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MYANMAR ECONOMIC ASSOCIATION • ECONOMICS PAPERS 2018

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Preface to the first edition of MEA Economic Papers

WE are pleased to present our first issue of MEA Economics Paper. It is a general economic research journal, containing survey articles; besides papers originally written by senior researchers in economics profession and from young enthusiastic researchers who are just starting off.

We are also very 'moved' that our first release has been able to attract papers from a variety of submissions of the researchers who demonstrate an interest to share their research with the readers of this journal not only from economics and applied economics aspects, but those that represent from the field of environmental research.

It is gratifying that the articles contribute help the aspired initiatives of our association activities.

This first issue of MEA Economic Papers is covered by nine articles which shed light on contemporary research arguments in economics and eco-environmental fields. The articles for this publication are as follows:

- Health Impacts of Industrial Waste Water Pollution in Yay Oakkan, Myanmar.
- The Impact of Pesticide use on human Health: a case study from Myanmar.
- Estimating Willingness to Pay for Bawditataung Nature Reserve, Monywa, Sagaing Region, Myanmar.
- The Role of Government and Its Development Management Capability. A Master Key for Political Stability and Sustainable Development.
- Economic Dependency of Local Communities on Mangrove Resources and Their Role in Mangrove Conservation in Myanmar.
- Land Degradation and the Effect of Sustainable Management Practices on Crop Profitability in Myanmar. Case Study: Taung Tha.
- Economic Losses to the Agricultural Sector from Water Pollution: a Case Study on Meiktila Industrial Zone.
- Role of Treasury Bill and Treasury Bonds in Myanmar.

Special thanks go to the organizing team of the journal for their patience and timely revisions. We know it is the toughest work for all of us in getting the work in print.

MEA very much welcome article submissions in the outlook on economic and social issues, as our excitement is to provide an outlet in theoretical and empirical aspects of economics related areas.

Last but not the least, we hope the readers find it helpful, however, we would like to request the readers to make suggestions for the improvement of upcoming publications.

Myanmar Economic Association
June, 2018

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Health Impacts of Industrial Waste Water Pollution in Yay Oakkan, Myanmar

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Abstract

In this area, the villagers can't get sustainable access to safe clean water is a major problem in the study area, Yay Oakkan Village Group in Hlaing Thar Yar Industrial Zone. Hence, the waste water disposed by the factories is an important factor for the region to consider when they suffer from the diseases. In this area, the residents have to use the four sources ofwater such as Lake-Water, Tube-well Water (90 feet, Tube-well Water (400 feet) and Joe-phyu Water.

This study aims to expose and provide to be able to reduce the health impacts of impurity water and wastewater disposal mainly by industries in Hlaing Thar Yar Industrial Zone. The study estimates the water and other causes which can affect the human health. It was exposed by analyzing the determination of background information, quality of water and awareness about water pollution and health habits. And also it was evaluated the level of awareness of the health problems among the people who suffer from the water pollution caused by the industry by using the systematic sampling method for data collection and testing the water quality and parameters in the hot season and the rainy season.

The findings show that the residents suffer from the (22) diseases and face the problems which does not get the sufficient clean water for their daily use due to the households survey. In accord with the water test, it is found the parameters which can harmful the human health such as turbidity, ammonia-nitrogen (NH_3N), Cyanide, alkalinity, iron and chloride mainly in the Tube-well water (90 feet). The diseases of dizziness, headache, fever, diarrhea, skin problems, asthma, nausea, typhoid, cholera and cramp are mostly related to the Tube-well water (90 feet), diseases caused by industry and distance of water sources from the industry and they can explain about (74%) of the variation in medical expenses.

(key words: water distribution system, waste water disposal, health impacts)

1. INTRODUCTION

1.1 A Brief Background History of Hlaing TharYar Township

Hlaing TharYar Township was established in 1985. Hlaing TharYar Township has an area of 26.01 sq miles and it is an administrative area of Northern Yangon Division. This township is situated on the west bank of Hlaing River, and it is surrounded in the east by Insein Township, on the west by Htantapin Township, on the south by Twantay Township and Panhlaing River, and in the north by ShwePyitha Township. There are 20 wards, 9 village groups and 18 villages in Hlaing Thar Yar Township.

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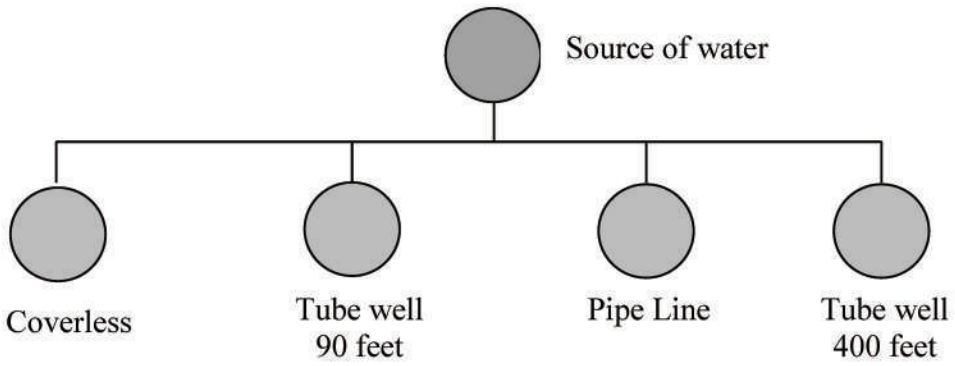
Water is the basic and primary need of all living processes. Water pollution is one of the serious problems for beings. Waste waters can be contaminated by feed-stock materials, by-products, product material in soluble as particulate form, washing and cleaning agents.

The shape of the HlaingTharYar Industrial Zone is in square shape and there are totally four villages near the zone. Two are outside the zone and another two are inside the zone. There are over (40) streets in the whole zone. Each street has (2) ditches which length is over two miles at left and right side. These ditches are being used for (588) factories to dispose their wastewater. So many gallons of wastewater are disposed daily through these ditches.

In HlaingTharYar Industrial Zone, the Zone Management Committee which was formed on 24th July 1996 has to carry out for the development of this Industrial Zone. Since establishing this zone, the responsible body did not serve the exact direction, laws and regulation for disposing wastewater and treatment for the water. So, all the factories except a few factories which obey the international standard have to dispose their wastewater themselves arbitrarily and they do not cost extraordinarily for their water treatment. Besides, no one knows exactly how much the volume of wastewater releases from these industries daily.

Although many areas are suffered from the health impacts caused by impurity and wastewater disposal from HlaingTharYar Industrial Zone, this study is focused on Yay Okkan Village Group in HlaingTharYar Industrial Zone which was selected for three reasons. Firstly, this area is suited in the center of Industrial Zone. Secondly, there are no proper sewage and drainage system which can expose the waste-water from the factories in this area. Thirdly, there is no sufficient clean water for drinking and other uses.

Yay Oakkan Village Group is situated beside Yangon-Pathein Highway, between HlaingTharYar Industrial Zone (3) and (4) in the North of Pan Hlaing River. The area of this village is (1.64685) square miles. The two villages: ThaungGyi Lay village and Yay Oakkan village consist of this village group. The total population is (41759) people and there are (4410) households and (2829) houses. Their main occupations are factory workers, vendors, trishaw drivers, manuals and small retailer shops. Most of the people are low-income group and according to the villagers' income level although it is divided into four main sources of using water, the pipe-line water, the tube-well water (90 feet) , the tube-well water (400 feet) and the coverless lake water, most of the people have to use the tube-well water because water supply supported by the government is not enough for all villagers. Moreover, the two-third of the population who is low-income group, can't use the pipe-line water sufficiently because of it is more expensive than the tube-well water and the cost of this water has been increasing year by year. So, those people have to use mainly the tube-well water (90 feet) for their water sources.



