformity is located at the base of the 3600ft sand. The base 3600ft sand is a generally sharp-based event in log expressions. Individual sand units show a typically serrated log pattern, indicative for mudstone intercalations in the sand bodies. This is also defined by core descriptions. Individual, well-to-well correlations of sand bodies with a similar log character are hard to make. This would indicate a high degree in mudstone intercalations and reservoir heterogeneities on a local scale.

The overall deepening of the depositional environment up to the 3200ft sand, interpreted in core, is not directly expressed by the sequence visible in logs in this lower Pyawbwe Formation. However, the core interpretations agreed with the general observation on the deepest deposits, the thick sequences of prodelta mudstones overlying the 3200ft sand, with its deepest deposits to occur between the 2900ft and the 2800ft sand. This brake represents a change from a more sandstone and shale dominated lower Pyawbwe sequence into a series of thicker prodelta mudstones and lower to upper delta front sands in the upper Pyawbwe sequence on basis of log

characteristics. In literature, there is not referred to any break in the Pyawbwe Formation, and has as such not been identified. If this is a local Mann Field feature is not known. Wells located towards the northern part of the Mann Field show less well developed sand units, according to log expressions, and sequences are increasingly mud rich.

Analytical Methods

Primary reservoir performance of oil and gas reservoirs is dictated by natural viscous, gravity and capillary forces. It is characterized by variations in reservoir pressure, production rates, gas oil and water oil ratios, aquifer water influx and gas cap expansion. Factor influencing the reservoir performance are geological characteristics, rock and fluid properties, fluid flow mechanisms, and production facilities. The quality of reservoir management is also very important because the same reservoir exploited by different engineering and operating personnel with different method used in reserves estimation.

Procedure

General

To better understand reserves estimation, a few important terms require definition. Original oil in place (OOIP) and original gas in place (OGIP) refer to the total volume of hydrocarbon stored in a reservoir prior to production. Reserves or recoverable reserves are the volume of hydrocarbons that can be profitably extracted from a reservoir using existing technology. Resources are reserves plus all other hydrocarbons that may eventually become producible; this includes known oil and gas deposits present that cannot be technologically or economically recovered (OOIP and OGIP) as well as other undiscovered potential reserves.

The process of estimating oil and gas reserves for a producing field continues throughout the life of the field. There is always uncertainty in making such estimates. The level of uncertainty is affected by the following factors:

1. Reservoir type,
2. Source of reservoir energy,
3. Quantity and quality of the geological, engineering, and geophysical data,
4. Assumptions adopted when making the estimate,
5. Available technology, and
6. Experience and knowledge of the evaluator.

Estimating hydrocarbon reserves is a complex process that involves integrating geological and engineering data. Depending on the amount and quality of data available, one or more of the following methods may be used to estimate reserves: 1. Analogy, 2. Volumetric, 3. Material balance calculations 4. Reservoir simulation 5. Decline analysis

Volumetric Estimation of Remaining Original Oil In Place Reserves

In the present study, the remaining original oil in place reserves of three oil pools such as 2400ft sand CD fault block, 2700 ft sand CD fault block and 3700 ft sand BC fault block by volumetric method..

The steps of the volumetric estimation used in the present are:

1. Measure the depth of the top of the oil reservoirs (below sea level) in the drilled wells by well to well correlation

2. Measure the subsurface position (distance and direction from surface position) of the individual oil reservoir by well deviation plot.
3. Draw the equal depth contour map of the top of the individual oil reservoir.
4. Draw the equal depth contour map of the each fault identified in the wells by well to well correlation
5. Superimpose fault contour map and depth contour map of the oil reservoir and generate stratum contour map on top of individual reservoir.
6. Draw the bubble map based on the cumulative production of the reservoir in each well.
7. Draw the original oil-water margin and original gas- oil margin based on the initial production of wells.
8. Draw the current oil- water margin and gas-oil margin based on the current production data of the well.
9. Calculate true vertical gross thickness of the reservoir from the thickness measured from the deep resistivity log motifs of the wells located in the oil zone.

TVT=(MLT)(cos Ø1-Øa)(cos Øa)

Where; TVT = true vertical thickness

MLT = MT=measured log thickness

Ø = apparent bed dip along directional well depth

Ø1= Angle of well Drilled up dip

MC=VE= true stratigraphic thickness

VT= true vertical thickness

Measure thickness of the shale and hard ban by using spontaneous potential (SP), gamma ray (GR) and deep resistivity log motifs. Then calculate net reservoir thickness by deducting the thickness of shale and hard band from the true vertical gross thickness.

10. Draw the net reservoir isopach map and transfer current oil-water margin and gas-water margin on the isopach map.
11. Calculate Sw value of the individual reservoir in the wells located within oil zone. Then draw iso-saturation map (Isosat) of the reservoir. Then transfer the oil-water margin and gas-oil margin on the isosat maps.
12. Calculate porosity value of the individual reservoir in the wells located within oil zone. Then generate iso-porosity (Isopor) map of the reservoir.
13. Generate 200m x 200m grid map and transfer on the isopach, isosat and isopor maps.
14. Calculate the area of the grid, respective average thickness, average Sw and average porosity.
15. Calculate oil formation volume factor of the individual reservoir based on the current reservoir pressure.
16. Calculate the original oil in place for each grid by using the formula OOIP= [7758x grid area (acre) X average thickness within the grid (in feet) x average porosity within the grid (fraction) x average Sw within the grid (fraction)]/ oil formation volume factor (Bo)

The OOIP results of the reservoirs within the remaining oil zones are described in table (5).

Calculation of net pay thickness

The net pay thickness of the individual sand is calculated as follows;

Net pay thickness = True stratigraphic thickness (TST) – Shale and hard band thickness (SHT)

True stratigraphic thickness of the sand is calculated by

BED DIP = DEGREES (ATAN (CI/HCS)

TST = MLT*(COS (RADIANS (WELL DEV - BED DIP)))

Where; CI = contour interval

HCS= horizontal contour spacing

TST = true stratigraphic thickness

MLT= measured log thickness

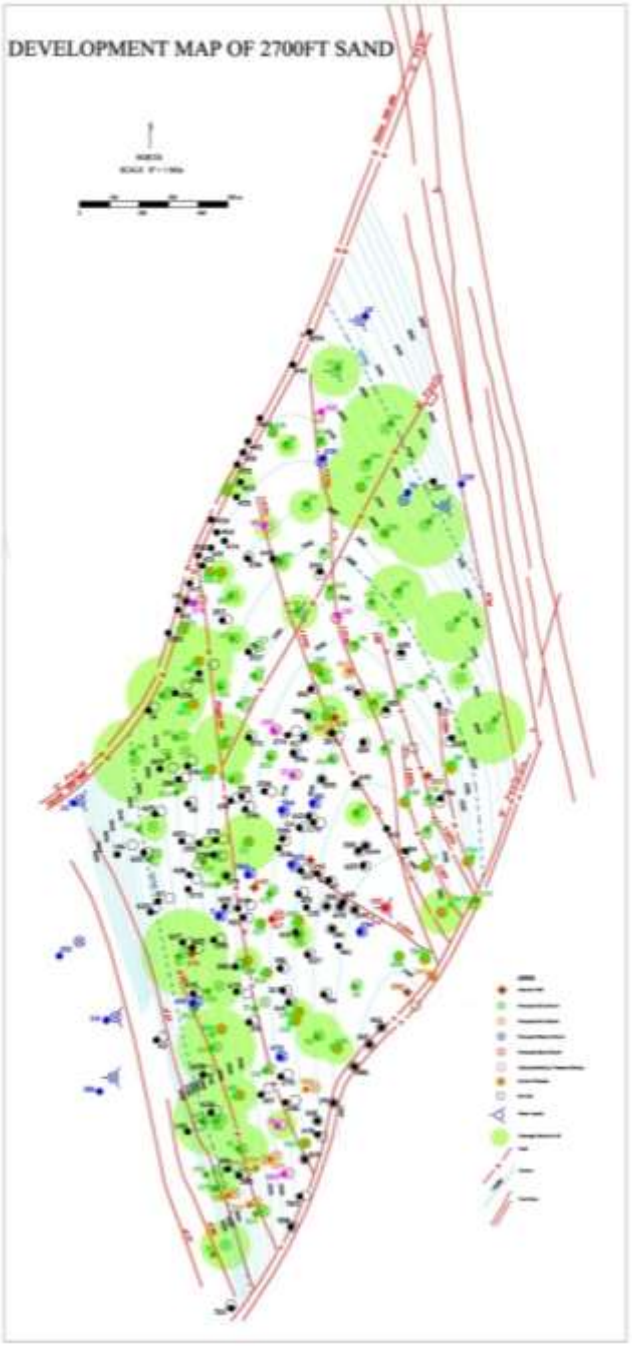


Figure (4) Strantum contour map on top of 2700 ft sand CD fault block, Mann oil field (Source: MPRL.E&P,2009)

Table (1) Net pay thickness of 2700 ft sand remaining oil area CD fault block

Well No	Top	Base	Gross Thickness (ft)	HCS (ft)	CI(ft)	Bed Dip angle	Well Deviation angle	TST (ft)	SHT (ft)	Sub-X	Sub-Y	NPT (ft)
80	2342.6	2409.1	67	121	100	39	2.1	53	12	694710.9	2237108.6	41
241	2458.9	2524.3	65	121	100	39	3.3	53	22	694768.6	2236788.1	31
13	1990	2051.1	61	151	100	34	3.5	53	12	694625.3	2236771.1	41
215	2068.3	2118	50	151	100	34	3.4	50	17	694628.5	2236884	33
196	2153.9	2200	46	151	100	34	3	40	12	694637.7	2236993.7	28
296	2194.7	2244	49	151	100	34	3	42	16	694674.6	2236989.1	26
139	2291.9	2330	38	151	100	34	4.3	33	10	694539.1	2237350.1	23
86	2460	2513	53	213	100	25	2.8	49	10	694615.5	2237384.3	39
620	2425.1	2480	55	243	100	22	1.5	51	20	694542.3	2237487.9	31
578	2451	2510	59	243	100	22	0	55	18	694516.4	2237565.1	37
137	2497	2545	48	272	100	20	1.9	46	18	694441.3	2237656.7	28
221	2481.7	2525	43	607	100	9	4.9	43	20	694304.4	2237691.6	23
38	2357	2401	44	453	100	12	3.7	43	20	694383.4	2237516	23
117	2234	2280	46	377	100	15	1.5	45	18	694448.9	2237319.3	27
185	2222.7	2270	47	377	100	15	2.5	46	21	694490.9	2237292.9	25
41	2134.2	2180	46	728	100	8	2.4	46	22	694490.5	2237164.6	24
196	2153.9	2200	46	728	100	8	3	46	12	694637.7	2236993.7	34
215	2068.3	2115	47	728	100	8	3.4	47	24	694628.5	2236884	23
94	1977.8	2000	22	607	100	9	2.5	22	3	694552.6	2236817.2	19
545	2166.7	2226	59	151	100	34	7	53	30	694680.8	2236617.2	23
19	2801.5	2852	51	545	100	10	1.4	50	18	694159.5	2238195.8	32
519	2838.2	2878	40	545	100	10	1.4	39	19	694274.3	2238208.9	20
632	2791.1	2845.9	55	545	100	10	0	54	31	694273.8	2238140.4	23
77	2818	2865	47	182	100	29	3.3	42	12	694407.4	2238053.8	30
184	2897	2942	45	213	100	25	4.1	42	9	694423	2238126.3	33
7	2572	2615	43	607	100	9	2.3	43	11	694283.6	2237827.3	32
293	2525	2565	40	607	100	9	1.5	40	12	694268.8	2237759.5	28
90	2469.3	2515	46	607	100	9	1.6	45	12	694201.2	2237632.7	33
154	2577.7	2618	40	394	100	14	2	39	9	694141.5	2237799.1	30
99	2666.1	2700	34	456	100	12	1.8	33	4	694091.1	2237920.4	29
443	7358	7418	60	545	100	10	0	59	30	693955.5	2238040.8	29
236	2653	2682	29	394	100	14	2.6	28	3	694035.6	2236642.2	25
2	2709.1	2760	51	331	100	17	2.4	49	7	693936.2	2237766.3	42
303	2650.4	2696	46	364	100	15	2	44	12	693977.7	2237687.5	32
357	2644.5	2690	46	364	100	15	2.3	44	17	693955.2	2237606.7	27
127	2590.8	2635	44	364	100	15	1.5	43	12	693983.1	2237542.1	31
173	2531	2575	44	364	100	15	1.9	43	11	694064.1	2237515.6	32
23	2471.5	2514	43	394	100	14	3	42	9	694060.4	2237413.3	33
103	2553.6	2597	43	269	100	20	4.5	42	6	693935.2	2237386.4	36
262	2490.9	2535	44	394	100	14	5	44	9	694018.3	2237313	35
89	2526.1	2571	45	269	100	20	2	43	2	693943.4	2237186.7	41
220	2550	2600	50	180	100	29	4.9	46	10	693899.8	2237100	36
298	2751.3	2800	49	304	100	18	7	48	10	693817.9	2237384.1	38
356	2679	2723	44	304	100	18	3	42	13	693910.5	2237455.7	29
98	2699.1	2745	46	304	100	18	2	44	6	693858.6	2237465.7	38
276	2768.2	2803	35	331	100	17	4	34	3	693869.4	2237674.1	31
278	2477.6	2516	38	304	100	18	4	37	5	693943.5	2236864.6	32
158	2456.8	2495	38	180	100	29	3.1	34	15	693949.2	2236743.1	19
5	2455	2500	45	180	100	29	2.8	40	8	693933.6	2236604.8	32

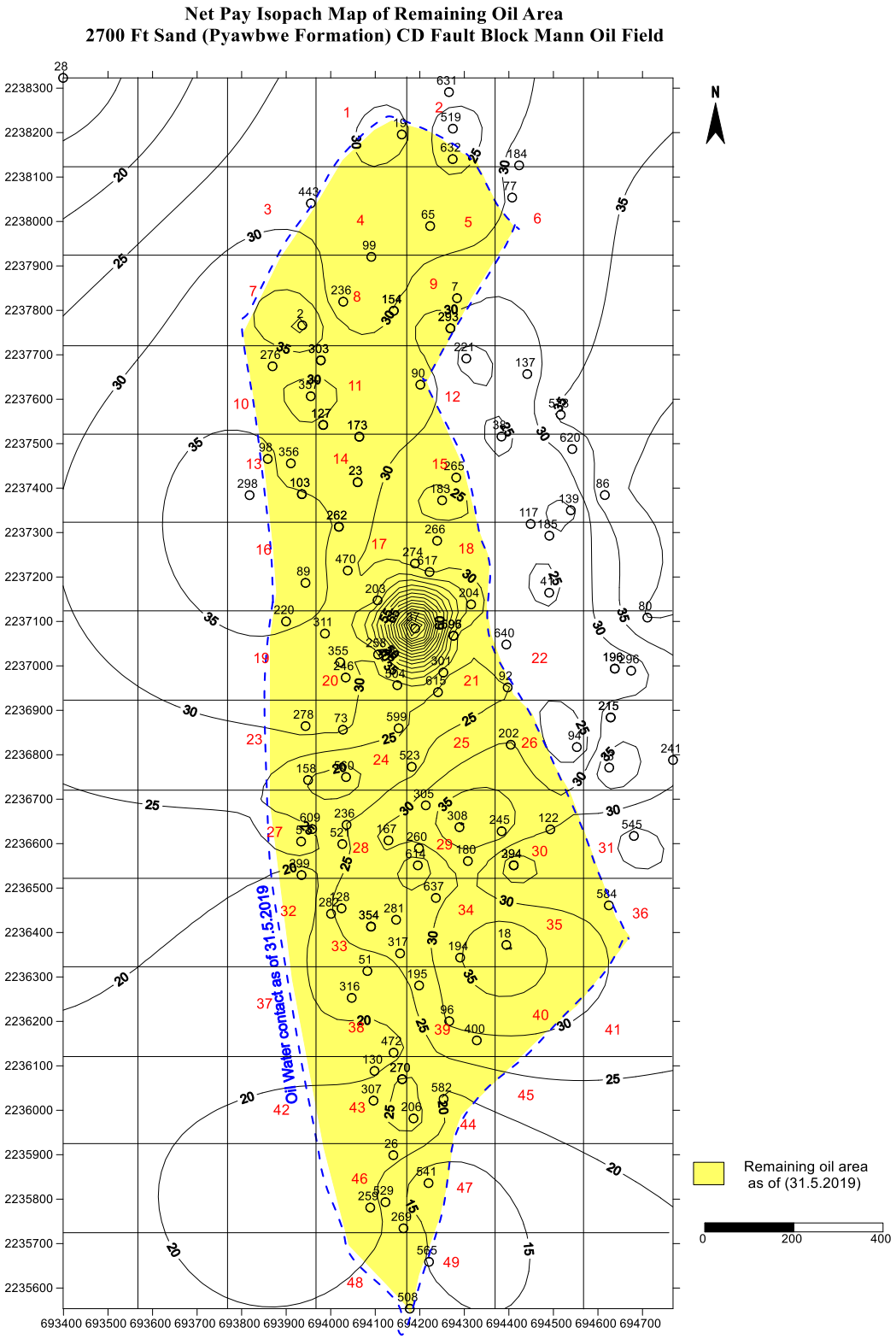


Figure (5) Net pay isopach map of remaining oil area 2700ft sand CD fault block

Calculation of Sw

Table (2) Calculation of Rw at reservoir depth from Rw catalog

RW CATALOGUE MANN OIL FIELD								
SR NO	**WELL NO**	**F/B**	**RW(OHM)**	**@DEG**	**SALINITY(PPMCL)**	**SAMPLE DEPTH**	**SAND(FT)**	**FORMATION**
1	25	BC/CD	1.05	@86	1600	2750-2770	2200	KYAUKKOK
2	100	BC/CD	1.14	@86	1200	3015-3160	23/2400	KYAUKKOK
3	170A	BC	2	@86	1900	2765-2810	2200	KYAUKKOK
4	170B	BC	1.13	@86	400	2890-2940	2300	KYAUKKOK
5	181	BC	0.92	@86	1150	2680-3020	22/23/24/2500	KYAUKKOK
6	187	BC	1.34	@82	1000	2875-3025	24/2500	KYAUKKOK
7	229	BC	1.69	@82	500	2940-3055	2400	KYAUKKOK
8	234	BC	1.69	@86	850	3065-3085	2300	KYAUKKOK
9	15	BC	0.59	@83	4900	4810-4825	3600	PYAWBWE
10	71	DS	0.74	@86	4000	1485-1510	2800	PYAWBWE
11	106	CD	1.64	@86	550	2932-2965	2700	PYAWBWE
12	123	CD	0.93	@82	2750	3090-3125	2700	PYAWBWE
13	149	AB	0.59	@83	5000	5225-5250	3600	PYAWBWE
14	193	CD	0.85	@80	3450	2992-3780	27/3200	PYAWBWE
15	197	CD	0.65	@82	4500	2815-3378	27/3200	PYAWBWE
16	240	CD	0.45	@82	7500	3160-3340	32/3300	PYAWBWE
17	32	CD	0.57	@94	4850	4965-4995	3800	OKHMINTAUNG
18	97	CD	0.52	@80	5850	4045-4080	3700	OKHMINTAUNG
19	150	CD	0.47	@84	7000	3530-3720	37/3800	OKHMINTAUNG
20	172	BC	0.49	@82	6350	4735-4810	3700	OKHMINTAUNG
21	193	CD	0.66	@82	4400	4735-4850	3800	OKHMINTAUNG
22	56	AB	0.56	@94	5050	5920-6315	44/45/4700	PADAUNG
23	61	DS	0.58	@86	5250	3167-3416	L41/43/4500	PADAUNG
24	173	CD	0.38	@80	8200	4120-4230	44/4500	PADAUNG
25	175	BC	0.51	@80	5400	5615-5685	U/L4100	PADAUNG
26	265	CD	0.42	@84	6950	3625-3640	U4100	PADAUNG
27	274	CD	0.43	@80	8750	3957-3967	4500	PADAUNG

Rw Catalogue of Mann oil field provides results at surface temperature and this value must be transformed to a different value based on the formation temperature.

STEP 1: Calculate formation temperature:

1. GRAD = (BHT – SUFT) / BHTDEP

2: FT = SUFT + GRAD * DEPTH

STEP 2: Calculate water resistivity at formation temperature:

3: RW@FT = RW@TRW * (TRW + KT1) / (FT + KT1)

Where: KT1 = 6.8 for English units

KT1 = 21.5 for Metric units

If water salinity is reported instead of resistivity, as may happen in reporting direct from the well site, convert salinity to resistivity with:

4: RW@FT = (400000 / FT1 / WS) ^ 0.88

Note: FT1 is in Fahrenheit

In some cases, salinity is reported in parts per million Chloride instead of the more usual parts per million salt (NaCl). In this situation convert Chloride to NaCl equivalent with:

5: WS = Ccl * 1.645

To convert a downhole RW to a surface temperature, reverse the terms in equation 3:

6: RW@SUFT = RW@FT * (FT + KT1) / (SUFT + KT1)

Where: KT1 = 6.8 for English units

KT1 = 21.5 for Metric units

Sometimes, it is nice to know what the resistivity log would read in a water zone (R0). For quick look work, use the following:

7: R0 = RW@FT ‘ (PHIe ^ 2) For example,

If RW@FT = 0.10 and PHIe = 0.20, then R0 = 0.10 / (0.20^2) = 2.5 ohm-m.

Calculation of Rw from spontaneous potential (SP)

If a good SP log is available, it may be used to calculate RW@FT, as shown below.

STEP 1: Calculate constants

1: GRAD1 = (BHT – SUFT) / BHTDEP

2: FT1 = SUFT + GRAD1 * DEPTH

3: KSP = 60 + 0.122 * FT1 , NOTE: FT1 is in Fahrenheit

STEP 2: Calculate resistivity values

4: RSP = 10 ^ (– SSP / KSP) 5: IF RMF@FT > 0.1

6: THEN RMFE = 0.85 * RMF@FT 7: IF RMF@FT <= 0.1

8: THEN RMFE = (1.46 * RMF@FT – 5) / (337 * RMF@FT + 77)

9: RWE = RMFE / RSP 10: IF RWE > 0.12

11: THEN RW@FT = – (0.58 - 10 ^ (0.69 * RWE – 0.24))

12: IF RWE <= 0.1213: THEN RW@FT = (77 * RWE + 5) / (146 – 337 * RWE)

Note: SP method is not applicable in low porosity (less than 5%) or where shale content is high (greater than 20%) and not work well in a hydrocarbon bearing zone.

Table (3) Well by well calculation of Rw for 2700Ft Sand in the oil remaining area CD fault block

Well No	Surf. Temp. (°F)	BHT (°F)	BHT Measured depth (ft)	Reservoir Depth (ft)	RMF @ surf.Temp. (°F)	SP mv	Fm Temp (°F)	RSP	RwCatlog (Ohm-m)	RwCatlog (TRW) (ohm-m)	RW @ FT Catalog (ohm-m)	RMFE Ohm-m	RMF@FT Ohm-m	RWE Ohm-m)	RW @ FT SP Ohm-m	KT1	KSP
5	74	122	2013	2465	0.84	5	132.8	1.16	1.64	86	1.09	0.41	0.49	0.36	0.43	6.8	76.2
19	91	131	4569	2800	0.52	10	115.5	1.36	1.64	86	1.24	0.35	0.42	0.26	0.29	6.8	74.09
26	78	130	4218	2185	0.67	5	104.9	1.17	1.64	86	1.36	0.43	0.51	0.37	0.45	6.8	72.8
41	86	124	3500	2135	0.79	10	109.2	1.37	1.64	86	1.31	0.54	0.63	0.39	0.49	6.8	73.32
51	99	126	4000	2265	0.52	8	114.3	1.28	1.64	86	1.26	0.39	0.45	0.3	0.35	6.8	73.94
65	85	117	3350	2660	0.48	9	110.4	1.33	1.64	86	1.3	0.32	0.38	0.24	0.26	6.8	73.47
90	76	100	3400	2471	0.62	5	93.4	1.17	1.64	86	1.52	0.44	0.51	0.37	0.46	6.8	71.4
130	72	120	3500	2260	0.36	3	103	1.1	1.64	86	1.39	0.22	0.26	0.2	0.21	6.8	72.57
158	71	124	3450	2456	1.85	15	108.7	1.6	1.64	86	1.32	1.06	1.25	0.66	1.06	6.8	73.27
173	98	132	4266	2530	0.74	8	118.2	1.28	1.64	86	1.22	0.53	0.62	0.41	0.53	6.8	74.42
184	80	118	3600	2897	0.3	8	110.6	1.28	1.64	86	1.3	0.19	0.22	0.15	0.15	6.8	73.49
185	73	116	2950	2223	0.69	8	105.4	1.29	1.64	86	1.36	0.42	0.49	0.32	0.38	6.8	72.86
194	76	124	2570	2012	0.6	1	113.6	1.03	1.64	86	1.26	0.35	0.41	0.34	0.41	6.8	73.86
202	100	122	2612	2010	1.39	18	116.9	1.75	1.64	86	1.23	1.02	1.2	0.58	0.87	6.8	74.27
206	96	123	2348	2114	1.5	20	120.3	1.85	1.64	86	1.2	1.03	1.21	0.56	0.81	6.8	74.68
215	80	128	2550	2068	0.56	9	118.9	1.32	1.64	86	1.21	0.33	0.39	0.25	0.27	6.8	74.51
236	90	130	3612	2653	0.35	5	119.4	1.17	1.64	86	1.21	0.23	0.27	0.2	0.21	6.8	74.56
246	78	121	3136	2381	1.11	6	110.6	1.21	1.64	86	1.3	0.68	0.8	0.56	0.83	6.8	73.5
262	87	130	4223	2490	0.43	7	112.4	1.24	1.64	86	1.28	0.29	0.34	0.23	0.25	6.8	73.71
276	75	136	4594	2770	0.9	5	111.8	1.17	1.64	86	1.28	0.53	0.62	0.45	0.6	6.8	73.64
278	66	126	4142	2478	0.64	2	101.9	1.07	1.64	86	1.4	0.36	0.43	0.34	0.41	6.8	72.43
294	92	110	2857	1951	0.83	2	104.3	1.07	1.64	86	1.37	0.63	0.74	0.59	0.89	6.8	72.72
296	88	122	3613	2195	0.98	5	108.7	1.17	1.64	86	1.32	0.68	0.8	0.58	0.88	6.8	73.26
298	78	132	4572	2750	0.56	5	110.5	1.17	1.64	86	1.3	0.34	0.4	0.29	0.34	6.8	73.48
303	95	126	3901	2650	0.48	5	116.1	1.17	1.64	86	1.24	0.34	0.4	0.29	0.33	6.8	74.16

Determination of Sw

Water saturation values of the 2400 ft sand CD fault block, 2700 ft sand CD fault block and 3700 ft sand BC fault block are calculated well by well in remaining oil area using the Archie's and Hingle methods.

Archie's method

Sw = SQRT (Ro/Rt) Where; SQRT = square root,

Ro = resistivity of 100% water zone-ohm-m, Rt = resistivity of uninvited zone ohm-m

Hingle method

1: Sw = (F*RW@FT/RES)^(1/N) 2: F = A/(PHIe^M)

Where; A= tortuosity exponent (fractional), F = formation factor (fractional)

M = cementation exponent (fractional), N = saturation exponent (fractional)

PHIe = effective porosity (fractional), RESD = deep resistivity (ohm-m)

RW@FT = water resistivity (ohm-m), Sw = water saturation (fractional)

Calculation of porosity

Since there is a limited porosity and core analysis data, the porosity value in each well within the current remaining oil zone is calculated by the formula below using deep resistivity value.

PHIrt = (A / ((RESD / RW@FT) * (SW ^ N))) ^ (1 / M)

Where:

A = tortuosity exponent M = cementation exponent

N = saturation exponent, PHIrt = porosity from deep resistivity (fractional)

RESD = deep resistivity log reading (ohm-m), RW@FT = fm. water resistivity (ohm-m)

SW = water saturation in un-invaded zone (fractional)

Comment

No shale corrections are applied, so use caution. This method is not usually used in hydrocarbon zones and is an absolute last resort. The result is often used in a porosity playback log (with SW = 1.00) to look for possible hydrocarbon zones by observing the separation between PHIrt and the other porosity logs. Shale corrected methods may be created from the various shale corrected saturation equations.

Recommended Parameters

Normal values for A, M, N and SW: for water zones SW = 1.00

for sandstone A = 0.62 M = 2.15 N = 2.00 and for carbonates A = 1.00 M = 2.00 N = 2.00

for hydrocarbon zone with (high porosity SW = 0.20,medium =0.04 and low= 0.60)

Table (4) Calculation of Sw and porosity for 2700ft sand in remaining oil area CD fault block

Well No	Fault Block	Sand	A	M	N	RESD (Deep resistivity	Ro	RW@FT Catalog	RW@FT SP	SW (Archie's)	PHIrt Catalog Fraction	PHI SP	PHI Deep	Avg.	F	Sw
		(FT)	tortuosity exponent	Cementation Exponent	Saturation Exponent	(Ohn-m)	(Ohn-m)	(Ohn-m)	Ohn-m)	uninvated zone (fractional)		fraction	fraction	PHI (friction)		(HINGLE) (friction)
19	CD	2700	0.62	2.15	2	15	5	1.24	0.29	0.58	0.54	0.43	0.43	0.47	3.17	0.51
26	CD	2700	0.62	2.15	2	30	7	1.36	0.45	0.48	0.57	0.51	0.43	0.5	2.72	0.35
41	CD	2700	0.62	2.15	2	18	7	1.31	0.49	0.62	0.5	0.42	0.38	0.43	3.76	0.52
51	CD	2700	0.62	2.15	2	20	7	1.26	0.35	0.59	0.51	0.41	0.39	0.44	3.67	0.48
65	CD	2700	0.62	2.15	2	13	7	1.3	0.26	0.73	0.45	0.3	0.35	0.37	5.37	0.73
90	CD	2700	0.62	2.15	2	11	6	1.52	0.46	0.74	0.48	0.36	0.39	0.41	4.22	0.76
130	CD	2700	0.62	2.15	2	23	5	1.39	0.21	0.47	0.6	0.5	0.47	0.52	2.49	0.39
158	CD	2700	0.62	2.15	2	23	5	1.32	1.06	0.47	0.6	0.59	0.46	0.55	2.24	0.36
173	CD	2700	0.62	2.15	2	13	5	1.22	0.53	0.62	0.52	0.45	0.41	0.46	3.25	0.55
184	CD	2700	0.62	2.15	2	23	6	1.3	0.15	0.51	0.56	0.43	0.43	0.48	3.05	0.41
185	CD	2700	0.62	2.15	2	15	4	1.36	0.38	0.52	0.59	0.51	0.48	0.53	2.46	0.47
194	CD	2700	0.62	2.15	2	25	5	1.26	0.41	0.45	0.61	0.55	0.47	0.54	2.34	0.34
202	CD	2700	0.62	2.15	2	17	6	1.23	0.87	0.59	0.52	0.49	0.4	0.47	3.13	0.48
206	CD	2700	0.62	2.15	2	25	6	1.2	0.81	0.49	0.57	0.55	0.43	0.52	2.58	0.35
215	CD	2700	0.62	2.15	2	20	4	1.21	0.27	0.45	0.62	0.54	0.48	0.55	2.28	0.37
236	CD	2700	0.62	2.15	2	10	5	1.21	0.21	0.71	0.49	0.33	0.39	0.4	4.41	0.73
246	CD	2700	0.62	2.15	2	18	5	1.3	0.83	0.53	0.57	0.54	0.45	0.52	2.55	0.43
262	CD	2700	0.62	2.15	2	12	5	1.28	0.25	0.65	0.52	0.38	0.41	0.44	3.69	0.63
276	CD	2700	0.62	2.15	2	12	4	1.28	0.6	0.58	0.57	0.5	0.46	0.51	2.65	0.53
278	CD	2700	0.62	2.15	2	23	4	1.4	0.41	0.42	0.64	0.58	0.51	0.57	2.04	0.35
294	CD	2700	0.62	2.15	2	13	5	1.37	0.89	0.62	0.54	0.5	0.43	0.49	2.93	0.56
296	CD	2700	0.62	2.15	2	15	4	1.32	0.88	0.52	0.59	0.56	0.48	0.54	2.3	0.45
298	CD	2700	0.62	2.15	2	10	4	1.3	0.34	0.63	0.55	0.43	0.45	0.47	3.1	0.63
303	CD	2700	0.62	2.15	2	13	4	1.24	0.33	0.55	0.57	0.47	0.46	0.5	2.74	0.51

PVT Analysis Result

The PVT analysis of the 2400ft sand CD fault block, 3200 ft sand CD fault block and 3700 ft sand BC fault block are mentioned in table. The oil formation volume factor of 2700 ft sand was not available in the present study and used the value of 3200 ft sand.

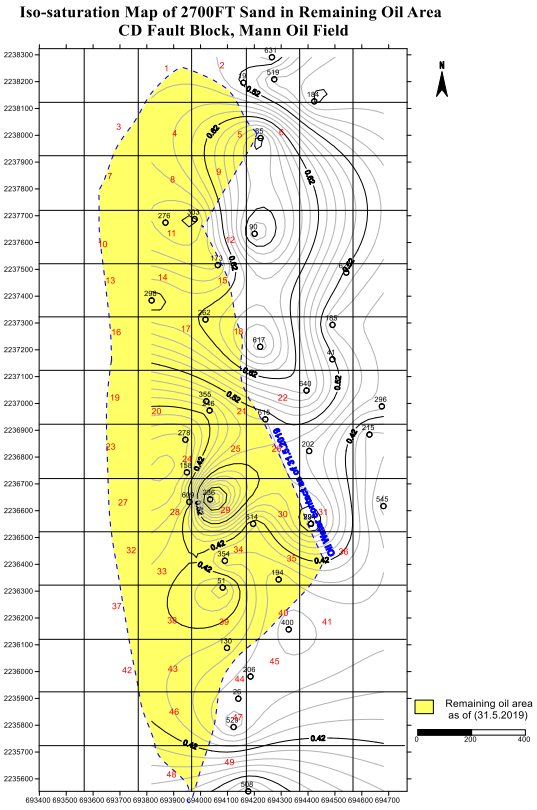


Figure (6) Iso-Saturation map of 2700ft sand CD fault block

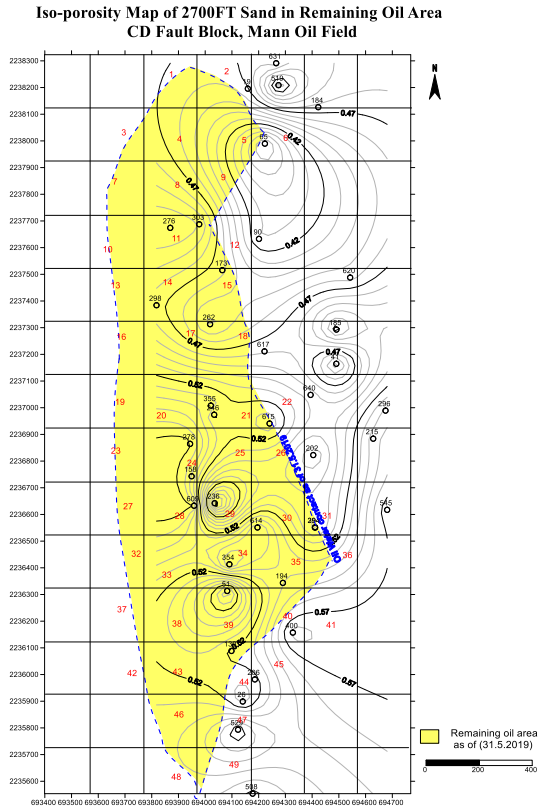


Figure (7) Iso-porosity map of 2700ft sand CD fault block

Table (5) 2700FT SAND CD FAULT BLOCK

Grid No	Area (m^2)	Area (acre)	Avg. Net Sand Thickness (ft)	Average Porosity	Average water saturation fraction)	Boi (rbbl/stb)	IOIP (stb)
1	17311.01	4.3	30	0.465	0.56	1.122	181547
2	17293.19	4.3	25	0.455	0.56	1.122	147883
3	8152	2	30	0.48	0.68	1.122	64182
4	40000	9.9	30	0.465	0.66	1.122	324154
5	40000	9.9	27.5	0.42	0.6	1.122	315748
6	3614.86	0.9	35	0.41	0.67	1.122	29248
7	25705.84	6.4	30	0.5	0.58	1.122	276701
8	40000	9.9	30	0.48	0.58	1.122	413343
9	27255.9	6.7	30	0.45	0.62	1.122	238900
10	26266.52	6.5	35	0.5	0.57	1.122	337713
11	40000	9.9	32.5	0.46	0.58	1.122	429130
12	16309.4	4	30	0.48	0.62	1.122	152483
13	21841.97	5.4	35	0.49	0.59	1.122	262409
14	40000	9.9	32.5	0.47	0.59	1.122	428020
15	30782.59	7.6	27.5	0.46	0.57	1.122	286090
16	18920.7	4.7	35	0.475	0.56	1.122	236478
17	40000	9.9	32.5	0.485	0.57	1.122	463225
18	38279.3	9.5	35	0.465	0.56	1.122	468356
19	21589.08	5.3	35	0.55	0.47	1.122	376339
20	40000	9.9	30	0.55	0.46	1.122	608943

Grid No	Area (m^2)	Area (acre)	Avg. Net Sand Thickness (ft)	Average Porosity	Average water saturation fraction)	Boi (rbbl/stb)	IOIP (stb)
21	40000	9.9	35	0.52	0.51	1.122	609489
22	6627.1	1.6	25	0.51	0.52	1.122	69297
23	21700.62	5.4	27.5	0.57	0.36	1.122	371962
24	40000	9.9	25	0.57	0.36	1.122	623295
25	40000	9.9	25	0.52	0.44	1.122	497542
26	27100.87	6.7	30	0.51	0.49	1.122	361313
27	19778.61	4.9	25	0.57	0.36	1.122	308198
28	40000	9.9	25	0.56	0.44	1.122	535815
29	40000	9.9	32.5	0.48	0.52	1.122	511758
30	40000	9.9	32.5	0.52	0.47	1.122	612155
31	4321.09	1.1	30	0.49	0.52	1.122	52094
32	14540.8	3.6	20	0.54	0.4	1.122	160991
33	40000	9.9	25	0.53	0.42	1.122	525222
34	40000	9.9	30	0.53	0.42	1.122	630266
35	40000	9.9	32.5	0.51	0.42	1.122	657023
36	14074.54	3.5	30	0.53	0.42	1.122	221768
37	8220.81	2	20	0.52	0.42	1.122	84726
38	40000	9.9	22.5	0.51	0.42	1.122	454862
39	40000	9.9	30	0.49	0.42	1.122	582699
40	25490.87	6.3	32.5	0.54	0.38	1.122	473906
43	40000	9.9	22.5	0.52	0.4	1.122	479773
44	28388.18	7	22.5	0.52	0.39	1.122	346172
46	30361.11	7.5	20	0.53	0.41	1.122	324425
47	17644.68	4.4	15	0.54	0.37	1.122	153843
48	8523.01	2.1	17.5	0.54	0.38	1.122	85321
49	6106.66	1.5	17.5	0.54	0.38	1.122	61132
							15835938

Determination of the Driving Mechanism of Mann Field Oil Reservoirs

The natural energy which is responsible for moving the reservoir fluids (oil, gas and water) from the reservoir to the wellbore come from are; liberation and expansion of solution gas, influx of aquifer water, contraction of reservoir rock skeleton, expansion of original reservoir fluids(free gas, interstitial water, oil etc.), gravitational forces. In order to properly understand the nature of a reservoir and to make predictions about its performance, it is necessary to evaluate how those mechanisms control fluids behavior. Seven types of driving mechanism that provide natural energy sources for hydrocarbons recovery.