Industrial zones have been established in HlaingTharYar Township since 1995. Now, the total number of factories is 588 in industrial zones. The industrial zones had been carried out by the Management Committee, which was formed on 24.7.1996 and maintenance fees are collected Ks.10000 for per acre / month from local investors and USD 50 for per acre/month from foreign investors.

1.2 Population

In 2009, the total population of HlaingTharYar Township is 340876, people that 164152 are males and 176724 are females. It has 55826 households and 73349 families. There are 340778 Myanmar nationals and 98 foreigners in this township. Myanmar nationals living in the township are Kachin, Kayah, Kayin, Chin, Bamar, Rakhaine, Shan and other nationals. Majority of people in the township are Bamar with 323497 people making up the 94.9% of the total population of the township, the second largest nationals are other races, 11222 people making up the 3.3% of the total population of the township, the third largest number of people is Kayin, 2739 people making up the 0.8% of the total population of the township. There are 23 Chinese 23.5% of the total numbers of foreigners living in the township: 73 Indians are 74.5% of the total number of foreigners living in the township. 2 Pakistanis are 2% of the total number of foreigners living in the township; Among them, there are 329371 Buddhists, 96.6% of the total population of the township; 7280 Islam, 2.7% of the total population of the township; 5399 Christians with 1.6% of the total population of the township; and 2652 Hindus with 0.8% of the total population of the township; 3452 Islam with 1.0% of the total population of the township.

1.3 Occupation

In HlaingTharYar Township, people earn their living by working as day and night shift workers in factories. There are businessmen, farmers, and general workers.

1.4 Research problems

HlaingTharyar Industrial Zone is bounded by Hlaing River in the east, ShweThanLwin Industrial Zone in the west, Pan Hlaing River in the south and Yangon Pathein Road in the north. It was established on 15th February 1995.The objectives of this Industrial Zone are (a) to create job opportunities and increase incomes of the people in the region,(b) to further enhance the social and economic development of national economy, promoting local and foreign investment and technology through industrial sector.

The total area of land is (1401.98) acres and (1087.98) acres has been used as the Industrial area. There are (588) operating factories in this Industrial Zone. There are different types of factories such as Garment, Food-Stuff, Toiletry, Construction Materials, Electrical Goods, Forest Products, Chemical Products, Press-related, Machinery Parts, Cold Storage, Grain and General.

These industries have not only exploited the natural resources to their maximum but also the discharge of toxic effluents and emissions from harmful industries have also polluted the surrounding environment. Water is one of the most important industrial materials required in the manufacturing process, and so many industries are established around the water bodies. These industries pollute the water resources by discharging toxic effluents causing health hazards to living beings.

Before 1997, the water source of this village, a tube well of 90 feet depth is not suitable for the human health because of its geographical situation and this water naturally contains iron, calcium and salinity. So, they have to rely on not only tube-well water but also other water sources for their livelihood. Before 1997, there were about (2000) people in this village and they could also get the water from two natural lakes. The water from these two lakes could provide enough water for their daily use.

According to the saying of the local villagers who have lived in this area before industrial zone and the members of Community Peace and Development Committee, after the establishment of the industrial zone, urbanization has been taken place and there is over population, causing the depletion of one of the lakes for drinking water. Urbanization also causes the degrading of water quality for consumption. However, not only pipe-line water can't be sufficiently supported to the required water for the whole area but also the villagers are to buy with money. Because of the government does not supply the pipe-line water to the villagers directly. The government directly supplies the water to the factories which has been officially allowed to use and the villagers have to pay fees through these factories. So, low income people can only rely on the pipe-line water for their drinking and they use the tube-well water for their other uses.

Besides, the villagers also suffers from water pollution because of the factories in the Hlaing Thar Yar Industrial Zone dispose the waste water, chemical and other byproducts into the small creeks and the Pan Hlaing River.

There are about (170) various kinds of factories around the Thaunggyi Lay Village Group and they are around this village track. Some of the factories such as chemical factory, dying factory, detergent powder factory, cold storage factory and so on are disposing their wastewater unsystematically through the ditches around them into the Pan Hlaing River.

Especially, one of the dyeing factories in this area disposes hot wastewater volume of (10000) gallons daily. This wastewater includes color, acid and chemical according to the testing of Yangon City Development Committee.

Some villagers who live near this dyeing factory have to walk in this water and they suffer from the skin problems. Although there are ditches with the depth of (12) feet for releasing the wastewater from various industries, the wastewater can't flow easily due to the bad drainage system. Then sedimentation up to (11) feet occurred which makes the flow worse. Another problem is the depletion of Pan Hlaing River since 2010. Because of these two problems, the wastewater can't flow quickly into the Pan Hlaing River.

In this village track, water pollution has been growing after 2008 caused by the rapid population growth and industrialization. Before 2008, there were (10) tube wells in this village group, (5) tube wells can be used for drinking water. But after 2008, the more factories were established, the more the volume of water disposed by various industries.

These effects of waste water disposed increased from industries can impact the tube-well water in this area indirectly because the color, taste and smell are gradually getting worse and worse compared to the situation in 1997. In the wet season, the color and smell of water significantly changes and it is not suitable for their daily use. So, the villagers suffer from the infection of cholera, diarrhea, typhoid, skin problems and others infectious diseases caused by impurity of water and disposed wastewater.

Based on the results mentioned above, it is hoped that our study would provide strong evidence to justify the dire necessity of support to get clean water cheaply for the people living in this area. Because they have to incur the health costs that are caused by coming into contact with contaminated water if they do not get the clean water in the long run. This study can be used by policy makers and government organizations, non-government organizations and international non-government organizations involved in reducing these problems in the areas of wastewater is disposed systematically, education the ways of using water to protect the health problems and protection the environmental problems caused by industrialization as minimum as possible in the future.

Until quite recently, the pollution of natural water was not much of a problem, but with rapid urbanization and industrialization, this problem is reaching alarming proportions. In this area, industries discharge their untreated or only partially treated sewage and industrial wastewater into neighboring ditches. In doing so, they create intense pollution in ditches and rivers and expose the people who live in surrounding area to dangerously unhygienic conditions especially in the rainy season, these wastewater cannot flow rapidly and flood in through the streets.

1.5 Significance of the Study

In this area, wastewater and chemicals from the factories are increasingly discharged into the ditches and rivers unsystematically. It can lead to degradation and pollution of water, air and soil. As well as the government can't provide enough water supplies for the whole area and the villagers have to use the impurity water consist of various chemicals because they can't afford to buy clean water all the time, except for their drinking. So, the villagers have suffered from the infectious diseases, causing loss of income or high expenditure for health.

Without attention to the existing pollution problems that underpin water resources use within this area, the life quality of the villagers can exacerbate. Thus, understanding how water pollution might harmful to the human health and environment is necessary as long as they use these water sources. This result will be useful to analyze the direct and indirect costs on health from declining water quality.

1.6 Policy Context

Myanmar is one of the developing countries in the world, and very little information is available regarding the nation's water quality.

No single institution is responsible for the overall management of Myanmar's water resources. Currently, the Ministry of Agriculture and Irrigation is the main Ministry involved in water resources, with the mandate to develop agriculture and irrigation. Urban water supply systems in Myanmar are generally very out -of-date, with only intermittent supply and poor water quality. The water supply system in Yangon operated by the Water and Sanitation Department of the Yangon City Development Committee provides piped water to probably 40% - 50% of the urban population.

The infrastructure of water distribution needs to be developed due to the country's further economic development. In Myanmar, the water quality testing of ground water is undertaken by Yangon City Development Committee but water management is a lack of appropriate monitoring

facilities, proper and systematic keeping of records, regular monitoring and surveillance data for water quality control and basis standards of water quality for drinking water.

Although there are many laws, acts, legislations and regulations related to water sector, most laws and acts for water sectors still need to be modified. In this area, Yangon City Development Committee is mainly responsible to monitor water quality in those water bodies where wastewater is discharged to regulate and to monitoring wastewater from the industrial zone.

Though the Management Committee of the Industrial Zone has to collect the maintenance fee (ks-10000) for per acre/month from local investors and (USD 50) for per acre/month from foreign investors for all-round development and has also to do monitoring the wastewater disposal especially cleaning the sediment in the ditches, they can do just one time per year.

To solve this problem, the Yangon City Development Committee built the main water distribution center in this area and the tube-well water is filtered by Reverse Osmosis System. And then the four pipe-lines were settled for free distribution this water into the village. Although Yangon City Development Committee has to pay these charges, now this system has stopped because of higher charges.

As well as, the Department of Health has been curing and providing the medicines for the infection of Cholera, diarrhea disease, typhoid, skin problems and other infectious diseases which more occur at the beginning of the raining season. Especially, during the disease occurs, this department has been curing, giving and distribution the vaccines and education not to drink impurity water, to drink boiled water to keep the meal systematically, to be clean in the house and surroundings.

1.7 Objectives of the study

Overall objective of the study is to analyze and evolve ways to reduce the health impacts of impurity water and wastewater disposal mainly by industries in Hlaing TharYar Industrial Zone.

Specific objectives of the study are:

(i) To evaluate the level of awareness of the residents about the costs what they incur for the decline in water quality

(ii) To expose the problems created by the establishment of the Industrial Zone causing declining water quality and health problems

(iii) To analyze the direct and indirect costs on health from declining water quality.

1.8 Scope of the Study

This study has to emphasize on the health costs that are related to declining water quality. Thaung Gyi Lay village and Yay Oakkan village consist of this village group and the industry zone is around this village group. So, this village group has suffered the water pollution problems more severe than the other villages.

1.9 Research Questions

In this study, the selected households will be asked to the following questions on

(1) Awareness of the costs what they incur for the decline in water quality
(2) Treatment of water by boiling or otherwise

(3) Medical cost on different types of health problems
(4) The ways they use to protect the current health problems
(5) The current water supply system provided by the government for this area
(6) Why the respondents did not boil the four water sources for their drinking

2. REVIEW OF LITERATURE

Under this health impacts from water pollution research area, water pollution is one of the most widely study topics among researchers. Water pollution is the contamination of water bodies (eg. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water.

2.1 Water Pollution

Water pollution has continued to increase from time to time for several reasons. Industrial waste, local sewage, pesticides and fertilizers, oil spills and others remain the major causes of water pollution. According to (Chiras, 2006), Water pollution is any physical or chemical change in water that directly affects the organisms. It's a global problem, the types of pollution differs from one country to the other according to the level of development. For example, in poor and non-industrialized countries, water pollution is mainly caused by human and animal wastes, pathogenic organisms, pesticides, and sediment from improper farming and timber practices. The developed countries also suffer from these same problems, but their more stable lifestyles and numerous industries create an additional chance other hazardous pollutants such as heat, toxic, metals, acids, pesticides, organic chemicals and a collection of pharmaceuticals.

Water pollution can generally be divided into two sources:

1. Point source

2. Non-Point source

Point sources include factories, power plants, mines, oil wells and sewage treatment plants which release huge amount of toxic chemicals into sewers, lakes and rivers, (Chiras, Environmental science, 2006). (Cech, 2003) also defined it as the contamination that occurs through a pipe or other items and their location can be easily identified.

Point source pollution is easy to identify and their impact can be easily evaluated. The main sources of point source pollution are considered to be factories and waste water treatment plants. The increase of population near the manufacturing centers can contribute to large amount discharge of waste. (Cech, 2003)

The non-point sources include farms, forests, lawns and urban streets. Both sources can create a lot of problems (Chiras, 2006). Non-point source pollution is so broad, it is so difficult to identify due to its large quantity into the source. They flow into rivers, lakes and other water bodies through the movement of surface and ground water and also through precipitation from the atmosphere. It is always difficult to identify, regulate and quantify due to such large and general uses it has. (Cech, Principles of water resources, 2003)

Industries remain the major cause of water pollution in most countries of regions in the globe. They produce large amount of waste causing pollution of rivers, lakes and other water bodies, which is transported directly into the water source then it causes water pollution.

Water pollution is the result of industrial waste and municipal waste. Industrial waste can be divided into two categories, the organic and inorganic waste. Most of the inorganic waste is mineral and chemical in nature which has added greatly to water pollution problems. The waste that contains metals such as nickel, iron, copper and chromium: salts such as compounds of sodium, calcium and magnesium: acids such as sulphuric and hydrochloric and several other compounds. The inorganic waste originate from pickling, acid mine drainage, metal finishing and plating and from the mining, processing and manufacture of a wide variety of metal and chemical products (Schwartz, 1966). This shows that when the concentration of industries in a region may increase the amount of water pollution, leading to increase in cancer and other water borne diseases due to the presence of chemicals in the water.

The main impact of water pollution is mainly water borne diseases, diarrhea, typhoid, cancer and others which lead to death. Since population depend on water mostly for our survival, water pollution is a threat to our lives. The impact of water pollution is a connected process, for instance if the water is polluted, it will have an impact on the organisms in the water as well as the humans who mostly depends on the organisms as their source of consumption.

3. RESEARCH METHODOLOGY

3.1 Study Area

This study was mainly conducted in residential and business areas along the Pan Hlaing River which is the length of 48.06 kilometers. This village group is typical of urban village in developing countries in that they are densely populated. Large numbers of people are poor and work in casual.

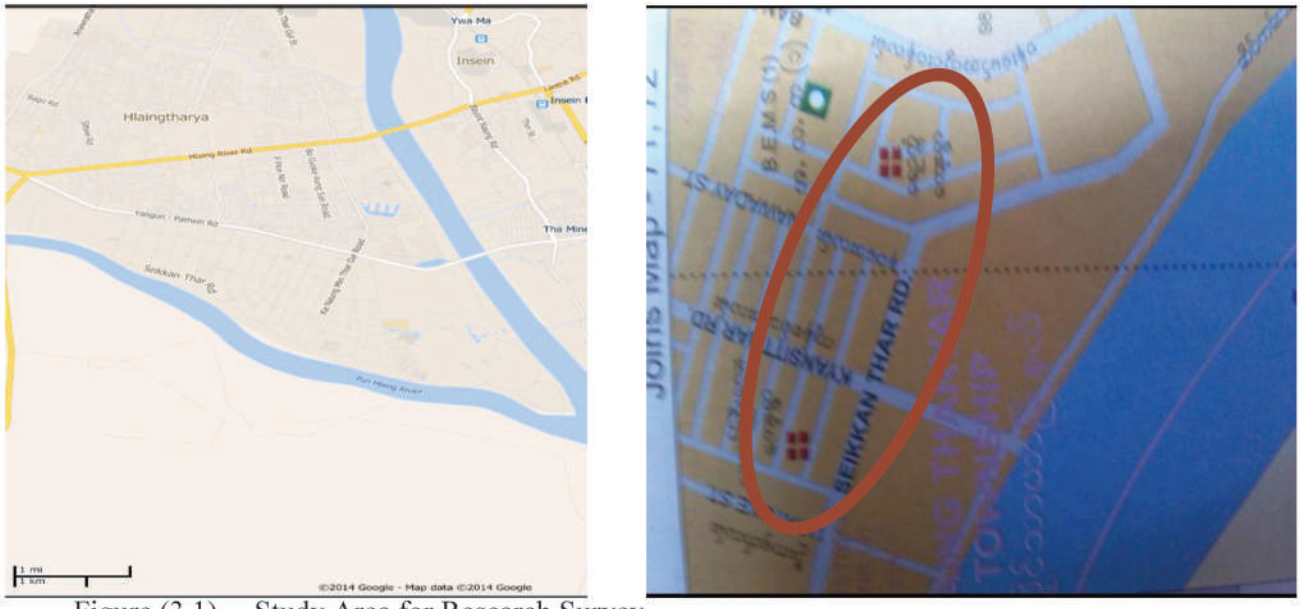


Figure (3.1) Study Area for Research Survey

This area was selected because they can't get enough clean water for their daily use, the garbage system is poor, the surrounding environment is unhealthy conditions such as muddy, dirty houses, the living standard is low and they have suffered from the infection diseases caused by wastewater of industries. Figure (3.1) shows the study areas and the study areas and the detailed survey locations are indicated by circles.