In order to properly understand the nature of a reservoir and to make predictions about its production performance, it is necessary to evaluate how those mechanisms control fluids behavior and movement.

Table (6) Estimation of recoverable reserves based on driving mechanism

Pool	Driving Mechanism	Recovery Factor	OOIP (mmstb)	Recoverable Reserves (mmstb)
2400 "B" CD	Solution gas	0.18	2.899621	0.5219318
2400 "C" CD	Solution gas	0.18	1.260102	0.2268183
2700 CD	Gas cap + solution gas	0.30	15.835938	4.750781
3700 BC	Gas Cap + Water	0.35	7.951607	2.783063
Total			**27947268**	**8.282594**

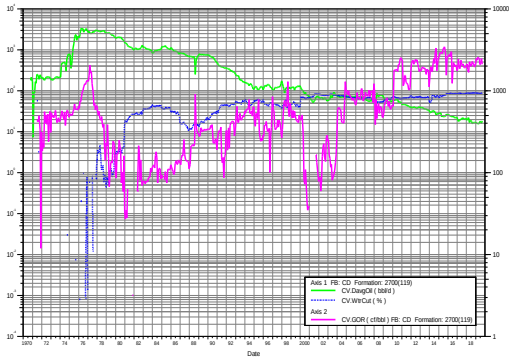


Figure (8) 2700 FT Sand CD Fault Block (Water Drive)

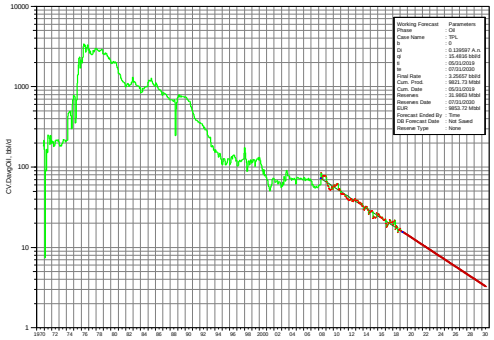
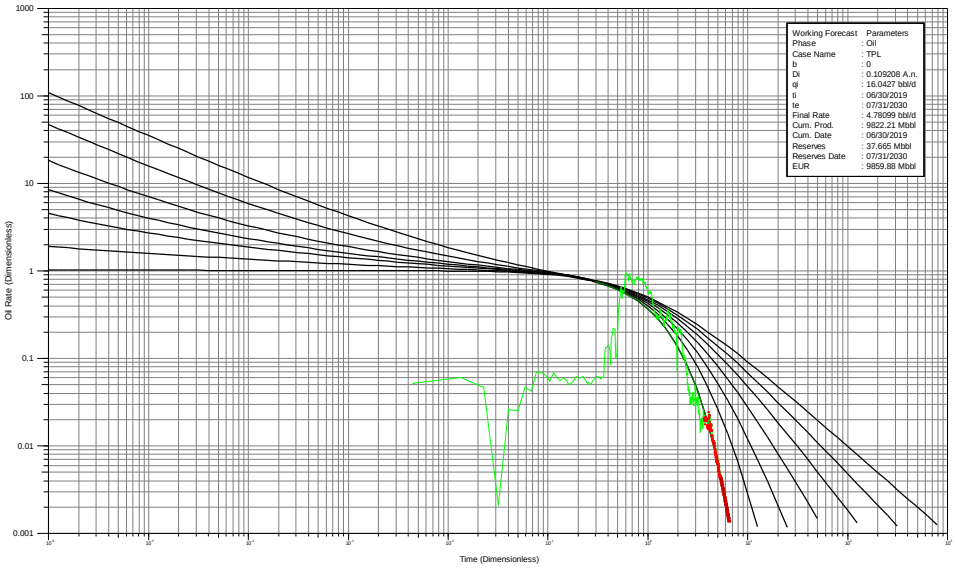


Figure (9) 2700 FT Sand CD Fault Block showing recoverable reserves by decline curve analysis (DCA)

Fetkovich Log-Log Type-Curves

Conventional decline-curve analysis should be used only when mechanical conditions and reservoir drainage remain constant and the well is producing at capacity. An advanced approach for decline-curve analysis, which is applicable for changes in pressure or drainage, has been presented by Fetkovich. This technique, which is similar to the approach used in pressure testing, involves log-log plots of q/qi (or qDd) versus at (or tDd) for different values of n. As shown in this figure, a log-log plot of the dimensionless rate and dimensionless time can identify transient data and/or depletion data, the Arps' equations only be applied to rate-time data that indicate depletion. Use of transient data in the Arps' equations will result in incorrect forecasts that are overly optimistic. Fetkovich focused on the early period of production i.e. transient flow and came up with set of type curves that could be combined with Arps empirical decline curve equation. Combining the Fetkovich transient type curves with Arps decline curves and blending them where the two sets of curves meet, result in Fetkovich Decline Type Curve. Fetkovich noted that sometimes the value of b as determined using Arps decline curves was greater than

1(expected to be between 0 and 1). He explained that this could happen if the data being analyzed was still in transient condition and has not reached boundary dominated flow. Accordingly, the Fetkovich type curves are made up of two regions which have been blended to be continuous and thereby encompass the whole production life from early time (transient flow) to late time (boundary dominated flow). The right hand side of Fetkovich type curves is identical to Arps type curve as shown below: The left hand side of Fetkovich type curves are derived from the analytical solution to the flow of a well in the center of a finite circular reservoir producing at a constant wellbore flowing pressure. Fetkovich was able to demonstrate that for all sizes of reservoirs, when transient flow ended, the boundary dominated flow could be represented by an exponential decline.



Figure(10) Type curve analysis of 2700 FT Sand CD Fault Block. (Fetkovich Method) using OFM 2014.

The field data are plotted on tracing paper that has the same log-log scale as the full-size type-curves. The log-log plot of flow rate and time can be in terms of barrels/day versus days, barrels/month versus months, or barrels/year versus years, depending on the time interval being studied. Using the best fit on the appropriate type-curve, a match point can be used to obtain qi and ai for the actual data. The appropriate equation can then be used to analyze the rate, time, and cumulative production behavior.

The decline rate and Ultimate Recovery of the individual pool are calculated by Oil Filed Manager (OFM) software version 2014.

Table (7) Reserves calculation of 2400 CD, 2700 CD and 3700 BC Fault block by Fetkovich Method

Sr. no.	Pool Name	b	Di	Production as of (31/7/2030)		Cumulative Oil Production)	Remaining Oil Reserves
				Rate Bbl/day	EUR Mbbl		
1	2400 CD	0.2939	0.0508	22.607	5769.93	5650.54	119.387
2	2700 CD	0	0.1092	16.043	9859.88	9822.21	37.665
3	3700 BC	0.2411	0.08494	19.572	8713.06	8590.04	123.023

Conclusion

The main objective of the present study is to evaluate the remaining oil potential of the developed oil reservoirs and potential of undeveloped reservoirs. Due to the limited PVT data, fluid properties measurement data, reservoir pressure measurement data and core analysis data, the remaining oil potential of the developed oil reservoirs are not calculated by material balance and reservoir simulation software. Two techniques; volumetric and production curve analysis could be done in the present study. The developed reservoirs in the field are in mature stage and most of them are nearly depleted. Therefore, Original Oil In Place (OOIP) of the four major oil pools which are still producing in considerable amount are estimated by volumetric method in the study.

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DIAGENESIS AND RESERVOIR QUALITY OF PONDAUNG FORMATION IN THE KYAUKKWET-LETPANTO OIL FIELD

Khaing Zin Phyu*

Abstract

The study area is located in the Pauk and Myaing Townships, Pakokku District, Magway Region. The main objective of the present study is to characterize reservoir quality of Pondaung Formation in terms of diagenesis process by SEM and petrography analysis. The two oil and gas fields namely Letpanto and Kyaukkwet, the study area is situated on the northern part of the Salin basin which is a fore-arc sub-basin of the Central Myanmar Tertiary Basin. The stratigraphy of the area includes the formations from oldest to youngest: Pondaung, Yaw, Shwezetaw, Padaung, Kyaukkok and Irrawaddian formations. In diagenetic processes of the Pondaung Formation can be grouped into early diagenesis and late diagenesis. Petrographic and SEM examinations of the studied sandstones revealed both primary and secondary porosities.

Introduction

Diagenesis of Sandstones

Recent diagenetic study have resulted in accurate predictions of sandstone reservoir quality. Petrographic studies are important for characterizing the types, timing and rate at which diagenetic processes affect porosity and permeability in sandstones (Ajdukiewicz, J.M., 2010). In most cases, reservoir quality of sandstones are functions of primary depositional. These depositional factors tend to control the depositional porosity and permeability of the sandstones and subsequently affect the types and extent of diagenetic alterations. Diagenetic modifications usually bring out the changes or variations in the depositional porosity and permeability (Makeen, Y.M., 2016). As burial depth increases, porosity and permeability are often reduced by compaction and cementation, enhanced by dissolution, and preserved by processes like grain coatings (Zhou, X.,2016). Burial diagenesis processes alter and eventually determine the porosity and permeability of the reservoir, hence having a significant impact on the clastics reservoirs quality (Ajdukiewicz, J.M.,2010).

Cementation

The types of cement in the purposeful sandstones are silica cement, calcite cement, smectite cement, kaolinite cement and hematite cement.

Silica cementation

Quartz giantism is the most usual type of silica cement in Pondaung Formation. The silica cement figure (1) precipitated around the detrital grains. The pore filling cement occurred authigenetically situated from pore-fluids. Silica cementation sees to originate from pore fluids which are enriched in silica and precipitated as overgrowths.

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Figure (1) Photomicrograph showing silica cement (red arrow) in the sandstone of the Pondaung Formation.

Calcite Cementation

This is another type of cement in the sandstones of the Pondaung Formation. This cement mostly occurs as a pore-filling and replacement mineral of clay matrix and detrital grains. The calcite cement corroded the grain margins and then produces irregular shaped grains (figure 2 & 3). Most of the clay minerals and detrital grains were attacked and replaced by calcite (figure 2). Precipitation of calcite cements tends to defeat later quartz overgrowth formation and feldspar alteration and reduction of porosity and permeability.

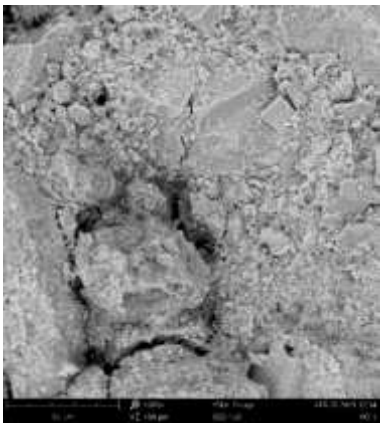


Figure (2) SEM photomicrograph of sandstone sample from the Pondaung Formation showing calcite cement.

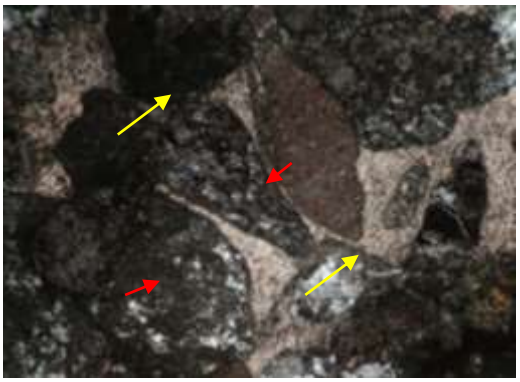
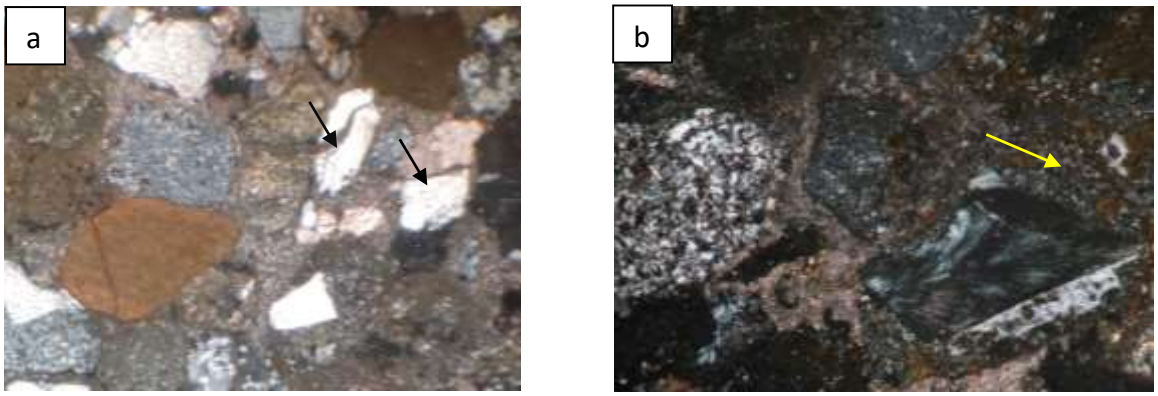


Figure (3) Thin section photomicrograph of sandstone from the Pondaung Formation showing calcite cement (red arrow). The calcite also replaced detrital framework grains (yellow arrow).

Hematite Cementation

Hematite cement is other types of cement in the sandstones. The cement causes directly in the intergranular pore space or line on the grain surfaces, visible as reddish-brown on grain surfaces (figure 4 & 5).



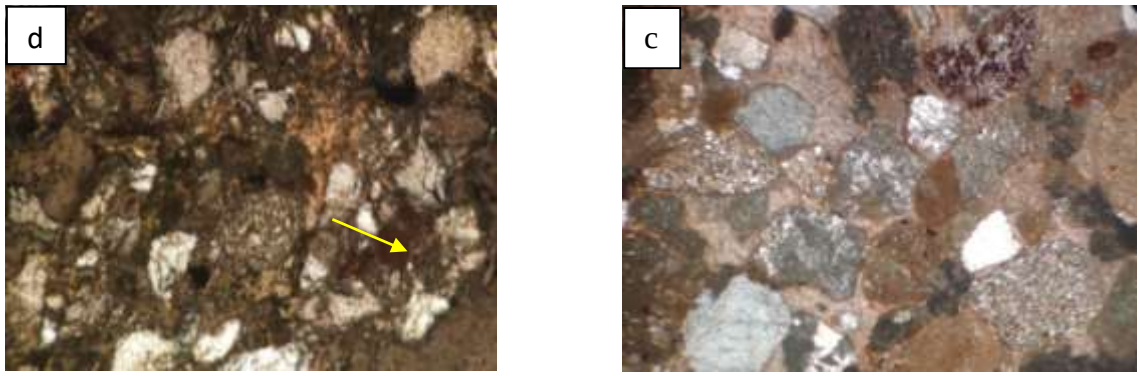


Figure (4) Thin section photomicroscope showing: (a) grain crack (black arrow) (b) Hematite cement (yellow arrow), and (c) Hematite pellet (yellow arrow) in sandstone of the Pondaung Formation. (d) Sandstone with hematite pellet (yellow arrow)

Figure (5) SEM image showing hematite pellet (red arrow) in sandstone of Pondaung Formation

Clay mineral cementation

Clay minerals are the most common cementing materials in the sandstones of the Pondaung Formation. These minerals act as pore lining and pore-filling cements. The most common authigenic clays in the sandstones are smectite, kaolinite, chlorite and illite respectively.

Kaolinite

This cement occurred as pore filling and lining clay mineral and sometimes as a replacement mineral. The pore filling piles which appears as booklet vermicules (figure 6 a & b).

Altered K-feldspars are a source of silicon and aluminium to form kaolinite and not exclusive to early diagenesis (Blatt, H., 1982).

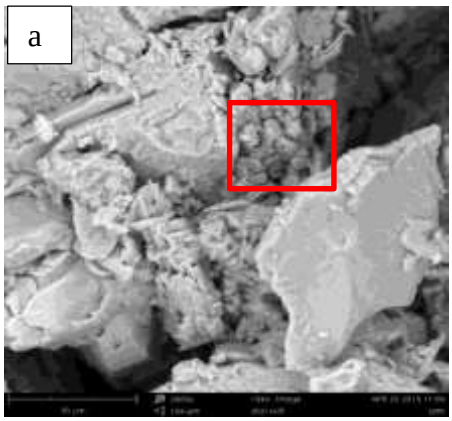


Figure (6 a) SEM photomicrograph showing according or book-like kaolinite (red areas) from Formation Formation

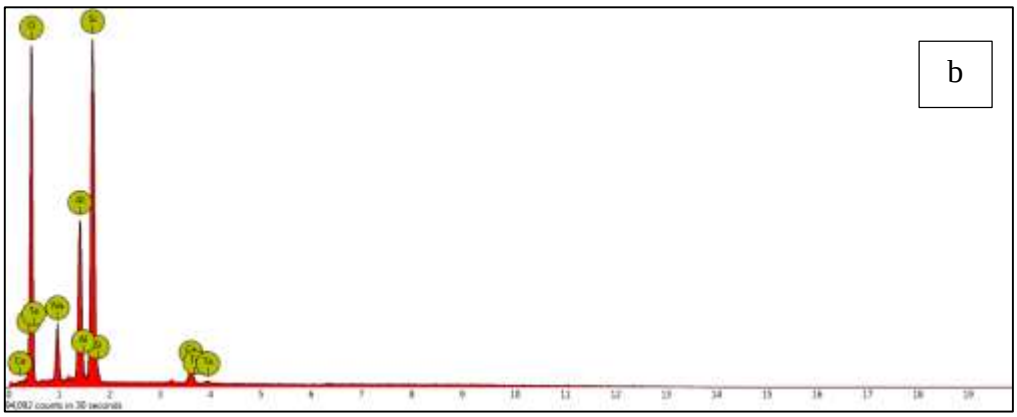


Figure (6 b) EDX graph showing elemental composition of kaolinite (red area)

Illite

It occurs as booklets and vermicular stacked platelets that come close to kaolinite. SEM revealed the transformation of smectite to illite (figure 7 a&b) through the process of illitization. The formation of illite requires a growth medium with high potassium, silica and aluminium compositions (Baiyegunhi, C.,2017). The EDX (figure 8) shows that the mineral is composed of silica and aluminium, whereas sodium and calcium elements only occur in small quantity.

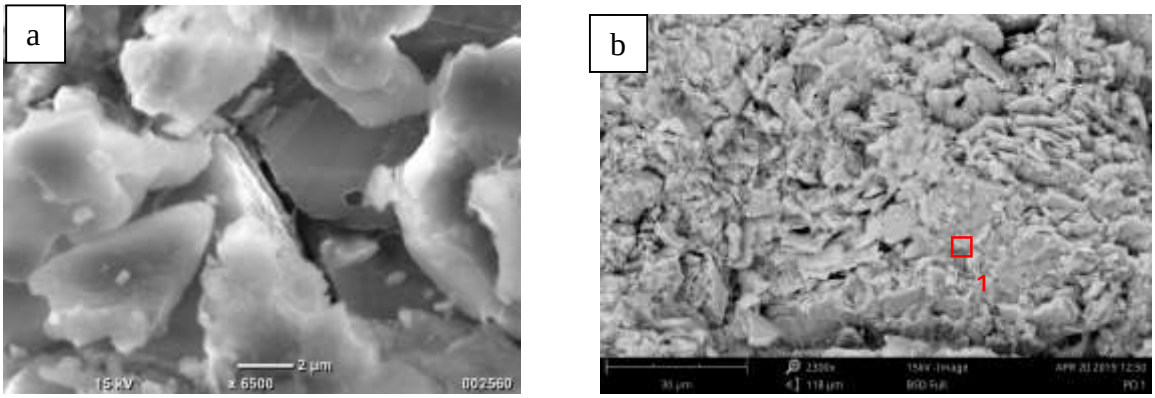


Figure (7a) SEM photomicrograph showing illite growth (yellow arrows) on smectite flakes (red arrows). (b) SEM photomicrograph showing fabric shaped illite from Pondaung Formation

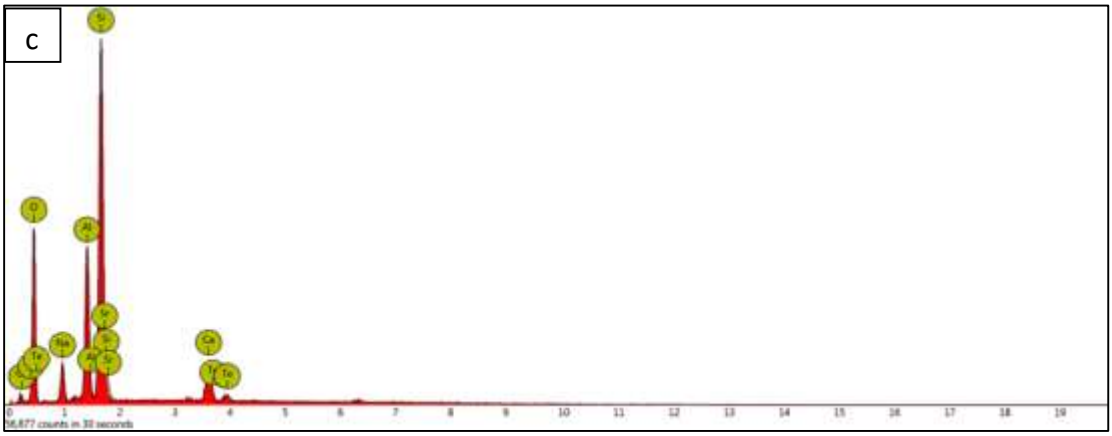


Figure (8) Figure: EDX graph showing elemental composition of illite at point 1 (red area)

Styles in grain compaction

The style of grain contact patterns slowly change from non-contact to point contacts to long contact, then to concavo-convex contact and in the end to sutured contact (figure 9) (Boggs, S.J.,2014). In the case of more rigid grains, the mechanical compaction caused floating and point contacts to become long contacts and fracturing of rigid framework component and this strain is attributed to some of quartz grains developing undulose extinction and even semi-composite undulose extinction. Chemical compaction is the formation of dissolution contacts which tends to concavo-convex and sutured grain contacts caused by pressure solution.

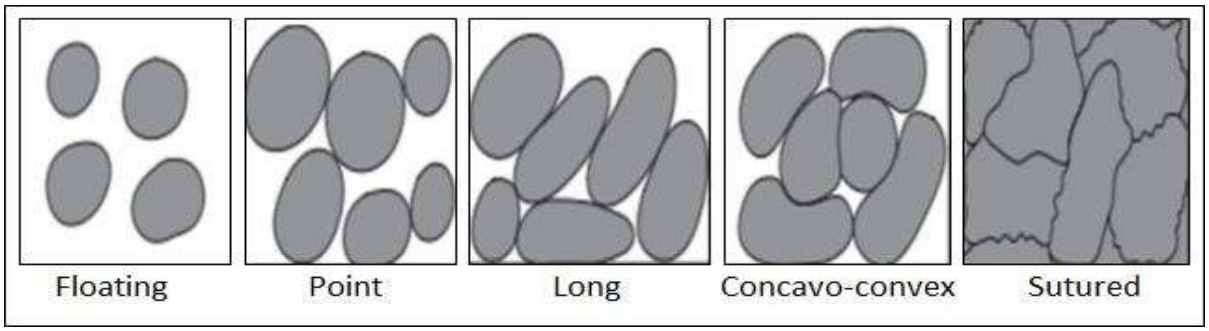


Figure (9) The variables of grain to grain contact patterns due to increased burial depth (Boggs: 2014)

Grain deformation and fracturing

Grain fracturing was observed on some detrital quartz grains from Pondaung Formation (figure 12). Some muscovite grains have been deformed due to pressure dissolution. Microscope observations of thin sections also show that these sandstones have undergone chemical compaction which involves dissolution, recrystallization and precipitation because points of contact between grains are susceptible to dissolution which is an apparent response to overburden weight and higher stress (Hu, X., Huang, S.,2017). There are various factors that affect the rock mechanical properties, including the component grains, textures, structures, porosity, permeability and pore fluids of the rocks (Boggs, S.J.,2014). Grain fracturing is the evidence of the processes of compaction (figure 13) and consolidation. Grain fracturing takes place mostly during late diagenesis and is influenced by processes such as dissolution, which tends to enlarge the fractures. As compaction, tectonic compression and other diagenetic processes continue to occur; the mineral particles become a point contact to a lineal grain contact (figure 10 & 11).

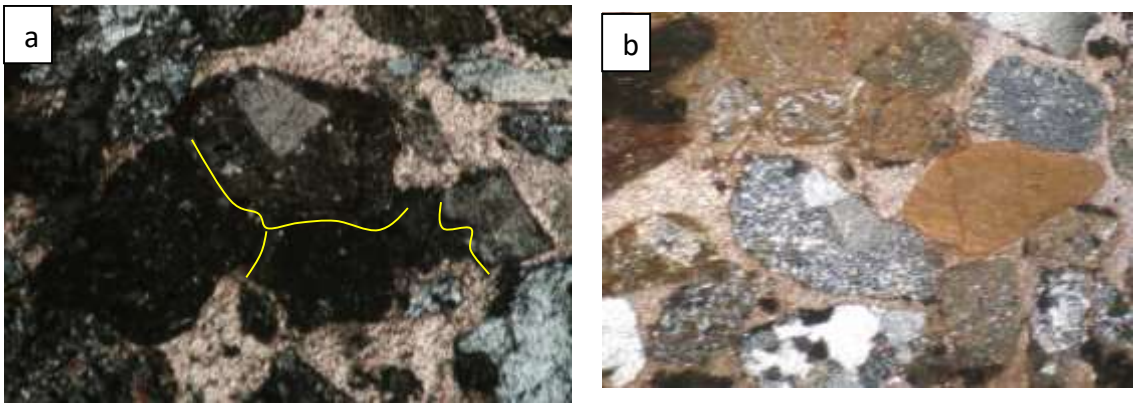


Figure (10) Photomicrograph of sandstone showing (a) concave-convex and sutured grain contacts between grains (b) point, long contacts between detrital grains

Figure (11) SEM image showed point contacts (red circle) between detrital grains

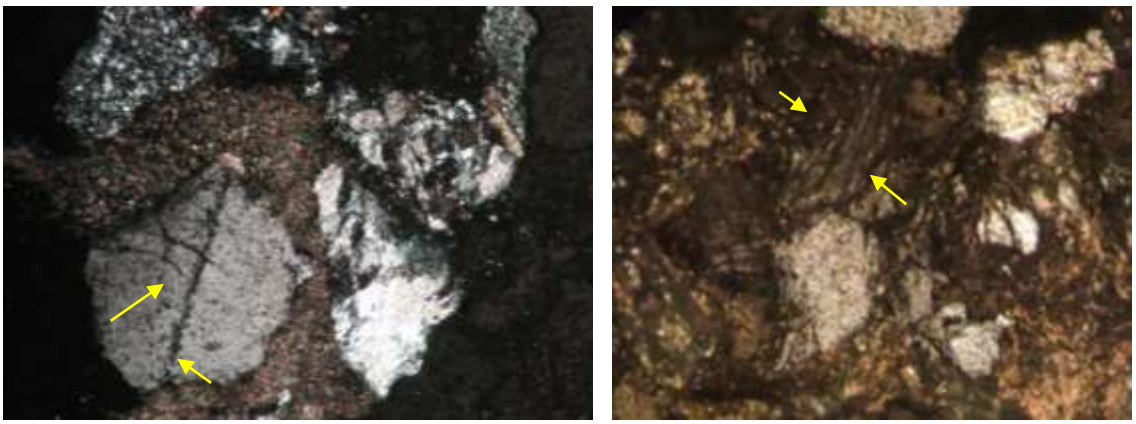


Figure (12) Photomicrograph of fractured grains (yellow arrows) due to increased burial pressure during deep burial diagenesis at Pondaung Formation

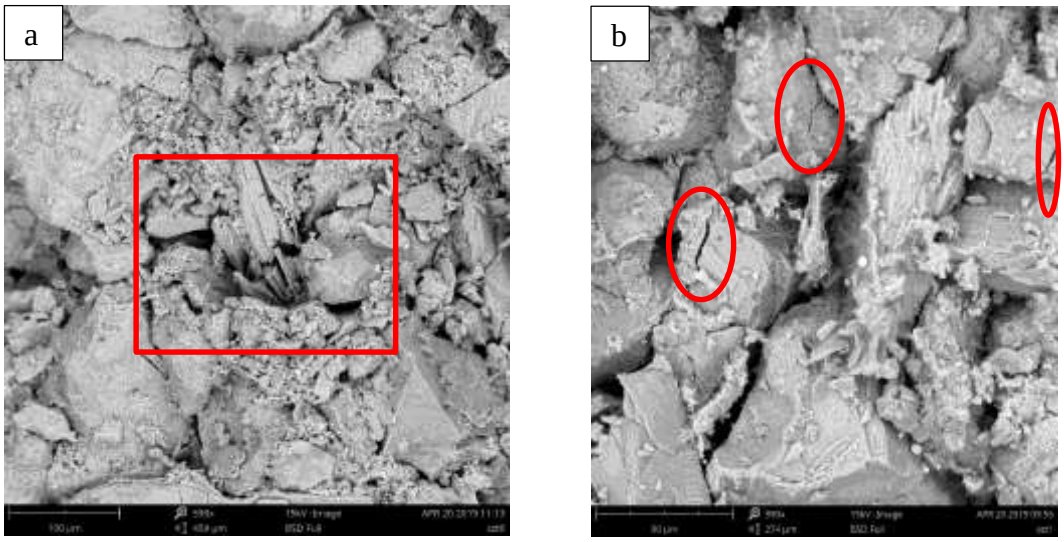


Figure (13) SEM image of (a) grain deformation and (b) grain fracturing

Mineral Replacement

Authigenic minerals tend to replace some cements and grains. Replacement of quartz, feldspars and clay matrix by calcite (figure 14) is a common replacement process in the studied sandstones.

Figure (14) Photomicrograph of sandstone showing calcitization (blue arrow)

Nature and occurrence of authigenic minerals

Common authigenic minerals which occur in the studied area include quartz, feldspar, chlorite and clay minerals such as kaolinite and smectite.

Authigenic clay minerals

Clay minerals in sandstones are from the alteration of feldspars. Smectite and kaolinite occurs in the samples as pore filling and pore lining authigenic clay minerals (figure 16). Most of the clay minerals and detrital grains in the sandstones of the Pondaung Formation have reddish colour. Clastics sediments gained the reddish colouration from hematite which is more common in continental depositional environments such as deserts, floodplains and alluvial fans The iron could have resulted from the weathering of iron bearing minerals such as laterite in upland areas, transported and deposited along with the sediments, which are later converted to hematite under

favourable moist tropical/subtropical climate conditions (Erikkson, P.G.,1983). This iron oxide in the form of reddish-brown cement occurs as pore filling cement, thin coatings around detrital grains and within mica flakes and along cracks margin (Figure 15). This suggests that the formation of these grain coatings occurred in the early diagenetic stage under the presence of oxygen (Erikkson, P.G.,1983).

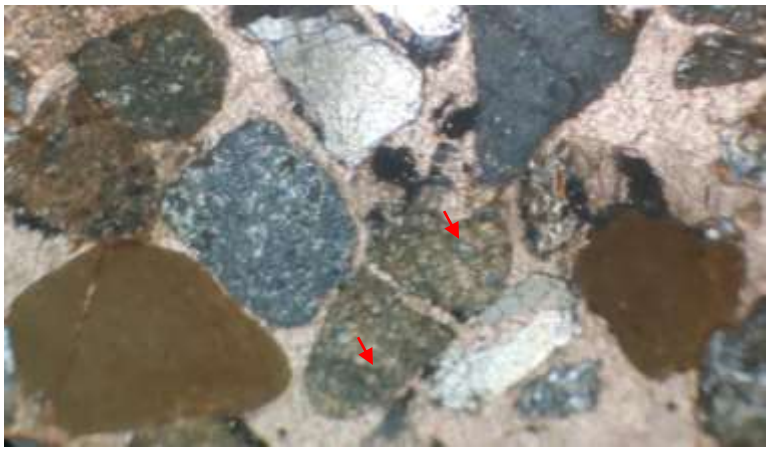


Figure (15) Photomicrograph showing authigenic clay minerals from Pondaung Formation, pore filling (red arrow)

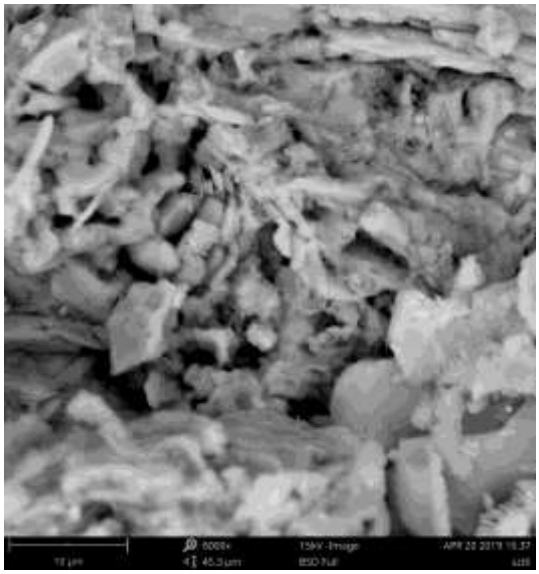


Figure (16) SEM image shown as pore filling and pore lining authigenic clay minerals

Authigenic feldspar

Authigenic feldspar commonly occurs as parallel thick plates (figure 17) developed by degradation of feldspar and partly surrounded by alteration products. In some samples the feldspars replaced the clastics calcite cement. However, the feldspar overgrowths tend to have their growth impeded due to the enlargement of nearby quartz grains (Xie, X.,2003).

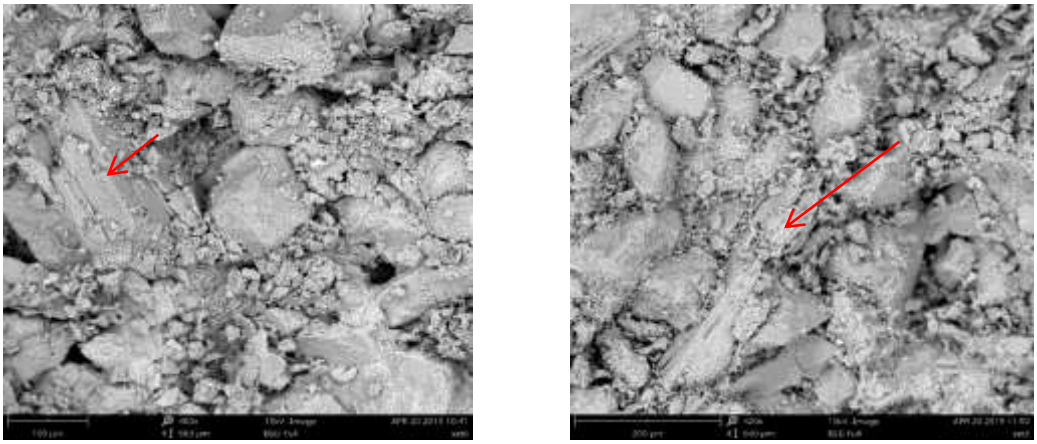


Figure (17) SEM image showing sub parallel thick plates feldspar (red arrow) surrounded by alteration products

Diagenetic Stages

The above diagenetic processes in the sandstones of the Pondaung Formation can be grouped into early diagenesis and late diagenesis.

Early Diagenesis

Time–temperature history, primary mineralogy and fabric and geochemistry of the pore water are the main factors that affect early diagenesis (Worden, R.H.,2003). In the early diagenetic stage include cementation and consolidation. These diagenetic processes often result in the destruction of primary and depositional porosity. The depositional environment influences the formation of sulphides in reducing environments, and iron oxides in oxidizing environments (Maynard, J.B.,2003). Also, the process of cementation initializes through the precipitation of clay matrix (cements), quartz and feldspar cements and overgrowths and authigenic clay minerals (Reed, J.S.,2005). The cementation tends to cause moderate lithification to the sediments. Cements such as calcite, smectite, kaolinite, quartz and feldspar cements occurred after the clay matrix, while authigenic minerals, illitization and compaction continue even to early stages of late diagenesis (Worden, R.H.,2003). Hematite cement especially occurs in the sandstones of the Pondaung Formation.

Late Diagenesis

Late diagenesis in the Pondaung Formation began with the compaction of sediments as a result of increase in overburden pressure. This led to more tightness of grain packing and partial loss of pore spaces (Baiyegunhi, C., 2017). Authigenic quartz and feldspars develop some overgrowths and there is also partial to complete replacement of silica minerals and clay matrix by new minerals (smectite, illite, sericite, kaolinite) thus impacting negatively on porosity (Priscilla Chima, 2018). Clay mineral authigenesis led to the alteration of one clay mineral to the other (*i.e.* smectite recrystallized into illite and sericite or chlorite and kaolinite recrystallized into illite, while illite changed to sericite (Baiyegunhi, C., 2017). The end of the late diagenetic stage, as a result of compaction, the grain contact patterns change from point to planar contact to concave-convex contact and finally to sutured contacts. Moreover, muscovite flakes became slightly bent and deformed due to over compaction. Grain supported sandstones are partially

cemented by calcite and occurs as an early diagenetic cement as well as late diagenetic replacement mineral cement (Worden, R.H.,2003).

Impact of diagenesis on reservoir quality

Porosity and permeability are decisive factors which resolved the reservoir properties of rocks, porosity can be grouped into primary and secondary porosity. Primary pores are also known as depositional porosity and are formed during the sedimentation process, whereas secondary pores (figure 18b) also known as post-depositional porosity are formed after deposition (Selley, R.C.,2000). Petrographic and SEM revealed both primary and secondary porosities. The observed primary pores are intergranular pores and intercrystalline pores. Primary porosity in sandstones is mostly inter-particle porosity which largely depend on the textural maturity of the sediments, controlled mainly by depositional processes and environments, though to some extent compositional maturity also plays a role. The secondary pores are secondary intragranular pores, dissolution pores and fractured pores. Secondary intragranular and dissolution pores are formed from the dissolution of unstable feldspar grains, clay minerals and cements. The fracture pores are formed as a result of structural forces and compaction. During late diagenesis, preferred destruction of less stable minerals or clastics grains by pore fluids produced pore spaces for secondary cementation. Dissolution which involves partial removal or dissolution of earlier formed carbonate cements also creates secondary porosity (figure 18b).

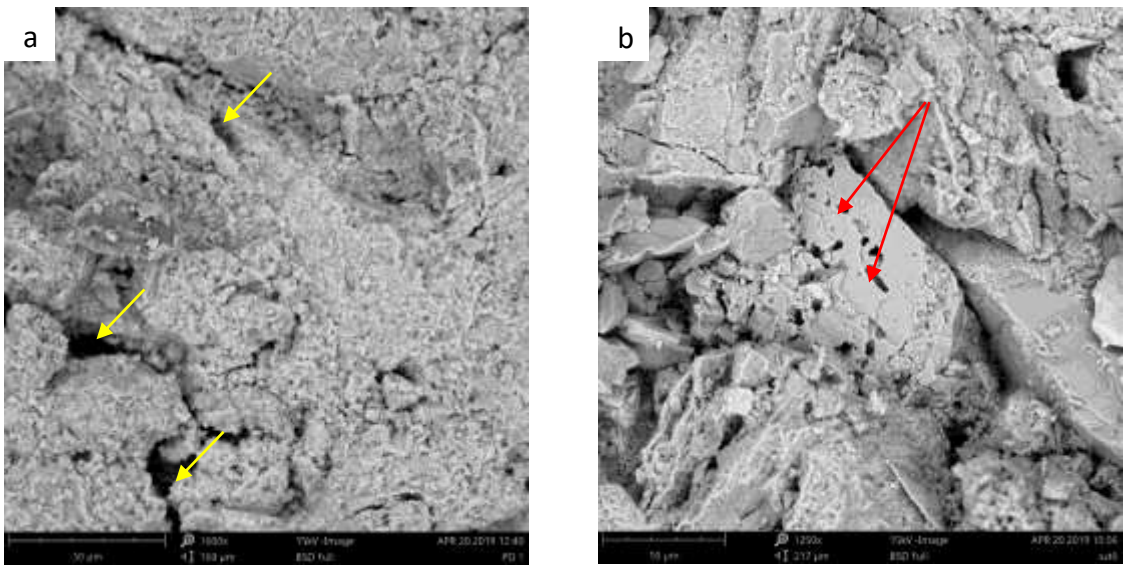


Figure (18) SEM image showing (a) secondary micro-pores from Pondaung Formation (pointed by arrow) (b) interparticle pores within feldspar grain (red arrow)

The Pondaung Formation are moderately compacted, and also contain a moderate amount of cement and authigenic minerals. The distribution of cements is said to be highly dependent on changes of burial depth and the grain sizes. Under the microscope Pondaung Formation samples having good pore network system. Figure (19) shows samples with different grain sizes and sorting. Under the microscope, most of the grains appear to be sub-rounded and sub-angular shaped. The shape of sediments is depended on the distance of transportation, documented that sediments composed of spherical grains tend to have lower porosities than those with grains of

lower sphericity (Selley, R.C.,2000). It is mainly because the spherical grains tend to fall into a tighter packing than sands of lower sphericity. The secondary porosity was partially to completely filled by calcite cements, especially in the Pondaung Formation.

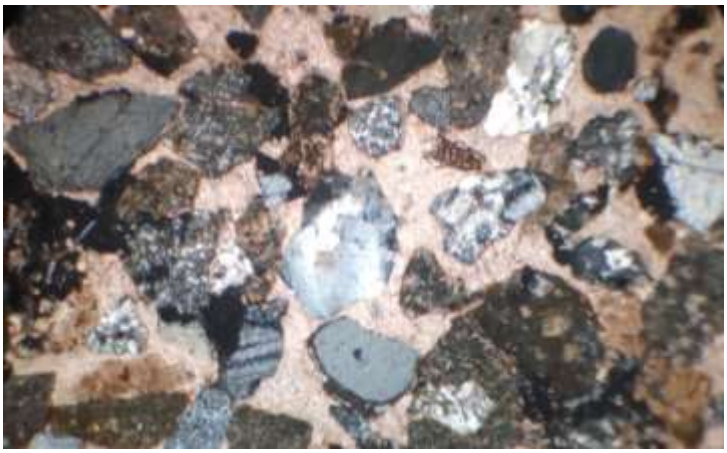


Figure (19) Photomicrograph showing grain shapes, sizes and sorting, Coarse grained moderately sorted, sub-rounded sandstone from Pondaung Formation.

Finding

Table (1) Comparison of diagenetic events in the Pondaung Formation.

Diagenetic processes	Pondaung Formation
Smectite cementation	Limited
Kaolinite cementation	Moderate
Quartz cementation	Moderate
Calcite cement	Common
Hematite cement	Common
Chlorite cement	Moderate
Compaction	Moderate
Grain contact patterns	Long/plane, concave, convex
Muscovite content	Moderate
Recrystallization	Common
Dissolution and Porosity	High

Conclusion

1- The main objective of the present study is to characterize the Eocene petroleum reservoir quality in terms of SEM and petrographic analysis by diagenesis process.

2- The study area is a northern segment of the petroliferous Salin Basin which is fore-arc sub-basin of the Central Myanmar Tertiary Belt.

3- The stratigraphic units exposed in the area and penetrated by the wells Pondaung (Late Eocene), Yaw (Late Eocene), Shwezetaw (Early Oligocene), Padaung (Early Oligocene), Kyaukkok (Early Miocene) and Irrawaddian (Pliocene) formations.

4- Diagenesis took place in three phases such as early and late diagenesis. The processes in the early diagenetic stage include cementation and consolidation. Late diagenesis in the Pondaung Formation began with the compaction of sediments as a result of increase in overburden pressure. This led to more tightness of grain packing and partial loss of pore spaces. These diagenesis process and the late formation of the clay minerals significantly reduce porosity and permeability of the reservoir rocks.

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Firstly, I would like to express my sincere gratitude to Professor Dr. Day Wa Aung, Head of the Geological Department of University of Yangon for the continuous support of my research, for his patience, motivation, and immense knowledge. My sincere thanks also goes to U Lynn Myint, President of the Myanmar Association of Petroleum Geologists for the suggestion which incented me to widen my research from various perspectives.

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DETERMINANTS OF CONTRACEPTIVE USE AMONG CURRENTLY MARRIED WOMEN IN MYANMAR*

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Abstract

This study attempts to investigate the factors affecting contraceptive use of currently married women aged 15-49 years in Myanmar. Data on contraceptive use were obtained from 2015-2016 Myanmar Demographic and Health Survey (MDHS). In this study, descriptive statistics, Pearson's Chi-square test and multinomial logistic regression analysis were used to explore the relationship between contraceptive use and demographic and socio-economic factors. According to the results of descriptive statistics, about 1% of women used traditional method whereas 50% of women used modern methods. The results of Chi-square test show that there exists association between contraceptive use and demographic and socio-economic characteristics. From the results of Multinomial logistic regression, demographic factors such as age of woman, place of residence viz, states/regions, number of living children, currently breastfeeding and currently residing with husband have statistically significant effects on the use of contraceptive methods. Socio-economic factors such as woman's educational level, husband's educational level, media exposure, wealth index etc. have statistically significant effects on contraceptive use. This study provides the background characteristics of currently married women who were reported to have been using the contraceptive methods and its determinants and the results of this study can provide the useful information for the government of Myanmar to set up the contraceptive plans and services.

Keywords: Contraceptive use, wealth index and multinomial logistic regression.

Introduction

Contraception is generally defined as the intentional prevention of conception. It is one of the proximate determinants of fertility and the most important predictor of fertility transition and is also called birth control or family planning. The growing use of contraceptive methods has resulted not only improvements in health related outcomes such as reduced maternal mortality, fetal death and infant mortality but also improvements in economic outcomes such as better jobs, higher labor force participation and higher wages, especially for women. Giving women access to voluntary family planning is one of the most effective ways to combat maternal death. When women can access contraceptives, they can avoid unintended pregnancy and related risks including unsafe abortion. Therefore, ontraception has direct health benefits on maternal and child health.

The level of contraceptive use varies significantly by women's background characteristics. In order to study the contraceptive use in Myanmar, it is necessary to understand which demographic and socio-economic factors influence on contraceptive use. Therefore, this study intends to investigate the factors affecting contraceptive use among non-pregnant currently married women in Myanmar. Firstly, the situations of contraceptive use, demographic and socio-economic characteristics of currently married women aged 15-49 in Myanmar were provided and

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secondly, the relationship between contraceptive use, demographic and socio-economic characteristics was investigated. Then the determinants of contraceptive use among currently married women aged 15-49 in Myanmar were explored.

Literature Review

Many studies around the world have found contraceptive use to be influenced by several demographic and socio-economic factors. In this study, some of these are as follows:

Palamuleni (2013) examined that demographic and socio-economic factors affecting contraceptive use in Malawi by using bivariate and multivariate logistic regression analyses. The study aimed to investigate the relationship between contraceptive use and social, demographic and economic characteristics of women and to identify the determinants of contraceptive use among women in Malawi. The results show that the major determinants of contraceptive use are age, respondents' and partners' approval of family planning, family planning discussion with partner, number of living children, work status, education and visit to health center.

Osmani et al. (2015) studied factors influencing contraceptive use among women in Afghanistan. Data were obtained from Afghanistan Health Survey 2012 and logistic regression analysis was used in the study. The main objective is to examine which explanatory factors influenced contraceptive use among currently married women aged 12-49 years in Afghanistan. From this research, age of women, place of residence, regions, women education, media exposure, wealth index, parity, number of living sons and child mortality experience were key factors of contraceptive use.

Al-Balushi et al. (2015) studied that the determinants of contraceptive use in Oman. Contraceptive prevalence study has been done using binary logistic regression model. The purpose of the study is to explore the true effect of factors which are affecting the regulation of fertility through contraception. The finding suggests that age of women, region, number of living children, education, place of residence and living arrangement have the most significant effects on contraceptive use among women.

Hossain et al. (2018) stated that identifying factors influencing contraceptive use in Bangladesh by binary logistics regression model. The aim of the study is to explore the socio-economic, demographic and other key factors that influence the use of contraception in Bangladesh. The study finds that administrative division, place of residence, religion, number of household members, woman's age, occupation, body mass index, breastfeeding practice, husband's education, wish for children, living status with wife, sexual activity in past year, women amenorrheic status, abstaining status, number of children born in last five years and total children ever died were significantly associated with contracepted use in Bangladesh.

M. M. Wai et al. (2020) revealed that the dynamics of contraceptive use among married women in North and South Yangon, Myanmar. Chi-square test and logistic regression analysis are used in this study. It is observed that the contraceptive prevalence of modern methods was 66% with better coverage in rural than in urban women. Contraceptive use varied by age and parity, demonstrating lower prevalence in the oldest age group (45-49) and high parity (five and above). The mean duration of contraceptive use rose with increased age and parity, except in the oldest age and high parity groups.

N. M. M. Myint et al. (2021) explored that the determinants of family planning among Myanmar women by using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The results show that socio-demographic factors (age, level of education,

marital duration, number of living children, religion, occupation, income), cognitive factors (knowledge), affective factors (attitude and motivation including support from health care providers, family, friend as well as husband and health education) and availability of service (distance form health care place, service available for 24 hours, cost) are the influencing factors on Family Planning.

Lun et al, (2021) examined that utilization of modern contraceptive methods and its determinants among youth in Myanmar: Analysis of Myanmar Demographic and Health Survey (2015-2016) by multivariable binary logistic regression analysis. This study included those individual characteristics that were age, sex, marital status, education, employment, previous exposure to family planning messages, sexual activity, and desire for more children and household characteristics were the residence, geographical zone and wealth index. This study pointed out the country's contraceptive prevalence rate among youth and factors influencing those conditions, which might help promote youth's family planning health services by pointing out the area to emphasize.

Data and Methods

Data from the 2015-2016 MDHS were used to examine the determinants of demographic and socio-economic factors on contraceptive use among currently married women aged 15-49 in Myanmar. According to this survey, interviews were done on 12,885 women. In this study, 7348 currently married women aged 15-49 were investigated by using descriptive statistics, Chi-square test and multinomial logistic regression analysis.

Variables Description

In this study, determinants of contraceptive use are classified into two categories: demographic factors and socio-economic factors. Demographic factors such as age of woman, place of residence, states/regions, number of living children, sex of household head, currently breastfeeding and currently residing with husband and socio-economic factors such as woman's educational level , husband's educational level, woman's occupation, media exposure and wealth index are used in this study. The categories of contraceptive use (dependent variable) and demographic and socio-economic factors (independent variables) are classified and shown in Appendix (A).

Multinomial Logistic Regression

Multinomial logistic regression is a classification method that generalizes logistic regression to multiclass problems. Therefore, multinomial logistic regression model requires that the response variable be more than two outcomes. The explanatory variable can be either dichotomous (i.e. binary) or continuous (i.e. interval or ratio). To construct the logits in the multinomial case, one of the categories must be considered the base level and all the logits are constructed relative to it. Any category can be taken as the base level, because there is no ordering. Multinomial logistic regression allows the simultaneous comparison of more than one contrast, that is, the log odds of three or more contrasts are estimated simultaneously (Garson 2009). Multinomial logistic regression is known by a variety of names, including polytomous LR, multiclass LR, softmax regression, multinomial logit (mlogit), the maximum entropy (MaxEnt) classifier, and the conditional maximum entropy model.

The multinomial logistic regression model may be presented as:

$$\text{Logit}\,(Y_j) = \ln\left[\frac{P(Y=j/X)}{P(Y=J/X)}\right] = \beta_{j0}+\beta_{j1}X_1+\beta_{j2}X_2+\ldots+\beta_{jk}X_k \qquad , j= 1,2,\ldots,J\text{-}1.$$

where,

P(Y=j/X) = the probability of Y being some categories of j for the predictor variables X

Y_j = outcome variable Y with j categories

$X_1, X_2,\ldots,X_k$ = independent variables

β_{j0} = intercept

$\beta_{j1,}\beta_{j2,}\ldots,\beta_{jk}$ = slopes of the regression

Intercept and slopes are also called coefficients of regression.

Descriptive Statistics

The contraceptive use, demographic and socio-economic characteristics of currently married women are presented in Appendix Table (1). Concerning the contraceptive use, 51% of women use modern contraceptive method, 47.7% do not use any method and only 1.3% use traditional method. In terms of woman age, 63.4% of currently married women are aged 20 - 39 years, 33.8 % of them are 40-49 years and only 2.8% are 15-19 years. Nearly the three-fourth of respondents resided in rural area and only one-fourth of currently married women are residents of urban area. The highest proportion of currently married women is found in Sagaing region (7.9%) and the lowest proportion is found in Taninthayi region (5.6%). Regarding the number of living children, 9.6% of the currently married women have no child, 25.7% of them have two children and 23.8% of those have only one child. Concerning about the sex of household head, the 86.8% of head of household are male and 13.2% are female. Regarding currently breastfeeding, 73.6% of currently married women are not currently breastfeeding and 26.4% of them are currently breastfeeding. Dealing the currently residing with husband, 91% of women are residing with husband compared to only 9% of women are not. In terms of woman education level, 46.4% of the currently married women have primary educational level and only 7.7 % have higher educational level while 15.4% have no education. With regard to husband education level, 38.8% have primary educational level, 38.7% have the secondary educational level and only 6.3% have higher educational level. Regarding the women occupation, about 5% of currently married women are professional workers, 16.2% are agriculture workers, 24% are unskilled workers, 5.1% are unskilled workers, 19.6% are other workers and 29.9% were unemployed workers. Concerning the media exposure, 15.3% currently married women have media exposure and 84.7% have no media exposure. Dealing with wealth index, 37.8% of women are in rich quintile, 20.6 are in middle quintile and 41.6% are in poor quintile.

Bivariate Analysis

Chi-square analysis is used to determine the relationship between contraceptive use and demographic factors and socio-economic factors. The results of Chi-square analysis are shown in Appendix Table (1). It can be seen that the demographic factors such as age of woman, place of residence, states/regions, number of living children, sex of household head, currently

breastfeeding and currently residing with husband and socio-economic factors such as woman's educational level, husband's education level, woman's occupation, media exposure, and wealth index are statistically significant at 1% level. Therefore, there exists relationship between contraceptive use and demographic factors and socio-economic factors.

Multinomial Logistic Regression Analysis

According to the results of Appendix Table (2), the value of Chi-Square statistics is 1610.101 and p-value is 0.000. It can be concluded that the MLR model is significant at 1% level. Therefore, this model can explain the association of contraceptive use and demographic factors and socio-economic factors. Cox & Snell R-Square, Nagelkerke R-Square and Mc-Fadden R-Square values are 0.197,0.253 and 0.146 respectively, suggesting that 19.7% to 25.3% and 14.6% of the variance in contraceptive use can be explained by variation of independent variables used in the model. The parameter estimates for the multinomial logistic regression model for contraceptive use among currently married women are presented in Appendix Table (3).

By comparing traditional contraceptive method versus non-use of contraceptive method, the coefficient of women aged at 20-39 years old is statistically significant at 1% level and positively related to the use of traditional method. The odds ratio of 2.749 indicates that women aged at 20-39 years are 2.749 times more likely to use traditional method than none use of any method.

It has been found that Kayah state and Naypyidaw region are statistically significant at 1% level, Kachin state, Yangon region and Magway region are statistically significant at 5% level and Kayin state is statistically significant at 10% level. The coefficients of all significant states/regions are positive and related to use traditional contraceptive method. It shows that women in Kayah state, Naypyidaw region, Kachin state, Magway region, Yangon region and Kayin state are more likely to use traditional method over those who do not use of any method.

With regard to number of living children, the coefficients of women have one living child, women have two living children and women have three living children are statistically significant at 1% level and positively related to use traditional method. The odds ratios are 4.355, 5.132 and 5.904 respectively. It shows that women have one living child, women have two living children and women have three living children are 4.355, 5.132 and 5.904 times more likely to use traditional method. The coefficient of women who have no living children is statistically significant at 5% level and positively related to use traditional method. The odds ratio of 2.376 illustrates that women have no living children are 2.376 times more likely to use traditional method.

In currently breastfeeding, the coefficient of women who are currently breastfeeding is statistically significant at 1% level and negatively related to use traditional contraceptive method. The odds ratio of 0.266 points out that women who are currently breastfeeding are 0.266 times less likely to use traditional method compared to modern contraceptives.

With regard to the currently residing with husband, the coefficient is statistically significant at 1% level and positively associated with traditional contraceptive method. The odds ratio of 3.177 suggests that women who are currently residing with husband are 3.177 times more likely to use traditional method than the use of any other method.

It is found that the coefficient of higher educational level of women is significant at 1% level and positively related to traditional contraceptive method. The odds ratio of 5.713 expresses that women have higher educational level are 5.713 times more likely to use traditional method compared to the use of any other method.

It can be seen that the coefficient of higher educational level of husbands is significant at 5% level and positively related to traditional contraceptive method. The odds ratio of 3.371 indicates that husbands have higher educational level are 3.371 times more likely to use traditional method than none use of any method.

In case of media exposure, the coefficients of women having media exposure is statistically significant at 5% level and positively related to traditional method. The odds ratio of 1.816 means that women have media exposure are 1.816 times more likely to use traditional method compared to the use of any other method.

By comparing modern contraceptive method versus non-use of contraceptive method, the coefficients of women aged at 15-19 and 20-39 years old are statistically significant at 1% level and the odds ratios are 8.963 and 4.137 respectively. It points out that women aged at 15-19 are 8.963 times and women aged at 20-39 years are 4.137 times more likely to use modern method than the use of any other method.

Concerning the place of residence, the coefficient of urban areas is significant at 1% level and positively related to modern method. The odds ratio of 1.276 indicates that women in urban areas are 1.276 times more likely to use modern method than the use of any other method.

According to the states/regions, the coefficient of the Kachin state, Kayah state, Kayin state, Mon stae, Rakhine state, Shan state and Naypyidaw region, Sagaing region, Tanintharyi region, Bago region, Mandalay region, Mgway region, Yangon region and Ayayarwaddy region are statistically significant at 1% levels and positively related to use modern contraceptive method. It means that women in the significant states and regions are more likely to use modern method than none use of any method.

It can be seen that the coefficients of women have no living children, one living children, two living children and three living children are statistically significant at 1% levels and positively related to modern method. The odds ratios are 3.974, 6.094, 6.588 and 5.514 respectively. It suggests that women have no living children, one living children, two living children and three living children are 3.974, 6.094, 6.588 and 5.514 times more likely to use modern method than none use of any method.

In the case of currently breastfeeding, the coefficient of women who are currently breastfeeding is statistically significant at 5% level and negatively related to modern contraceptive method. The odds ratio of 0.863 indicates that women who are currently breastfeeding are 0.863 times less likely to use modern method than none use of any method.

It has been found that the coefficient of women is currently residing with husband is statistically significant at 1% level and positively associated with modern contraceptive method. The odds ratio of 4.415 reveals that women who are currently residing with husband are 4.415 times more likely to use modern method than none use of any method.

In woman's educational level, the coefficients of primary, secondary and higher educational levels of women are significant at 1% levels and positively related to modern

contraceptive method. The odds ratios are 1.558, 2.018 and 2.340, respectively. It specifies that women have primary, secondary and higher educational levels are 1.558, 2.018 and 2.340 times more likely to use modern method than none use of any method.

In terms of husband's educational level, the coefficients of primary and secondary educational levels of husbands are significant at 1% levels and positively related to modern contraceptive method. The odds ratios are 1.309 and 1.364, respectively. It illustrates that husbands have primary and secondary educational levels are 1.309 and 1.364 times more likely to use modern method than none use of any method respectively.

Regarding with wealth index, the coefficients of rich quintile and middle quintile are statistically significant at 1%, 10% levels and positively related to modern method. The odds ratios are 1.258 and 1.149, respectively. It indicates that women from rich quintile are 1.258 times and women from middle quintile are 1.149 times more likely to use modern method than the use of any other method.

Conclusion

The study revealed the factors influencing contraceptive use among currently married women in Myanmar. It can be seen that demographic factors such as age of woman, place of residence, states/regions, number of living children, currently breastfeeding and currently residing with husband and socio-economic factors such as woman's educational level, husband's educational level, media exposure and wealth index are significant predictors of contraceptive use in Myanmar.

In demographic factors, women age at 20-39 years has more chance to use traditional method and women age at 15-19 years and women age at 20-39 are more likely to use modern method. Women in urban areas have more chance to use modern method than women in rural areas. Because women in urban area are more educated, they have better knowledge about the contraception and easy access to family planning services. Women in Kachin state, Kayah state, Kayin state, Nay Pyi Taw region, Magway region and Yangon region have more chance to use traditional method than Chin state and all states/regions have more likely to use modern method than Chin region. This is because Chin state has the highest fertility and lowest use of contraceptive methods. Regarding with number of living children, women have no living children, one living children, two living children and three living children have more chance to use tradition method and modern method. This is because most of women in Myanmar do not want to have many children. So, they are using the family planning methods to attain their desired children. Concerning currently breastfeeding, women who are currently breastfeeding have less chance to use the traditional method as well as modern method. It has been found that women who are currently residing with husband have more chance to use traditional method and modern method.

In socio-economic factors, women and husbands with higher educational levels have more chance to use traditional method and women with primary, secondary and higher educational levels and husbands with primary and secondary educational levels have more chance to modern method. This is because educated women and husbands can decide their relationships, bodies and their lives. Women who have media exposure have more chance to use traditional method because they can get knowledge of family planning and learn the benefits of using contraception from media. In case of wealth index, women in rich and middle quintiles

have more chance to use modern method. This finding in this case, it is observed that the use of family planning methods depends on the wealth of the households.

Therefore, these factors are considered in the redesigning of family planning program in Myanmar. In addition, it is expected that the results of this study would be helpful for the government and policy makers when planning the policy about the contraceptive prevalence rate in Myanmar. Because of being studied by states and regions, the government can also be able to find out the status of contraceptive use among currently married women by region and can support the family planning plans and services to areas with low usage. Moreover, the government needs to hold health talk about contraception at public and to inform that contraceptive methods are easily available at public and government health care department and to encourage married couples to use contraceptive methods to avoid maternal mortality, fetal death and infant mortality.

This study only focuses on demographic and socio-economics characteristics of currently married women and contraceptive use. Since our variable selection is limited, further studies should perform to study the contraceptive use by adding other relevant independent variables. Moreover, further researchers are recommended to analyze the determinants of the contraceptive use from wider perspectives.

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Appendix (A)

Dependent variable

Y = Contraceptive Use
= 1, if traditional method
= 2, if modern method
= 3, if none use of any method (reference category)

Demographic factors

X_1 = Age of Woman
= 1, if woman age group is at 15-19
= 2, if woman age group is at 20-39
= 3, if woman age group is at 40-49 (reference category)

X_2 = Place of Residence
= 1, if urban
= 2, if rural (reference category)

X_3 = States/Regions
= 1, if woman lives in Kachin
= 2, if woman lives in Kayah
= 3, if woman lives in Kayin
= 4, if woman lives in Naypyidaw
= 5, if woman lives in Sagaing
= 6, if woman lives in Tanintharyi
= 7, if woman lives in Bago
= 8, if woman lives in Magway
= 9, if woman lives in Mandalay
= 10, if woman lives in Mon
= 11, if woman lives in Rakhine
=12, if woman lives in Yangon
=13, if woman lives in Shan
=14, if woman lives in Ayeyarwady
=15, if woman lives in Chin (reference category)

X_4 = Number of Living Children
= 1, if woman had no living child
= 2, if woman had one living children
= 3, if woman had two living children
= 4, if woman had three living children
= 5, if woman had four and more living children (reference category)

X_5 = Sex of Household Head
= 1, if head of household is male
= 2, if head of household is female (reference category)

X_6 = Currently Breastfeeding
= 1, if yes
= 2, if no (reference category)

X_7 = Currently Residing with Husband
= 1, if yes
= 2, if no (reference category)

Socio-economic factors

X_8 = Woman's Educational Level
= 1, if woman's educational level is primary
= 2, if woman's educational level is secondary

= 3, if woman's educational level is higher
= 4, if woman's educational level is no education (reference category)

X_9 = Husband's Educational Level
= 1, if husband's educational level is primary
= 2, if husband's educational level is secondary
= 3, if husband's educational level is higher
= 4, if husband's educational level is no education (reference category)

X_{10} = Woman's Occupation
= 1, if woman is professional worker
= 2, if woman is agricultural worker
= 3, if woman is skilled worker
= 4, if woman is unskilled worker
= 5, if woman is other worker
= 6, if woman is unemployment

X_{11} = Woman's Exposure to Media
= 1, if yes
= 2, if no (reference category)

X_{12} = Wealth Index
= 1, if woman is in rich quintile
= 2, if woman is in middle quintile
= 3, if woman is in poor quintile (reference category)

Appendix Table (1) Percentage frequency distribution and the relationship between contraceptive use and demographic and socio-economic characteristics among currently married women aged 15-49 in Myanmar.

Variables	Categories	Frequency	Percent	Chi-square
Contraceptive use	Non-use	3505	47.7	
	Traditional Method	95	1.3	
	Modern Method	3748	51.0	
Age of Woman	15-19	203	2.8	
	20-39	4661	63.4	449.45***
	40-49	2484	33.8	
Place of Residence	Urban	1940	26.4	72.129***
	Rural	5408	73.6	
States/Regions	Kachin	457	6.2	
	Kayah	430	5.9	
	Kayin	458	6.2	
	Naypyidaw	469	6.4	362.52***
	Sagaing	581	7.9	
	Taninthayi	411	5.6	
	Bago	561	7.6	

Variables	Categories	Frequency	Percent	Chi-square
	Magway	528	7.2	
	Mandalay	493	6.7	
	Mon	445	6.1	
	Rakhine	490	6.7	
	Yangon	555	7.6	
	Shan	483	6.6	
	Ayeyarwaddy	554	7.5	
	Chin	433	5.9	
Number of Living Children	1	705	9.6	281.717***
	2	1750	23.8	
	3	1888	25.7	
	4	1356	18.5	
	5	1649	22.4	
Sex of Household Head	Male	6377	86.8	14.831***
	Female	971	13.2	
Currently Breastfeeding	Yes	1937	26.4	48.995***
	No	5411	73.6	
Currently residing with husband	Yes	6684	91.0	207.219***
	No	664	9.0	

Appendix Table (1) Distribution of contraceptive use and the relationship between demographic and socio-economic characteristics and contraceptive use among currently married women aged 15-49 in Myanmar (Continued)

Variables	Categories	Frequency	Percent	Chi-square
Woman's Educational level	Primary	3408	46.4	219.248***
	Secondary	2245	30.6	
	Higher	566	7.7	
	No Education	1129	15.4	
Husband's Educational Level	Primary	2853	38.8	146.894***
	Secondary	2845	38.7	
	Higher	464	6.3	
	No Education	1186	16.1	
Woman 's	Professional labour	377	5.1	40.285***

Occupation	Agricultural labour	1194	16.2	
	Skilled labour	376	5.1	
	Unskilled labour	1766	24.1	
	Other worker	1439	19.6	
	Unemployment	2196	29.9	
Media Exposure	Yes	1121	15.3	48.437***
	No	6227	84.7	
Wealth Index	Rich	2779	37.8	
	Middle	1511	20.6	78.863***
	Poor	3058	41.6	

*****denotes significant at 1%level**

Data source: MDHS (2015-2016)

Appendix Table (2)

Model Fitting Information for Contraceptive Use with Independent Variables

Model Fitting Criteria	χ^2 value	df	p-value
-2 Log Likelihood	1610.101	72	0.000
Cox & Snell R-Square	0.197		
Nagelkerke R-Square	0.253		
Mc-Fadden R-Square	0.146		

Data source: MDHS (2015-2016)

Appendix Table (3) Parameter estimates for the multinomial logistic regression model for contraceptive use among currently married women aged 15-49 in Myanmar

Variables	Contraceptive use			
	Traditional Method		Modern Method	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Intercept	-10.194		-5.862	
Age of woman				
15-19	1.118	3.058	2.193	8.963***
20-39	1.011	2.749***	1.420	4.137***

Variables	Contraceptive use			
	Traditional Method		Modern Method	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Place of Residence				
Urban	.322	1.380	.244	1.276***
States/Regions				
Kachin	2.405	11.076**	.656	1.927***
Kayah	3.366	28.951***	1.273	3.572***
Kayin	2.041	7.696*	1.006	2.734***
Naypyidaw	3.456	31.696***	1.515	4.548***
Sagaing	.134	1.143	1.148	3.152***
Taninthayi	1.563	4.774	.918	2.505***
Bago	1.787	5.974	1.692	5.431***
Magway	2.595	13.392**	1.137	3.117***
Mandalay	.797	2.220	1.414	4.112***
Mon	1.086	2.964	1.278	3.588***
Rakhine	.415	1.515	.905	2.473***
Yangon	2.553	12.839**	1.614	5.024***
Shan	1.519	4.567	1.093	2.983***
Ayeyarwaddy	.471	1.601	1.507	4.513***
Number of Living Children				
1	.865	2.376**	1.380	3.974***
2	1.471	4.355***	1.807	6.094***
3	1.636	5.132***	1.885	6.588***
4	1.776	5.904***	1.707	5.514***
Sex of Household Head				
Male	.237	1.267	.033	1.033
Currently Breastfeeding				
Yes	-1.323	2.66***	-.147	.863**
Currently Residing with Husband				
Yes	1.156	3.177***	1.485	4.415***
Woman's Educational level				

Variables	Contraceptive use			
	Traditional Method		Modern Method	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Primary	.417	1.517	.443	1.558***
Secondary	.759	2.136	.702	2.018***
Higher	1.743	5.713***	.850	2.340***

Appendix Table (3) Parameter estimates for the multinomial logistic regression model for contraceptive use among currently married women aged 15-49 in Myanmar (Continued)

Variables	Traditional Method		Modern Method	
	Coefficient	Odds Ratio	Coefficient	Odds Ratio
Husband's Educational Level				
Primary	.303	1.354	.270	1.309***
Secondary	.753	2.123	.311	1.364***
Higher	1.215	3.371**	.142	1.153
Woman's Occupation				
Professional worker	-.503	.605	.042	1.043
Agricultural worker	-.263	.769	.001	1.001
Skilled worker	-.116	.890	.007	1.007
Unskilled worker	.375	1.455	.101	1.106
Other	-.309	.734	-.083	.920
Media Exposure				
Yes	.597	1.816**	.111	1.118
Wealth Index				
Rich	.407	1.502	.229	1.258***
Middle	-.227	.797	.139	1.149*

*****,**,* denote significant at 1%, 5% and 10% level**

Reference Category = no use of contraceptive method

Data source: MDHS (2015-2016)

EFFECT OF PERSONALITY TRAITS ON PREFERENCE ON ONLINE LEARNING AT YANGON UNIVERSITY OF ECONOMICS*

Myint Myint Kyi[1]

Abstract

This paper intends to analyze the influence of personality traits on preference regarding online learning, and the effect of preference on online learning on learning effectiveness of online MBA (Master of Business Administration) students who are attending at Yangon University of Economics in 2020. Out of 85 students, 43 are randomly selected. To collect data from them, questionnaire method is applied by sending structured questionnaires to them via e-mail. Data are being analyzed by both descriptive and multiple linear regression analyses. From analyses, it is found that students' success is largely depending on their preference on self-evaluation and their behavior of effective help seeking from instructors and other students. To seek help, they need to have high agreeableness and openness. For effective self-evaluation, they should be extraverts with high openness. Thus, online students should not be isolated. They should be friendly and emphasize on keeping in touch with university teachers and also with other students.

Keywords*:* Extraversion, Agreeableness, Conscientiousness, Openness, Neuroticism, Goal Setting, Environmental Structuring, Task Management, Time Management, Help Seeking, Self-Evaluation

Introduction

The role of technology has been rising year by year all over the world. Individuals, groups, businesses and organizations become rely more and more on technology, especially on information and communication technology in various aspects. In many countries, information and communication technology is necessary in daily lives of people. It is more obvious in individual learning. In Myanmar, Yangon University of Economics launched Master of Business Administration program in 1994, and launched Executive Master of Business Administration program in 2000 due to the requirements for developing country's economy and also for developing industries. However, these two programs have limitation to exclude the interested persons who cannot come in person to classrooms daily except on Sunday. To fill this gap, in 2007, the online Master of Business Administration program has been launched by Yangon University of Economics. In 2020, this online program produced 112 graduates, and about 85 students are in the process of learning and doing theses. Their reasons of joining the online program may not be the same. Some chose the online learning due to time and location constraints. They are living away from Yangon area: in other regions and divisions. Some do not have chance to manage time or devote time to come to physical classrooms. However, some might choose online learning it because of these two reasons but because of their preferences. This paper analyses the effect of personality traits on preferences on online learning.

Rationale of the Study

People choose online learning instead of learning at physical classrooms concerning their convenience, personal constraints, as well as appropriateness to their personal characteristics. If students choose online learning due to other reasons instead of relevancy to their personal

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characteristics (personal traits), they will not prefer their selected way of online learning. This lack of preferences in online learning will lead to ineffectiveness in this type of learning.

Since 2007, Yangon University of Economics has launched online Master of Business Administration (MBA) program. The main objective of this program is to support to community development through providing qualified and responsible leaders of businesses, organizations, and ministries. By concerning the discipline of this program, most of the subjects are business management related subjects and the degree is ascribed to social science nature. To become high quality graduates, students must learn business cases through online, discuss real and updated trends and issues through online, and conduct research and projects based on the information collected through online. They have less chance to discuss through face-to-face channel. If they choose online learning due to their constraints, not with their personal motives, their involvement in searching information, discussion, and doing research and projects will not be high. Their motives will be closely related to their personality traits. Some may be introvert, curious type and like challenging and finding new things. They will prefer online learning to classroom learning. If they prefer online learning, they will highly involve in getting knowledge from various sources and also in knowledge sharing. Eventually they will become high quality graduates. This paper will find the hidden reasons of preferring online learning and its effectiveness at online MBA program of Yangon University of Economics.

Research Questions

1. What are the main reasons of students choosing online MBA of Yangon University of Economics (YUEco)?
2. Do the YUECo's online MBA students prefer online learning?
3. Is the online learning of YUECo's online MBA students effective to become quality graduates?

Research Objectives

1. To analyse the effect of personality traits on preference on online learning of YUECo's online MBA students.
2. To analyse the influence of preference on online learning on effectiveness of online learning of YUECo's online MBA students.

Research Design

(a) Sampling

There are 85 students who are attending YUECo's online MBA program. In this study, the sample size is 43 (50% of the population). The sampling frame is the list of these 85 students. Source of this list is the student database kept at student affair office of YUECo's online MBA program. This data is received with the permission of the online MBA program director. The 43 students are randomly selected by using simple random sampling method.

(b) Data Collection

The questionnaire method is applied. Data collection medium is online. Questionnaires are sent to sample students' emails. After one week, filled questionnaires are collected. Data are received from only 31 students among 43 randomly selected students.