3.2 Methods of the Study

For the purpose of achieving the research objectives, inferential statistical method was used in this study and systematic sampling method is mainly used for primary data. Primary data on the using types of water of residents will be gathered through the 296 respondents from Yay Oakkan village and Thaung Gyi Lay village, questionnaires from the households. The questionnaire consists of the points for asking may include awareness about the role of purified water, experiences with water shortages and rationing, the amounts paid to water vendors other than the concessionaires. Secondary data will also be gathered from the reports, journals and related government departments.

Sampling Procedure

Systematic sampling method is mainly in this study. Regarding the Determination of sample size (n), since most of the variables in this research are qualitative variables, the required sample size (n) will be computed on the estimation of a population proportion (P) with a desired bound (B) of error on estimation of P. The formula for n is given,

$$n = \frac{Npq}{(N-1)D + pq}$$

Where:

n	=	sample size
N	=	total number of houses in the area
p	=	population proportion
B	=	bound on the error of estimation
q	=	(1-p)

$$D = \frac{B^2}{4}$$

Where, B is 95 %, bound on the error of estimation. Here, in this survey, N= 2829; and p and q, are taken to be 0.50 to allow for the maximum sampling error of the estimate. B is taken to be 0.055=5.5%. Putting the corresponding values of N,p,q,B and D in the above formula, the required sample size (n) turned out to be n. So, the research picks this interval, 9. The members of this sample will be individual 1,10,19,28,37,46,55, ……., and the estimated number of houses is 296.

3.3 Data Collection Methods

This study consisted of two types of survey: the household survey and water test. In the household's survey, inferential statistical method was used and systematic sampling method was mainly used for primary data. Structured face-to-face interviews were conducted by trained interviewers in order to collect a cross-section data. Secondary data will also be cited from literature and related government departments.

For the water test, the water sample was mainly collected from the tube-well (below 90 feet depth), tube-well (above 400 feet depth), coverless lake water and Joe-phyu pipeline water supported by the government that are situated in Hlaing Thar Yar Industrial Zone in two seasons during the period of March 2015 to August 2015 the covering hot season and rainy season.

3.4 Survey Instruments

For the household's survey, primary data on the using types of water of residents will be gathered through the 296 questionnaires from the households. The household questionnaire covered four areas: Background Informing, Water Quality, Awareness about Water Pollution and Health Habits of the Household.

For the water test, all water were carried 2L of sterilized with prewashed polyethylene containers. They were packed in an ice box and quickly taken them to the laboratories within 6 hours and placed in cool and dark conditions for analytical purposes.

4. RESULTS AND DISCUSSION

4.1 Household Survey

In this survey, 296 households were interviewed. At (74 %), slightly more women participated in the survey than men. But these women could explain the situation of the water what they have been using daily and answered the questions clearly.

Most respondents come from low or middle income households. They lived, on average, 30 minutes away from the industry. Their houses were mostly apartments and narrow spurious. One third of the respondents were migrants from outside of this area but most of them had been living in this area so long. On average, their monthly income was 150000 kyats (USD $ 150) and (120) had monthly incomes below that standard national minimum income, which is USD$ 108. The majority of people in these village groups mostly work in factories in the industrial zone.

4.1.1 Educational Level

Educational levels were directly related to the availability of livelihood options and the decision making process of using the best water types for their family's health. This survey illustrated a mixed picture.

Table 4.1 Educational profiles of respondents

Educational Level	Number of Respondents	%
Primary Education	117	39.5
Middle Education	93	31.4
High Education	48	16.2
Graduate	9	3.0
Monetary Education	10	3.4
Others	19	6.5

Source: Calculated from survey data

4.1.2 Kinds of water and using purposes

Table (4.2) shows the number of households which is using the four types of water: (1) from Lake, (2) Tube-well (90 feet), (3) Joe-phyu and (4) Tube-well (400 feet) in this villages group for drinking, cooking and washing purposes. Majority of the households use more than one type of water daily.

Table 4.2 Kinds of water and using purposes

Using Purposes	Types of Water									
	Purified water		Lake water		Tube-well water (90 feet)		Joe-phyu water		Tube-well water (400 feet)	
	Qty	%	Qty	%	Qty	%	Qty	%	Qty	%
Drinking	68	23.1	0	0	3	1.0	206	70.1	17	5.8
Cooking	16	5.0	9	2.8	7	2.2	186	57.9	103	32.1
Washing	1	0.3	18	5.0	145	40.3	43	11.9	153	42.5

Source: Calculated form survey data

The households usually use two types of water jointly together for their drinking, cooking and washing. Some households use Joe-phyu water for drinking as well as for cooking. Some households use Joe-phyu water and Tube-well water (400 feet) for cooking. Some households use not only purified water but also Tube-well water (400 feet) for their drinking. In accord with our survey results, drinking water is the most form of Joe-phyu water. As their cooking they use mostly Joe-phyu water and Tube-well water (400 feet). Tube-well (90 feet) and Tube-well (400 feet) are used the most for washing.

4.1.3 Number of Households using Boiled Water and Raw

Table (4.3) shows the number of households using boiled water and not using boiled water. In this survey, two-third of the households know very well to use boiling water for the health of their family but most of them are not used to boiling water.

Table 4.3: Number of households using boiling water and raw

Sr. No	Types of Households	Number of Households	Percentage (%)
1	Using boiled Water (drinking)	221	74.7
2	Not using boiled water (drinking)	75	25.3

Source: Calculated from survey data

4.1.4 Number of Households Awareness the Water Pollution

Table (4.4) shows the number of households' awareness on water pollution. According to the data collection, most of the respondents are not only low educated person but also they have a little knowledge about water pollution.

Table 4.4: Number of Households awareness on water pollution

Sr. No	Types of Households	Number of Households	Percentage (%)
1	Awareness of the water pollution	202	68.2
2	Not awareness of the water pollution	94	31.8

Source: Calculated from survey data

4.1.5 Disease profile of survey subjects

Table (4.5) shows the disease suffered from the both respondents and family members. According to this survey, (22) kinds of disease were found.

Table 4.5: Disease profile of survey subjects

Sr. No	Name of Disease	Qty of person who suffered from disease
1	Headache	46
2	Dizziness	38
3	Fever	32
4	Diarrhea	20
5	Hypertension	18
6	Skin problem	12
7	Heart disease	12
8	Neuritis	9
9	TB	8
10	Asthma	7
11	Nausea	6

Sr. No	Name of Disease	Qty of person who suffered from disease
12	Hay fever	6
13	Stomachache	5
14	Arthritis	5
15	Cramp	4
16	Diabetes	4
17	Typhoid	3
18	Cholera	2
19	Liver disease	2
20	Yellow fever	2
21	Epilepsy	2
22	Colic	1

According to our study, there are four kinds of water which the households use in this area and there is no household which use only one. All households have to use at least two or three kinds of water for their daily use. So, it is difficult to separate this information according to the source of water.

But in accord with the water test, (62.6%) of the respondents have to use the Tube-well water (90 feet) for their washing and we found the high value of turbidity, Ammonia-Nitrogen (NH_3N), Cyanide, Alkalinity, iron and chloride mainly in the Tube-well water (90 feet) and the bromine, turbidity, Cyanide and Alkalinity value are also high in the Lake-water (LW).