(c) Data Collection Instrument

Structured questionnaire is used to collect primary data from randomly selected students. The questionnaire consists of 4 parts: personality traits of students, their preference on online learning, effectiveness of online learning, and demographic data. Question items of the first two parts (part A and B) are in Likert-type five point scale (from 1 to 5: from strongly disagree to strongly agree).

Part (A) personality traits part consists of 8 question items including 3 reverse items for extraversion, 9 items including 4 reverse type items for agreeableness, 9 items including 4 reverse items for conscientiousness, 8 items including 3 reverse items for neuroticism, and 10 items including 2 reverse items to measure openness trait. Part (B) preferences on online learning part consists of 5 question items for goal setting, 4 items for environmental structuring, 4 items for task strategy, 3 items for time management, 4 items for help seeking, and 4 items for self-evaluation regarding online learning.

Part (C) effectiveness part contains only quantity type question: student's grades for all subjects they already sit the exam. Part (D) is for demographic factors focusing on number of subjects they have completed.

(d) Data Analysis

For data analysis, descriptive method and multiple linear regression method are applied. To reach the research objectives, the multiple linear regression method is applied. All the Likert type questions are converted from ordinal type into scale type. The data from part (C): grades of students are converted into grade point average (from nominal data type into ratio type).

Theoretical Background

The five personality traits such as extroversion, neuroticism, agreeableness, conscientiousness and openness to experience are rare to change or fluctuate with life cycle stages and these traits are also impacting on behavior (William & Debra A, 1992), especially on learning behavior (Heinstrom, 2000). Students' happiness with online learning would be depending on their characteristics.

The extraverts are active and not reluctant to talk to others while introverts would like to stay away from people and like silence (Howard & Howard, 1998). Extrovert persons will be outgoing as well as energetic while introvert persons will be isolated or solitary. The agreeableness trait is relating to caring and emotional, support, and sympathy and empathy versus ego, selfness, and rude (Feist & Feist, 2008). Persons with high agreeableness will be kind, polite, patient and friendly while persons with less of this trait will like challenging and risk taking. Conscientiousness is relating to focus, concentration achievement and goal oriented versus flexibility, easiness to change and to behave with new style (Howard & Howard, 1998). Persons possess high conscientiousness would like to be efficient and to do tasks systematically. At the other side, ones with less this trait will be careless in doing things.

Neuroticism is relating to anxiety, impatient, temperamental, and hedonic bias versus stability, maturity, calm, and acceptance of reality (Howard & Howard, 1998). The neuroticism does not mean anxiety neurosis; it is nervousness or negative affectivity (McCrae & John, 1992). Persons with high neuroticism will be emotional, moody and easy to be nervous while persons with less of this trait will have high self-confidence.

High openness scale is broader view, creativity, thinking outside the box, easy to learn (Howard & Howard, 1998) and also relating to talent in art and science (Wallach & Wing, 2012). People who have high openness to experience would like to know new things, will be observes, interested in investigating the hidden issues, will like creating new things. However, the persons who have low level of this trait would be consistent and cautious in general.

Literature Review

(a) Effect of Personality Traits on Learning

Personality traits are influencing on learning strategies, which will lead to learning effectiveness of different learners (De Raad & Schouwenburg, 1996)**.** These traits would be driving forces or restraining forces to enthusiasm to learn with a particular style (Blickle, 1996). Conscientiousness and openness are affecting on preference on learning styles and educational interests (De Fruyt & Mervielde, 1996).

Openness is connecting to asking questions, examining, and critical evaluation on assumptions, presentations and theories (Schouwenburg & Kossowska, 1999). The person with high openness scale will link the problems and cases with his or her learning and knowledge (Entwistle & Tait, 1996). Neuroticism has effect on learning style, and students with high neuroticism will try to remember learned things. They will not conduct critical analysis on cases. They like written exam and close book exam, which can be approached by learning by-heard (Entwistle, "Motivational factors in students' approaches to learning", in: learning strategies and learning styles, 1988).

Bayram, Deniz, & Erdogan (2008) stated that there is a significant relationships between learners' personality traits, academic achievement and attitudes towards web based education. Their research focused on 127 students in the e-MBA Master Degree of Bilgi University. Bruso (2019) also proved that personality traits are affecting on self regulated learning strategies: conscientiousness has the strongest effect on learning followed by agreeableness; and neuroticism has no effect on learning. This research covers 4,200 graduate students.

(b) Online Learning Preference

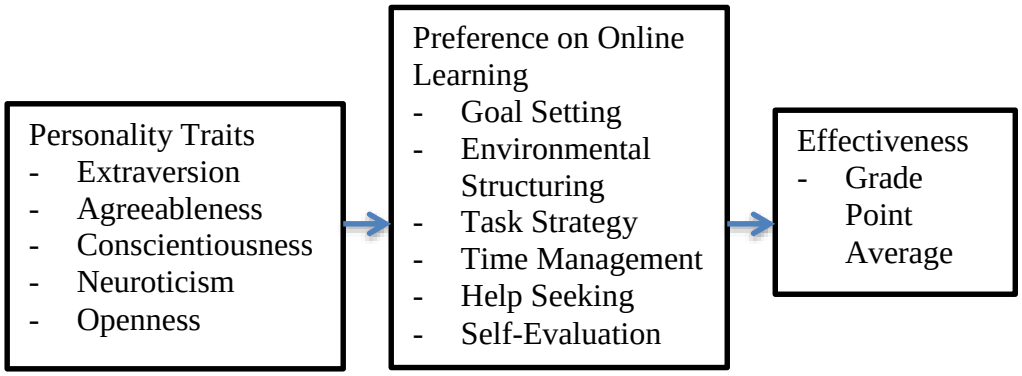
Bruso (2019) explored the variables to measure the online learning preference of students. These variables are goal setting, environmental structuring, task strategy, time management, help seeking, and self evaluation. Goal setting variable measure the student's behavior of identifying short and long term goals to accomplish the online course in time, setting high goals and not compromising for the sake of online learning. Environmental structuring concerns choosing comfortable, quiet and appropriate place for attending online classes and online studying.

Task strategy is to measure preparation for online class: for note taking, to ask questions, and read in-advance the instructed readings. Time management focuses on devoting time to attend online classes regularly and managing time for regular periodic self study. Help seeking measure the effort to get help from classmates, try to discuss face-to-face online, and enclosing the problems for collecting opinions of classmates. Self evaluation is to access finding the similarities and differences between other student's ways of leraning and self ways.

Conceptual Framework

Accounting for the findings from theoretical and literature develops the conceptual framework of the study. This conceptual framework is shown in Figure (1).

Figure (1) Conceptual Framework



Source: Developed for this Study Adapted to Bruso (2019)

In this study, the three variables are focused: personality traits, preference on online learning and effectiveness of learning. The assumption is that the student's preference on online learning will be varied with his or her personality traits, and their preference will lead to the learning effectiveness measured with grade point average. Five personality traits such as extraversion, conscientiousness, agreeableness, openness and neuroticism are considered. Preference on online learning is approached from student's goal setting, environmental structuring, task strategy, time management, help seeking and self-evaluation.

Data Analysis

Descriptive and multiple linear regression analyses are conducted by using the data collected from 31 out of 43 sample students. Based on findings from descriptive analysis, the personality traits of students are shown in Table (1).

Table (1) Personality Traits of Online MBA Students

Sr. No.	Personality Traits	Mean Value
1	Extraversion	3.7
2	Agreeableness	4.1
3	Conscientiousness	2.5
4	Neuroticism	2.8
5	Openness	4.2

Source: Survey Data, June 2020

According to the results, it can be seen that most of the respondents have high tendency to agreeableness and openness. Extraversion is also at high level although it is not too high. Their conscientiousness and neuroticism traits are at the low level (below average). It seems that students are patient and have high emotional quotient. They also like openness; they are not reluctant to take help, to give help and to share knowledge. They are also inventive and like challenging. However, they are not trying for efficiency and well planning. They are calm. They are not moody and nervous in turbulent times.

Based on findings from descriptive analysis on second variable, the students' preference on online learning is shown in Table (2).

Table (2) Students' Preference on Online Learning

Sr. No.	Personality Traits	Mean Value
1	Goal Setting	2.3
2	Environmental Structuring	3.5
3	Task Strategy	2.8
4	Time Management	3.9
5	Help Seeking	4.3
6	Self-Evaluation	3.1

Source: Survey Data, June 2020

Most of the respondents are preparing their online learning with good time management and seeking help and giving helps each other. They are weak in task strategy. They are normally read and think about lessons after lecturing, rather before the class. They are very weak in goal setting: not focusing on course accomplishment in time by schedule. They are not too conscious on learning environment although they consider this point. They are not doing self-evaluation seriously although normal evaluation is conducted.

After the descriptive analysis, to reach the research objectives, multiple linear regression analysis is conducted. Before starting this analysis, data reliability test is conducted. The results are shown in Table (3).

Table (3) Reliability Test Results

Sr. No.	Leadership Styles	No. of Items	Cronbach's Alpha
1	Extraversion	8	0.746
2	Agreeableness	9	0.760
3	Conscientiousness	9	0.761
4	Neuroticism	8	0.684
5	Openness	10	0.711
6	Goal Setting	5	0.823
7	Environmental Structuring	4	0.690
8	Task Strategy	4	0.713
9	Time Management	3	0.821
10	Help Seeking	4	0.822
11	Self-Evaluation	4	0.779

Source: Survey Data, June 2020

As shown in Table (3), the Cronbach's alpha values of both independent variables and dependent variables are above 0.7. Thus, the question items used to measure variables and the respondents' responses are reliable for further analyses (George & Mallery).

The multiple linear regression analysis is conducted to analyze the effect of personality traits on students' preference on online learning. The results of effect of personality traits on goal setting for online learning accomplishment are shown in Table (4).

Table (4) Effect of Personality Traits on Goal Setting

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	0.181	0.266	0.681	0.497	3.069
Agreeableness	0.783***	0.277	2.823	0.005	2.751
Conscientiousness	0.235***	0.043	5.468	0.000	1.000
Neuroticism	0.194***	0.037	5.182	0.000	1.000
Openness	0.266	0.222	1.196	0.234	2.431
R Square	0.295				
Adjusted R Square	0.281				
F Value	21.299***				

Source: Survey Data, 2019

*** Significant at 1 percent level
** Significant at 5 percent level
* Significant at 10 percent level

By concerning the results from multiple linear regression analysis, it is found that students' agreeableness, conscientiousness and neuroticism have positive effect on goal setting for online learning accomplishment. If they are flexible, they will pay more attention to reach learning target (to complete course as per schedule), and they will sacrifice on time finishing for their duties at workplace. If they are taking acre on things and they have anxiety, they will set specific time goals for completion of course.

The results of effect of personality traits on environmental structuring for online learning convenience are shown in Table (5).

Table (5) Effect of Personality Traits on Environmental Structuring

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	0.540***	0.128	4.213	0.000	2.717
Agreeableness	-0.092	0.129	-0.714	0.478	2.847
Conscientiousness	-0.020	0.123	-0.165	0.869	2.937
Neuroticism	0.313**	0.124	2.522	0.014	2.398
Openness	0.340***	0.120	2.839	0.006	2.630
R Square	0.686				
Adjusted R Square	0.664				
F Value	30.983***				
Durbin Watson	1.987				

Source: Survey Data, 2019

Students' extraversion, neuroticism and openness are positively influencing on environmental structuring for online learning convenience. Students who are energetic, sensitive, emotional and inventive, they will find the quiet and convenient place to attend online classes.

The results of effect of personality traits on task strategy for online learning convenience are shown in Table (6).

Table (6) Effect of Personality Traits on Task Strategy

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	0.140	0.164	0.854	0.396	2.717
Agreeableness	0.143	0.166	0.866	0.390	2.847
Conscientiousness	0.292*	0.159	1.836	0.071	2.398
Neuroticism	0.044	0.158	0.277	0.782	2.937
Openness	0.481***	0.154	3.132	0.003	2.630
R Square	0.572				
Adjusted R Square	0.541				
F Value	18.945***				
Durbin Watson	1. 739				

Source: Survey Data, 2019

Students' conscientiousness and openness have positive effect on their task strategy. Students who are efficient and curious, they will prepare questions at ask at the class, and they will read instructed materials ahead the class time.

The results of effect of personality traits on time management for online learning convenience are shown in Table (7).

Table (7) Effect of Personality Traits on Time Management

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	-0.001	0.190	-0.005	0.996	2.717
Agreeableness	0.377**	0.192	1.964	0.053	2.847
Conscientiousness	0.087	0.183	0.477	0.635	2.937
Neuroticism	0.278	0.184	1.511	0.135	2.398
Openness	0.314*	0.178	1.769	0.081	2.630
R Square	0.468				
Adjusted R Square	0.431				
F Value	12.513***				
Durbin Watson	1.742				

Source: Survey Data, 2019

Students' agreeableness and openness have positive effect on time management for online learning. If students have high agreeableness, they won't like challenging. Thus they will manage time well to attend classes regularly. If they have high openness, they will be inventive as well as

curious. Thus they do not want to miss the classes, they like getting knowledge from instructor and classmates.

The results of effect of personality traits on help seeking for online learning convenience are shown in Table (8).

Table (8) Effect of Personality Traits on Help Seeking

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	0.198	0.176	1.125	0.264	2.717
Agreeableness	0.311*	0.178	1.750	0.084	2.847
Conscientiousness	0.250	0.169	1.473	0.145	2.937
Neuroticism	0.234	0.171	1.368	0.176	2.398
Openness	0.342**	0.165	2.077	0.014	2.630
R Square	0.622				
Adjusted R Square	0. 595				
F Value	23.365				
Durbin Watson	2.202				

Source: Survey Data, 2019

If students have high tendency to agreeableness and openness, they will like to share knowledge, and they will not be reluctant to take help from both instructor and classmates.

The results of effect of personality traits on self-evaluation for online learning convenience are shown in Table (9).

Table (9) Effect of Personality Traits on Self Evaluation

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Extraversion	0.430***	0.144	2.997	0.004	2.717
Agreeableness	0.023	0.145	0.157	0.876	2.847
Conscientiousness	0.133	0.138	0.963	0.339	2.937
Neuroticism	0.039	0.139	0.280	0.780	2.398
Openness	0.229*	0.134	1.702	0.093	2.630
R Square	0.521				
Adjusted R Square	0.488				
F Value	15.462***				
Durbin Watson	1.922				

Source: Survey Data, 2019

If students are extroverts and they have high openness trait, they will do self-evaluation by comparing with classmates' ways of learning, their performance and improvements.

Multiple linear regression analysis is also conducted to analyze the effect of students' preference on online learning on effectiveness of learning (accomplishment). The results are shown in Table (10).

Table (10) Effect of Preference on Online Learning on Learning Effectiveness

Model	Unstandardized Coefficients		t	Sig	VIF
	B	Std. Error			
Goal Setting	0.223	0.173	1.290	0.201	2.717
Environmental Structuring	0.127	0.175	0.727	0.470	2.847
Task Strategy	0.061	0.166	0.369	0.713	2.937
Time Management	-0.033	0.168	-0.198	0.843	2.398
Help Seeking	0.317***	0.041	7.736	0.000	1.000
Self-evaluation	0.499***	0.162	3.077	0.003	2.630
R Square	0.451				
Adjusted R Square	0.413				
F Value	11.678***				
Durbin Watson	2.129				

Source: Survey Data, 2019

To achieve good results, online students' help seeking behavior and self-evaluation practice are very important. If they seek help through social networking, they can learn from others and they can take advantage over others' knowledge sharing. They will also get support and help from instructors for preparation of exams. If they evaluate their way of learning and performance with others', they can find the weakness areas as well as areas for improvements. These practices will lead them to high achievements.

Findings and Discussion

From this research, it is found that high achievers have been practicing help seeking and self-evaluation for learning lessons and also for continuous improvement. If online MBA students would like to gain high grade point average (high marks from exams), they should be open to ask for help from both instructor and other students. They should also do bench marking by evaluating themselves and by comparing with other students.

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VIRTUAL LEADERSHIP, WORK ENGAGEMENT AND EMPLOYEE PERFORMANCE OF TELECOMMUNICATION INDUSTRY IN YANGON DURING COVID-19 CRISIS

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Abstract

This study aims to examine the virtual leadership, work engagement and employee performance of telecommunication industry in Yangon due to Covid-19 crisis. It uses both primary data and secondary data. There are about 3,000 employees working in Yangon telecommunication industry. A simple of 314 employees are selected as respondents by using simple random sampling method. Primary data are collected from these respondents with structured questionnaire. Secondary data are gathered from government documents, internet websites, relevant research papers and text books. Descriptive statistics and regression analysis are used to analyze the collected data. According to regression results, communication, trust and coordination have positive effect on work engagement; more over work engagement has also positive effect on employee performance. To strengthen work engagement, virtual leadership should focus more on building effective communication, creating an environment with trust in a systematic and correct way, and working in coordination.

Keywords: virtual leadership practices, work engagement, employee performance

Introduction

Every organization needs a leader who can set goals/objectives/vision and give clear direction to make the right decisions to achieve them. In business organizations, the activities and actions of individuals and groups play a key role in trying to achieve the goals set by the leader. Leadership is very important for every organization to achieve organizational goal and to enhance employee performance. Leadership practices, work engagement and employee performance are closely related. Leader behaviors play a critical role in shaping working engagement and employee performance. Nowadays, leaders are facing with unpredictable challenges, which required knowledgeable leadership because of global economic competitiveness and Covid-19 crisis. Especially, virtual leaders must take a different management approach compared to leading in a physical work place since team communication isn't done in person. Some of the challenges concerned with the virtual leadership are working in different time zones, sense of isolation, pressure for creating trust.

Work engagement is an important part and its outcomes will be reflected in employee performance (Borst et al., 2020). Employee performance will reach its peak when individual employee effort level is raised (Pawar, 2021). Organizations today use engaged employees as a tool for strategic partner in the business. The concept of work engagement, since many drivers have been identified, impacts employee performance and well-being at workplace. As companies across industries strive to survive and rise above the stiff competition, physical and mental well-being of employees will be one of the important aspects that every leader needs to tend focus on. Hence, work engagement is seen as a powerful source of competitive advantage in the turbulent times.

A telecommunications industry that sells products and services to many customers in a large area clearly affects the society of every country. In telecommunications, which is an

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essential pillar of every country, where operators not only produce the core telecommunications products such as mobile telephony, messaging, and the internet but also provide services such as mobile money, games, news, music, and health. When different leadership styles and approaches are used, they have different skills, thinking and qualities (Graves, 2017). The telecommunications industry is one of the sectors of the economy that is taking full advantage of its human resources and leadership. The telecommunications industry, which applies staff, technology, finance, and many other resources, is a large industry with a lot of innovative functions. Telecommunications is a booming industry and an essential sector for every country. Myanmar's telecom market, which grew rapidly from 2014 to 2020, has seen a steady economic expansion, with B2B and B2C-based products and services being marketed, with business partnerships forming in both the telecom and non-telecom industries. From now on, all four operators (MPT, Ooredoo, Atom and Mytel) are working to maintain a fixed return, looking for areas where market demand is still strong to support revenue declines and market losses, and working with their business partners to create new products and services. In this industry, the role of leadership is very important, and in the face of great challenges and competition, the organization strives to succeed and survive. Therefore, this study is to find out how leaders can better perform for an organization to fulfill the highest demand and respond to challenges during the crisis period.

Objectives of the Study

Objectives of the study are:

(1) To analyze the effect of virtual leadership practices on work engagement of the telecommunication industry in Yangon

(2) To examine the effect of work engagement on employee performance of the telecommunication industry in Yangon

Research Method of the Study

A descriptive research method and a quantitative research design are used to analyze the effect of virtual leadership practices on work engagement and on employee performance. Geographically, there are Yangon-based offices of four operators in Myanmar's telecommunications industry. The target population of telecom operators has approximately 3,000 employees and a sample of 341 employees is selected based on simple random sampling method (calculated using the Raosoft sample size calculator). Primary data are collected from these 341 respondents with structured questionnaire. Items of structured questionnaire are measured with five-point Likert scale. Secondary data are gathered from government documents, Internet websites, relevant research papers and text books. Descriptive statistics and multiple regression analysis are used to analyze the collected data.

Literature Review

Leadership is life blood of any organization and its importance cannot be underestimated. Many authors have studied this phenomenon, but there is no conscious definition of what leadership is, no dominant paradigm for studying it, and little agreement regarding the best strategies for developing and exercising it (Blom & Alvesson, 2014). Leadership plays a significant role in organizational development and is also a significant factor that helps and motivates employees to increase their performance.

Virtual Leadership Practices

The COVID-19 crisis in 2020 has suddenly created many organizations around the world require their employees to work from home, which has led to the shift from physical leadership

to virtual leadership, and the emergence of virtual work teams (Mysirlaki & Paraskeva, 2020). A key factor in virtual leadership is that the entire organization is not active in the form of physical communication. It is necessary to exchange information to maintain productivity and maximize mutual understanding than physical contact work environment that has existed for centuries (Banfield, 2020). Global pandemics such as Covid-19 crisis, which have had a profound impact on the global economy, are constantly changing market needs. Therefore, the leaders who lead the organization have to work remotely to lead the organization during Covid-19 crisis.

It is important to note that virtual leadership has significant impact on work engagement and employee performance, which is important for business organizations. It is interesting to find out what components of virtual leadership are having these effects. The distinctive style of virtual leadership is the reason why this leadership is innovative and brings with it challenges, benefits and changes. The virtual leadership practices consist of virtual team communication, trust and coordination of leader (Kandil & Moustafa, 2021).

Communication is defined as the transmission and exchange of information and data through the use of common symbols between two or more members of the team in an appropriate manner (Gilson, 2015). In virtual leadership, communication enables the leader to systematically transmit organizational values, goals, guidelines, missions, and information to the organization and receive specific successes, needs, suggestions, and challenges from the organization. Communication is one of the most important aspects of virtual leadership, and regular communication builds connection between the organization and its employees. Leader must be able to communicate the vision, the path, the direction, the purpose of each action in line with the aims of the business.

Trust is defined as the desire of virtual team members to believe in one another based on the expectation that each team member will take actions beneficial to the team's overall success (Gilson et al., 2015). Open communication is very important in virtual leadership. It is the leader's responsibility to provide access to data to the extent necessary, clear information on the company's affairs, and on the expected results. This makes employees able to consider the depth of their responsibilities and tasks and make necessary effort to correct conclusions and increase understanding (Dinibutun, 2020).

Coordination is defined as the set of efforts exerted by team members to manage the organization's resources and the extent of consistency and coherence of the work activities of team members (Tan et al., 2019). Working well together can lead to positive results and increase the chances of success. Virtual leadership requires more than just existing methods and processes of coordination. This requires more collaborative coordination and systematic procedures. The leader must ensure that virtual teams are ready to develop tasks and share information and create knowledge, thus widening the historical heritage of the organization and participating, actively in community, in its evolution to new stages of development in line with the organizational changes imposed by a globalized and globalizing society.

Work Engagement

Schaufeli and Bakker (2004). defined work engagement as positivity and loyalty, the connection of work with the mind. It is a positive attitude held by the employees towards the organization and its values. The organization must work to develop and nurture engagement, which requires a two-way relationship between employer and employee (Robbins & Judge,

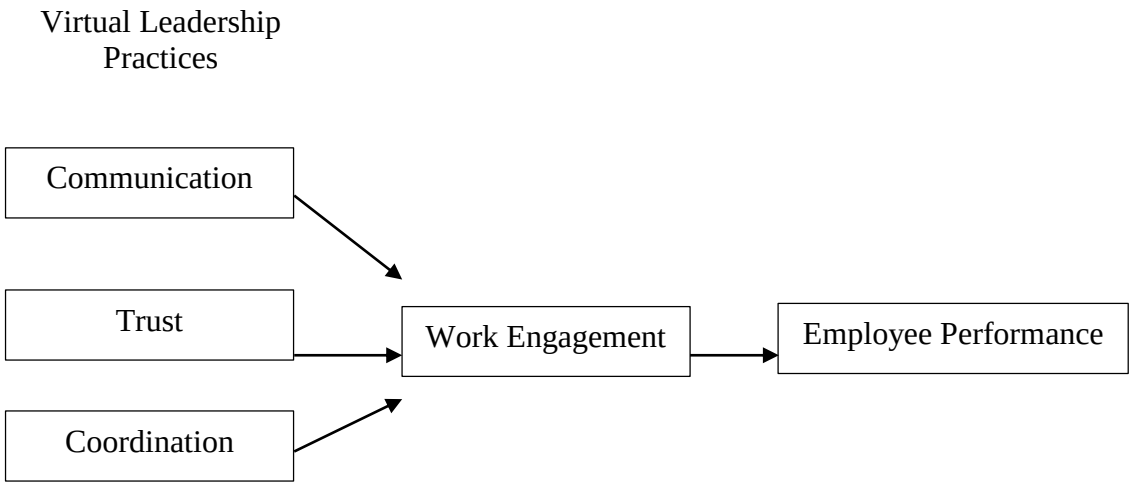
2018). Apart from this, Baig (2010) argued that employee engagement is concerned with the individual contribution under healthy working conditions, promote individual development, encourage mutual confidence and understanding between the employer and the employee, and between the employees themselves.

Employee Performance

Performance is defined as a variable having multiple dimensions and distinct components and elements according to the job (McCloy et al., 1994). Employee performance is normally looked at in terms of outcomes. Leaders can influence the quality of an organization's human resources, which include the relevant skills and experience of members (Hitt & Ireland, 2002). Performance also depends on member motivation and the quality of their social relationships and networks. Collective work is performed more effectively by people who have strong skills, strong commitment to task objectives, confidence in their ability to achieve challenging objectives, a high level of mutual trust, and strong identification with the organization and its mission. Talented, dedicated employees are often instrumental for the achievement of both efficiency and innovative adaptation (Yukl, 2013). At the organizational level, human capital is more important when the organization is heavily dependent on people who have unique talents, require extensive training, and would be difficult to replace if they left. Employee performance determinants and their relative importance depends on the type of team and situation that the leader affects the performance, satisfaction and motivation of a group in a number of ways.

Kandil and Moustafa (2021) examined the effect of virtual leadership practices (communication, trust and coordination) on work engagement during the Covid-19 crisis. The results of this research showed that some practices of virtual leadership had a significant effect on the dimensions of work engagement. Barhite (2017) revealed that perceived organizational communication has the most significant relationship with employee engagement. Bernhardsson et al. (2021) discovered a change in work relations between leaders and followers, and further discovered a set of new challenges that managers have had to face after this sudden transition to virtual leadership. Based on the literature review, the following conceptual framework is developed in this study.

Figure (1) Research Framework



Source: Own Compilation (2022)

According to the research framework, virtual leadership practices (communication, trust and coordination) are independent variables while work engagement is dependent variable. Work engagement is independent variables and employee performance is dependent variable.

Findings and Discussions

This study emphasizes virtual leadership practices, work engagement and employee performance of telecommunication industry in Yangon. Demographic profile of the respondents is described before the analysis of the research objectives.

Table (1) Demographic Profile of Respondents

Sr. No.	Description	Category	Number of Respondents	Percentage
	Total		341	100.0
1	Gender	Female	161	47.2
		Male	180	52.8
2	Marital status	Single	110	67.7
		Married	231	32.3
3	Age (Years)	20 Years and below	-	-
		21-30 Year	124	36.4
		31-40 Years	103	30.2
		41-50 Years	75	22.0
		51-60 Years	39	11.4
		Above 60 Years	-	-
4	Job Position of the Respondents	Manager	118	34.6
		Supervisor	85	24.9
		Specialist	72	21.1
		General Staff	66	19.4
5	Education	Undergraduate	7	2.1
		Graduate	159	46.6
		Post Graduate	173	50.7
		Others	2	0.6
6	Monthly salary (Kyats)	Below 5 Lakh	67	19.7
		Between 5 and 10 Lakh	86	25.2
		Between 10 and 20 Lakh	97	28.4
		Above 20 Lakh	91	26.7
7	Working experiences (Years)	Below 2	49	14.4
		2 to 5	57	16.7
		6 to 9	31	9.1
		9 to 11	150	44.0
		Above 11	54	15.8

Source: Survey Data (2022)

The results show that there are 341 respondents, 161 male (47.2%) and 180 female (52.8%) are involved in this survey. There are 100 single respondents and 231 married respondents in marital status. Hence, the married respondents are more than the single. In terms of age, the respondents who are 21-30 years old range is the highest with 36.4% and the 51-60

years age range is the lowest with 11.4%. There are no respondents under 20 years and above 60 years old. Among the respondents, managers are the most with 34.6%, followed by supervisors with 24.9%, specialists with 21.1%, and general staff with 19.4%. According to the results, there are only 4 types of respondents' education. Among them, regarding salary post graduate respondents are the largest with 50.7% and others are the lowest with 0.6%. 26.7% of the respondents get the highest salary range, 10-20 Lakh Kyats, and 19.7% of the respondents who earn the minimum salary range, below 5 Lakh Kyats. Most of the respondents have 9 to 12 years of working experience with 44.0%, and least of the respondents have 6 to 9 years experiences with 9.1%.

To analyze the research objectives, 341 employees who are working in telecommunication industry in Yangon are asked with structured questionnaire. To describe the overall perception of respondents towards virtual leadership practices, work engagement and employee performance, mean values are calculated. Moreover, to explain how much deviate from the mean value, standard deviation is also calculated. Means and standard deviation results are shown in Table (2) together with the Cronbach Alpha values.

Table (2) Descriptive Statistics of the Variables

Sr. No.	Variables	Mean	Standard Deviation	Numbers of Items	Cronbach's Alpha
1	Communication	3.94	0.322	5	0.787
2	Trust	3.88	0.332	5	0.798
3	Coordination	3.96	0.273	5	0.806
4	Work Engagement	3.97	0.246	5	0.729
5	Employee Performance	3.96	0.244	5	0.777

Source: Survey Data (2022)

This study consists of five variables. The Cronbach alpha value is applied to test the reliability of the variables. Since the values of all variables are greater than 0.7, it shows the reliability and further analysis should be conducted. Moreover, the standard deviations of all variables are below one which describes that they don't deviate from the mean value of each variable.

Among the overall mean values of virtual leadership practices, coordination has the largest mean value, 3.96 and trust has the lowest mean value, 3.88. However, all the overall mean values are at the agree level. It means that employees agree their leaders are applying all leadership practices in their business during Covid-19 crisis. Communication is achieved by providing information and advance notice for important decisions at that time. The overall mean value indicates that a strong sense of effective communication, trust and coordination generates the leader to achieve organizational goals by supporting their team members. Leaders are getting informed about company news and developments to their followers by working from home. To find the research objective for the effect of virtual leadership practices on work engagement, multiple regression analysis is applied in this study.

Table (3) Multiple Regression Analysis of Virtual Leadership Practices on Work Engagement

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.309	0.131		10.032	0.000		
Communication	0.143***	0.046	0.188	3.139	0.002	0.366	2.730
Trust	0.159***	0.041	0.215	3.864	0.000	0.424	2.360
Coordination	0.373***	0.057	0.414	6.539	0.000	0.326	3.069
F	142.593***						
R	0.748						
R^2	0.559						
Adjusted R^2	0.555						
Durbin-Watson	2.005						

Source: Survey data (2022)
Note. *** Significant at 1% level
Dependent variable: Work Engagement

As shown in Table (3), the coefficient of determination i.e., the R-square value is 0.559. This represents that communication, trust and coordination have 55.9% variation on the work engagement. The overall significant of the model, the value of F test, comes out highly significant in telecommunication industry at 1% level. The model for telecommunication industry is a good descriptor of the relation between virtual leadership practices and work engagement.

The result of regression analysis exposes that virtual leadership practices have significant and positive effect on work engagement. These variables are significant at 1% level. Communication has positive and significant effect on work engagement at 1% level. It can be inferred that the more the leader apply communication, the more become work engagement of their employees. As the unstandardized coefficient is 0.143, one unit increase in communication can lead to increase work engagement by 0.143 units. Interpersonal skills of leaders with their followers make engaged employees in their virtual workplace. Leaders in telecommunication industry are effectively communicating the information with their followers to understand clearly.

Trust has also significant and positive effect on work engagement at 1% level. It can be concluded that the more the leader apply trust, the more increase work engagement of their employees. As the unstandardized coefficient is 0.159, one unit increase in trust can lead to increase work engagement by 0.159 units. Transparency of information and decisions practiced by leaders with their followers make engaged employees in their virtual workplace.

Coordination has also significant and positive effect on work engagement at 1% level. It can be inferred that the more the leader apply coordination, the more increase work engagement

of their employees. As the unstandardized coefficient is 0.373, one unit increase in coordination can lead to increase work engagement by 0.373 units. Leaders of telecommunication industry have strong sense of belonging to their followers. They support others in achieving their organizational goals by coordinating at virtually during Covid-19 crisis. Moreover, among the three independent variables, coordination has the most significant effect on work engagement with a coefficient of 0.373.

Communication channels are well established and effective technology is used to divide roles according to the interactions required in virtual teams. In addition, establishing policies according to communication style, setting rules and providing training to build trust, coordination and a systematic communication style promote the effectiveness and usefulness of communication and support work engagement. Linear regression analysis is applied to analyze the effect of work engagement on employee performance. The results for this second objectives are shown in Table (4).

Table (4) Linear Regression Analysis of Work Engagement on Employee Performance

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
1 (Constant)	1.116	.148		7.553	.000
Work Engagement	0.716***	0.037	0.723	19.274	0.000
	371.473***				
R	0.723				
R^2	0.523				
Adjusted R^2	0.521				
Durbin Winston	1.822				

Source: Survey data (2022)

Note. *** Significant at 1% level

Dependent Variable: Employee Performance

According to the linear regression analysis, work engagement has significant and positive effect on employee performance at 1% level. The coefficient of work engagement is 0.716, so every unit increase in work engagement increases employee performance by 0.716 units. Work engagement can be a deciding factor for employee performance. A highly engaged employee will consistently deliver beyond expectations in the workplace. Engaged employees will stay with the company, be an advocate of the company and its products and services, and contributes to bottom line business success. They will normally perform better and are more motivated. It can be seen a significant link between work engagement and employee performance.

Conclusion and Recommendations

This study examines the employee perception towards their leaders' virtual leadership practices, work engagement and employee performance. The primary data needed for this study is collected from 341 respondents selected by using simple random sampling method. According to the survey results, among the respondents, the participation of female is higher than that of

male. Regarding on marital status, married people are almost half as many as single people. The largest group age of the respondents is young and middle-aged, and the rest are old. In terms of job position, the greatest numbers of the respondents are at the management level. It is found that most of the respondents are graduate and post graduate. More than half of the respondents are earning a high salary; A comparatively more respondents who have long working experiences (6 years of working experience or more) are more participated in this study.

According to descriptive statistics, coordination has the maximum overall mean value and trust has the minimum mean value. All the mean values of virtual leadership practices are at the agreed level. It means that the employees are involved in virtual leadership by role, so it is found that virtual leadership practices exist. Also, employees believe that their leaders are practicing virtual leadership practices during the Covid-19 crisis to solve the problems of the temporal and geographical dimension. Working from home during Covid-19 crisis can reduce costs, remove physical limits, form new partnerships without looking at the location, improve efficiency through virtual work teams by satisfying the social and material needs of their employees.

According to multiple regression analysis, all leadership practices have significant effect on work engagement. According to linear regression analysis, work engagement has also significant effect on employee performance. Leading in the coordination role and implementing trust and coordination will make a great impact on work engagement. To be able to achieve work engagement of the employees, the style of leadership practiced at virtually plays a very important role and creates the environment where employees can perform their utmost to their organization. In telecommunication industry, communication channels are established and effective technology is used to face the obstacles during Covid-19 crisis. Coordination is most important factors to increase work engagement when leaders are working from home during crisis. Adequate access to information and mutual understanding are important for the coordination at virtual teams.

Communication is an important practice for work engagement in telecommunication industry. This study recommends that the leaders should pay attention to provide the technological infrastructure to facilitate the communication process such as Wi-Fi internet and mobile data. And the leaders should increase the effectiveness of personal relationships with different workgroups to increase coordination and cooperation between them. Trust is also the important practice to get work engagement. The leaders should discuss with their employees in decision making, solve employees' needs and transparent in business transaction within their virtual team.

Coordination is the most influencing practice on work engagement. Leaders should work closely with internal and external parties to shape and implement an accountability culture suitable for their organization. Therefore, the virtual leadership should focus more on communication, trust and coordination in work engagement efforts in order to achieve the best employee performance. Leaders should practice suitable leadership style in the organization for turbulent situations where the employee performance need to be heightened to the utmost. For achieving work engagement and employee performance, the leader should be aware of what is important for the subordinates and the organizations as a whole and encourage the employees to see the opportunities and challenges around them creatively. The leader should have their own visions and development plan for subordinates, working in group and team work sprit. Employees would like to see more participation attributes in their leader; therefore, the leader should have to promote faith from the subordinates. They should connect with the working

groups and the individual beyond self-interest. A sense of confidence and power for the workloads should be displayed. Leader's virtual leadership practices can increase employee performance. Thus, leader should use this type of leadership practices in important situation. At the same time, leader should clarify expectations and provide goals and standards to be achieved by the subordinates.

The organization and leader should allow involvement of employees in decision making and leadership improvement and provide training and teamwork facilitation. In addition, policies and practices related to rewards or feedback system in the organization can be adjusted to meet employees need in order to improve employee performance. The most important thing is that the leader's need to explore new ways of the employees' thinking, arouse and change their awareness of problems and the capacity to solve those problems. In conclusion, the more the staffs performed very well depending upon the virtual leadership practices the more the organization would be successful. Their perception and attitude toward their leader would affect the life, efficiency and effectiveness of the organization.

Limitation and Needs for Further Research

This study explores the virtual leadership, work engagement, and employee performance. Since virtual leadership is a new and emerging form of leadership, it needs to know more about it and should be widely studied. Regarding the practices of virtual leadership, further researches should study more practices. Because of Covid-19 crisis, many people around the world are adopting a work from home style, so it should also be investigated whether virtual leadership has the potential to be used by businesses in the long term. Only then, it will be able to fully understand virtual leadership and be able to predict its direction and possibilities. Further studies should be conducted regarding employee satisfaction and commitment.

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ANALYTICAL STUDY ON SYSTEM AND PRACTICE OF LEGISLATION IN SOME COUNTRIES*

Khin Maung Oo[1]

Abstract

Legislation is the most important function of the sovereignty, which is divided into legislative, executive and judicial powers. It is very important and essential for every country to make rule of law, development, stability, peace and tranquility of the country. Legislation is made by the legislature which may be formed according to the Constitution of the state. Some parliaments are two houses, bicameral legislatures and some are single house, unicameral legislatures. The outcomes of good laws are important, but more importantly the enforcement and implementation of these laws are able to reach its goal and purpose. Therefore, pre-legislative scrutiny and post-legislative scrutiny are also important. Moreover, the type of government is also important in the legislative process. The legislatures and legislative processes of the United Kingdom, the United States of America, Japan and Myanmar are comparatively analyzed in this paper.

Keywords: *Legislation, legislature, parliament, parliamentary and presidential system, and constitution.*

Introduction

Legislation is the most important power for an independent sovereign state. A state cannot achieve rule of law without good legislation and law. Legislation process of each state is not the same but the purpose and enforcement of legislation is not different.

According to the Constitution of a state the legislature may be unicameral or bi-cameral. The legislation process is different depending on the composition of legislature or legislative assembly. Moreover, legislation partly depends on the systems of government.

Generally, constitution do not expressly declare that they have adopted a presidential, parliamentary or mix system government. The key characteristic of the presidential system government is that the executive and legislature are separate agents of the electorate, and their origin and survival are thus separated (which creates the possibility of an impasse between the two without a constitutionally available device to break the impasse). The president is both the head of state and the head of government. [2]

The key characteristics of a parliamentary system government is that the executive is hierarchically subordinated to the legislature, thus its origin and survival depend on the legislature. The head of government is elected by the legislature. The head of government is accountable to parliament (through a vote of no confidence) and dependent on his or her party's support. Generally, the head of state (often a monarch or ceremonial president) is not the same person as the head of government.[3]

Under the 1947, Constitution of the Union of Myanmar the government was parliamentary system. President was elected by the parliament and the head of state. But, the

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[2] The Design of the Legislature, Markus Bockenforde, International Institute for Democracy and Electoral Assistance (International IDEA),2011, page-3

[3] The Design of the Legislature, Markus Bockenforde, International Institute for Democracy and Electoral Assistance (International IDEA),2011, page-5

head of government was the prime minister. According to the Constitution of the Socialist Republic of the Union of Myanmar, 1974, the president was the head of state and also the head of government. The president was elected by the Pyithu Hluttaw (parliament). It cannot say presidential or parliamentary system exactly and it was a mix system or a semi- presidential system. Under the Constitution of the Republic of the Union of Myanmar (2008), the political and economic system, the state structure and other factors were changed. But, president was the head of state and the head of government, was elected by the Pyidaungsu Hluttaw (parliament). Therefore, the government system was semi-presidential system.

Legislative Authority or Legislature

"Legis" means law and "latum" means making. Legislation means law making. It also refers to the law made by the legislature. It may also be defined as the promulgation of legal rules by an authority which has the power to do so.[1]

A legislature is the generic name for the national parliaments and congresses that act as a plenary general assembly of representatives and that have the power to legislate. [2] The function of government begins by law making and is followed up by law-enforcement and adjudication functions. Therefore, the legislature is the first organ of the government.

Legislature means the branch of government responsible for making statutory laws. The federal government and most states have bicameral legislature, consisting of a house of representatives and a senate. Also termed legislative assembly.[3]

The Composition of Legislatures are two types, namely, bi-cameral legislature and unicameral legislature. Bi-cameral legislature has two houses, upper house and lower house. Unicameral legislature has only single house.

United Kingdom: In the United Kingdom the legislature composed of the House of Commons and the House of Lords. It is bi-cameral legislature. Most bills can begin either in the House of Commons or in the House of Lords. However, certain bills must start in the House of Commons, such as a bill whose main aim is the imposition of taxation (the annual finance bill is an example of this). Bill of major constitutional importance also conventionally start in the House of Commons.[4] Individual person cannot introduce a bill to the parliament.

United States: The main function of the Congress is the making of law. In the United States no individual person has the right to initiate a law to the congress. All legislative powers herein granted shall be vested in a congress of the United States, which shall consist of a Senate and House of Representatives.[5] Only members of the House of Representatives or Senate may introduce legislation, though occasionally a member introduces legislation by request of the President.

Japan: In accordance with the Constitution of Japan, which came into effect in 1947, the principle of separation of powers are divided into legislative, judicial and executive organs. The

[1] https://www.legalbites.in/law-notes-administrative-law-legislation-types/
[2] http://www.fresherslive.com/current-affairs/article/legislatures-of-the-world---national-assembly-
[3] Black's Law dictionary, eighth edition Bryan. A Garner, Editor in Chief. Page-2639
[4] https://www.gov.uk/guidance/legislative process taking a bill through parliament;
[5] The Constitution of the United States of America, Article 1, Section 1

emperor is the symbol of the state and unity of the people. The Constitution of Japan proclaims a system of representative democracy in which the Diet is the highest organ of state power.[1]

Japan's parliament is known as Diet which is a bicameral legislature, composed of the House of Representatives and House of Councilors. The Diet shall be the highest organs of state power, and shall be the sole law-making organ of the state.[2] All legislations must flow a process leading to final approval in the Diet.

A bill may be submitted to the Diet either by a Diet member or by the Cabinet. The Cabinet may submit a bill before either house. A bill may not be submitted personally.

Myanmar: After the independence on 4th January 1948, Myanmar was administered under the Constitution of the Union of Myanmar (the then Burma).

The legislative power of the Union shall be vested in the Parliament which shall consist of the President, a Chamber of Deputies and a Chamber of Nationalities and which is in the Constitution called "the Parliament" or "the Union Parliament."[3] Subject to the provisions of this Constitution, the sole and exclusive power of making laws in the Union shall be vested in the Parliament. It was bi-cameral legislature.

In 1974, the Constitution of the Socialist Republic of the Union of Myanmar was adopted and Myanmar exercised the Myanmar ways to socialism. The composition of parliament and state structure was changed according to this constitution.

The Pyithu Hluttaw is the highest Organ of state power. It exercised the sovereign powers of the State on behalf of the people.[4] The legislative power of the State is vested solely in the Pyithu Hluttaw.[5] At that time it was unicameral legislature.

In 1988, Myanmar changed its policy into market oriented economic system and practiced multi-party democracy system. Constitution of the Republic of the Union of Myanmar was promulgated by the Announcement No. 7/ 2008 of the State Peace and Development Council on 29th May, 2008.

After the enforcement of the Constitution of the Republic of the Union of Myanmar, 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.[6] Schedule One of the Union Legislative List includes such as Union Defence and Security Sector, Foreign Affairs Sector, Finance and Planning Sector, Economic Sector, Agriculture and Livestock Breeding Sector, Energy, Electricity, Mining and Forestry Sector and so on. Schedule two, Region or State Legislative list includes Finance and Planning Sector, Economic Sector, Agriculture and Livestock Breeding Sector, Industrial Sector Social Sector and so on which are relating to the respective Region and State. According to section 8 of the 2008 Constitution, Union is constituted by the Union system and there are Region or State Hluttaw in every region and state which possess the legislative power in their areas.

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[1] The Constitution of Japan (1947) Article .1 and 6
[2] The Constitution of Japan (1947) Article.41 and42
[3] The Constitution of the Union of Burma, 1947 Section -65
[4] The Constitution of the Socialist Republic of the Union of Burma 1974, Section-41
[5] The Constitution of the Socialist Republic of the Union of Burma 1974, Section-44
[6] The Constitution of the Republic of the Union of Myanmar (2008), Section-96

The legislative power is vested in the Pyidaungsu Hluttaw relating to other matters not enumerated in the legislative list of the Union, Region or State and Self-Administered Division Leading Body or Self-Administered Zone Leading Body.[1]

The Pyidaungsu Hluttaw shall enact the required laws if the need arises to do so for the Union territories relating to matters for which legislative power are vested to the Region Hluttaw or the State Hluttaw, or Self-Administered Division Leading Body or Self-Administered Zone Leading Body.[2]

Most of the countries, a law is initiated and introduced in the parliament by the members of parliament or by the government. Individual person cannot directly submit a bill to the legislature. But a person can submit a bill through the member of parliament.

Legislative Process and Legislative Scrutiny

The outcome of a good law is very important in legislation. Therefore, pre-legislative scrutiny is important in the process of legislation. One of the main tasks of parliament in a democratic system of governance is to consider, debate, review and adopt legislation. No matter how or by whom a draft law is developed, parliament's job is to review the draft law prior to deciding whether or not to adopt it, with or without amendments. The exact process by which a parliament reviews or scrutinizes a draft law is varied and depends on a number of factors. However, there are a few principles that are recognized as best practices for forming the foundation of a review.

The first principle is called "Multiple Votes". It suggests that a parliament considers a draft law and votes upon it more than once before it is considered adopted.[3]

The second principle is called "Measured Consideration". It recommends that each stage of the review process is given enough time. Preferably, there is a period of several days, or more, between each stage of the review process. This enables concerned citizens and groups to consider the content and for MPs and parliamentary groups to conduct consultations before deciding how they will vote. Again, like the need for multiple votes, this ensures that the parliament and its MPs have thoroughly and thoughtfully considered the proposed law. In several parliaments, the possibility of fast-tracking of legislation has been established. While fast-tracking of legislation is sometimes considered necessary when there are time or constitutional constraints.[4]

The common stages of the institutional review process in parliament are as follows: [5]

Committee Stage: A smaller group of MPs representing a cross-section of the parliament considers bills in detail and sometimes conducts public consultations. The objective is to look at each clause of the draft law and to propose any amendments to improve it. Where more than one committee reviews the draft law, it is generally accepted that one committee should report back to the plenary the agreed upon amendments. Some parliaments have "standing committees" to

[1] The Constitution of the Republic of the Union of Myanmar (2008), -Section 98
[2] ibid, Section-99
[3] Legislative Scrutiny, Overview of Legislative Scrutiny Practices in the UK, India, Indonesia and France, London, November 2018 (Westminster Foundation for Democracy) page- 6
[4] Legislative Scrutiny, Overview of Legislative Scrutiny Practices in the UK, India, Indonesia and France, London, November 2018 (Westminster Foundation for Democracy) page- 6
[5] ibid

review Bills. The UK House of Commons has ad-hoc Bills Committees and the House of Lords has Grand Committees.

Review in Principle: This stage can occur before or after the committee stage and is the first vote in the plenary session of the parliament on a draft law. The details are not to be debated but MPs are to decide if the general concepts and principles of the law are appropriate and if the law should continue forward for a more detailed review.

Clause-by-Clause Review: Once the draft has been approved in principle and reviewed in detail by one or more committees, it is presented to the plenary for debate on the individual clauses of the draft law. The recommendations of the committee(s) are considered along with the original wording of the draft.

United Kingdom: The United Kingdom, Westminster parliament is the most experienced and the oldest one in the world. Most of the British colony countries' parliaments are the same types of the United Kingdom.

Most Bills will need to go through the following stages in each House before becoming law.

First reading: This is purely a formal stage, and there is no debate on the Bill.[1] Every bill must be published when it is read the first time.

Second reading: This is a debate on the main principles of the Bill, held in the chamber. A government minister will open the debate by setting out the case for the Bill and explaining its provisions. The opposition will respond and then other members are free to discuss it.[2]

Committee stage: This is a line by line consideration of the details of the Bill. In the House of Commons this process may be carried out by a specially convened committee of Members of Parliament (a Public Bill Committee) that reflects the strength of the parties in the House as a whole.[3]

Report stage: In both Houses this stage takes place in the chamber. Only amendments are discussed, so if none are tabled this will be a purely formal stage.[4]

Third reading: After the report stage third reading will be taking place. In the House of Commons this is another general discussion of the Bill which invariably takes place immediately after report. No amendments are possible in the House of Lords. Third Reading will take place on a later day, and tidying up amendments can be tabled.[5] Both Houses must agree on the text of a Bill before it can become an Act.

In the United Kingdom most of the bills are started by the government. A bill must start in the House of Commons or the House of Lords. But finance bill, taxation and of major importance also conventionally are started in the House of Commons. The important fact of a bill to become a law is both houses must agree on this bill. If there is no agreement between the both houses, the bill cannot become a law and it will be dead.

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[1] https://www.gov.uk/guidance/legislative process taking a bill through parliament
[2] https://www.gov.uk/guidance/legislative process taking a bill through parliament
[3] Ibid
[4] Ibid
[5] ibid

United States: The legislative process is a series of steps that a legislative body takes to evaluate, amend and vote on a proposed legislation. The US Congress, state legislatures, county boards and city councils are machineries engaged in the legislative process. Most legislation in the United States is enacted by the Congress and state legislatures.[1]

The following is a step by step description of how a proposed legislation or a bill is passed into law. All bills and resolutions that are officially introduced in the House of Representatives or Senate are then "referred" to one or more House or Senate standing committees. Major legislation is usually referred to more than one committee.[2]

A bill can be referred to a subcommittee or considered by the committee as a whole. If the bill must go through more than one committee, the first committee must refer it to the second committee. The subsequent committee can then only act on the bill. If the committee does not act on a bill, it is equivalent to killing the bill. If the committee approves the bill, it moves on in the legislative process.[3]

Usually, the committee sends bill to a subcommittee for further study and public hearings. Hearings based on the bill provide the executive branch, experts, other public officials, supporters and opponents of the bill, an opportunity to put on record their views regarding the bill.[4]

Once the bill has been reported with a favorable report and published, it will be placed in chronological order on the legislative calendar of the House of Representatives or Senate and scheduled for "floor action" or debate before the full membership.

Both of the House of Representatives and Senate must approve the conference report. If not approved, it the bill will be sent back to the conference committee for further work.[5]

Japan: Drafting of a Legislative bill: Drafting and introducing a bill of Japan is partially different from the United Kingdom and the United States. A legislative bill that is to be introduced by the Cabinet is drafted by the ministry having the jurisdiction. A ministry draws up the first draft of a legislative bill, once it decides either to enact a new law or to amend or abolish an existing law in order to achieve a policy goal set in the performance of its administrative duties. On the basis of this first draft, consultations take place with other ministries concerned. In addition, where necessary, procedures are followed for its referral to advisory councils or to public hearings. Once all of the above has been completed and the legislative bill is considered ready, the ministry in charge puts the draft into a proper statutory form. The final draft of the legislative bill has now been prepared.[6]

Examination by the Cabinet Legislation Bureau: All legislative bills that are to be introduced by the Cabinet are examined by the Cabinet Legislation Bureau before being brought before Cabinet meetings. In principle the examination of a bill by the Bureau should begin only after the request addressed to the Prime Minister for a Cabinet meeting relating to the bill is sent by the ministry in charge.

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[1] https://system. uslegal.com/congress/legislative. process/
[2] ibid
[3] https://system. uslegal.com/congress/legislative. process/
[4] ibid
[5] ibid
[6] http://www.clb.go.jp/english/process/

Cabinet decision to submit the bill to the Diet: As to the legislative bill for which a Cabinet meeting has been requested, if the Cabinet decides in favor without objection, the Prime Minister submits the bill to the Diet (either to the administrative work related to the submission to the Diet of a bill introduced by the House of Representatives or to the House of Councilors). Cabinet is conducted by the Cabinet Secretariat.[1]

Examination by the Diet: When a legislative bill is submitted to either the House of Representatives or the House of Councilors, the leader of the House (the Speaker in the case of the House of Representatives, the President in the case of the House of Councilors), in principle, refers the bill to an appropriate committee. The committee then conducts an examination, starting with an explanation by the state minister in charge regarding the reason for proposing the bill.[2]

When the legislative bill passes both the committee and the plenary of the House to which it was first submitted, it is sent on to the other House (i.e. it is sent from the House of Representatives to the House of Councilors or vice versa). The same procedure involving deliberation and decisions both by a committee and a plenary is then followed by the second House.

Myanmar: In 1988, Myanmar changed its policy into market oriented economic system and practiced multi-party democracy system. Constitution of the Republic of the Union of Myanmar was promulgated by the Announcement No. 7/ 2008 of the State Peace and Development Council on 29th May, 2008.

After the enforcement of the Constitution of the Republic of the Union of Myanmar, 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.[3]

Submission of Bill: The Union level organization formed under the Constitution shall have the right to submit the Bills relating to matters they administered among the matters included in the Union Legislative List to the Pyidaungsu Hluttaw in accordance with the prescribed procedures.[4]

Bills relating to national plans, annual budgets and taxation, which are to be submitted exclusively by the Union Government shall be discussed and resolved at the Pyidaungsu Hluttaw in accord with the prescribed procedures.[5]

The Bills submitted to the Pyidaungsu Hluttaw by the Union level organizations formed under the Constitution, except the Bills that are prescribed in the Constitution to be discussed and resolved exclusively at the Pyidaungsu Hluttaw, are entitled to initiate and discuss at either the Pyithu Hluttaw or the Amyotha Hluttaw in accord with the prescribed procedures.[6]

The Bills, which are to be discussed and resolved exclusively at the Pyidaungsu Hluttaw need to be vetted before being discussed at the Pyidaungsu Hluttaw, those Bills shall be vetted jointly by the Pyithu Hluttaw Bill Committee and the Amyotha Hluttaw Bill Committee, and

[1] http://www.clb.go.jp/english/process/
[2] ibid
[3] The Constitution of the Republic of the Union Myanmar (2008), Section-96
[4] The Constitution of the Republic of the Union Myanmar (2008), section 100 (a)
[5] Ibid section 100 (b)
[6] ibid section -101

the findings and remarks of the Joint Committee together with the Bill may be submitted to the Pyidaungsu Hluttaw session in accord with the prescribed procedures.

Promulgation as Law

The parliament(legislature) has been passed the bill; the bill is presented to the Head of State for signature. After the president signs the bill, it becomes into law. Once adopted, the law is presented to the Head of State for signature. Depending on the political system, there is some flexibility in whether the Head of State must agree to the proposed law, or has the possibility to return it to parliament for reconsideration.

A law enters into force once published in the official gazette, or a few days after its publication allowing time for citizens to know about it. This depends on the political system. It is important to note that the date the law enter into force is different from the date it is adopted.

United Kingdom: A bill that has been passed by both Houses becomes law once it has been given Royal Assent and this has been signified to parliament. It will then become an Act. Even then the Act may not have any practical effect until later on. Most provisions in an Act will either come to operation within a set period after Royal Assent (commonly two months later) or at a time fixed by the government.[1]

In the United Kingdom most of the bills are started by the government. A bill must start in the House of Commons or the House of Lords. But finance bill, taxation and of major importance also conventionally are started in the House of Commons. The important fact of a bill to become a law is both Houses must agree on this bill. If there is no agreement between the both Houses, the bill cannot become a law and it will be dead.

United States: Once both the House of Representatives and Senate have approved the bill in identical form, it becomes "Enrolled" and sent to the President of the United States. The President may sign the bill into law. If the President is opposed to the bill, he can "veto" it.[2]

In the United States, although the congress approved a bill and sent it to the president to sign this bill, the president has the power to oppose or to sign it. According to the Constitution of the Republic of the Union of Myanmar (2008) the President had the same power. But, there is a little difference between Myanmar and the United States. According to the Myanmar Constitution, President may refuse to sign the law. But if the President did not sign the law the day after the completion of the limitation period the law will be enforced as it was signed by the President.

Japan: Enactment of a new law: Except otherwise provided by the Constitution, a legislative bill becomes a law when it passes both the House of Representatives and the House of Councilors. The leader of the House that examined the bill second (the Speaker in the case of the House of Representatives, the President in the case of the House of Councilors) then submits the new law to the Emperor via the Cabinet (the Emperor's approval is a formality).[3]

Japan is a constitutional monarchy system and emperor is the head of state and symbol of the country. Legislative authority is in the diet which is composed of the representatives elected by the people. Sovereignty, including legislative power comes from the people. It is bi-

[1] http://www.gov.uk/guidance/legislative process taking a bill through parliament
[2] https://system.uslegal.com/congress/legislative-process/
[3] http://www.clb.go.jp/english/process/

cameral parliament and most of the legislative process are same to the other bi-cameral parliaments in the world.

Myanmar: Under the 2008 Constitution, promulgation of law is made under the Section 105 of the Constitution.

(a) The President shall sign the bills approved or the bills deemed to be approved by the Pyidaungsu Hluttaw, within 14 days after the day of receipt, and shall promulgate it as law.

(b) The President within the prescribed period, may send the bill back to the Pyidaungsu Hluttaw together with his comments.

(c) If the President does not send the bill back to the Pyidaungsu Hluttaw together with his signature and comments within the prescribed period, or if the President does not sign to promulgate, on the day after the completion of that period, the Bill shall become a law as if he had signed it.[1]

If the President sends the Bill back to the Pyidaungsu Hluttaw together with his comments within the prescribed period, the Pyidaungsu hluttaw, after discussion of the President's comments, may accept his comment and resolve to amend the Bill or may resolve to approve the Bill as it is without accepting the President's comment.

When the Bill which is amended in accord with the President's comment or the Bill which is approved as it is without accepting the President's comment is sent back to him by the resolution of the Pyidaungsu Hluttaw, the President shall sign the Bill and promulgate it as law within seven days after receiving the Bill back.

If the Bill sent back by the Pyidaungsu Hluttaw is not signed by the President within the prescribed period, it shall become law as if he had signed it on the last day of the prescribed period.[2]

The Laws signed by the President or the laws deemed to have been signed by him shall be promulgated by publication in the official gazette. The Law shall come into operation on the day of such promulgation unless the contrary intention is expressed.[3]

Conclusion

Legislation is essential to make rule of law in the society. Legislative process and system are important to come out good laws. The constitutional systems and political systems are not same in the world. Some states are republics and some are constitutional monarchy. Moreover, some countries' parliaments are two houses, bi-cameral chambers and some are single house, unicameral chambers.

In some countries, the constitution was changed from time to time. The state structure, political system and legislature are changed in accordance with the state constitution. In Myanmar, there were many constitutions, such as 1947, Constitution of the Union of Burma, 1974, the Constitution of the Socialist Republic of the Union of Myanmar and the Constitution of the Republic of the Union of Myanmar,2008. Legislation practice and system also changed,

[1] The Constitution of the Republic of the Union of Myanmar (2008), section 105
[2] ibid, section 106
[3] Ibid section 107

depending on the constitution. If legislative process is not a stable and strong format, it will be changed depending on current situation. Political system and constitution may change from time to time, but legislative process and procedures should be the same. Myanmar has no legislative council, no cabinet legislation bureau like the United Kingdom and Japan. Before a bill is submitted to the Pyidaungsu Hluttaw, there should be a strong and reliable team or organization to vet or scrutinize the bill for the best one.

The United Kingdom and Japan are constitutional monarchy states. The United States is a federal democracy country. Their political systems, state structures, composition of parliaments, legislatures and legislative practices are not same and partially different. The United Kingdom and Japan are constitutional monarchy systems. But election of Members of parliament, submission of a bill is not the same. In the United States the president has veto power to reject a law. But it was not in the United Kingdom and Japan. Every country has their own system which is suitable and appropriate for their situations.

In the modern legislative process, legislative scrutiny which includes pre and post is also important to make the effective laws. Myanmar is not familiar with legislative scrutiny and it needs to learn and implement it in the legislative process. Myanmar needs to find the ways and means and to create the pre- legislative scrutiny system to enact the good laws. Moreover, how to make the enforcement and implementation to reach the goals of law by means of post legislative scrutiny should be applied in Myanmar Hluttaws. Development of legislation will make prosperity, stability, peace, tranquility and rule of law of a country. The members of parliaments and legal draftsmen need to try hard to make better laws for the nation and the people.

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LEGAL PROTECTION OF SHWEBO THANAKHA IN MYANMAR

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Abstract

Intellectual Property refers to creations of human mind and it comprises two main branches: copyright and industrial property. Industrial property includes patents, industrial designs, trademarks, service marks, collective marks, commercial name and geographical indications. Geographical indications shall be the indication that identifies certain goods as goods originating from the territory of specific country, region or a locality with such territory, where specific quality, reputation or other characteristics of the goods can be essentially attributed to their geographical origin. Legal Protection of Geographical indications (GI) enables those who have the right to use the indication to take measures against other who use it without permission and benefit from its reputation. Geographical indications of protection treaties are the Paris Convention for the Protection of Intellectual Property, 1883, the Convention Establishing the World Intellectual Property Organization (WIPO), 1995 and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), 1994, Madrid Agreement, 1891, and Lisbon Agreement (1958). Thanakha would be incomplete to leave out Shwebo whose indigenous Thanakha is said to be the best known for its superior quality. According to "Myanmar Thanakha" by U Tha Hla, Thanakha from Theinkataw region about two miles downstream of Sihataw pagoda on the western bank of Ayeyawady River in Khin U Township, Shwebo District was offered to the court on a regular basis during the region of King U Aung Zeya, the founder of the third Myanmar Kingdom and the court recognized it as the best Thanakha suited for the court to use. However, Theinkataw Thanakha is now on the verge of extinction. Therefore, Geographical indications should be enacted as a separate law. Myanmar should get Geographical Indication right in Shwebo Thanakha as a local product of Shwebo Township in accordance with the Conventions and Myanmar Domestic Laws.

Keywords: Appellations of Origin, Quality, Reputation and Characteristic of the Shwebo Thanakha, the Paris Convention, WIPO, TRIPs, Lisbon, Madrid.

Introduction

The term "Intellectual Property" refers to all categories of intellectual property namely; Copyright and Related Rights, Trademarks, Geographical Indications, Industrial Designs, Patents, Layout-designs of Integrated Circuits and Protection of Undisclosed Information.

The use of geographical indications is an important method of indicating the origin of goods and services. One of the aims of their use is to promote commerce by informing the customer of the origin of the products. They can be used for industrial and agricultural products.

There are three major conditions for the recognition of a sign as a geographical indication:

- it must relate to a goods (although in some countries services are also included, for example in Azerbaijan, Bahrain, Croatia, Jamaica, Saint Lucia, Singapore and others);
- these goods must originate from a defined area;
- the goods must have qualities, reputations or other characteristics which are clearly linked to the geographical origin of goods.[4]

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[4] Geographical indications and TRIPs: 10 Years Later… A roadmap for EU GI holders to get protection in other WTO Members, p5.

Geographical indications (GI) are signs (most usually proper names) which identify a goods as originating in the territory of a particular country, or a region or locality in that country, where a given quality, reputation or other characteristic of the goods is essentially attributable to its geographical origin. It is a separate type of intellectual property.

Articles 22(1) of the Trade-Related Aspects of Intellectual Property Rights, Geographical Indications (GI) are protected under the Trade-Related Aspects of Intellectual Property Rights (TRIPs) Agreement as an intellectual property right under the jurisdiction of the World Trade Organization (WTO). "Geographical Indication" encompasses many concepts, including, but not limited to, "indications of source" and "appellations of origin". As defined by TRIPs, "geographical indications are indications which identify goods as originating in a territory or a region or locality in that territory, where a given quality, reputation or other characteristic of the goods is essentially attributable to its geographical origin."

Geographical indications are place names (in some countries also words associated with a place) used to identify products that come from these places and have these characteristics (for example, "Champagne", "Tequila", or "Roquefort").[1]

Legal Framework of International Law

The first efforts to adopt a common approach to intellectual property resulted in the Paris Convention on the Protection of Intellectual Property which was adopted in 1883. The Convention concerned all aspects of intellectual property and not just geographical indications.

Paris Convention for the Protection of Intellectual Property, 1883

The Paris Convention was the first multilateral agreement, which included "indications of source or appellations of origin" as objects of protection.

Article 1(2) of the Paris Convention states: "The protection of industrial property has as its object patents, utility models, industrial designs, trademarks, service marks, trade names, indications of source or appellation of origin, and the repression of unfair competition".

The Paris Convention identifies geographical indications as a separate intellectual property right, but does not clearly define this concept.

Article10 Paris Convention, (1) the provisions of the preceding Article shall apply in cases of direct or indirect use of a false indication of the source of the goods or the identity of the producer, manufacturer, or merchant. (2) Any producer, manufacturer, or merchant, whether a natural person or a legal entity, engaged in the production or manufacture of or trade in such goods and established either in the locality falsely indicated as the source, or in the region where such locality is situated, or in the country falsely indicated, or in the country where the false indication of source is used, shall in any case be deemed an interested party.

Article10 (b) of the Paris Convention,

(1) The countries of the Union are bound to assure to nationals of such countries effective protection against unfair competition.

(2) Any act of competition contrary to honest practices in industrial or commercial matters constitutes an act of unfair competition.

(3) The following in particular shall be prohibited:

[1] https://www.wto.org.

1. all acts of such a nature as to create confusion by any means whatever with the establishment, the goods, or the industrial or commercial activities, of a competitor;
2. false allegations in the course of trade of such a nature as to discredit the establishment, the goods, or the industrial or commercial activities, of a competitor;
3. indications or allegations the use of which in the course of trade is liable to mislead the public as to the nature, the manufacturing process, the characteristics, the suitability for their purpose, or the quantity, of the goods.

The Paris Convention does mention appellations of origin expressly. However, they are covered by the term "indications of source" as all appellations of origin are considered to be indications of the source of goods.

Article 11bis of the Convention gives the basis for protection against misleading indications of source, including appellations of origin. It obliges members to provide protection against unfair competition and contains a non-exhaustive list of acts, which are to be prohibited. The Paris Convention does not provide for any special remedies against infringement of this provision.

Paris Convention in Article 19 allows the parties "to make … between themselves special agreements for the protection of industrial property". Two such agreements of relevance to GIs were duly made. These are the 1891 Madrid Agreement and the 1958 Lisbon Agreement.[1]

Madrid Agreement Concerning the International Registration of Marks, 1891

In some countries geographical indications could be only protected as trademarks. Therefore, the Madrid system for the International Registration of Marks as collective marks, certification marks or guarantee marks is of relevance to the protection of Geographical indications.

Madrid Agreement on Indications of Source

The Madrid Agreement for the Repression of False or Deceptive Indications of Source of Goods is specific to indications of source.

Article 1(1) of the Madrid Agreement provides that: "All goods bearing a false or deceptive indication by which one of the countries to which this Agreement applies, or a place situated therein, is directly or indirectly indicated as being the country or place of origin shall be seized on importation into any of the said countries."

The Madrid Agreement was the first multilateral agreement to provide specific rules for the repression of false and deceptive indications of source.

Nationals of countries not having acceded to this Agreement who, within the territory of the Special Union constituted by the said Agreement, satisfy the conditions specified in Article 3 of the Paris Convention for the Protection of Industrial Property shall be treated in the same manner as nationals of the contracting countries.[2]

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[1] Lisbon Agreement for the Protection of Appellation of Origin and their International registration, 31 October, 1958.

[2] Article 2 of the Madrid Agreement Concerning the International Registration of Marks, 1891.

Article 3 (1) of the Madrid Agreement concerning The International Registration Of Marks, 1891 state that, every application for international registration must be presented on the form prescribed by the Regulations; the Office of the country of origin of the mark shall certify that the particulars appearing in such application correspond to the particulars in the national register, and shall mention the dates and numbers of the filing and registration of the mark in the country of origin and also the date of the application for international registration.

(2) The applicant must indicate the goods or services in respect of which protection of the mark is claimed and also, if possible, the corresponding class or classes according to the classification established by the Nice Agreement concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks. If the applicant does not give such indication, the International Bureau shall classify the goods or services in the appropriate classes of the said classification. The indication of classes given by the applicant shall be subject to control by the International Bureau, which shall exercise the said control in association with the national Office. In the event of disagreement between the national Office and the International Bureau, the opinion of the latter shall prevail.

(3) If the applicant claims color as a distinctive feature of his mark, he shall be required: 1. to state the fact, and to file with his application a notice specifying the color or the combination of colors claimed; 2. to append to his application copies in color of the said mark, which shall be attached to the notification given by the International Bureau. The number of such copies shall be fixed by the Regulations.

(4) The International Bureau shall register immediately the marks filed in accordance with Article 1. The registration shall bear the date of the application for international registration in the country of origin, provided that the application has been received by the International Bureau within a period of two months from that date. If the application has not been received within that period, the International Bureau shall record it as at the date on which it received the said application. The International Bureau shall notify such registration without delay to the Offices concerned. Registered marks shall be published in a periodical journal issued by the International Bureau, on the basis of the particulars contained in the application for registration. In the case of marks comprising a figurative element or a special form of writing, the Regulations shall determine whether a printing block must be supplied by the applicant.

(5) With a view to the publicity to be given in the contracting countries to registered marks, each Office shall receive from the International Bureau a number of copies of the said publication free of charge and a number of copies at a reduced price, in proportion to the number of units mentioned in Article 16(4)(a) of the Paris Convention for the Protection of Industrial Property, under the conditions fixed by the Regulations. Such publicity shall be deemed in all the contracting countries to be sufficient, and no other publicity may be required of the applicant.

Any contracting country may, at any time, notify the Director General of the Organization (hereinafter designated as "the Director General") in writing that the protection resulting from the international registration shall extend to that country only at the express request of the proprietor of the mark.[1] Such notification shall not take effect until six months

[1] Article 3bis (1) of the Madrid Agreement Concerning The International Registration Of Marks, 1891.

after the date of the communication thereof by the Director General to the other contracting countries.[1]

Article 4(1) of the Madrid Agreement Concerning The International Registration Of Marks, 1891 state that, From the date of the registration so effected at the International Bureau in accordance with the provisions of Articles 3 and 3ter, the protection of the mark in each of the contracting countries concerned shall be the same as if the mark had been filed therein direct. The indication of classes of goods or services provided for in Article 3 shall not bind the contracting countries with regard to the determination of the scope of the protection of the mark.

(2) Every mark which has been the subject of an international registration shall enjoy the right of priority provided for by Article 4 of the Paris Convention for the Protection of Industrial Property, without requiring compliance with the formalities prescribed in Section D of that Article

The Madrid Agreement did not add much to the protection already given by the Paris Convention, but it extended protection to deceptive indications of source in addition to false indications. A deceptive indication of source can be the true name of the place where the goods originates from, but nevertheless confusing the purchaser in respect to the true origin and quality of the goods.

Lisbon Agreement for the Protection of Appellation of Origin and their International Registration, 1958

The Lisbon Agreement provides for the protection of appellations of origin, that is, the "geographical denomination of a country, region, or locality, which serves to designate a product originating therein, the quality or characteristics of which are due exclusively or essentially to the geographic environment, including natural and human factors".[2]

Appellations of origin

Article 2(1) of the Lisbon Agreement, Appellations of origin is protected under the Lisbon Agreement for the Protection of Appellations of Origin through registration under the jurisdiction of the World Intellectual Property Organization (WIPO). Appellation of origin means "the geographical denomination of a country, region, or locality, which serves to designate a product originating therein, the quality or characteristics of which are due exclusively or essentially to the geographical environment, including natural and human factors".

Article 2(2) of the Lisbon Agreement, furthermore, "the country of origin is the country whose name or the country in which is situated the region or locality whose name constitutes the appellation of origin which has given the product its reputation"

Geographical Indication generally protects agricultural products, foodstuffs, wines and spirits, handicrafts, and industrial products. A Geographical Indication is not a trademark with geographical significance, such as NORTH POLE for Bananas or HYDE PARK for men's suits, nor is it a generic term such as Swiss cheese.

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[1] Article 3bis (2), Ibid.

[2] Article 2 of the Lisbon Agreement for the Protection of Appellations of Origin and their International Registration, 1958.

Basically, a geographical indication is a notice stating that a given product originates in a given geographical area. The best known examples of geographical indications are those used for Wines and spirits. For instance, the geographical indication Champagne is used to indicate that a special kind of sparkling Wine originates in the Champagne region of France. In the same way, Cognac is used for brandy from the French around the town of Cagnac, also tabacco from Cuba, cheeses from Roguefort. They may also be used for industrial products, as Sheffield is for steel.

An appellation of origin is a special kind of geographical indication generally consisting of a geographical name or a traditional designation used on products which have a specific quality or characteristics that are essentially due to the geographical environment in which they are produced. Example for protected appellations of origin are "Bordeaux" for wine, "Noix de Grenoble" for nuts, "Tequila" for spirit drinks, or "Jaffa" for oranges. Consumers are familiar with these products and often request them even unknowingly using their geographical name. The Following examples may ring a bell.

One such appellation of origin is Prociutto di Parma or Parma ham. For ham to receive the Parma name, it must be produced in the province of Parma – in the Emilia – Romagna region of north – central Italy using exclusively pigs from that area. Each step in production, from the breeding of the pigs and their diet through processing to the final packaging, is closely monitored and controlled by the Instituto Parma Qualita. Only the Instituto can be brand the finished ham with the seal of Parma's five-pointed ducal crown, qualifying the ham as true Parma ham.[1]

In addition, Thailand the geographical indication obtained is tamarind fruit, rice, silk, etc,. Similarly, Indonesia got the white papper, Amen Bali Salt, Flores Bajawa Arabica Coffee, and so on. Malaysia achieved ginger, Sarawak pepper, Doi Chaang Coffee, etc….

Appellations of the origin are specific types of geographical indication. A geographical indication is a notice stating that a given product comes from a particular area. For example, the expression "Made in Japan" is a geographical indication. An appellation of origin is a more precise indication which qualities are due essentially or exclusively to its place of origin. Their products are special qualities to the place that they come from. This is very common with agricultural products such as Roquefort cheese. All appellation of origin are geographical indication but not all geographical indications are appellations of origin.

Trade-Related Aspects of Intellectual Property Rights Agreement, 1994

The essential elements of the standards concerning the availability, scope and use of rights involving geographical indications include the following:[2]

As a general rule;

- Members must provide the legal means for interested parties to prevent the use of indications that misleading indicates or suggests that goods originate in a geographical area other than the true place of origin.
- Members shall refuse or invalidate the registration of a trademark which consists of a misleading indication, and provide means to prevent any use which constitutes an act of unfair competition within the meaning of Article 10bis of the Paris Convention, 1883.

[1] https://www.wto.int/Famous_appellation_of_origin.
[2] Section 3 (Article 22 to 24) of TRIPS Agreement, 1994.