Higher turbidity levels are associated with higher levels of disease and can cause symptoms such as nausea, cramps, diarrhea and headaches. And also if there is much amount of cyanide contamination in water, the villagers can feel dizzy, skin problems and in the long run they also cause nerve damage or thyroid problems. Excessive levels of iron can damage DNA, protein, lipids and other cellular components and if there is much amount of Bromine can affect seriously the human health.

So, although all diseases are not related to all sources of water, the diseases of dizziness, headache, fever, diarrhea, skin problems, Asthma, nausea, typhoid, cholera and cramp are mostly related to the impurity water, Tube-well water (90 feet) and Lake-water (LW).

4.1.6 Changes of water color (%) (296 respondents)

Table (4.6) shows the comparison of the changes of water color before and after establishing the industrial zone for four water sources answered by the respondents in the survey area.

Table 4.6: Changes of water color (%) (296 respondents)

Type of Water	Unchanged	Changed
Joe-Phyu Water	78.7%	21.3%
Tube-Well Water(90 feet)	24.3%	75.7%
Tube- Well Water	43.2%	56.8%
Lake Water	3.7%	96.3%

Source: Calculated from survey data

4.2 Data Collection Analysis

The regression and correlation analysis was used in our study. Many empirical studies rely quite heavily on these statistical tools. They are perhaps the most commonly used forms of statistical analysis, and are individual when making a large number of business and economic decisions.

4.2.1 Regression Analysis

Regression is a quantitative expression of the basic nature of the relationship between the dependent and independent variables. Regression and correlation analysis recognize that there may be a determinable and quantifiable relationship between two or more variables. That is, one variable depends on another and can be determined by it; or we can say that one variable is a function of another. This can be stated as

$$Y = f(X) \qquad (4.1)$$

Which is read "Y is a function of X", and states that Y depends on X in some manner? Since Y depends on X. It is the dependent variable and X is the independent variable.

Correlation determines the strength of the relationship. That is, while regression describes the basic nature of the relationship between the two variables, correlation measures how story that relationship is. In this study, we used multiple regressions.

Multiple regressions involve two or more independent variables. If Y is said to depend on three independent variables, we can write $Y= f(X_1, X_2, X_3)$. A model containing K independent variables can be expressed as

$$Y= f(X_1, X_2, \text{----------}, X_k) \qquad (4.2)$$

Or

$$Y=b_0 + b_1 X_1 + b_2X_2 + \text{---------}+ b_k X_k + e \qquad (4.3)$$

Where K is the number of independent variables and b_1 are the coefficients for the variables. e is the random error-component made necessary because not all observations fall directly on the regression line.

4.3 Testing Multiple Regression Coefficients

In this multiple regression coefficients, we test the relation between the diseases by industry, distance from industry and the medical expenses (the sum of medical expenses and income loss per day while feeling the disease) the villagers. We have to test these four water altogether because all respondents use the all kinds of water for their drinking, cooking and washing purposes. So, we assumed that the villagers felt the direct effects of water pollution from these factors.

(1) Hypothesis

$H_0: \beta_1 = \beta_2 = \beta_3 = \text{----------} = \beta_k = 0$

H_1: At least one is not zero.

$Y= \beta_0 + \beta_1 X_1+ \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4+ \beta_5 X_{5+} \beta_6 X_6 + \epsilon_i$

$Y = 996.630X_2 + 10641.393X_6 + €_i$

Y = Medical Expenses (Medical charges + income loss per day)

X_1 = Lake Water (LW)

X_2 = Tube-Well (90 feet) (TW 90)

X_3 = Joe-Phyu Water (JW)

X_4 = Tube-Well (400 feet) (TW)

X_5 = Distance of Water Sources from Industry

X_6 = Disease Caused by Industry

In this regression analysis, the dependent variable is the sums of medical charges which are the villagers have to pay when they feel illness and all the other independent variables are binary variables. X_1, X_2, X_3 and X_4 are four types of water they are using and if the villagers use them, the value of variable is 1 and if not, the value is zero.

X_5 is the distance of water sources from industry and we have to use the dummy variables 1 and 2. If the source of water they get is near the industry, the value is 1 and if not, the value is 0.

X_6 is the disease caused by the industry and we have also to use the dummy variables and 1 and zero. We asked the villagers "Do you think the disease you surfer from is caused by the industry" for this variable and the answer is 'yes' or 'no'. If it is yes, we put the value of variable, one and if it is no, we put zero.

We applied SPSS>stepwise linear regression approaches to the data to consider which variables are the explanatory variables affecting the change in medical expenses of the sample families. We found that only 3 variables, Tube-well water (90 feet), Distance of water sources from industry and whether the cause of disease is due to industry, are significant. The other sources of water are interrelated and hence the multicolinearity assumption is violated and found to be insignificant.

According to the significant variables, the relationship between the medical expenses (Y) and Tube-well water (90 feet) (X_4) and disease caused by industry (X_6) is positive. But the medical expenses (Y) and the distance of water sources from the industry (X_5) is negative relationship. So, the further the distance from industry, the less they feel the diseases and the less they spend for the medical expenses.

Table 4.8: Relationship between diseases suffered from the residents and four types of water estimates for the targeted area

	Coefficients	**Std Error**	**Sig**
Lake Water (LW)	-1518.204	821.104	.065
Tube-well Water (90feet) (TW 90)	996.630	375.364	.008
Joe-Phyu Water (JW)	375.956	577.584	.516

Tube-well Water (400 feet) (TW)	360.717	566.746	.525
Distance of water sources from industry	-293.839	555.668	.597
Disease Caused by industry	10641.393	413.775	.000

Dependent Variable: Total medical expenses, $R^2 = 0.825$, adjusted $R^2 = 0.821$, total n=296

In previous result, we had to entry the data of distance of water sources from industry wrongly. In our questionnaire, we put the six answers which they can choose; (1)under 5 minutes, (2) between 5 and 10 minutes, (3) between 10 and 20 minutes, (4) between 20 and 30 minutes, (5) over 30 minutes and (6) over one hour. So, there are various numbers (1 to 6) in our data entry for that and our result was not exact between the independent variable (X_5) was not dummy variables. Now, we have to divide the distance into two parts. If the distance is under 20 minutes, it is near the industry and if the distance is 20 minutes and over 20 minutes, it is far from the industry. If it is near the industry, the dummy is 1 and if not, 0.

We performed a multiple regression analysis to predict the actual impact from the water in the study area. So, illness occurs caused by the waste water disposal from industry at 100% level of confidence (0.000). And also, there is only Tube-Well Water (90 feet), TW (90) is at 98% level of confidence (0.002) and related to the dependent variable. According to its geographical situation and this water contains iron, calcium and salinity. So, the more tube-well water they use, the more ill they become. According to the interview, almost all households have to use more the tube-well (90 feet) than the other types of water. Turbidity, total dissolved solid (TDS), iron and cyanide values in the tube-well water (90 feet) are high compared with the other types of water and it is higher than the permissible level according to the water test. The results of the experiments for four types of water are shown in Table (4.8),(4.9),(4.10) and (4.11) in detail.

Before 2008, there are (10) tube wells in this village group, (5) can be used for drinking. But after 2008, more factories establish, the more the volume of waste water disposed by various industries. Industries discharge their untreated of only partially treated sewage and industrial wastewater unsystematically into neighboring ditches and on the road. In doing so, they create intense pollution in ditches and rivers.