- Protection shall be applicable against a geographical indication which is literally true but misleading and in the case of wines or spirits, even where the true origin of the goods is indicated or the geographical indication is used in translation or accompanied by expressions such as 'kind', 'type', or 'style', 'imitation' or the like.
- Protection is not required in respect of a geographical indication of another Member which is identical with the common name for goods or services, or, for products of the vine, which is identical with the customary name of a grape variety existing in the territory of that Member as of the date of entry force of the WTO Agreement.
- There is no obligation to protect geographical indications which are not or cease to be protected in their country of origin, or which have fallen into disuse in that country.
- Guidelines are provided for additional protection for geographical indications for wines and spirits, including concurrent protection of homonymous geographical indications for wines, certain exceptions to substantive rights such as prior eights and the right to use personal names, and time limits for registration in certain cases.

Article 22 of the TRIPs Agreement provides a definition of geographical indications. They are: "geographical indication are indications which identify a goods as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the goods is essentially attributable to its geographical origin".

Protection of Geographical Indications

Originally, Geographical Indications were protected in accordance with national laws developed locally. As the law was national it was limited in effect to the state territory. It became quickly apparent, once commerce expanded in the 19th century, that national protection was not sufficient as products were often imitated outside of the country of origin. Therefore, international cooperation was required to ensure that Geographical Indications were also protected internationally and that there was mutual reciprocity in the level of protection between states.

In accordance with the territoriality principle, and in line with Article 1(1) of TRIPs that stresses that "members shall be free to determine the appropriate method of implementing the provisions of this Agreement within their own legal system and practice", various countries and regions have adopted a variety of mechanisms for the protection of geographical indications, including *sui generis* registries, single-purpose laws, collective marks, and certification marks. Such rights may exist in parallel or in combination, thereby providing complementary protection, and generally prescribe the requirements for registration and the public or private persons and entities that are entitled to own and control such designations under applicable national laws. Geographical Indications protection as an Intellectual Property right differs depending on the jurisdiction or region. Jurisdictions that provide a regulatory scheme to register Geographical Indications (the European Union, for example) offer an enhanced "*sui generis"* protection that requires specific labeling and certification. Other countries protect marks with geographic significance as trademarks and/or allow protection of geographic terms as collective and/or certification marks subject to specific standards and/or user requirements.[1]

[1] International Trademark Association, Protection of Geographical Protection, Sponsoring Committee: Geographical Indications Committee, November 2019, p3.

Unlike trademarks and Patents, there's a wide variety of type of protection available for geographical indications they can be protected either through *"sui generis"* Legislation or decrees that is the system used by France and Portugal. Another register of geographical indications, possibility again is to rely on the law against "unfair competition" or the tort of "passing off". To use a geographical indication for product that does not originate in the region named would be very good examples of an "unfair trade Practice". If protection is sought under tort law, there are no formalities to be observed such as registration or decree, the injured party goes to court and puts this case.

Geographical Indication can also be protected by the registration of collective marks or certification marks. Unlike individual trademarks, collective marks belong to a group of traders or producers. It does not belong to anyone; anyone who meets the specified conditions is allowed to use it.

Geographical Indications and Traditional Knowledge go hand and hand, as Traditional Knowledge means the knowledge of a particular community passed on from generation to generation and Geographical Indications refer to recognizing the art and culture practiced by a particular community residing in that region.

Geographical Indications acts as a tool in protecting Traditional Knowledge and encourages the communities with such knowledge to continue to practice and promote the same to their future generations. It helps to bridge the gap between the older generations of the society and the upcoming generations.

Materials and Methods

A review was made of the various concepts to intellectual property rights and geographical indications and an analytical study of the International Conventions, Domestic Laws, Jurist's books, Journal, Paper, Article and Internet Website related means of protection for Shwebo thanakha product in Myanmar. Therefore, Geographical Indications should be enacted as a separate law for the protection of products in Myanmar.

Findings

Geographical indications is an important issue to have legal protection of the products of Myanmar not only need to educate and awareness to understand about Geographical Indications for the local producer and community but also need to cooperate and coordinate with local and international organizations to promote the reputations and enter the international market of our products. In some ASEAN countries have adopted the geographical indications law to manage their infringement of intellectual property rights. Myanmar being a member of the ASEAN Framework Agreement on Intellectual Property Cooperation should be adopted as a separate law on the geographical indications arena.

Discussion of Myanmar Thanaka

Myanmar Thanapkha is derived from the world "Thanaka", "Thana" which means "unclean" and " Kha" means "discharge", so Thanakha is a means of disposing of bad impurities. It is written in Maung Mya Nan (Yesakyo) article on "Myanmar Nanthar Myay."[1]

The names and classifications of Thanakha can be observed as follows:[2]

(1) Myanmar name - Thanakha

(2) English name - Chinese Box Tree

(3) Origin - Ruaceac

(4) Seed - Limonia

(5) Species - Acidissima

(6) Scientific name - Naringi crenulata (Roxb.)

Shwebo is a city in Sagaing Region, Myanmar, 110km north-west of Mandalay between the Irrawaddy and the Mu-rivers. The city was the origin of the Konbaung Dynasty, established by King Alaungpaya in 1752, that was the dominant political force in Myanmar after the mid-18th century. It served as Alaungpaya's capital from 1752 to 1760. As of 2021, it has a population of 88,914. It is located the coordinates: 22°34′0″N 95°42′0″E in Myanmar.

Thanakha would be incomplete to leave out Shwebo whose indigenous Thanakha is said to be the best known for its superior quality. According to "Myanmar Thanakha" by U Tha Hla, Thanakha from Theinkataw region about two miles downstream of Sihataw pagoda on the western bank of Ayeyawady River in Khin U Township, Shwebo District was offered to the court on a regular basis during the region of King U Aung Zeya, the founder of the third Myanmar Kingdom and the court recognized it as the best Thanakha suited for the court to use. However, Theinkataw Thanakha is now on the verge of extinction.[3]

There are other kinds of Thanakha from other regions, for example, Shinmataung Thanakha from the central region of Myanmar is famous for being used by Princess Vishanu and is widely used in lower parts of Myanmar.

Thanakha is also grown on a large scale in Kyaukse, Pakokku, Taungdwingyi, Monywa and Ayadaw. However, their barks are not as smooth as those of Shwebo Thanakha and their fragrance is also incomparable with Shwebo Thanakha's.

Quality

Thanakha is widely liked either by the rich or the poor, single or the married. It is common that female manual workers and paddy-growing lasses apply Thanakha on their faces and bodies to prevent themselves from sunburn, chapped skin and freckles.

Thanakha can cool the skin, provide protection from the sunray, and its fragrance makes the people fresh. Most of the Myanmar girls apply Thanakha after bathing, or they wear it whenever they go to pagodas or religious occasions.

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[1] Myanmar Alin Newspaper, 2020, page 24.
[2] Ibid.
[3] The New Light of Myanmar, 12 May 2013, p8.

Thanakha is full of refreshing and refreshing aroma. Cooling the skin, Smoothing the skin, the ancient countries and cultivators could not let go of Thanakha because of its beauty and beautification properties. Therefore, the ancient Burmese women used to say, "You get Thanakha Skin", when you see a person whose skin is moisturized due to the constant application of Thanakha.[1]

Thanakha can protect the human body from heat-related problems. The fragrance of Thanakha can also cure the headache, dull pain, neck pain and nasal congestions. If the women suffer from the menses, they can apply Thanaka with the turmeric. If they have high body temperature, they can take liquid Thanaka with the nectar of Mesua Ferrea. If the men suffer from the headache, dull pain, toothache and blurred vision due to urinary disease, they can take liquid Thanakha by grinding the root of Thanakha.

Reputation

Thanakha's reputation is mentioned as Thanakha, people immediately ask if it is a product of Shwebo. If Shwebo is out of thanakha product, they sing the song of "Shwebo Thanakh".

"I've taken Thanakha from Shwebo to Yangon; however black one's complexion is, Shwebo Thanakha can turn it into fair and fresh one; it helps ladies from Pazundaung, Kyimyindine and Mandalay have beautiful and glowing complexion."

Composed by Nandawshae Saya Tin and sung by Mandalar Myint, " Shwebo Thanaka" is a famous song amusingly written about Thanakha from Shwebo and the nature of women who want to be beautiful.

Characteristics

The shape of the Thanakha tree is a medium-sized tree. It rises to a height of 20-30 feet and is about half an inch in height on the stems and branches. It has hard thorns about an inch long. When the plant is young, it does not run, and when the plant matures, it runs. The leaves are compound and deciduous. Two to three pairs of leaflets, one at the apex. The leaves are smooth and firm. It is dark green. The flower is small. Light yellow, the lungs open. It is depending on the climate of the water. Tagu, the flowers bloom during the month of Kason, Waso and Wakaung, the fruit ripens in the new moon. The water source is long. The roots are also contains bark. Tumors usually grow from the root.[2]

Plant shape is a medium-sized tree up to 20-30 feet height. The branches of the trunk have sharp spines that are ½ to 1 inch long. When the plant is young, it does not run and as the plant matures, it grows thicker. In Thanakha, there is a male tree. There are two types of female plants, the male tree does not bear fruit and the female tree bears fruit leaves compound, deciduous. It is 3 to 5 inches long and has wings on the petiole. It has two to three pairs of leaflets and a single leaf. The leaves are smooth, firm and dark green.

At three and a half month of age, the seedlings are about 10 inches in size and are most suitable for transplanting into the field. Twice a year, weeding and cultivating Thanakha plants

[1] https://www.my.m.wikipedia.org.
[2] https://www.my.m.wikipedia.org/characteristics_of_the_plant.

after planting. Natural fertilizer feeding, if sprayed with pesticides,the plants will be 7 years old. Thanakha tree can be sold in about 8 years. Unfinished Thanakha plants have been on the market for more than 10 years.[1]

White Thankha is fragrant and yellow Thanakha is beautiful on the face. Oily bark is the most fragrant of all Thanakha. Kyout Kone bark is similar to oily bark. The most popular of the Thanakha is ShinmaTaung Thanakha. Because of the fragrance of ShinmaTaung Thanakha, every Myanmar person loves Shinma Taung Thanakha. In addition to ShimaTaung Thanakha, they also like Shwebo Thanakha. Shwebo Thanakha is not as fragrant as Shinma Taung Thanakha, but Burmese women also like Shwebo Thanakha because of its yellowish texture. There is also a fruit tree (limonia acidissima) which has the same name as the Thanakha tree and is also called Thanakha. The fruit tree is called wood apple. Myanmar is a fruit tree and plam. They are often mixed and eaten. Blood is also applied to the bark of the fruit tree as Thanakha. Although it does not smell like. ShimaTaung Thanakha, Myanmar women also like the fruit because it moisturizes the skin applied to Kyaukpyin. Chet bark is very rare. Its aroma is fragrant and oily. The appearance of the bark is small.

Figure 1: Yellow Thanakha

Figure 2: White Thankha

Figure 3: Oily bark

Figure 4: Chet bark

[1] www.thefarmermedia.com.

Legal Framework of Myanmar

Myanmar legal framework of geographical indication concerning with laws are,

(1) Penal Code,1861
(2) Specific Relief Act, 1877
(3) Competition Law, 2015
(4) Consumer Protection Law, 2019
(5) Trademark Law, 2019.

Section 28 The Penal Code provides that, "A person is said to "Counterfeit" who causes one thing to resemble another thing, intending by means of that resemblance to practice deception or knowing it to be likely that deception will thereby be practiced".

Explanation 1. It is not essential to counterfeiting that the imitation should be exact.

Explanation 2. When a person causes one thing to resemble another thing, and the resemblance is such that a person might be deceived thereby, it shall be presumed, until the contrary is proved, that the person so causing the one thing to resemble the other thing intended by means of that resemblance to would thereby be practiced.

Section 54 of the Specific Relief Act,1877 mention that, Subject to the other provisions continued in, or referred to by, this Chapter, a perpetual injunction may be granted to prevent the breach of an obligation existing in favor of the applicant, whether expressly or by implication. Such obligation arises from contract, the Court shall be guided by the rules and provisions contained in Chapter II of this Act. When the defendant invades or threatens to invade the plaintiff's right to, or enjoyment of, property, the Court may grant a perpetual injunction in the following cases (namely):

(a) Where the defendant is trustee of the property for the plaintiff;
(b) Where there exists no standard for ascertaining the actual damage caused or likely to be caused, by the invasion.
(c) Where the invasion is such that pecuniary compensation would not afford adequate relief;
(d) Where it is probable that pecuniary compensation cannot be got for the invasion;
(e) Where the injunction is necessary to prevent multiplied of judicial proceedings.

Explanation - For the purpose of this section a trademark is property.

The basic principle of Competition Law, 2015 mention that the section 4(g) concerning with the geographical indication is "Encouraging the innovative capability by protecting intellectual property rights of investors, inventors and producers".

No businessman shall carry out any of the following acts which mislead the consumers;

(a) Carrying out with intention to complete with the use of deceptive information which mislead the legally registered name of the goods, business organ, logo, packaging, geographical indication and other elements.
(b) Carrying out business such as production of goods and services by using the information contained in sub-section (a).[1]
(c) No businessman shall, for the purpose of unfair competition, carry out any of the following advertising acts:

[1] Section 18 of the Competition Law, 2015.

(a) Comparing directly goods or services of a business with those of the same type of other business;
(b) Misleading customers by imitative advertising of the goods of others;
(c) Broadcasting false or misleading information to the customers on one of the following matters;
  (1) Price, quantity, quality, utility, designs, varieties, packaging, date of manufacture, durability, origin, manufactures, place of manufacture, processors or place of processing;
  (2) Usage, service, warranty period.[1]

Any businessman who violates the prohibitions contained in section 23, section 24 or section 29 shall, on conviction, be punished with imprisonment for a term not exceeding three years or with fine not exceeding kyat one hundred and fifty lakhs or with both.[2]

Any person who violates the prohibitions contained in section 18, section 20, section 21, section 25 or section 28 shall, on conviction, be punished with imprisonment for a term not exceeding one year or with fine not exceeding kyat fifty lakhs or with both.[3]

Section 8 of the Consumer Protection Law, 2019 states that, "Goods mentioned improperly in respect of place of yield or place of production".

The Trademark Law including Geographical Indications (GI) protection was promulgated by Union Law No. 3/2019 on 30 January 2019. This Law will be enforced at the date when the president issues an order. Goods mentioned improperly in respect of place of yield or place of production.

Geographical Indication means any indication which identifies goods as originating in the territory of a country or a region or a locality in that territory where a given quality, reputation or other characteristics of the goods is essentially attributable to its geographical origin.[4]

Any legally formed organization, representing the following persons within the area where the related goods are produced, must apply to the Registrar for the registration of the geographical indications, in accordance with stipulations:

(a) manufacturers who produce goods using natural products or natural resources;
(b) producers of agricultural products;
(c) manufacturers who produce handicrafts or industrial products;
(d) authorities from relevant government departments and governmental organizations in the Republic of the Union of Myanmar who represent the persons described in subsections (a) to (c). [5]

The registration of geographical indications must be applied for in accordance with the following stipulations:

(1) applicant organization or representative's name, nationality and address;
(2) geographical indication for which the application is submitted for;
(3) region of origin of the geographical indication in question;

[1] Section 23 (c), Ibid.
[2] Section 40, Ibid.
[3] Section 42, Ibid.
[4] Section 2(o) of the Trademark Law, 2019.
[5] Section 53, Ibid.

(4) goods which are indicated as geographical indication.[1]

The following must be attached to said application:

(1) distinguishing characteristics, quality, or reputation of the goods;
(2) a goods' accurately defined quality, reputation or relation between its characteristics, origin and production process;
(3) other stipulated matters. [2]

The stipulated registration fee must be paid when applying.[3]

The Geographical Indications is ineligible for registration if it meets any of the following conditions:

(a) it does not conform to the definition of a geographical indication stated in subsection (o) of section 2;

(b) the goods for which the geographical indication is used has become common usage or customary in the Republic of the Union of Myanmar;

(c) it is a geographical indication that is contrary to public order, morale or public policy.[4]

Any stakeholder or relevant department or organization may apply to the Registrar to make an invalidation announcement or cancel the registration for a geographical indication for the following reasons:

(a) it does not conform to the definition of a geographical indication stated in subsection (o) of section 2;

(b) failure to ensure conformity with the requirements in subsection (b) of section 54 and related requirements;

(c) a foreign geographical indication which is not protected or for which protection has been terminated in the foreign country of origin or which is no longer used in said country;

(d) it is a geographical indication which is contrary to public order, morale or public policy.[5]

Section 57 (a) of the Trademark Law, 2019 A registered geographical indication may be used in the course of trade only by producers who carry out their activities in the region described in the registration for the goods described in said registration. Such goods must meet the quality, reputation or other characteristics stipulated in the registration records.

(b) For homonyms in geographical indications, protection shall be granted only if there is a significant difference, in practice, between the name of the geographical indication which is already registered and that of the geographical indication which is registered later. Protection shall be rendered by considering the need to treat relevant producers fairly and to not mislead consumers.

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[1] Section 54 (a), Ibid.
[2] Section 54(b), Ibid
[3] Section 54 (c), Ibid.
[4] Section 55, Ibid.
[5] Section 56 of the Trademark Law, 2019.

(c) The right holder of a registered geographical indication is entitled to prohibit the following:

(1) use of a geographical indication in any manner by falsely describing that a product is from the region stated in said geographical indication even though it is from another place of origin in order to deceive the public;
(2) any use of a registered geographical indication which creates unfair competition;
(3) the use of a disputed geographical indication for goods that are not from the region indicated in said geographical indication for indicating the origins of goods, for use after translating said geographical indication, or for the use of a geographical indication together with the description of the type, group, form, imitation or similar descriptions.

(d) Though the region, zone or territory of a goods is accurately described, other geographical indications, which mislead the public by incorrectly stating that the goods are produced from another region, shall not be granted rights under subsections (a) and (c).

The Registrar must examine whether an application is in conformity with the provisions of sections 53, 54 and 55. If all requirements are fulfilled, he must publicize the information and facts contained in the application in the manner prescribed. Provisions relating to the objection of registration of a mark shall be applied as necessary to the objection of registration of a geographical indication. The Registrar must register a geographical indication if he does not receive an objection or if he refuses such objection.[1]

The term of a registered geographical indication shall receive protection under this Law as long as its distinguishing characteristics, quality or reputation for which protection was initially granted exists.[2]

According to section 60(a) of the Trademark Law, if the registration of a mark is applied for after the application for the registration of a geographical indication has been submitted in accordance with this Law, the Registrar must refuse the mark registration application which violates section 57 or where the mark will be used for an identical goods.

(b) Registered marks shall be announced as invalid if they fulfill the conditions of subsection (a).

(c) Notwithstanding any provisions relating to the registration of geographical indications, a mark, which has been registered or applied for registration in good faith before the submission of the registration application for a geographical indication, is permitted to be used continuously even if it violates section 57 provided that it does not fulfill the provisions in Chapter XV. In such cases, the Registrar shall allow the use of geographical indication as if it were the use of the mark related to it.

The relevant department and organizations shall supervise the protected geographical indications. They may assign some of the supervision work to another person.[3]

[1] Section 58, Ibid.
[2] Section 59, Ibid.
[3] Section 61(a) of the Trademark Law, 2019.

Supervision shall include the following:

(1) Consistency between the descriptions of the products registered as geographical indications and the relevant products;
(2) The use of the names of registered geographical indications in the market. [1]

The stakeholders shall pay the expenses for supervision required to ensure conformity with the descriptions of the products. [2]

Regarding the violation of the rights of geographical indications, action must be taken according to the provisions on taking action against the violation of rights of a mark if the stipulations in addition to the provisions in this Law are violated.[3]

Procedure for Registration

The proceedings for the registration of the appellation of origin and geographical indication shall be initiated by the appropriate application.

The application for the registration of an appellation of origin or geographical indication may be filed by the following persons:

(1) natural or legal persons who produce within a specified geographical area the products that bear the name of that geographical area,
(2) associations of persons referred to in item 1 of this paragraph, chambers of commerce, associations of consumers and the authorities interested in protection of an appellation of origin or a geographical indication, within their activities;
(3) foreign natural or legal persons or foreign associations, if an appellation of origin or a geographical indication were registered in the country of origin or where it stems from the international agreements.

The application for registration of an appellation of origin or a geographical indication may be related to only one geographical indication or a name and to only one type of product.

The prescribed fee shall be payable for the application for the registration of the appellation of origin or a geographical indication.[4]

The following shall be the essential elements of the application:

(1) request for the registration of an appellation of origin or a geographical indication;
(2) description of the geographical area;
(3) information on specific characteristics of the product.[5]

The ASEAN region registration process is

(1) Formal examination
(2) Substantive examination
(3) Publication (for opposition purpose)
(4) Opposition
(5) Registration (GI certificate by some ASESN Countries).

[1] Section 61(b), Ibid.
[2] Section 61(c), Ibid.
[3] Section 62, Ibid.
[4] Article 14 of the Law on Indications of Geographical Origin, Official Gazette No.15/95 and 28/96.
[5] Article 15, Ibid.

Duration of the Registration of geographical indications is 6 months to 12 months in ASEAN level.

Geographical indications protected under the Trademarks Law as collective or certification marks, the Pyidaungsu Hluttaw Law No.3, which enacted on 30 January 2019.

The objective of the provision is to improve the quality of regional products of Myanmar and to promote the economic development by penetrating the global market through protection of geographical indications.

The requirement of the information shall be submitted for the Geographical Indications application, are

(a) Name, nationality and address of the application entity or representative;
(b) The geographical indication for which registration is sought;
(c) The applied area to which the geographical indication;
(d) The good designated by the geographical indication;
(e) The specific characteristic of the good or quality or its reputation;
(f) The link between the prescribed specific quality, its reputation or characteristic and original area and technology of production;
(g) A copy of payment receipt of fees;
(h) Related documents required by the Department of Intellectual Property (if needed)
(i) Other prescribed particulars.[1]

When the application of the registration of Geographical Indications the following elements is complied with, the geographical indication is not entitled for registration.

(a) Not complying with the definition of geographical indication in section (2) sub-section (o) of the trademark law,
(b) Being a generic term or customary in common language of the good that are to use such geographical indication in the Union.
(c) Being a geographical indication, which is contrary to public order or good morals or public policy.

If the application complies with all regulations, the Registrar shall publish the contents of the application and specifications as prescribed in the regulation. In case of objection, the Registrar will follow the same regulations of objection of the mark as necessary. In case of no objection or the objection is rejected, the geographical indication shall be registered.

A product of Geographical Indications registration in Myanmar, any legal entity representing the following persons of the locality in which the relevant good is produced, desirous of registration a geographical indication shall apply to the Intellectual Property Office of Myanmar for registration in conformity with the stipulations:

(a) Persons who produce goods of natural products natural resources;
(b) Producers of agricultural products;
(c) Producers who make handicrafts or industrial products;
(d) All national competent authorities on benefit of the persons indicated under (a) to (c).

[1] https://www.ipd.gov.mm/IPD-Myanmar.

Conclusion

International Convention on Geographical indications is Paris Convention, WIPO and agreements are Madrid, Lisbon and TRIPs. Myanmar has become a signatory member in WIOP since 25, November 1994. As a member of these organizations, it is necessary to abide by the TRIPs agreement. Myanmar should sign to the Paris Convention for the protection of Industrial Property. Industrial Property includes Patents, Industrial design, trademarks, service marks, collective marks, commercial name and Geographical Indications. In domestic law concerning with Geographical Indication are Consumer Protection Law 2014, Competition Law 2015 and Trademark Law 2019. But there is no separate law on geographical indication in Myanmar. In Trademark Law, there is only one chapter for geographical indication. Therefore, Geographical indication should be enacted as a separate law. If enacted as a separate law, it would greatly protect for local protect in Myanmar. In addition to, if enacts as a separate law on Geographical indication, it will protect not only in the world but also in the ASEAN. For example, Thailand the geographical indication obtained is tamarind fruit, rice, silk, etc... Similarly, Indonesia got the white pepper, Amen Bali Salt, Flores Bajawa Arabica Coffee, and so on. Malaysia achieved ginger, Sarawak Pepper, Doi Chaang Coffee. Myanmar should also get for all local products in terms of geographical indication. Therefore, Shwebo District wants to get Geographical Indication right as Shwebo Thanaka as a local Product. No mitigation is allowed on the product, promoting the product by saying the name of a region, improving the quality of the product, guarantee that the buyer will not be harmed in the transaction, manufacturers can also benefit from expending their market. It is an important issue to have legal protection of the geographical indications of Shwebo Thanakha product in Myanmar. It will need to educate and awareness to understand about Geographical Indications for the local producers and community. It is also need to cooperate and coordinate with local and international organizations to promote the reputation and enter the international market of our Geographical Indications products.

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SIGNIFICANCE OF MONASTIC EDUCATION IN BASIC EDUCATION SECTOR

Phyu Phyu Thinn[1], Yu Mon Cho[2]

Abstract

The research study focuses on how monastic education in Myanmar provides basic education to marginalized children who cannot afford to attend public government schools and how these schools work in cooperation with the government. The study has been carried out using a case study approach to make a contextual analysis of the recognition and collaboration between primary stakeholders concerning monastic schools of Myanmar. This study proposes to identify key elements that impacts the complete and fully provision of basic education in monastic schools. It finds out that there are many academic and contextual factors influencing the sustainability of monastic schools. The study recommends that improved cooperation between the principal institutions_ Ministry of Religious Affairs and Culture (MoRAC) and Ministry of Education (MoE) _ should be strengthened in many ways to provide overall quality basic education that can be accessible by every child under monastic education system.

Keywords- right to education, basic education, monastic schools

Introduction

Myanmar's monastic schools are schools operated by Buddhist monks or nuns providing basic literacy (and culture/ethics course in some schools) designed to teach basic education to children who cannot afford to join government public schools using the national curriculum prepared by the Ministry of Education (MoE). Such schools have been long established, addressing basic educational needs in Myanmar and especially of vulnerable children[3] as well as monasteries have been the main vehicle for advancing inclusion in education by offering schooling to poor and disadvantaged children[4]. Monastic schools operate throughout the country but there is a higher concentration in certain states and regions. In Yangon, there are 234 monastery schools offering basic education as of 2019-2020 Academic Year (AY) data covering 15.5 % of monastic schools in the whole country.[5]

Monastery education is deep-seated in Myanmar since the monarchical period[6] and monastic schools have also been centers of education, actively providing education for the public.[7] With their increasing recognition by the community, the Government officially recognizes monastic schools under educational law[8] as one type of formal education and supports them as a complementary provider of basic education. Monastic schools operate under the auspices of the Ministry of Religious Affairs and Culture (MoRAC) with the collaboration of the Ministry of Education (MoE), while the sector is still developing as a 'formal system' under the National Education Law (2014) and Basic Education Law (2019).

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3 U Thein Than Naing, "A Study of Monastic and Nunnery Education Schools in Thanlyin Township", 2017.

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6 Ei Ei Lwin, "Monastic Education in Myanmar (1300–1750)", Diss. MERAL Portal, 2020.

7 Phrakru Arunsutalangkarn, "Buddhism and Education in Thai Society." *Online Submission* 2.1 (2016): pp. 8-16.

8 Section 34, National Educational Law 2014 [hereinafter cited as NEL, 2014).

Monastic schools are not centralized as in the state system, and are typically operated with autonomy with self-funding and as a result, there is minimal national level governance or management. There is a tripartite governance structure comprising the MoRAC, MoE and the national level supervisory committee known as "Monastic Education Central Supervisory Committee". [1] The Committee is formed by "Rules for Monastic Education Schools" (1994 Rules) and is purportedly having the most active role in supervising schools through its sub-supervisory committees formed at each level of Township as well as State and/or Division respectively.

The research identifies the institutional and legal framework that governs monastic education system in basic education sector of Myanmar. It elaborates how the monastic education system contributes the basic education system and identifies its role to access education by all children who cannot afford to attend public government schools. The research proposes recommendations to key stakeholders concerning monastic education in Myanmar to improve the better achievement of quality basic education for all children.

Method of the Study

Research has been conducted using a combination of qualitative and quantitative research method with the use of both legal instruments concerning education and interviews as data collection tool. In order to conduct contextual analysis, the research applies case study approach on some monastic schools in Yangon area where the second highest numbers of monastic schools are operated. The number of six schools were chosen from three different townships and these are situated in economically disadvantaged areas in Yangon[2] and are providing free basic education.

For Legal documents, this study explores domestic legislation and instruments related to education, and academic papers, government as well as civil society reports and research articles concerning monastic education. For primary data collection, the researchers conducted in-depth interviews with the key informants[3] as well as applied three focused-group discussions (FGDs).

Problem Statement

Monastic schools are originally operated based on community donations designed to provide basic literacy skills. Such schools are operated under 1994 Rules with the auspices of the MoRAC and provides basic education in line with curriculum prepared by MoE. National Education Law[4] and Basic Education Law[5] recognizes the existence of monastic education as a complementary to implement free and compulsory primary education. The government provides stationary, salary stipends and financial supports to monastic schools. However, the needs of monastic schools are, in some way, distinct from public government schools. For instance, monastic schools offer school meals to the children. In addition, many monastic schools are operated as boarding schools creating a place for children to learn and live. Their expenditures have to be allocated upon the matters in addition to normal school activities. Monastic schools

[1] Ohnmar Tin and E. Stenning, "Situation Analysis of the Monastic Education System in Myanmar Final Report", 2015.
[2] 1 school in East-Dagon Tsp, 2 in South-Oakalapa Tsp, 3 in Thanlyin Tsp.
[3] 5 Principal monks and nuns; 15 Teachers at monastic schools; 2 Township Education Officers; 2 Government School Teachers.
[4] Pyidaungsu Hluttaw, Law No. 41, 2014.
[5] Pyidaungsu Hluttaw, Law No. 34, 2019.

are originally operated based on community donations and that is why government and public supports are demanding in many ways not only to ensure its sustainability but also to provide complete basic education for all children at monastic schools.

Monastic Education in Myanmar

The monastic education system has a long history dating back to the 11th Century, in the time of King Anawrahta who was known as the founder of the Bagan Empire and embraced Theravada Buddhism. During the monarchical period, education was provided almost entirely by Buddhist monks in monasteries which taught not only basic literacy skills but also other subjects and practical skills such as arts and crafts, medicine, astronomy and military strategy. There was no assessment or grading system beyond noting the lessons the students had completed.[1]

After colonization by the British government in 1885, Sir Arthur Fare, a senior British administrative officer, noticed the great influence of Buddhist monasteries and monks on Myanmar society and mandated the recognition and support of monastic schools of which there were over 6,500 in the country. Eventually, the British introduced their own education system and provided more support to these states recognized schools and it was unsurprising that monastic schools were reduced and in 1932, only 928 recognized monastic schools were left.[2]

With the reorganization of the Public Education Council in 1952, Pyi Taw Thar's Monastic Education Project aimed to open 5,000 monastic schools and succeeded in opening 4,239 schools by 1956-57. When the military Revolutionary Council seized State power in 1962, a section of monastic education was established under the Department of Basic Education. However, the Council abolished the monastic education system in 1972.[3]

During the period of the State Law and Order Restoration Council (1988-1996), an agreement to resume monastic education was reached at the 3rd State Sangha Maha Nayaka Committee (SSMNC)[4] Plenary Meeting, thanks to the advocacy of State Sangha Mahar Nayaka Sayartaws who were the core member monks of central Buddhist affairs Committee (SSMNC), with senior officials about the important role of monastic education in nurturing cultured and educated citizens.[5] In order to implement monastic education throughout the country with consistent standards and principles, "Rules for Monastic Education Schools" (hereinafter referred as 1994 Rules) was enacted in 1994. The Monastic Education Central Supervisory Committee was established in 1995 so as to adopt policies and guidelines to govern the system. Amendments to the rules have been made since then in order to establish sub-supervisory committees at the different levels as well as to recognize nunnery schools, with the latest amendment made in 2005.[6] Monastic schools are currently operated under the 1994 Rules as self-governing donation-based institutions.

[1] Ei Ei Lwin, "Monastic Education in Myanmar (1300–1750)", Diss. MERAL Portal, 2020.
[2] U Thein Than Naing, "A Study of Monastic and Nunnery Education Schools in Thanlyin Township", 2017.
[3] Ibid.
[4] The State Saṅgha Mahā Nāyaka Committee is a government-appointed body of high-ranking Buddhist monks that oversees and regulates the Sangha in Myanmar.
[5] Rules for Monastic Schools (1994), State Sangha Mahar Nayaka Committee, MORAC, 2nd Amendment, 2005, p. 2,3.
[6] Rules for Monastic Education Schools (1994), State Sangha Mahar Nayaka Committee, MORAC, 2nd Amendment, 2005, p. 5, 6.

With the enactment of the new National Education Law in 2014 and Basic Education Law in 2019, monastic schools were recognized as 'a system' by the MoE. Such schools have traditionally relied on community donations to fund infrastructure as well as teachers' salaries. Since the official recognition of monastic education schools, they have received government support including textbooks, exercise books, uniforms (which are no longer provided) at the primary level, salary stipends to teachers and infrastructure grants to some extent.

Unique Features of Monastic Schools

Monastic schools are operated and administered by monks or nuns funded by voluntary contributions from the donors. The biggest proportions of donations are received from the local community and are a combination of money and gifts in kind (e.g. food and clothes). Some schools, which have a wide network and good reputation, often receive money from individual and community donors. Charitable organizations often provide gifts in kind. The two main areas of support are infrastructure (school buildings) and teacher training.[1]

Teaching staff are privately appointed by the school itself and there is no minimum educational qualification required to be a teacher at monastic schools, recruitment being at the discretion of the principal monk or nun: typically, any graduate can be appointed. Salary of these teaching staffs are paid from school owned funds and the amount may vary from one school to another. Moreover, there are also volunteers as well as senior students working as volunteer teachers. Most of the volunteers are university students who are working at the monastic schools in their free time willingly.

Monastic schools provide basic education in line with the curriculum prepared by the MoE. In addition to government designed curriculum, most monastic schools teach a culture/ethics course as a subject and students have to sit an exam test for it. But it is not mandatory requirement for their final assessment. However, few monastic schools design this course as a compulsory subject, and this may depend upon the policy adopted by the principal monk or nun. This course is simply intended to teach moral ethics and behavioral patterns in order to become a good person.

Monastic schools are normally operated free of charge together with a school meals programme which is one of its distinct features that can contribute a lot to incentivizing children from disadvantaged backgrounds to study and ultimately to prevent them from dropping out of school. It comes from the fact that many monastic schools are operating as boarding schools, giving a place to learn and sleep for marginalized and/or ethnic minority children with no financial difficulty.

It is obvious that monastic schools attract children from economically disadvantaged backgrounds and can be a complementary pathway for those children who cannot access public schools. Through monastic schools, education can be available and accessible to the disadvantaged children with the government recognition and provision of necessary support.

Laws, Plans and Policies for Monastic Education

Monastic schools are operated by the 'Rules on Monastic Education' 1994 and governed by the Monastic Education Supervisory Committees which are formed at different levels

[1] Situational Analysis of the Monastic Education System in Myanmar, Myanmar Education Consortium, Final Report, July 2015, p.21.

(national, state/division, and township). Under the 1994 Rules, the committee takes responsibility to solve any difficulties faced by monastic schools, such as insufficient teaching staff, and makes recommendations to upgrade schools _ from primary to post-primary level school for instance.[1]

The Central Monastic Education Supervisory Committee is the body formed by State Sangha Mahar Nayaka Committee to supervise monastic education at national level while others sub-committees_ Monastic Education Supervisory Committees (MESC)_ are formed at state/division and township levels to govern and supervise the activities of monastic schools at respective levels. The Central Committee is made up of senior monks among the State Sangha Mahanayaka Sayadaws and officials from the MoRAC, the MoE, and the Ministries of Social Welfare, Relief and Resettlement; Border Affairs; and also Immigration and Population respectively.[2] State/Division level and Township level Monastic Education Supervisory Committees are formed under Rule 15 and 24 of the 1994 Rules.[3] The Committees were designed to address many cross-cutting areas and in practice led by prestigious monks from monastic schools who are involved at school administration.

Basic education in Myanmar can be designed and carried out for a total period of twelve years and comprises the following levels and classes.[4]

(a) primary level (from Grade 1 to Grade 5)

(b) secondary level (from Grade 6 to Grade 9)

(c) higher level (from Grade 10 to Grade 12)

Basic Education Law 2019 clearly identifies the nature of monastic schools and recognizes them as one type of 'formal' education systems providing basic education in the country.[5] This Law reaffirms that the MoRAC administers monastic education under the 1994 Rules[6] and so the Central Committee supervise monastic schools and authorizes sub-supervisory committees concerning the registration of monastic schools, giving recommendations for monastic schools.[7] With the recommendation of relevant supervisory committee, the MoE recognizes and confers school status to such monastic school and then starts to provide government support.[8] Government support and recognition of monastic schools is crucial for the effective provision of basic education in all monastic schools.

When a monastic school is permitted to open as primary school (Grade 1 to Grade 5) with the recommendation of relevant monastic school supervisory committee, it have to inform the

[1] Personal Interview with a Principal Monk, [10.10. 2021]

[2] Rule 4 of the 1994 Rules.

[3] State/Division Monastic Education Supervisory Committees include the chairman and secretaries of the Township Monastic Education Supervisory Committee, State/Division Education Officer or Deputy State/Region Education Officer who is Buddhist, and State/Region Religious Affairs Officer. Township Education Supervisory Committee is formed by head monks of monastic schools, a head-nun of a nunnery school, a Township Religious Affairs Officer, a Township Education officer or a Deputy Township Officer who is Buddhist, and a headmaster of Basic Education Primary School or a headmaster of Basic Education Middle School who is interested in monastic Education.

[4] Section 5 of Basic Education Law, 2019.

[5] Ibid, Section 7 (e).

[6] Ibid, Section 36.

[7] Situational Analysis of the Monastic Education System in Myanmar, Myanmar Education Consortium, Final Report, July 2015, P.14.

[8] Personal Interview with a Principal Monk, [10.10. 2021]

MoE via Township Education Officer (TEO). After the completion of 3 years-operation as a primary level, such school can apply to be upgraded to post-primary level (Grade 6 to Grade 7). It finds out that all monastic schools are normally granted to operate as post-primary level and only a small percentage of monastic schools are being granted as middle school status. In Yangon, as of the 2019-2020 AY data, there were totally 234 monastic schools registered in 36 townships covering 77,702 students. Among them, 132 schools are operated as primary, 93 schools are as post-primary, and only 9 are as middle schools.[1]

There is no monastic education high school in Yangon. If those students who have completed post-primary level at a monastic school wish to complete their basic education, they can join to any secondary-level monastic (middle) school. Or they can join any public government secondary and/or high school nearby. This is the 'affiliated' school plan designed by the MoE due to the shortage of adequate secondary-level monastic schools in every Region and State. Such affiliated school idea has been extended to higher level basic education. Monastic schools are at last being recognized as secondary-level monastic schools until 1998-99 AY. Later on, the affiliated system has been implemented as linkage between monastic schools and government public schools.

It can be assumed that monastic schools provide basic education up to secondary level by themselves. For higher level, students need to enrol at affiliated government public schools and they have to sit Grade 12 exam at these schools. One condition is that if a novice or nun (who is also a student of a monastic school) wish to sit Grade 12 exam, it is not permitted for them to join higher-level government public school without abandoning their Sangha status and they will have to change into layman. There are only two monastic schools with high school status in the country, both in Upper Myanmar. All novices or nuns can get the chance to sit their Grade 12 exam at these two schools. However, it is quite challenging for every monastic school's student (novices or nuns) to go to there and sit the exam without sufficient support. The reduce in number of secondary level monastic (middle) schools directly influence upon the completion rate of basic education by students and impacts the school drop-out rate of children in monastic schools.

Under the education law, MoRAC has the authority to manage and assess all monastic schools in Myanmar.[2] Among the strategies adopted by the MoE for basic education reform in the National Education Strategic Plan (NESP) (2016- 2021), Strategy 2 concerns 'strengthening partnerships', and prioritizes the development of a partnership mechanism to support the participation of different educational service providers, including monastic schools, in basic educational reforms. Recognition and supporting monastic schools by MoE can enhance the partnership with monastic education schools concerning educational matters.

Governance of Monastic Schools

Principal monks or nuns are responsible for administration and management of the school. Their main functions are clearly elaborated in the 1994 Rules[3] and in some schools, administrative functions are supported by the school committee. There are no formal guidelines nor trainings concerning school administration and management mandatory to heads of monastic

[1] Myanmar Information Management Unit MMIU, 2021, http://themimu.info/monastic-education-dashboard [last access on 5 Aug 2022)

[2] Sec 57 (2) of National Education Law, 2014.

[3] Part 4 of the 1994 Rules.

schools. Principal monk has fully responsible to collaborate with the Township Education Officer (TEO). A good collaboration between the principal monk or nun and TEO is an essential tool in order to ensure the partnerships with monastic schools.

For the appointment of teaching staff, no standard qualifications are prescribed by 1994 Rules. Therefore, principal monk or nun can identify the qualification of teachers. Normally, schools prefer the graduated person of any degree. Likewise, there is no standard pay-scale for monastic schools' teachers. The teachers' salary may range from MMK 38,000 to 120,000 depending upon school budgets.[1] Monastic schools cannot equate with salaries offered in government schools[2] for its dependency on donors and self-funding. Ultimately, it can lead to difficulties in recruiting teachers and in maintaining retention rate among teachers.

The government has started to provide salary subsidies for teachers at monastic schools since 2013-14 AY, demonstrating its role in providing basic education services. The government started to provide salary stipends to every monastic school teacher depending basically upon their teaching level. For instance, in case of primary level teachers, provision of MMK 36,000 per month as salary stipends. The actual amount of salary was not enough to live in a community. Hence, the principal nun may negotiate with teachers to specify a certain amount (MMK 60,000 in one nunnery school) as a monthly salary. Since monastic schools and nunnery schools mainly depend on donors, the extra payments beyond these 36,000 MMK become a challenge for a principal nun.[3] Salary stipends is based upon the number of enrolled students subject to a '40:1 standard student-teacher ratio'. This contribution does not cover actual number of teachers because in some monastic schools, student-teacher ratio tends to be 80:1 and/or 60:1 per classroom.

Since 2015-2016 AY, the government has expanded its support for grants to monastic schools the same as provided to government public schools. Monastic schools are allowed to use such grants only for infrastructure development. For monastic boarding schools, there are also a limited sanitary and hygiene and sleeping facilities, as well as challenges for high electricity bills, student illness, etc. Issues such as unequal pay and poor infrastructure are not solely administrative issues but also directly relate to issues of availability defined in the 'essential features' of the right to education.[4] It can be said that reducing availability challenges can improve the quality of monastic education schools.

In addition to stipends and grants, MoE provides learning materials including textbooks, exercise books, uniform (which is not currently available) as well as stationary. The provision of exercise books with four-lines is still demanding in Grade 1 whereby four-lines exercise books are especially suitable for younger learners to practice handwriting. Moreover, the primary and middle school curriculum consists of Aesthetics (Music and Art). To learn Art, the students may need sketchbooks and color pencils in addition to exercise books.[5] In such situation, the principal monk or nun have to fill up the necessary stationery and books with their own funds.

Monastic schools provide not only basic education but also give shelter and food to those children in need. Almost all monastic schools offer school feeding programme arranged from

[1] Personal Interviews and Focused Group Discussions (FGD) with monastic school teachers [18. 12. 2020]
[2] Range from MMK 180,000 to MMK 226,000.
[3] Personal Interview with a Principal Nun, [27.10.2021]
[4] General Comment No. 13, "The Right to Education", CESCR, 1999, para 6 (a).
[5] Personal Interview with a Principal Nun, [27.10.2021]

their own budget and it persuades parents to send their children to school without worry for lunch box. To achieve quality basic education for all children, one of the strategies adopted by the MoE in the NESP is supporting compulsory and inclusive education, whereby it commits to provide support to at-risk students to help them stay in school through school feeding programmes. According to its strategic plan of MoE, it will be better to provide a particular support for school feeding programmes of these schools in addition to stipends provision.

Training and Professional Development for Monastic School Teachers

Recruitment policy for teachers is not formally defined for monastic schools and the recruitment process and criteria may vary between them. There is no formal pre-service training for those who would like to work as a teacher. Once being appointed as teachers, MoE offers to attend training concerning teaching pedagogy as well as curriculum and assessment training. Almost all monastic school teachers have the chance to attend these kinds of training.[1] The opportunity to get training depends on collaboration level of such school with TEO and sometimes a training cannot be accessible by the teachers due to its geographical location.

The NESP emphasised that a motivated and well-trained teaching staff is a prerequisite for quality education, and that this can only be realized through improving the status, quality, management and professional development of teachers.[2] In addition, the MoE must ensure that teachers have access to ongoing continuous professional development in collaboration with relevant ministries. The NESP also requires the MoE to establish a system of quality assurance for every level of education, including for teacher education, to ensure that quality teaching translates into meaningful student learning outcomes.[3] While providing technical support (professional) trainings, the training level have to be adjusted with the trainees. When the participants' level is not adjusted, the content and output of the training cannot be resulted as expected.

Findings

Monastic education is a distinct and traditional educational system in Myanmar with a long history, where schools are operated by monks or nuns to provide basic literacy skills to any children with school meal plan. At present, they provide basic education in accordance with the national curriculum designed by the MoE and their funding is mainly based upon individual and community contributions.

Many monastic schools operate as boarding schools for those who have difficulty to attend school daily from their places for various reasons. The Ministry of Religious Affairs and Culture (MoRAC), the Ministry of Education (MoE), and the National Sangha Mahar Nayaka Committee comprise a tripartite monitoring body named Monastic Education Central Supervisory Committee for governance of monastic education. While these three entities are responsible for the success of the monastic education system, it actually works with little coordination with each other upon the completion of quality basic education by all children under monastic education. Through the extension of government budget provision to include the

[1] Personal Interviews, FGDs with monastic school teachers, [18. 12. 2020].
[2] National Education Strategic Plan 2016- 2021, NESP, Ministry of Education, 2016, p. 140.
[3] Ibid, p. 141.

monastic education system, the MoE provides textbooks, exercise books and pencils, school grants for infrastructure, as well as salary stipends. But it still demands concerning provision of suitable exercise books, infrastructure, school-meals and adequate salary stipends.

Recommendations

To effectively implement quality basic education by monastic education, there would be a minimum standard qualification to become a monastic school teacher as well as provision of teacher salaries identical in amount to those in government public schools. With no formal standard for teacher recruitment, there is a need for a uniform formal recruitment policy that ensures both quality education and retention of staff that can foster sustainability. There is also a need to undertake capacity development training for each and every teacher in any monastic school level to enhance their teaching profession as well as improve knowledge on particular subjects. Through capacity development training, monastic school teachers should have routes to certification and pathways for their professional development.

The unique features of monastic schools include school feeding programmes and the option of students. While all government public schools are opened solely for day students, the government should develop a policy to extend support and funding aims to cover school meal programmes in monastic schools. There is also a need to strengthen the capacity of Tripartite body and also to form a representative body under the Department of Basic Education (DBE) of the MoE to strengthen co-ordination between concerned government departments and the monastic schools.

To expand access to basic education without barriers and improve completion rates of basic education, the recognition level of monastic schools to higher-level should be extended with scrutiny so that every child including novices and nuns under monastic education can accomplish their basic education under the monastic education system without any barrier. Cooperation needs to be strengthened between the MoRAC and the MoE concerning in such matters as teacher training, quality assurance and professional development of teachers, performance standards for teaching and learning, developing curriculum, school management and assessment, and infrastructure development.

Conclusion

Monastic education can be recognized as a system to achieve basic and all-inclusive education for all school-age children especially those from marginalized backgrounds. It can also be identified as complementary education system in Myanmar to get basic education by all. This research identifies the challenges faced by monastery schools providing basic education and its outcomes will contribute to make better cooperation between the stakeholders for the progressive development of monastic education system in Myanmar and to the implementation of basic education reform under NESP by reducing barriers and promoting collaboration between different stakeholders. Eventually, strengthening collaboration of concerned government departments particularly between MoE and MoRAC will increase the accessibility of quality basic education for every child in Myanmar with the support of monastic schools.

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LEGAL PERSPECTIVE ON THE ELECTRONIC BILLS OF LADING

Thet Oo Zan*

Abstract

The Bill of Lading is the most important document for international trade and has been for hundreds of years. The bill of lading permits goods to be traded while in transit, many times before they reach their destination. Possession of the bill of lading is equivalent to the possession of the goods. Today, traditional bill of lading faces problems caused by the delay of the document, fraud, and high costs of generating. International trade transactions are increasingly using EDI (Electronic Data Interchange) and the problem of the bill of lading was to introduce the use of the electronic bill of lading in shipping trade by replicating the traditional bill of lading with the electronic bill of lading. Using the electronic bill of lading will reduce time and cost. But the electronic bill of lading faces problems in some jurisdictions relating to its legal recognition.

Keywords – Bill of Lading, Electronic Bills of Lading, Contract of Carriage, Transport Document

Introduction

The bill of lading is the most important document that is widely used in the international shipping industry. The bill of lading performs three main distinct functions. The receipt of a bill of lading at the port of destination is too slow to enable the delivery of the goods to the party who is entitled to them. The reasons for the delayed movement of the bill of lading are lengthy and complex banking processes slowed the movement of the bill of lading. The emergence of electronic commerce in the shipping industry has exposed the inadequacy of the traditional bill of lading. In the end, the electronic bill of lading is introduced. The advantages of electronic bills of lading are it assists to get rid of delays that are caused by paper bills of lading and it also helps reduce the cost of documentation and improve transaction efficiency.

The objective of this paper is to analyze the legal and challenges faced by the electronic bill of lading.

Materials & Methods

Qualitative research methods are applied in this paper. A study of relevant articles, journals, books, and cases will be undertaken throughout the courses of this paper. Theoretical analysis and examinations of the bill of lading and all relevant shipping documents will be carried out to ensure that the paper topic is fully addressed.

Results

Under the instruments of the international approach, electronic bills of lading perform the three main functions. The electronic bill of lading may be recognized by law as a receipt for the goods and evidence in the contract of carriage. Electronic documents, electronic messages, and electronic signatures are already recognized as evidence. Although electronic bills of lading should perform the same three functions as bills of lading, they are not yet recognized under English law. The paper will find out the difficulties of the authentication and signature requirements and the evidential value and admissibility of electronic documents.

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Discussion

The functions of the Bill of Lading: The bill of lading is one of the documents applied in the carriage of goods by sea. "Bill of lading" means a document that evidences a contract of carriage by sea and the taking over or loading of the goods by the carrier, and by which the carrier undertakes to deliver the goods against surrender of the document. A provision in the document that the goods are to be delivered to the order of a named person, or to order, or to bearer, constitutes such an undertaking.[1]

A bill of lading is a transport document issued by or on behalf of a carrier to the person with whom he has entered into the contract of carriage of the goods, usually known as the shipper. The bill of lading embodies the promise of the carrier to carry the goods to the port of destination and to deliver them in accordance with the terms of the bill of lading to the consignee.[2]

A bill of lading has various aspects: -

(1) It is very good evidence of the contract of affreightment,
(2) It is a receipt for the goods shipped and contains certain admissions as to their quantity and condition when put on board.
(3) It is a document of title, without which delivery of the goods cannot normally be obtained.[3]

The most important function of a bill of lading is a document of title in international maritime trade. Possession of a bill of lading is equivalent to possession of the goods. While the goods are in transit, the holder of the bill may negotiate it by endorsement and delivery. A bank may use it as a guarantee for the issuance of credit, which is often necessary to finance a sale. This function of the bill of lading increases confidence in maritime trade.[4]

The holder of the bills of lading shall have not only the right of ownership over the good but also the constructive possession of the cargo. Because the bills of lading can be sent to whoever will have the right to claim them from the carrier at the port of discharge, and since the bills of lading can represent the goods, it can be traded several times while the cargo is still in transit. Furthermore, it is this feature that makes the bills of lading acceptable for a bank as security or collateral for the letter of credit advances to the importer and exporter.[5]

Problems associated with the bill of lading: The traditional bill of lading also has several disadvantages in the modern shipping environment. Containerization and modern vessels have resulted in a speedier carriage of goods. The result is that the goods arrive at the port of destination before the relevant shipping documents. This causes delay and erodes the advantage

[1] Article 1 of the United Nations Convention on Carriage of Goods by Sea, 1978 (Hamburg Rules).
[2] Caslav Pejovic, (2020) Transport Documents in Carriage of Goods by Sea, Informa Law from Routledge.
[3] E.R. Hardy Ivamy (1979) Payne and Ivamy's Carriage of Goods by Sea, London Butterworths.
[4] Abdul Ghafur Hamid @ Khin Maung Sein, (2004) "The Legal Implications of Electronic Bills of Lading: How Imminent is the Demise of Paper Documents? The Journal of the Malaysian Bar, Vol. 33, No 3, p 2.
[5] Thi Mai Anh Doan, (2018) Switching paper to electronic bills of lading: legal perspective and reform options for Vietnam, World Maritime University.

gained by the expedited voyage. Considerable expenses are also incurred in the issuing and processing of bills of lading.[1]

In maritime trade, the carrier has an obligation to issue the bill of lading to the shipper. The shipper sends the bill of lading to the consignee. The consignee has possession of the goods by the presence of the bill of lading to the carrier. The problem is that the goods arrive at the port of destination before the bill, and the consignee would not be able to claim the goods at the port of destination.

The slowness of traditional bills of lading is one of the important problems that is linked to this form of bills of lading. As it has to be handled hand to hand in different places and intervals, the traditional bills of lading proved incapable to cope with the development and the speed needed in this new century. The slow nature of a negotiated bill of lading and its interference with other contracts such as the documentary letter of credit has revealed its inability to develop. It should not be forgotten that the delays that are caused by the slowness of the paper bill of lading can result in demurrage and extra freight charges.[2]

These are the disadvantages of the traditional bills of lading and this is the main reason why the maritime trade substitute for the traditional bills of lading.

Sea waybill: The sea waybill has emerged as an alternative sea carriage document to the bill of lading by resolving some of the issues associated with the late arrival of documents.[3]A sea waybill constitutes only two functions of a traditional bill of lading, namely; (1) as a receipt for the goods shipped; and (2) as evidence of the contract of carriage. It is not a document of title and it cannot be used to transfer the ownership of the goods.[4]

The sea waybill is easier than the bill of lading to replicate in electronic form. A waybill is not negotiable and not a document of title, it may be carried on board the ship itself, or the information it contains may be reproduced and transmitted electronically, thus avoiding the delays associated with the movement of paper documents.[5] The sea waybill's lack of negotiability makes it a safer commercial document that is less likely to be lost stolen, or subject to fraud.[6]

Today, Electronic commerce is currently becoming more prevalent in international trade. Electronic Data Interchange (EDI) is the electronic system currently employed for trading reasons.

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[1] A. Elentably, (2012), "The Advantage of Activating the Role of the EDI-Bill of Lading And its Role to Achieve Possible Fullest", International Journal on Marine Navigation and Safety of Sea Transportation, Vol.6, No. 4, p.599.

[2] Kamal Alawamleh, Traditional Bills of Lading V. Electronic Bills of lading: Pros and cons and the way forward, Proceedings of 64th The IRES International Conference, Oxford, United Kingdom, 19th-20th March 2017, ISBN: 978-93-86291-88-2, http://www.worldresearchlibrary.org/up_proc/pdf/711 149128316801-03.pdf

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[6] Boris Kozolchyk, (1992) Evolution and Present State of the Ocean Bill of Lading from a Banking Law Perspective.(https://openyls.law.yale.edu/bitstream/handle/20.500.13051/11949/45_35YaleLJ548_1925_1926_.pdf?sequence=2)

Electronic Data Interchange (EDI): "Electronic data interchange (EDI)" means the electronic transfer from computer to computer of information using an agreed standard to structure the information. [1]The major objective of EDI is the creation of a platform of transmission whereby connect multi-user, including shippers, carriers, forwarders, banks, etc., in a safe network and the accomplishment of a fully interpreted electronic process to forward paperless international trading.[2]

Due to its benefits, which include time savings, the convenience of conducting business over long distances, and cost savings, EDI is becoming more and more popular.

The Electronic Bills of Lading: The initiatives taken to introduce an electronic bill of lading or an equivalent alternative began in 1983, leading to the subsequent introduction of the BOLERO system. In 1990 the Committee Maritime International (CMI) published the Rules on Electronic Bills of Lading and in 2008, the United Nations adopted a new convention on 'Contracts for the International Carriage of Goods Wholly or Partly by Sea' (known as the Rotterdam rules) that permit and regulate the use of electronic bills of lading.[3] In the digital age, it should not be too surprising that many projects are in progress to replace traditional paper bills of lading with more "ethereal bills of lading", that will, henceforward, appear on the computer screen for electronic transmission. To a limited extent, this is already being done by a number of liner services for non-negotiable or sea waybills.[4]

The Electronic bills of lading include data that is inserted in a computer and is transmitted electronically, using electronic messages, so that an electronic bill of lading consists of the series of electronic messages sent and received among a carrier, shipper, and consignee. Consequently, electronic bills of lading cannot be issued in several originals, nor can it be signed in the same sense as a paper bill of lading.[5]

There is a question that is the function of electronic bills of lading is equivalent to the function of traditional bills of lading.

According to Article 8 (a) of the United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (Rotterdam Rules) 2009;

Subject to the requirements set out in the Convention:

(a) Anything that is to be in or on a transport document under the Convention may be recorded in an electronic transport record, provided the issuance and subsequent use of an electronic transport record is with the consent of the carrier and the shipper; and (*b*) The

[1] Article 2(b) of the UNCITRAL Model Law on Electronic Commerce, 1996.
[2] Thi Mai Anh Doan, (2018) Switching paper to electronic bills of lading: legal perspective and reform options for Vietnam, World Maritime University,p. 17.
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[4] Marsh, (2016). "Switching from paper to electronic bills of lading", https://www.marsh.com/uk/insights/research/switching-from-paper-to-electronic-bills-of-lading.html
[5] Caslav , P. (2004). Documents of title in carriage of goods by sea under english law: Legal nature and possible future directions. p 43-83. https://hrcak.srce.hr/file/65803

issuance, exclusive control, or transfer of an electronic transport record has the same effect as the issuance, possession, or transfer of a transport document.[1]

The Rotterdam Rules recognize the legal equivalence of electronic bills of lading to the traditional bill of lading.

The electronic bill of lading is the legal and functional equivalent of traditional bills of lading. The electronic bill of lading must digitize the core functions of traditional bills of lading, namely its legal acceptance as a receipt, as evidence of or containing the contract of carriage, and as a document of title.[2]

The UNCITRAL Model Law on Electronic Commerce: UNCITRAL is the United Nations Commission on International Trade Law established to harmonize and promote international trade. The United Nations established the Model Law on Electronic Commerce in 1996 to enhance the use of paperless communication.[3] The Model Law is a series of guidelines for states planning to enact similar laws on electronic commerce, not a source of law.

"Data message" means information generated, sent, received or stored by electronic, optical, or similar means including, but not limited to, electronic data interchange (EDI), electronic mail, telegram, telex, or telecopy.[4]

The Model Law on Electronic Commerce applies to any kind of information that is

transferred in the form of a data message used in commercial activities. Ocean bills of lading are one kind of document within the scope of the Model Law. The purpose of the UNCITRAL Model Law on Electronic Commerce that was adopted by UNCITRAL in 1996 is to offer national legislators a set of internationally acceptable rules in terms of which a number of legal obstacles to electronic commerce may be removed, and a more secure legal environment may be created for electronic commerce. Accordingly, the regulations of the Model Law can only be taken as a model set of rules for electronic commerce and will only have the force of law if adopted in national legislation.[5]

The Model Law introduced a new approach known as "functional equivalence". It is based on an analysis of the functions of paper-based requirements and determines how those functions can be fulfilled through EDI. It simply means that where there is a legal requirement for, e.g., writing, signatures, and originals, that requirement can be satisfied by equivalent data messages.[6]

The issue is whether a data message can be treated as a document in court and utilized as evidence. In certain nations, these are considered as evidence in general. They are generally regarded as proof in various nations.

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[1] Article 8 (a) of the United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (Rotterdam Rules) 2009.

[2] Florian Kuester. (2017). Electronic bill of lading – how is paperless trade possible? Combined Transport Magazines, https://combined-transport.eu/electronic-bill-of-lading

[3] Holtzhausen A (2006) "Electronic Bills of Lading", University of the North West Potchefstroom, p.42.

[4] Article 2 of the UNCITRAL Model Law on Electronic Commerce 1996.

[5] Holtzhausen A (2006) "Electronic Bills of Lading", University of the North West Potchefstroom, p.44.

[6] Abdul Ghafur Hamid @ Khin Maung Sein, (2004) "The Legal Implications of Electronic Bills of Lading: How Imminent is the Demise of Paper Documents? The Journal of the Malaysian Bar, Vol. 33, No 3, p 5.

If there is an original document, a data message may not be accepted as evidence and may be considered hearsay evidence. in the case where there is no original document, a data message or a computer print-out could be considered as evidence.[1]

This problem solves that information shall not be denied legal effect, validity or enforceability solely on the grounds that it is in the form of a data message.[2]

Moreover, it clearly stated that;

"In any legal proceedings, nothing in the application of the rules of evidence shall apply so as to deny the admissibility of a data message in evidence:

(a) on the sole ground that it is a data message; or,

(b) if it is the best evidence that the person adducing it could reasonably be expected to obtain, on the grounds that it is not in its original form."[3]

In most jurisdictions, writing or document are required. The Model Law, clearly expresses that electronic message have the same legal status as writings. Where the law requires information to be in writing, that requirement is met by a data message if the information contained therein is accessible so as to be usable for subsequent reference.[4]

The signature in commercial transactions is important because it authenticates the parties to a contract and is legally bound. In most jurisdictions, a manual signature is the only acceptable form of authentication. The courts will not recognize an electronic form of verification as satisfying the legal need for a "signature" in the absence of legislation. A solution to the problem can be found in Article 7 of the Model Law, it states that;

"(1) Where the law requires a signature of a person, that requirement is met in relation to a data message if:

(a) a method is used to identify that person and to indicate that person's approval of the information contained in the data message; and

(b) that method is as reliable as was appropriate for the purpose for which the data message was generated or communicated, in the light of all the circumstances, including any relevant agreement".[5]

Today, some countries enacted laws that the legal effect of electronic signatures. For example, In the Myanmar Evidence Act, 2015 provides that;

"Where any existing law requires a signature or provides for certain consequences if a document or a record is not signed, that requirement is satisfied in relation to an electronic record if-

(a) a method is used to identify the person and to indicate that person's intention in respect of the information contained in the electronic record; and

(b) the method is used either-

[1] Hill & Walden, (1996) , 'The Draft UNCITRAL Model Law on Electronic Commerce: Issues and Solutions', p. 13.
[2] Article 5 of the UNCITRAL Model Law on Electronic Commerce 1996.
[3] Article 9(1) of the UNCITRAL Model Law on Electronic Commerce 1996.
[4] Article 6 of the UNCITRAL Model Law on Electronic Commerce 1996,
[5] Article 7 of the UNCITRAL Model Law on Electronic Commerce 1996.

(i) as reliable as appropriate for the purpose for which the electronic record was generated or communicated, in the light of all the circumstances, including any relevant agreement; or

(ii) proven in fact to have fulfilled the functions described in sub-section (a), by itself or together with further evidence.[1]

The Electronic Transactions Law (2014) further provides that

(a) Matters prescribed to be reduced to writing or to be signed under any existing law may be made by electronic record, electronic data message or electronic signature.

(b) The electronic record, electronic data message or electronic signature made under sub-section (a) shall be lawful as if they were made under the relevant law.[2]

An electronic Signature is defined as in Section 1 (f) of the Electronic Transactions Law (2014) states that an electronic signature means any symbol or mark arranged personally or on his behalf by electronic technology or any other similar technologies to verify the authenticity of the source of the electronic record and the absence of amendment or substitution.

According to these definitions, the electronic signature serves as a means of authenticating the signatory's identity and confirming that the signed document contains all the signatory intended.

With regard to the negotiability and the transferability of an electronic bill of lading Article 17(3) of the UNCITRAL Model Law on Electronic Commerce, states as follows:

"If a right is to be granted to, or an obligation is to be acquired by, one person and no other person, and if the law requires that, in order to effect this, the right or obligation must be conveyed to that person by the transfer, or use of, a paper document, that requirement is met if the right or obligation is conveyed by using one or more data messages, provided that a reliable method is used to render such data message or messages unique".

In order to transfer the right and obligation, this Article requires, first, the transfer must be made by means of data messages, and that in doing so a "reliable method is used to render the messages unique". No further information is provided on what is a "reliable method" but it can be supposed that this method should be verified and proved to be reliable.[3]The transfer of the right or duty via a data message satisfies the negotiable conditions. It's also crucial to remember that a document's negotiability must be established by law or commercial practice.

Therefore, the Model Law Electronic Commerce is a model set of rules governing electronic documents, including electronic bills of lading, although it is not a binding document.

In 2017, Only one country, Bahrain adopted this Model Law and incorporated it into the legal system of their nation. In February 2021, Singapore became the second country to adopt the model law. They amend the Electronic Transactions Act (ETA) and make consequential and related amendments to the Bills of Lading Act and the Contracts Act. The ETA amendments will enable the creation and use of electronic bills of lading that are legally equivalent to paper bills of lading. Singapore has been encouraging the adoption of electronic bills of lading and has conducted technical trials through the Trade Trust digital utility as they realised that adopting this

[1] Section 67A of the Law amending the Myanmar Evidence Act, 2015
[2] Section 19 of the Electronic Transactions Law (2014).
[3] Senekal, J. (2010). The electronic bill of lading: A legal perceptiveness; http://hdl.handle.net/ 10394/4995

globally harmonized framework will enable the creation and use of ETRs under the law and allow alignment with Singapore's trading partners, benefitting both domestic and international industry players across the shipping, finance and legal sectors.[1]

The others adopted the legislation in 2021 in Bahrain, Belize, Kiribati, Papua New Guinea, Paraguay, Singapore, and Abu Dhabi Global Market (U.A.E). Therefore, the MLETR has not been implemented by a significant number of the world's top trading nations. It is challenging for the Model Law to be adopted because it just serves as an enabling vehicle and ignores regulatory issues that belong in the purview of each individual nation.

The CMI Rules for Electronic Bill of Lading: The Comite' Maritime International (CMI) adopted the rules for electronic bills of lading in 1990. The CMI Rules are optional, and they only take effect if both parties to a carriage contract agree to them. The Rules then take effect as part of the contract. They allow for the use of electronic messages as bills of lading in a private registration system.

A transfer of the Right of Control and Transfer shall be effected:

(i) by notification of the current Holder to the carrier of its intention to transfer its Right of Control and Transfer to a proposed new Holder, and
(ii) confirmation by the carrier of such notification message, whereupon
(iii) the carrier shall transmit the information as referred to in article 4 (except for the Private Key) to the proposed new Holder, where after
(iv) the proposed new Holder shall advise the carrier of its acceptance of the Right of Control and Transfer, whereupon
(v) the carrier shall cancel the current Private Key and issue a new Private Key to the new holder.[2]

Under the CMI, the Private Key, unlike the paper bill of lading, is unique to each successive holder and is not transferable, as only 'the carrier' is authorized to issue it. This method of negotiation breaks with tradition in that it requires the participation of the carrier. In other words, the carrier acts as a registrar and is involved in the transfer process every time a bill is negotiated[3].

The CMI Rules state that the result of the legal requirements of the writing and signature in Article 11 of the CMI Rules.

The carrier and the shipper and all subsequent parties utilizing these procedures agree that any national or local law, custom, or practice requiring the Contract of Carriage to be evidenced in writing and signed, is satisfied by the transmitted and confirmed electronic data residing on computer data storage media displayable in human language on a video screen or as printed out by a computer. In agreeing to adopt these Rules, the parties shall be taken to have agreed not to raise the defence that this contract is not in writing.[4]

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[1] https://www.shippingandfreightresource.com/electronic-bill-of-lading-are-you-and-your-country-ready-for-it-part-2/

[2] Article 7 (b) of the CMI Rules for Electronic Bills of Lading

[3] Abdul Ghafur Hamid @ Khin Maung Sein, (2004) "The Legal Implications of Electronic Bills of Lading: How Imminent is the Demise of Paper Documents? The Journal of the Malaysian Bar, Vol. 33, No 3, p 11.

[4] Article 11of the CMI Rules for Electronic Bills of Lading.

Currently, the CMI Rules are a helpful set of regulations that provide a legal framework for the use of computerized bills of lading.

Challenges in using the Electronic Bills of Lading: The electronic bills of lading should be the legal and functional equivalent of a paper bill of lading. The electronic bills of lading must digitize the core functions of a paper bill of lading, namely its legal acceptance as a receipt, as evidence of or containing the contract of carriage, and as a document of title.[1]

The main use of a bill of lading is its ability to act as a title to the goods which are represented in the bill which allows a holder of the bill to transfer the title to the goods represented in the bill to another party by a simple endorsement. This negotiability of the bill of lading allows a holder to receive the cargo upon its presentment to the master, to transfer it to a third party and use the bill of lading as collateral to obtain credit and other monetary facilities from banks. An electronic bill of lading, if successfully implemented and widely accepted, would have to match up to the functional equivalence of the paper-based bill of lading.[2]

The electronic bill of lading should be able to establish the right of its holder to take up possession of the goods with its presentation. It should be able to transfer the rights and duties under the contract of carriage and should also allow for the transfer of the title to the goods represented in the bill. Further, it should also be capable of providing the legal recourse to carriers that would protect them from liability when they deliver the goods upon

the presentment of the bill of lading while also protecting their right of refusing to do so when no bill of lading is presented.[3]

The main problem is hacking which is one of the riskiest problems that the electronic bill of lading is facing. From one point of view, electronic widespread communication is untrustworthy and able to encompass fraud. Taking into consideration the sensitive nature of the bill of lading as evidence of title, with many important issues such as the passing of property depending on it, it is difficult to imagine the dangers posed by an unreliable electronic bill of lading and its impacts.[4]

Another point is that for an electronic bill of lading to be used legally and securely, it must be acknowledged by the courts as a document. In many jurisdictions, electronic documents face challenges related to the writing component that is required in all legal documents internationally.

Myanmar is a member of the International Maritime Organization (IMO) and has ratified international conventions in the maritime field. Myanmar has ratified The Hague Rules. In 2014, Myanmar Multimodal Transport Law was enacted by Pyidaungsu Hluttaw. Myanmar has created

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[1] Florian Kuester, (2017) 'Electronic Bill of Lading – How is paperless trade possible?' (Combined Transport Magazine, https://combined-transport.eu/electronic-billof- lading> accessed 20 May 2020

[2] K.A.A.N.Thilakaratne and Major H.S.D.Mendis (2020) "Using an Electronic Bill of Lading as a document of title: Prospects and Challenges", The Bar Association Law Journal, Vol. 25.

[3] P. Todd, (2019) 'Electronic bills of lading, blockchains and smart contracts', international Journal of Law and Technology.

[4] Kamal Alawamleh, Traditional Bills of Lading V. Electronic Bills of lading: Pros and cons and the way forward, Proceedings of 64th The IRES International Conference, Oxford, United Kingdom, 19th-20th March 2017, ISBN: 978-93-86291-88-2, http://www.worldresearchlibrary.org/up_proc/pdf/711 149128316801-03.pdf

and implemented laws to establish legal foundations for e-commerce trade, including Electronic Transaction Law 2004, Telecommunications Law 2013 and etc. Some of the provisions of the Electronic Transaction Law are legal recognition of electronic signatures. Myanmar is concerned with e-commerce, there is no plan to develop e-commerce associated with international trade. There are no regulations for electronic transport documents especially electronic bills of lading.

Conclusion

In the shipping industry, there have been a large number of parties. Banks from different countries, insurance companies, carriers, and forwarders can involve in the contract of carriage. It is particularly challenging to design a comprehensive electronic bill of lading because each of the parties may have a documentary requirement. At the international level, the UNCITRAL Model Law on Electronic Commerce and CMI rules for electronic bills of lading solve the difficulties of the authentication and signature requirements and the evidential value and admissibility of electronic documents. These instruments recognized electronic bills of lading are equivalent to the paper bill of lading. It needs to, particular attention to UNCITRAL's future work to develop a legal foundation in the field of electronic transfer rights and to successfully address the legal issues left by existing national laws and international agreements in the international carriage of goods by sea.

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APPLICATION OF POLLUTER PAYS PRINCIPLE THROUGH ENVIRONMETNAL TORT IN MYANMAR

Swe Zin Oo*

Abstract

Polluter pays principle (PPP) is a widely accepted and applied concept both in the context of developed and developing countries to address the environmental problems. In the simplest term, the principal means that the polluter should bear the costs of the pollution prevention and control to maintain the environment in an acceptable state. Later, it has been extended to use as an instrument to implement the civil liability regime to compensate the environmental damage. PPP can be implemented through various instruments such as economic instruments, standards-based regulations, or liability rules. Myanmar's legislation specifically provides the any person who pollute or caused damage to the environment to pay compensation for such damage. However, these provisions apply only to public environment and not cover environmental related private injury or property damage. Since Myanmar practices common law based legal system, private party can recourse to tort litigation to seek remedy for environment related private property damage. This paper critically analyzes the application of PPP through environmental tort litigation in Myanmar based on the available reported case. It is found out that the decisions of the courts do not support application of PPP as proclaimed in the environmental legislation. Moreover, some procedural rules should be amended specifically for the civil suit involving environmental related damage since they do not correspond/reflect to the nature of environmental related injury. The paper also suggests the use of strict liability in cases involving activities inherently dangerous to the environment to enable the effective application of PPP in Myanmar.

Keywords: Polluter Pays Principle; Environmental tort litigation; Environmental Liability

Materials and Method

This research uses a combination of doctrinal analysis and case analysis. Doctrinal analysis is used to analyze primary documents as well as secondary documents. Primary documents include international environmental conventions, policy documents, legislations and reported cases. Secondary sources include books, bibliography and academic on the related topics. First, it studies the origin, development, and concepts of the PPP in international documents and national legislations. Secondly, it studies a related reported case to understand and analyze the position of the courts in deciding environmental tort cases in Myanmar. And finally, it discuss whether the aims of the environmental legislations in Myanmar to apply PPP is achieved through the tort litigation.

Introduction

Polluter pays principle (PPP) first appeared in "Guiding Principles concerning the International Economic Aspects of Environmental Policies" on 26th May 1972. It was adopted by Organization of Economic Cooperation and Development (OECD). The policy was aimed to be used for the allocation of costs related to pollution prevention and control, to encourage rational use of scarce environmental resources, and to avoid distortions in international trade and investment. PPP means that polluter should bear the expenses of pollution prevention and

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control decided by public authorities to maintain the environment in an acceptable state. Afterwards, PPP gains acceptance as an international and national environmental principle and implemented through standard-based instrument and economic instruments and liability regime, etc. In Myanmar, Environmental Conservation Law, 2012 also proclaimed to implement PPP.

Development of Concept of Polluter Pays Principle

In Guiding Principles Concerning the International Economic Aspects of Environmental Policies of 26th May 1972 adopted by Organization for Economic Cooperation and Development states that -

"(t)he principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called 'Polluter-Pays-Principle'. The principle means that the polluter should bear the expenses of carrying out the above-mentioned measures decided by public authorities to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption. Such measures should not be accompanied by subsidies that would create significant distortions in international trade and investment."[1]

PPP has been recognized as a basic principle and repeatedly prescribed in several international environmental documents.

Principle 16 of the Rio Declaration provides –

"(n)ational authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment[2]."

Principle 16 has become known as "polluter pays principle" or "PPP". According to this principle, governments should strive to encourage the internalization of environmental costs into the costs of economic activities by considering the use of polluter pays principle. In doing so, the governments should ensure that the use of the policy do not cause distortion in international trade and investment. Since the Rio declaration, both developed and developing countries alike have increasingly accepted the principle. The scope applicable to the principle has also expanded and applied to all costs relating to pollution.[3]

PPP was enunciated in many international instruments, especially those adopted after 1992. Despite the enunciation of the principle in many international instruments the principle has not been followed when deciding who should bear the cost of polluting activities. For example, the Rhine Convention on Chlorides was adopted in 1976 and entered into force on 1st November 1994 expressly provides the Kingdom of Netherlands to pay for some costs of

[1] OECD, Guiding Principle Concerning the International Economic Aspects of Environmental Policies, 26th may 1972

[2] Principle 16, Rio Declaration.