Besides, before 1997, there were about (2000) people in this village but there are over populated and become urbanization in this area after establishing the Industrial Zone because most of the people in other areas had to migrate for their job opportunities. Being rapid pollution growth and industrialization, not having been well-housing system and not having been proper swage system, drainage system and garbage system, water pollution has been growing. These factors can impact indirectly the water sources in this area because the color, taste and smell of Tube-well water are gradually worse and worse comparing with the situation in 1997.

Nevertheless, turbidity, total dissolved solid (TDS), iron and cyanide values in the Tube-Well water (90 feet) are high compared with the WHO and EPA standard according to the water test. Higher turbidity levels are associated with higher levels of disease causing microorganisms such as viruses, parasites and some bacteria.

Total dissolved solid (TDS) is directly related to the purity of water and quality of water purification systems and affects everything that consumes, lives in, of uses water. According to the answers of respondents, changing the color of JW (90) is (76%) and no change is only (24%). So, the color and smell of tube-well (90 feet) water significantly changes and not suitable for their daily use caused by these factors.

According to the our interview results, almost of the villagers in this area have to use the Tube-well (90 feet) water for their daily use that they can't spend their much money for purified water. Although they know the color, taste and smell of Tube-well (90 feet) water are gradually worse and worse, they have no choice to more use other types of water because the situation of their income and they have no enough knowledge the danger of this water. They always think that their daily small income can be provided for their daily costs. According our water test, turbidity, total dissolved solid (TDS), iron and cyanide values in this water are high compared with the WHO and EPA Standard.

So, if the villagers use this type of water for so long, they can suffer symptom such as nausea, cramps, diarrhea, and associated headaches caused by high level of turbidity. They can also feel not only dizzy, skin problems and in the long run also nerve damage or thyroid problems due to the cyanide but also damage DNA, proteins, lipids and other cellular components caused by excessive levels of iron.

Distance means the distance of water sources they get and the industry. According to our regression analysis, distance from the industry is significant but the coefficient sign is negative. So, we assumed that there is negatively relationship between the distance from industry and the cost of illness. The nearer the water sources they use from the industry, the more ill they suffer and the higher the health cost. The greater the distance, the less ill they suffer and the lower the health cost. This makes sense since it implies that water taken from a location further away from the point source is less polluted.

4.4 Community Perceptions of Health Profile

In an open question on predominant health problems in the community, the respondents mentioned that skin problems, diarrhea, illness, headache, dizziness were the most common health problems amongst the population in this area. In addition, people also suffer from hypertension, asthma, TB, neuritis, hay fever, arthritis, stomachache, hearth disease, nausea, cramp, cholera, epilepsy, yellow fever, colic, liver disease, diabetes and typhoid.

Headache and dizziness were widespread in the study area. Almost all participants of interview claimed to have experienced headache and dizziness because of their frequent contact with water and some participants were currently suffering from dizziness because the water they use daily includes the high level of turbidity and cyanide. The people suffer from diarrhea, hypertension and skin problem are a little high in this study. Diarrhea is one of the most prevalent health problems reported to be suffered by children as well as some adults. The source of the problem is the place where they live is unhealthy environments and contact with the chemicals used in the factories.

The majority of the respondents also blamed the lack of proper sanitation system, drainage system and sewage system and lack of knowledge about hygiene for diarrhea, skin problem, TB, frequently illness which are frequent among children, slum dwellers and factory workers.

Currently, 62.6 percent of the villagers and 32.4 percent of villagers were found to be using tube-well (90 feet) and tube-well (400 feet) water for washing and day-to-day household activities. Culturally open water bodies have been the most common source of water for bathing. People generally bathe at least once a day.

4.5 Water Quality Analysis

Results of the experiments are presented in above table. It shows the quality parameters of the untreated water samples collected from four sampling sites in Industrial Zone and their disposal channels.

Table 4.8 Physiochemical Parameters of Water Sample Collected from Industrial Zone (Hot Season)

Parameter	Unit	SI	SII	SIII	SIV	WHO standard*	EPA standard**
pH	-	7.95	7.06	7.32	7.42	6.5 ~8.5	6.5 ~8.5
Bromine	ppm	1.19	0.82	0.01	0.02	1	-
Turbidity	NTU	61	174	4.69	3.88	5	-
TDS	mg/L	230	380	40	45	500	500
Ammonia Nitrogen (NH_3N)	mg/L	0.09	0.4	0.2	0.1	0.5	0.5
Nitrite Nitrogen (NO_3-N)	mg/L	0.06	0.04	0.02	0.02	1.0	1.0
Cyanide	mg/L	9	6	0	1	0.07	-
Alkalinity	mg/L	169	190	30	31	500	30 ~ 150
Hardness	mg/L	90	70	32	45	500	90 ~ 100
Chloride	mg/L	0.32	0.37	0.01	0.02	250	-

Sources: (1) Laboratory of Small Scale Industries Department

(2) Water and Soil Examination Laboratory, Department of Fisheries

* World Health Organization Standard for drinking water (2006)

** Environmental Protection Agency for domestic water (2003)

ND = not detectable

S_I = Coverless Lake Water

S_{II} = Tube-well (below 90 feet depth)

S_{III} = Joe Phyu Pipe Water

S_{IV} = Tube-well (above 400 feet depth)

TDS = Total Dissolved Solid

4.6.2 Some Organic Pollutants Parameters of Water Samples Collected from Industrial Zone

Results of the experiments are presented in above table. It shows the organic pollutants parameters of the untreated water samples collected from four sampling sites in Industrial Zone and their disposal channels.

Table 4.9 Some Organic Pollutants Parameters of Water Samples Collected from Industrial Zone (Hot Season)

Parameter	Unit	SI	SII	SIII	SIV	WHO Standard *	EPA Standard**
COD	mg/L	29.4	8	20.6	22.6	10	5
DO	mg/L	5.0	4.75	7.0	6.0	-	4~6
BOD	mg/L	0.5	1.0	1.5	1.0	6	5

Sources: (1) Laboratory of Small Scale Industries Department

(2) Water and Soil Examination Laboratory, Department of Fisheries

* World Health Organization Standard for drinking water (2006)

** Environmental Protection Agency for domestic Water (2003)

COD = Chemical Oxygen Demand

DO = Dissolved Oxygen

BOD = Biochemical Oxygen Demand

4.6.3 Heavy Metals of Water Samples Collected from Industrial Zone

Results of the experiments are presented in the above table. It shows the organic pollutants parameters of the untreated water samples collected from four sampling sites in Industrial Zone and their disposal channels.

Table 4.10 Heavy Metals of Water Samples Collected from Industrial Zone (Hot Season)

Parameter	Unit	SI	SII	SIII	SIV	WHO Standard *	EPA Standard**
Lead	mg/L	ND	ND	ND	ND	0.01	0.05
Iron	mg/L	1.71	12.58	ND	0.063	0.30	0.30
Cadmium	mg/L	ND	ND	ND	ND	0.003	0.01
Copper	mg/L	0.006	0.005	0.002	0.002	2.00	1.00
Total Mercury	Hg	0.0064	0.0015	0.0041	0.0007	0.001	-
Arsenic	ppm	0.0021	0.005	0.0009	0.0067	0.01	-

Sources: (1) Laboratory of Small Scale Industries Department

(1) Water and Soil Examination Laboratory, Department of Fisheries
(2) Customer Support & Laboratory Department, Australasia Marking Trading & Technology Co.,Ltd.

* World Health Organization Standard for drinking water (2006)

** Environmental Protection Agency for domestic water (2003)

ND = Not detectable

4.6.4 Microbiological Parameters

Results of the experiments are presented in above table. It shows the microbiological parameters of the untreated water samples collected from four sampling sites in Industrial Zone and their disposal channels.

Table 4.11 Microbiological Parameters

Parameter	Unit	SI	SII	SIII	SIV	WHO Standard *	EPA Standard**
Total Coliforms	MPN/100 ml	<103				0	-
E-coli	MPN/100 ml	0	0	0	0	0	-

Sources: (1) Laboratory of Small Scale Industries Department

ND = Not detectable

In this study, we had to choose (296) households for data collection using the systematic sampling method and test the four water samples which they are using daily in this area for the hot season and the rainy season. According to this study, there were (22) kinds of diseases are occurring in this area: They are typhoid, diabetes, liver disease, colic, yellow fever, epilepsy, cholera, cramp, nausea, heart disease, stomachache, arthritis, hay fever, neuritis, TB, asthma, skin problem, hypertension, diarrhea, dizziness, headache and fever.

In accord with the result of water test, we found the high value of parameters which can be harmful the human health such as turbidity, ammonia-nitrogen (NH_3N), cyanide, alkalinity, iron and chloride mainly in the Tube-well water (90 feet) and the bromine, turbidity, cyanide and alkalinity in the Lake Water (LW).

In the regression model, only three variables (Tube-well water (90 feet), disease caused by industry and distance of water sources from industry) are found to be significant. But they can explain about (83%) of the variation in medical expenses, (17%) of the variation is due to other factors which we could not explain. They could be due to personal hygiene, as well as the other environmental issues and lack of knowledge on health education etc. So, the result of water test and the regression analysis show that the diseases of dizziness, headache, fever, diarrhea, skin problems, asthma, nausea, typhoid and cholera are mostly related to the Tube-well Water (90 feet).

5. CONCLUSION

In this study, we found that Tube-well water (90) feet is not suitable for their daily use. As well as the government organization is lack of responsibility to monitor water quality in those water bodies where wastewater is discharged to regulate and to monitoring wastewater from the industrial zone.

The water distribution system in this area is very weak for the households. Most households have to use the impurity water and they have to spend their some income for the water sources. Although the residents suffer from the several diseases, two-third of the respondents does not exactly know that it is caused by water pollution. Because of they are uneducated and they team to use unclean water. As well as they have no enough knowledge that the diseases are related to the water pollution and water pollution can be occurred by the industrial zone and poor sanitation infrastructure especially bad garbage system, ill sewage system and poor drainage system.

According to this study, industrial zone is very close to this village group as well as the wastewater and byproducts released from the factories are not be disposed systematically. This fact can be harmful not only the health of the villagers but also the groundwater and environment. Nevertheless, we found that the households which use the water sources near the industrial zone suffer more diseases them the households away from the industrial zone.

This research report serves as a guide to reduce the health impacts of impurity water and wastewater disposing from the industries. Our hope is that our findings will help the authority to understand the existing problems and to implement the necessary policies and guidelines.

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Estimating Willingness to Pay for Bawditataung Nature Reserve, Monywa, Sagaing Region, Myanmar

Khin Thida Nyein[1]

Abstract

This study estimates people' willingness to pay for Bawditataung Nature Reserve which is situated at Monywa, Sagaing Region, Myanmar by employing the contingent valuation method. Regarding the willingness to pay (WTP) questions, a single-bounded dichotomous choice contingent valuation method is employed with five bids: 100 Ks, 300 Ks, 600Ks, 900 Ks, and 1,200 Ks. The study finds that most respondents (both visitors and non-visitors) are willing to pay for the nature reserve conservation in support of the environmental conservation program and to reduce the impact of natural hazards. It is found that parametric mean value for WTP of visitors, non-visitors and total respondents are 147.89 Ks, 813.64 Ks and 567 Ks respectively. Non-parametric mean value for WTP of visitors, non-visitors and total respondents are 620 Ks, 653 Ks and 637 Ks respectively. According to logit regression result, it can be said that the coefficient of bid, education level of respondents, and family income are significant. Accordingly, it is affirmed that the theory supports. Higher bid price reduces people' WTP for conservation of the nature reserve. Higher education level of people encourage people' WTP. Higher family income increases the willingness of people to contribute in the conservation program. Having employing Contingent Valuation Method, there is no doubt that this study gives the considerable information to policy makers in making a decision regarding the conservation of Bawditataung Nature Reserve.

1. INTRODUCTION

Bawditataung Nature Reserve is located in the middle of Myanmar. It is situated in the area of Monywa and Chaungoo townships of the Sagaing Region. The total area of the nature reserve is 14,020 acres. Geographically, it lies between north latitude 22 degrees 04 minutes and east longitudes 95 degrees 18 minutes. The area of the reserve is surrounded by 21 boundary posts on the ground. The upper layer of this area is young sandstone, and the lower layer of this area is old sandstone. As this area is included in dry zone of Myanmar, the Bawditataung Nature Reserve is established aiming at protecting of the environmental degradation in the dry zone. The following figure shows the Bawditataung Nature Reserve.

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Originally, Kyaukka-Shwemyintin Nature Reserve is established in 1970, and the area of Kyaunkka-Shwemyintin Nature Reserve is 17,920 acres. In 2008, it is declared as a "Bawditataung Nature Reserve". Originally, the area of the nature reserve included the religious area, namely Bawditataung Pagoda's area. At this moment in time, as the area of the nature reserve excluded the religious area, the current area of Bawditataung Nature Reserve is 14,020 acres.

The average rainfall of the area is between 25 inches and 30 inches, and the average temperature is between 8 degree centigrade and 40 degree centigrade. As this region is at dry zone in the middle of Myanmar, the weather is very hot and dry. Therefore the type of forest in this area is tropical dry forest. Names of trees which are naturally grown in this area are tectona tree, terminalia tree, cutch, acatia tree and so on.

Currently, the Dry Zone Greening Department and the Forest Department under the Ministry of Natural Resources and Environmental Conservation have been conducting management matters which could be greening environment in the area of Bawditataung Nature Reserve. The existing activities are as follows;

(1) Fire wood plantation for people living in rural area,
(2) Mountain range plantation,
(3) Reforestation, and
(4) Nature conservation.

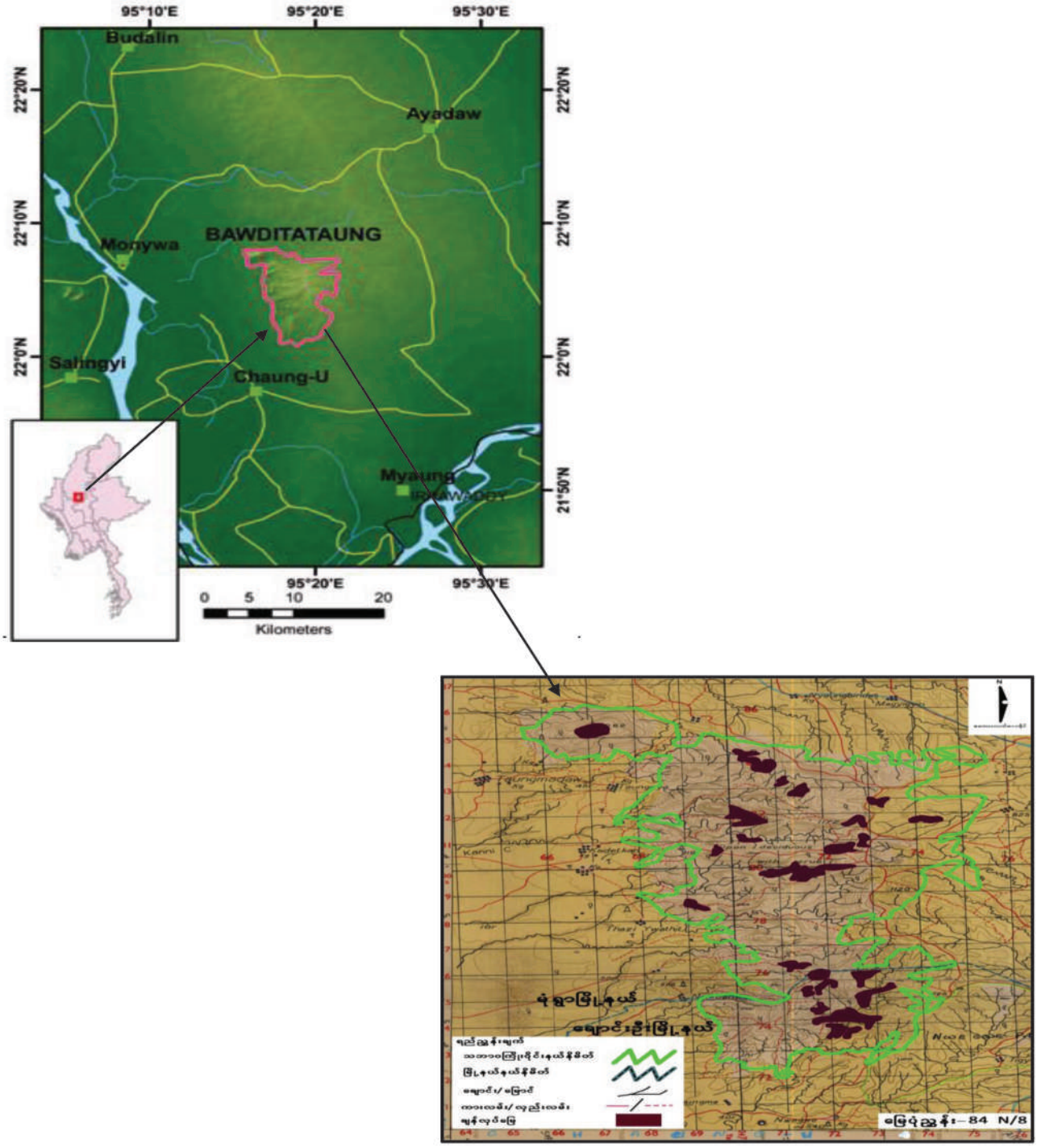
At this moment in time, one staff officer, one ranger, three deputy rangers and five foresters are carrying out these tasks for the whole area of nature reserve.