[3] UNEP, 2006, Training Manual on Environmental Law: Principles and concepts of international environmental law, p-34.

pollution prevention although Netherlands is the recipient of pollution.[1] In the Chernobyl disaster, many countries were affected by the radioactive fallout. However, no country demanded compensation for damages they suffered from Soviet Union. And the Soviet Union claimed that measures undertaken by the affected countries were overcautious and denied any responsibility.[2]

Without the use of PPP and internalization of environmental cost in the economic activities, the public must shoulder the burden of the pollution by paying the costs for elimination and mitigation of the pollution. Thus, the purpose of PPP is to avoid the pollution costs, or economic externalities, which otherwise be incurred by the public, by mandating this obligation to the polluters. Usually, the polluters will incorporate the costs into the total costs of their products, and this again will be incurred by the users or consumers of the product.

An important issue of the use of PPP is the difficulty of identifying the polluter and sometimes victim of such pollution sources. It is because air pollution can be caused by various pollutants which come from different sources and different locations beyond one country's jurisdiction.[3] Moreover, the consumers may also be the polluters because they are benefited from the polluters products and services such as foods, clothes and transport, etc.[4] Moreover, according to the nature of environmental pollution, certain sources of pollution are difficulty to identify (eg., the use of pesticide in agriculture).

Implementation of PPP at National Level

PPP can be implemented through various instruments such as economic instruments, standards-based regulations, and liability rules.[5] In this research, for the simplicity, economic instruments and other standards and rules-based instrument are not considered. Instead, the use of civil liability to remedy private environmental damage focusing on the current judicial practice in Myanmar is considered and discussed.

PPP has developed to internalize the cost of pollution control as well as an instrument to implement the civil liability regime of environmental damage relating both to private and public property.[6]

The application PPP through civil liability regimes depends on the following circumstances;(i) there should be identifiable polluters, (ii) the damage is concrete and quantifiable, and (iii) the possibility of proving a causal link between the damage and the actions of the polluters.[7]

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[1] Elli Louka, 2006, International Environmental Law: Fariness, Effectiveness, and World Order, Cambridge University Press, p-51

[2] Ibid, pp 51-52

[3] Does the polluter Pays, European Environment Agency,https://www.eea.europa.eu/signals/signals-2020/articles/interview-does-the-polluter-pay

[4] Ibid.

[5] Michael Faure & Nicole Niessen(Editors), "Environmental Law in Development; Lessons from the Indonesian Experience", 2006, Edward Elgar Publishing, p-28.

[6] UNEP, 2006, Training Manual on Environmental Law: Principles and concepts of international environmental law, p-51.

[7] Ibid, p-57.

Application of the liability rules can revoke to satisfy the problem of externality in environmental pollution control.[1] Thus, it is the direct implementation of PPP. In common law systems, liability can be invoked through tort litigation.[2] A tort is "an act or omission which constitutes a breach of duty fixed by law."[3] Tort is related to "loss allocation". In any society losses may occur under any circumstances arising either from a failure to exercise due care or willful conduct of some description.[4] Traditionally, tort action is used to settle private dispute. In this sense, tort is not related to any objectives of environmental protection. However, in case an owner of a house has been disturbed by some noxious fumes, then the tort has become concerned with environmental aspect.[5] Moreover, many hazardous substances can be a trespass to land and cause property damage and personal injury.[6] Thus, tort related with environmental damage or environmental tort can specifically be instituted under the two forms of legal action, namely, trespass and nuisance. "Trespass" is used when there are direct incursions of tangible matters. On the other hand, "nuisance" is used when there are indirect incursions by intangible phenomena, such as noise or fumes, exists.[7]

In application of the tortious liability there are more than one method of categorization of liability. For environmental tort, there are generally three types of liability available, namely, fault liability, strict liability, and absolute liability.[8]

In fault liability, the plaintiff is required to prove that the wrong doer acted the injurious act with intent or negligently or without due care. Therefore, in environmental cases it would be difficult to prove that there is fault on the part of the wrong doer especially when the environmental legislations are ambiguous.[9]

In the case of strict liability, it is not necessary to establish fault. It is not necessary to test if there is violation of a duty of care or a norm or any negligence exist. The fact that the damage is caused by the defendant's conduct is material. There are certain exemptions to the strict liability if the damage is caused by an act of God, an act of war and by the interference of a third party.[10] The underlying reason of using strict liability in environmental tort is that an actor who benefits from inherently harmful activities should incur for the damage arising out of such activity. Thus, it serves the purpose of PPP.[11]

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[1] Michael Faure & Nicole Niessen (Editors), "Environmental Law in Development; Lessons from the Indonesian Experience", 2006, Edward Elgar Publishing, p-28.
[2] Mark Wilde, 2013, "Civil Liability for Environmental Damage; Comparative Analysis of Law and Policy in Europe and the US", 2nd Edition, Wolters Kluwer, p-22.
[3] Ibid.
[4] Ibid.
[5] Ibid.
[6] Ibid.
[7] Ibid, p-22.
[8] UNEP, "Liability and Compensation Regimes Related to Environmental Damage" in "Training Manual on International Environmental Law", p-57.
[9] Ibid.
[10] UNEP, "Liability and Compensation Regimes Related to Environmental Damage" in "Training Manual on International Environmental Law", p-57
[11] Ibid.

Absolute liability basically differs from strict liability in that it allows only the defense of an act of God. In environmental case, this kind of liability is imposed only on ultra-hazardous activities such as nuclear facility.[1]

Nowadays, many countries in the world has introduced and practiced strict liability for environmental damage, for example – countries in European Union, China and India, etc.

PPP in Myanmar's Environmental Legislations

The benefits of providing environmental principle in national environmental legislation is that they can complement the legislation in case there is any gaps in the provisions. Thus, an effective method of implementing PPP is that it should have a legal basis in national environmental legislation. Myanmar's commitment to environmental conservation is already embodied in Myanmar Agenda 21 in which it proclaimed its specific aim "to facilitate the incorporation of environmental and sustainable development policy considerations into the decision-making and policy formulation processes of the government in the economic and social sectors."[2] The Constitution of the Republic of the Union of Myanmar (2008) says in its Section 45 "The Union shall protect and conserve natural environment".[3] And, also under Section 390 (b), the Constitution provides that every citizen has the duty to assist the Union in carrying out the environmental conservation.[4]

In Myanmar, Environmental Conservation Law was provided in 2012 and The Environmental Conservation Rules in 2015 respectively. Myanmar's environmental legislation does not explicitly say that PPP is to use in addressing environmental pollution and damages. But many provisions in the Law includes prohibitions and designation which requires to use the principle without wording "PPP". For example, under Section 7(o) of the Environmental Conservation Law provides the duties and powers of the Ministry to include "managing to cause the polluter to compensate for environmental impact, cause to contribute fund by the organizations which obtain benefit from the natural environmental service system, cause to contribute a part of the benefit from the business which explore, trade and use the natural resources in environmental conservation works;".

And, under Section (33) of the Law provides; whoever shall:

"(a) if convicted under section 32, be passed an order to compensate for damage due to such act or omission.

(b) if ordered under sub-section (a), and fails to pay the compensation to be paid, be recovered in accord with the existing revenue laws."

Rules (30) of the Environmental Conservation Rules reaffirmed the provisions of the Environmental Conservation Law, which says: -

"(t) he Ministry:

[1] Ibid, p-58.
[2] Para 0.0.7, Myanmar Agenda 21, National Commission for Environmental Affairs, 1997.
[3] Section 45, Constitution of the Republic of the Union of Myanmar.
[4] Section 390(b), Ibid.

(a) May determine with the approval of the committee the necessary facts including the amount of money which would be compensated and to cause compensate by the polluter to environment in environmental damage;
(b) May determine, with the approval of the Committee, to contribute fund by the organizations which obtain benefit from the natural environmental service system and other necessary facts including the amount of money to be contributed for contributing in environmental conservation works from a part of benefits from the businesses which extract, trade and use the natural resources."

Thus, it is obvious from the above provisions that the environmental legislation in Myanmar is intended to use the polluter pays principle as a basic tool to remedy the environmental damage. However, the laws do not lay down any plan or scheme of calculation of the damages. Moreover, the environmental damage mentioned in the above sections are referred to damage to the public environment and not applicable to environmental damage to private property. Thus, any private individual can seek remedy through tort litigation available under traditional common law for any injury they suffered arise out of environmental consequences of a business activity.

Application of PPP and Environmental Tort in Myanmar

Environmental liability under Myanmar's environmental legislations is based on the fault-liability. Section 32 of the Environmental Conservation Law provides: - "whoever violates any prohibition contained in the rules, notification, orders, directives and procedures issued under this Law shall, on conviction, be punished with imprisonment for a term not exceeding one year, or with fine, or with both." And then, Section 33(a) of the Environmental Conservation Law provides that "if convicted under section 32, be passed an order to compensate for damage due to such act or omission." According to Section 32 and 33(a), the compensation for environmental damage will be incurred only in case the requirements of the laws are violated. Thus, it implies that Myanmar applies fault liability rules. The Law does not say anything on private environmental damage. On the other hand, Section (128) of the Environmental Impact Assessment Procedure confirms that the project proponents shall not be relieved from any liability for the claims against the project by any third parties in relating to any damage incurred or any injury suffered because of the failure of the project proponents or any breach or defects in the performance of the projects.[1] According to this Section, it can confirm that environmental laws of Myanmar also recognize individual rights to seek remedy for environmental damage or loss suffered arising out of business activity. Therefore, any person or individual who suffers any loss or damage to them or their property by environmental consequences of any business activity can recourse to civil liability for redress.

In Myanmar, there are only a few cases relating to environmental tort and most of which did not reached to the Supreme Court. So far, there has been only one reported case decided relating to environmental tort litigation, ie., U Soe Naing and eight others Vs Myanmar Pongpipat Mining Co., Ltd and one (Special Civil Appeal, 2018, MLR, No. 26, p-30).[2] The case can offer a good discussion how PPP is applied in the environmental tort case in Myanmar.

[1] Section 127, The Environmental Impact Assessment Procedure, 2015.
[2] U Soe Naing and eight others Vs Myanmar Pongpipat Mining Col, Ltd and one (Special Civil Appeal, 2018, MLR, No. 26, p-30

The facts of the case are as follows. The defendant Myanmar Pongpipat Mining Co., Ltd is operator of Heinda tin mines in Tenasserim Division. The plaintiffs are residents of the nearby villages of Heinda tin mine. The Pongpipat Co., Ltd signed a production-sharing contract with Mining Enterprise II in 1999. It is reportedly said that Pongpipat Co., Ltd holds 65% of the production. The villagers have been suffered the environmental consequences of the tin mine since it started operating in 1999. Then, due to the heavy rain in 2012, the mine tailing ponds overflew and flooded the village. It also contaminated the water sources and villagers were not able to use or drink.[1] Therefore, a group of villagers filed a civil suit to seek compensation for damage to their property. The case was filed by U Soe Naing and eight against the Myanmar Pongpipat Co., Ltd and Ministry of Mine II originally at the Dawei District Court and accepted as Civil Suit No.19/2014. The court decided upon three preliminary issues in favor of the plaintiffs; that there was ground to institute the case; it did not exceed period of limitation; and the notice has been duly served. Then the defendants applied for the civil revision cases separately (Civil Revision No.10/2015 and 11/2015) at High Court of Tenasserim Division. The Court decided that the case did not exceed the period of limitation, but it remove the Ministry of Mine II from the proceeding. Thus, both parties applied for Civil Revision case at Supreme Court. The Supreme Court dismissed the plaintiffs' application (Civil Revision Case 508/2015) but accepted the defendant's application (Civil Revision Case 607/2015) and reversed the decision of the lower courts (Dawei District Court and High Court of Tenasserim Division). Thus, finally the plaintiffs (U Soe Naing and eight) filed for the Special Civil Appeal Case No. 392/2016 and the Supreme Court accepted the case and continued the proceeding.

The Supreme Court finally decided that the loss suffered by the plaintiffs started in 2008 and continued until 2012. Thus, the plaintiff's rights to sue against the defendant appeared in 2008 where the loss began and as well as in 2012 where the loss last appeared. However, the plaintiffs instituted the suit only on 14/5/2014, which was more than one year after the loss finally appeared in 2012. Therefore, the plaintiffs' rights to institute the suit exceeded the period of limitation (Limitation Act, First Schedule, Clause 22).

Discussion

In the case mentioned above, Supreme Court finally dismissed the case on the ground of procedural defect that the time to institute the case is beyond the limitation provided for the suit. Thus, the plaintiffs did not receive any remedy for their loss.

In this case there are two important issues to discuss if consider the case as an environmental civil suit or environmental tort case. Firstly, it can be said that the decision of the court does not reflect the application of PPP as provided in environmental laws of Myanmar. In its decision, the Supreme Court did not reject the decision of the lower courts that there is ground for the plaintiffs to institute the suit against the defendant. In other words, the Supreme Court did not reject the fact that the plaintiff suffers loss and injury to their private property due to the environmental consequences of the tin mine operated by the defendant. Despite no rejection to the injury on the part of the plaintiffs caused by the defendant, the plaintiffs were denied for appropriate remedy. Thus, the decision does not reflect the application of PPP as proclaimed in

[1] "Pongpipat follows Myanmar environmental regulations", Monday, June 28, 2021, The Nation (Thailand), https://www.nationthailand.com/in-focus/30326330

the environmental legislations of Myanmar. Since the case is environmental related civil suit or environmental tort case, it should also reflect the provisions of environmental law and thus the court should make the polluter pays for loss which he has done and the environmental cost incurred by the individuals which he has done.

Secondly, the fact that the case exceeded the limitation of the time should not be a decisive matter to give effect to the merit of the case. While the case is considered and decided in the way that an ordinary tort case might have been done, it should also be taking into consider the very nature of environmental pollution issues and its consequences. In this case, the consequence of environmental impact is physical and visible, and the plaintiffs' claim is based on the ground of property damage only. However, it should well be noted that environmental problems used to trigger serious human health. According to the environmental incidents in many other countries, environmental related health issues can appear long after they have exposed to the environmental pollution or hazardous materials. For this reason, relying on the same rule of limitation of time used in ordinary tort case and deciding the merit of the case may not properly serve justice for the injured party in the environmental tort.

Another important issue is that the liability provided in Myanmar's environmental legislations is based on the fault liability. It means that an operator of a business or an activity will not be liable for the environmental consequences so long as the operator abide by the laws or is done his business or activity in accordance with the requirements of the law. In this context, Myanmar should consider that many business activities, such as mining in this case, are inherently hazardous in nature. On the other hand, in tort liability instituted under common law, the merit of the case is mainly dependent on the ability to prove on the part of the plaintiff a causal link between his injury and the injurious act of the defendant. In many cases, it is difficult to construct the causal link between the health problems and environmental issues since many health problems can occur naturally without the disturbance of environmental factors.

Conclusion

Therefore, to assure application of PPP in environmental related tort liability, Myanmar should consider introducing strict liability for environmental damage especially those for inherently dangerous and hazardous activities. The rationale to suggest the use of strict liability is that since Myanmar is based on common law tradition, the merits of the suits are largely, if not absolutely, depend on the skills of the lawyers representing the plaintiffs on how to approach the case, the perception of the judges on the nature of the case and their discretion to decide the case. Thus, by introducing strict liability, the injured parties are guaranteed to a certain level that they have access to remedy for their personal injury or property damage.

Moreover, Myanmar also should consider amending related procedural rules, especially those relating to limitation to institute an environmental suit. As it has been discussed above, many environments related diseases take time to surface. And it is also possible that injured party may not have enough knowledge, information, and ability to bring the suit to the court and they might cost them extraordinary duration. This is particularly relevant if consider Myanmar situation since it is a developing country where majority of population do not have a level of legal knowledge. Therefore, this paper would like to suggest Myanmar to introduce strict liability for environmental damage and to make necessary amendment of related procedural rules

to be able to effectively implement polluter pays principle (PPP) and enhance access to environmental justice in Myanmar.

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FITSPIRATION AND SOCIAL MEDIA: AN UNTOLD NARRATION OF HEALTH AND FITNESS COMMUNICATION AMONG MYANMAR YOUTHS*

Hsu Thiri Zaw[1]

Abstract

Social media becomes the most necessary in the daily lives of not only youths but also the older generation for their everyday activities. It intervenes in many ways of lifestyle such as education, entertainment, information, health and community settings for the users. In recent years, a new fitness trend has developed on social media especially among young people, called "Fitspiration". Fitspiration on social media which is the term for "Fitness Inspiration" is about receiving motivation from fitness and health related posts on social media and change the daily lifestyles, exercise habits and even to diet among the youngsters. This study focuses on the interrelated link between fitspiration on social media and significantly changing lifestyles of young adults in Myanmar who become loving in fitness culture in their daily lives. The research is based on narrative analysis to conduct the quality information and narration from the participants throughout their experiences before and after the fitness inspiration. Moreover, the study will clearly present the impact of social media on the young adults in consuming health related information and fitness culture and how those impacts lead them changes up and down in their daily lives.

Keywords; fitspiration, social media, youths, fitness, health communication.

Introduction

In the current community which mostly relies on the modern technology, people are spending much hours on using social media than walking or exercising in their free time. Therefore, the contents on social media which can mention and contains fitness and health related ideas have big impacts on the people's perspectives on physical activities and fitness culture in society. However, these days, people are being interested in sports and fitness for attaining either better physical appearance or staying healthy and fit. It is also mentioned that online fitness culture on social media leads the users in finding their health and fitness goals (Yang & Thi Ngoc , 2017).

It is argued that people are lack of physical activities and more dull due to the modern technology and social media by spending their most of the time sitting and using social networking sits and online. However, an undeniable fact is that people get lots of information about health on social media. Significantly, during the Covid-19 pandemic time, health expertise, governments, professionals and more applied social media for the wider and faster health information coverage (Friedman , et al., 2022).

Being a key player of health information, social media offers its users communication channels where users can communicate with the specialists or communicators concerning different health perspectives. On social media, recently, most of the health-related topics are about fitness and physical exercises (Ramme , Donovan , & Bell , 2016). The most popular social

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media network, YouTube, is the main access point of work out videos of fitness influencers by demonstrating their workouts ways and routines. With the Covid-19 outbreak worldwide, people have been more relying on online and social media for their daily workout plans and physical activity routines as gyms and fitness clubs were closed.

Mass media effects on body image and beauty perception could only considered about print such as magazines, journals and so on and television channels in previous times. However, internet and social media becomes the primary source of media effect on idealizing beauty and body among youths lately (Vaterlaus , Patten , & Young , 2015). The term "fitspiration" is the combination of "fitness" and "inspiration" which refer to gaining inspiration for work out and fitness in daily live. Fitspiration is evidently remarkable among social media because those are based on eye-catching images, photos and videos. Fitspiration on social media could be trending positively or negatively among young adults either by supporting fitness culture and healthy lifestyles or body dissatisfaction. Apparently, women consume more time by looking at image-based media online rather than other types of media (Willis & Knobloch-Westernwick , 2014).

Fitspiration contents are mostly popular on social networking sites and online media to motivate the viewers leading healthy lifestyle and diet. Fitspiration on Instagram which is one of the most popular social media means that influencers or role models show the photos, images and videos about their experiences and motivation words or quotes. Such technique is quite effective among the users as there are over 65 million posts on Instagram displaying and relating fitspiration messages (Ahrens , et al., 2022).

Concerning bodybuilding and fitness contents, young male adults usually share knowledge about weight-lifting, lean, muscular bodies including the photos and images, diet plan, dietary supplements and even their experiences throughout their fitness journey (Deighton-Smith & Bell , 2018). Viewers on social media such as Facebook, Instagram and so on, often gain inspiration and motivation for their fitness routines. On the other hand, those posts also lead young people to negative shortcut ways in obtaining physique modeled in the pictures (Robinson , et al., 2017). Therefore, this study highlights the impact of social media on fitness culture among Myanmar youths concerning the perception of fitness and gym culture and habitual changes and daily lifestyles in term of health communication.

Literature Review

Sport, Fitness Culture, Human beings and Society

It is undeniable that sport has been stick strongly together as a part of culture in the society throughout the history. The researchers also mentioned that sport is not only the model reflection of social life but also autonomical being, in different ways of anticipating social trends. Moreover, in the society, the role of sport has been so significant that brings many health benefits not only in physical but also in psychosocial development among young and old people (Audience Project, 2017).

Apart from visible positive effect on the people around the society, sport helps to promote personal development and also indirectly, it increases lesser consumption of alcohol and illegal drug usage. Doing sport can increase the youth's knowledge of diet and nutrition, exercises and their daily health-related knowledge. In real situation, human bodies need a specific amount of physical activity for maintaining their wellbeing and good bodies (Jung & Lee , 2006). According to the anthropological point of view, biological adaptation to lives of people with

physical passiveness and lesser sport might take down many generations of human being. People who are living in this generation need the same or similar physical activities as 40,000 years ago (Grabe , Ward , & Hyde , 2008).

In practical situation, an ordinary person with a body weight of 65 kg needs more than 10 km daily walking distance and also physical activities for his or her wellbeing. The daily energy intake is directly linked to daily energy output for a person's weight balance (Perloff , 2014). If a person's daily energy consumption is more than his or her energy output, there is an energy surplus, and from this point, the problem even leads to overweight problem and its related health issues such as diabetes, high blood pressure problem and even to cardiovascular diseases (Malm , Jakobsson , & Isaksson , 2019).

According to the statistics by World Health Organization (WHO), one in four adults who are at the minimum age of 18 and older and three in four adolescents who are at age of 11 to 17 are not currently meeting the global standard recommendations for physical activity. Based on the globally data, it is estimated that poor diet and nutrition causes about 22% of all adult deaths including high sodium consumption and eating less wholegrains and fruits in their daily meal plans (Holland & Tiggemann, 2016).

Fitness culture can be regarded as a sociocultural impression which involves sports and physical exercises. Fitness culture is also interlinked with the gym culture where gym and wellness centers, fitness and health clubs have emerged for workout routines and physical activities. Under the term "fitness culture", it can be also regarded as an industry which includes sportswear, sport and fitness equipment, diet and nutrition and also fitness club (Jong & Drummond , 2016).

Based on the statistics and facts on health and fitness clubs, the global fitness market value hit to $81.2 billion in 2015 and there are nearly 200,000 gym and fitness clubs at the global coverage. Such blooming economy due to fitness culture in the society has been forming competitive business war (Baker & Churchill , 1977). Academically, some literature stated that fitness culture is as part of booming economy for mobile fitness applications, social media websites and health related information. Recently, in the society, fitness culture is being highlighted as a developing digital technology such as health and fitness apps (Anderson & Wolff, 2010).

Impact of Social Media on Youths

Modern technologies can be applied in different ways positively in daily lives of people including youths and elders. Social networks, e-learning platforms and websites, compute games and mobile application which we are using as leisure activities can bring the easy and effective education system in ways of benefits. Moreover, such applications and modern technologies are even being applied in physical education and tracing physical activities in their everyday lifestyle. Using modern technologies of information age quickly leads the young people towards the new and effective chances in maintaining their health and fitness in their practical situation (Cojocaru , et al., 2022).

Many researches already mentioned that young people are addicted to the information technologies due to its accessibility, effectiveness and easy coverage. Social media addiction on young people has both positive and negative perspectives such as social media stimulate brain activity by improving feelings, emotion, collaboration and solidarity in the community in positive

ways. On the other hand, such addiction leads to sociopsychological problems due to information overload on social media in their daily information intake negatively (Millington , 2014).

People are using social media for the better and effective communication and connecting with each other and also find information about different matters. After Covid-19 pandemic time, social media is being applied positively not only in entertainment but also in education, workplace, society communication and even in the physical exercises and diet tracing. It can be undeniable that interventions of social media support positive changes to healthy behaviors, increasing physical activities and monitoring daily nutrition intake (Limniou, Mahoney, & Knox, 2021).

Fitspiration on Social Media

According to the researches, it is estimated that 79% of young people these days are using social media daily. Moreover, young people these days have begun relying on social media for their health and fitness related information in their daily lives. Recently, the trend of health and fitness sector has been changing into web-based and social media-based trends for each and every person to participate in fitness and wellbeing (Homan, McHugh, Wells, Watson, & King, 2012).

Fitspiration on social media encourage social media users in viewing health and fitness related images, posts and videos and diet and nutrition ideas, and even physical exercises to make inspiration among the youths. Such fitspiration on social media comes into many forms such as exercise tips, photos and images of fitness models, posts about experiences and emotion in fitness industry, before and after images in highlighting weight lost and muscle gain achievements (Carrotte, Carrotte, Prichard, & Su Cheng Lim, 2017).

As use of social media becomes quite largely popular among the young adults, fitspiration on social media quickly turns into the most well-known trend all over social media which can motivate and encourage the young people showing healthy lifestyle, nutrition and diet and physical exercises (Eveland , 2003). Fitspiration contents are mostly and significantly shared on famous social media applications such as Instagram, Facebook, YouTube and even TikTok lately (Homan , McHugh , Wells , Watson , & King , 2012).

World Health Organization (WHO) also set up Global Action Plan for physical activity to meet the biggest coverage reaching to targeted audiences in promoting physical activity engagement (Goodyear, Wood, Skinner, & Thompson, 2021). Social media participates in key role in growing the perception of fitness culture among the young adults. Fitness culture can be also seen as everyday communication tool and online dialogue, so scholars focused that social media is a possible and tangible source of fitness and health information. Rapid and wide social media consumption is an alternative source for collecting and learning health and fitness information among the young people (Feng & Xie , 2015).

Around 38% of the global population regardless of gender, ethnicities, cultures and socio-economic groups are using social media applications and websites such as Facebook, Instagram, YouTube, WhatsApp, and TikTok. Therefore, social media is regarded as one of the most powerful communication mediums in influencing a person’s lifestyle, physical activity, and even behaviors (Durau , Diehl , & Terlutter , 2022).

Research Methodology

The principal objective of this study is to investigate and analyze the impact of modern technology on the habit of fitness and physical activities of youths of Myanmar in the recent years. Perceiving an in-depth understanding on social media usage among young people in Myanmar, the following main research questions are developed;

1. How much social media has impacts on the inspiration of fitness culture among the Myanmar youths?
2. Which habitual changes do the youths encounter via fitspiration on social media in their daily lives?

In order to meet the research objective and find out research questions, the research is solely based on narrative analysis research method which is a powerful qualitative research tool in social science study. Narrative research mainly explores about the behaviors, feelings and motivations which cannot be shown explicitly in many research methods. As the narrative analysis supports the researchers with the detailed information about the subjects and participants which the researchers cannot dig up easily with other methods, such research method is mostly regarded as a tool for revealing hidden feelings, motivations and experiences that would be difficult to perceive directly in research.

In other words, narrative research is a study of human experience and opinions, so it can be regarded as key human activity which shapes experience and offers it meaning. Narrative research process and the result is different from each other. Therefore, narrative research is defined as a method of shaping and collecting new experiences and knowledge by building knowledge and creating it more learnable. Narrative research is usually applied in various field such as sociology, anthropology, history, nursing, psychology and communication studies (Jong & Drummond , 2016).

In narrative research, storytelling is the main feature for data collection and analysis, so the research process can be sometimes intimate and powerful in highlighting the participants' experiences and emotions applied for the research. Therefore, in this fitspiration and social media study, the researcher collected the data from 15 participants; ten males and five females within the age of 20 – 30 years' old who are keen on working out at gym and fitness centers. The researcher has been spending seven months together with the participants at gym and talking with them in order to collect the information including their emotions, experiences and even about their motivation on fitness culture in their daily lives.

The detailed explanation of participants who participated in this narrative research and shared their experiences, opinions, lifestyles and even their interesting stories spending time together with the researcher throughout seven months are shown as below –

Participants No.	**Gender**	**Age**	**Occupation**
Participant – 1	Male	24	Gym trainer
Participant – 2	Male	22	Gym trainer
Participant – 3	Male	24	Own business
Participant – 4	Male	20	Student

Participants No.	Gender	Age	Occupation
Participant – 5	Male	26	Own business
Participant – 6	Female	27	Company staff
Participant – 7	Female	24	Student
Participant – 8	Female	30	Own business
Participant – 9	Female	26	Company staff
Participant – 10	Female	30	House wife
Participant – 11	Male	27	Own business
Participant – 12	Male	27	Company Staff
Participant – 13	Male	29	Gym trainer
Participant – 14	Male	28	Own business
Participant – 15	Male	21	Company Staff

Finding

The research findings are shown based on the themes and discussed topics during the data collection, deep conversation with participants and narration and observation on the participants while the researcher had spent seven months together with them in fitness club. The findings are shown as both in positive and negative experiences and perceptions including their beginning of the fitness journey, their perceptions and experiences on fitspiration and social media, how fitness contents lead and motivate them to new lifestyle and how their habitual lifestyle changed as the workout plans become part of their daily routine.

Starting Point of Fitness Journey

Out of many popular sports and physical exercises, gym trainings and fitness culture has become popular not long ago among Myanmar people, apparently just few decades ago. Most people love to do sports due to health reason. In this study, the participants come to gyms for different reasons, however, most of their basic and fundamental reason on coming to gym and started working out is due to health and fitness matter.

> "I has started my workout routine when I was 17 years old. At that time, I have amenia. I often passed out when I felt tired or even while I was walking down the streets."
>
> (Participant – 1, Male)

> "I didn't like when my friends called me 'bony' because I was so skinny. And, I saw some advertisements about fitness club with fitness models' photos. So, I decided to start my fitness journey."
>
> (Participant – 3, Male)

> "I had arthritis problem since I was in middle school. So, my mother sent me to the fitness club when I finished my matriculation exam to make me strong and healthy."
>
> (Participant – 6, Female)

> "I started going to gym when I was 18 years old because my weight is just 80 lbs at that time. I want to become a model, so I have to think about my body. So, I searched the solutions on social media and my friends suggested me to go to gym."
>
> (Participant – 4, Male)

> "I began working out at gym because I wanted to start doing physical exercise, but I didn't know any sports. So, my friends suggested me to go to gym near my house, and I become addicted since that time."
>
> (Participant – 10, Female)

People mostly choose to go to gym mainly due to health reason at the first time. According to the participants, some people do not know how to play any kind of sport or being trained at training course or sport equipment are expensive, however, they would like to do physical exercises for their health and fitness. Hence, they become coming to gyms and fitness clubs for their physical activities and getting trained based on their body types and age group by the trainers.

Fitspiration, Social Media and Me

Using social media in their daily lives, participants see fitspiration contents on social media applications what they are using in free time. So, the quotations and their answers are explaining what they think about the contents and how they consume those fitspiration contents.

> "I saw many fitspiration posts, sometimes video, sometimes photos and sometimes even written texts. Whenever I see any fitspiration posts on social media, I just read or look at them."
>
> (Participant – 6, Female)

> "I really like fitness models. I always look at their posts and photos. How should I say? I just love to seeing such fitness posts and photos rather than any other posts."
>
> (Participant – 12, Male)

> "I use social media most of my time because of my business. Apart from checking things about my business, I usually look at fitness posts and videos, and also nutrition plans shared by others. I really love seeing those things on social media."
>
> (Participant – 8, Female)

> "Yes, I usually check fitness posts and photos whenever I have free time. I am mostly at home, so whenever I use social media, I always check fitness sites that I follow on social media, such as Facebook and Instagram. I find it amazing."
>
> (Participant – 10, Female)

> "I follow many fitness models' accounts both on Facebook and Instagram. I become obsessed with gym training and so, I always look for the videos, photos and even guidelines shared by others' professionals or players."
>
> (Participant – 3, Male)

Along with the trending social media usage on health and fitness, all participants claim that they watch fitness videos or read fitness posts on social media. Most participants express that they intentionally find fitness accounts to see those photos and videos because they just cannot resist those posts being attractive, useful and interesting.

Motivated by Social Media Fitspiration

> "I really love seeing fitness models' photos. They make me motivated a lot, for example; whenever I feel lazy to workout, those photos make me feel to try harder and better."
>
> (Participant – 15, Male)

> "My job is fitness trainer, so I am really devoted into this workout routine. But I have sometime feeling depressed and don't wanna do anything. At that time, those fitness posts on social media make me feel motivated again."
>
> (Participant – 13, Male)

> "I follow many male fitness models' account on Instagram and I have lots of idol fitness models – IFBB Pro Anderi Deiu, IFBB Pro Thanos and so on. They and their posts always inspire me doing workouts regularly in my daily lives."
>
> (Participant – 4, Male)

> "The only and main reason why I am using Instagram is about seeing fitness contents. I prefer tanning and strong women's photos than skinny and thin ones. I am really impressed with the female bodybuilders' exercise posts. Those posts really make me go and be trained at gym."
>
> (Participant – 6, Female)

> "I use social media most of time for many reasons, learning, socializing, entertainment, shopping and so on. I really envy what I see on social media about fitness models and their body appearances. So, I have started to go to fitness center to receive workout plans."
>
> (Participant – 7, Female)

Motivation from fitspiration contents on social media is the most controversial topic among the participants in this research. Stating the term of fitspiration, it is discussed about trending body appearance, workout plans, fitness routines, exercise plans, nutrition and so on. Anyone can feel impact of social media posts meaning the contents what they see online and the trending social perception of 'popular body image' on social media. Participants mention that fitspiration contents on social media mostly affect their motivation level for fitness training.

Now, Workouts Become Part of my daily routine

> "Every day, I spent at least one or one and half hour at gym. Even my family members said I become addicted to gym. But I really love to go to gym and now it becomes part of my daily life."
>
> (Participant – 9, Female)

> "Whenever after I get trained at gym, I check my body in the mirror myself. The now me is quite different from the before me. I am gaining confidence about that. I am enjoying myself. Seem like, gym is part of my daily routine now."
>
> (Participant – 5, Male)

> "I never thought that seeing some ads on social media make me addicted to gym and such habit also becomes one of my daily routines now."
>
> (Participant – 3, Male)

> "Actually, I started going to gym because I saw some attractive and sexy fitness models on Instagram and want to get some sort of trainings. Now, what should I say? I become loving gym lifestyle. Every morning, the only job I do after I wash up is going to gym."
>
> (Participant – 8, Female)

Regardless of any reason for choosing fitness journey, working out and physical exercises are necessary parts of their lives for participants. Apart from kind of doing sports or support for individual's health, workouts and physical activities are their habitual thing in their everyday lifestyles.

Discussion

Motivation is the most basic reason for physical exercise behavior. It is also occurred that motivation to work out routines can sometimes begin from the encouragement from friends, family and from role model which can either be in neighborhood or on social media. Due to the social cognitive theory, the model behaviour which is accessed by observing role model or inspired person performs can influence on the individual's lifestyles practically.

In digital world these days, social media influencers who are attractive and reliable on specific topics or issues gradually become health communicators to interact with the users and motivate the people to work out at home or fitness clubs. This study proves the impact of fitspiration contents on the social media among young adults and how fitspiration contents contribute to individuals' health and fitness. Even before the Covid-19 era and its restrictions, young adults have become more interested in joining gyms and fitness clubs during their leisure time. More adults have started caring about their physiques and aiming for their targeted body goals.

Many research about social media and body appearance mostly focused on female behaviour and dietary practices based on body image goal. On the other hand, most study has lacked on the typical understanding of body image goal and perception concerning male body types among male adults. Frequently, a male ideal body type has assumed as muscular and tanning physiques, on the other side, such influential body perceptions lead many young male

adults' depression, lower self- esteem, eating disorder and even supplement addictions. However, it is widely seen that women prefer thin and skinny body type while men focus on muscular and toning body goals.

Positive impacts can be highlighted when the social influencers or fitness models uploaded fitspiration contents about healthy lifestyles and behaviors. According to the study, men are interested in gaining weight and toning their upper bodies while women are aiming for thin and skinny bodies mostly. Male participants in the research openly express that they keep idol fitness models or persons what they are seeing and liking on social media for their motivation in fitness journey. Starting the fitness journey with the motivation by social media's fitspiration contents, participants admit that gym and fitness clubs are the places where they spend their time everyday and feel like they worth spending time in it. Male participants even admit that they prepare their meals according to diet plans shared by fitness influencers on social media.

Nevertheless, with the emerging of Korean popular culture and Chinese culture via drama series and movies, the preferred body types by Myanmar young female adults are skinny, white and thin bodies like Korean or Chinese actresses. Based on the trainers at fitness clubs who participated in this study, they claim that younger female within around 16 to 24 years old are keen on getting skinny body while women in their late 20s and early 30s are interested in healthy and fit physiques. It is significant that mass media and social media have huge impact on the audiences' consumption of their contents and leads to different perceptions. Therefore, there are still possible concerns regarding the negative influence of fitspiration contents and its focus on only weight loss and reduce meal sizes aiming to thin and skinny body shapes have been seen on all over the social media.

Conclusion

Generation these days are always together with social media from the dawn to the dusk, so it also means that those young adult generations sometimes even create their virtual community on social media. Considering such habits, fitspiration contents including photos, images, text posts and videos are usually consumed by the younger generation who are spending their time with social media. It is undeniable that fitspiration contents by social media influencers lead different perceptions to the individual social media users regarding health issues, body image goals, lifestyles, diet and nutrition and so on. Therefore, apart from fitness inspiration, there might occurs problems of low self-esteem among the social media users when their body targets do not result like the influencers' although they strictly follow their fitspiration guidelines.

Spending time together with the participants for seven months and listening to their conversation, the study shows that women are used to experience more mood dissatisfaction regarding their body targets whilst males are aiming for gaining muscular and toning physiques. However, it is necessary to be understood that different bodies need diverse workout routines and diet plans. It is found out that young adults; both female and male only focus on one ideal body type which they assume attractive, trending and most popular on social media, but they do not intend to learn about anatomy of bodies and nutrition.

Fitspiration contents surely encourage the fitness and workout motivation of youth, but sometimes those can be stereotype showing muscular, strong and toning body shapes for men, thin and skinny for women body appearance. As a part of the most popular communication medium, social media fitness trend should focus on more about the nutrition and body anatomy

in preventing body dissatisfaction problems among the youths. In current situation, social media is quite effective health communication trend by bring fitness and gym culture among Myanmar youths, however, there is no wide knowledge coverage about sport medicine in Myanmar, so the researcher recommend about the participation of nutritionists and sport medicine physicians in health and fitness communication.

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