Therefore it can be said that the management of the reserve is under the Ministry of Natural Resources and Environmental Conservation, and source of finance also comes from budget of that Ministry. Based on this condition, it is hard to say that the strength of total of 10 staffs, and also finance are sufficient for greening the whole area.

Accordingly, this study intends to investigate whether people have willingness to pay for conservation of this nature reserve.

The total area of the nature reserve is 14,020 acres. Of this, over 9,000 acres have been developed for fire wood plantation, mountain range plantation, reforestation and nature conservation since the establishment of the reserve until now. However, only about half of the area developed has been successfully cultivated. The developed area is in the tropical dry zone wherein trees planted need continuous care to ensure successful growth.

Figure 1.1. Bawditataung Nature Reserve



Source: Forest Department

The Dry Zone Greening Department and Forest Department under the Ministry of Natural Resources and Environmental Conservation have been continuously conducting mountain range plantation at a rate of 100 acre per year. Based on these conditions, the following tasks are still left in an attempt to build a thickly forested area;

(1) Replanting the areas with unsuccessful growth, and
(2) Widening the rehabilitation efforts to new areas within the nature reserve

These situations say that trees could not still cover the whole area. Hence, there is need for additional funds to support these activities and it is hoped that this can be sourced through people's contribution.

As the area of Bawditataung Nature Reserve is in Dry Zone, the weather condition is very hot and dry. Accordingly, local residents constantly encountered the problem of scarce water. After establishing the reserve, local residents can utilize water from the spring (*locally named Kyauk-pyin-taung Spring*) for the whole year. In addition, rural people near the reserve are taking a benefit from fire wood plantation. Besides, they say that they are enjoying delightfully the shade of trees and forests.

Therefore, there is no doubt that people have the benefit of the Nature Reserve. Accordingly, this research intends to analyze whether people would like to pay to conserve the Bawditataung nature reserve.

Although people recognize that environmental conservation is very important for the society, people usually do not contribute on the environmental conservation. Regarding Bawditataung Nature Reserve, only the Forest Department and Dry Zone Greening Department have been implementing reforestation and nature conservation for this site. Only one staff officer, one ranger, three deputy rangers and five foresters from the Forest Department and Dry Zone Greening Department are designated to conserve this Nature Reserve. In fact, it can be understandable that such a few workforces could not cover the whole area. Accordingly, it cannot be denied that people's contribution to conserve this Nature Reserve is crucial.

However, as it is unattainable to reach the whole population in our society as an individual researcher, it would be needed to designate the scope of the study.

Geographically, Bawditataung Nature Reserve shares border with Bawditataung Pagoda in the west, and South Khattagan village is next to the Bawditataung Pagoda. Many people from various part of Myanmar come to Bawditataung Pagoda to pay homage every day, and also simultaneously enjoy the beauty of nature as the Nature Reserve is next to the Pagoda.

According to local residents, 20 visitors per day come to this site on average. It may be said that over 7,000 visitors per year come to this area. It is sure that interviewing many people is very costly.

1.1 Objectives

General Objective

This research aims at analyzing whether people have willingness to pay to conserve Bawditataung nature reserve.

Specific Objective

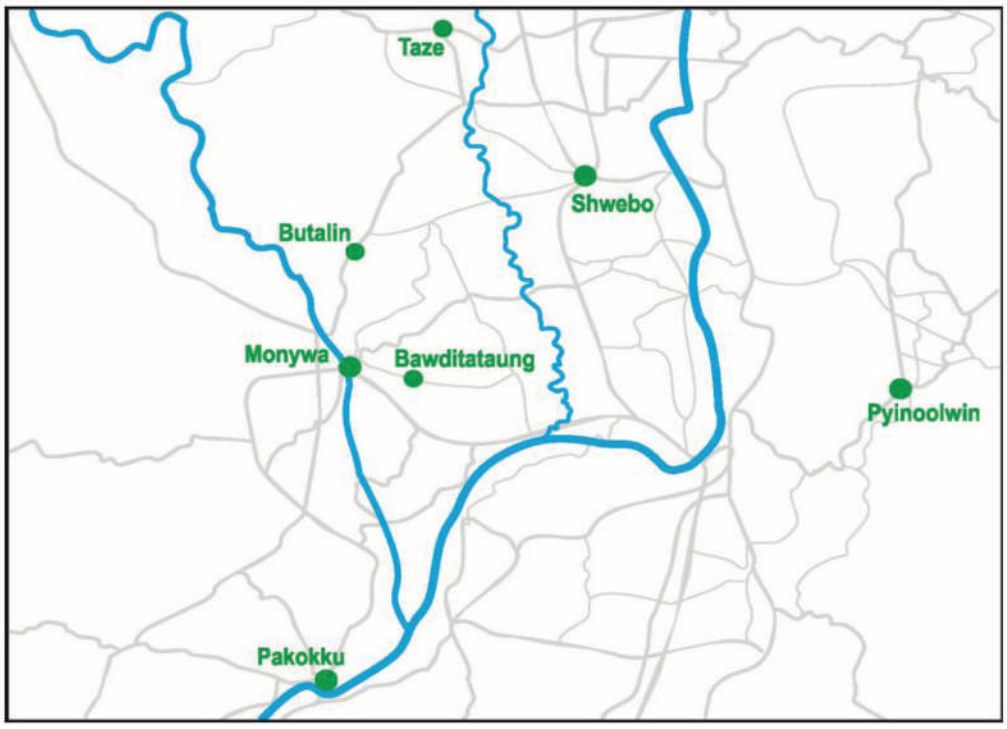
Specifically, this research aims to estimate the individual's willingness to pay for the conservation of the Bawditataung nature reserve by using Contingent Valuation Method (CVM).

1.2 Scope of the Study

The research team conducted face-to-face interviews with two groups of respondents: (a) visitors to Bawditataung Pagoda, which is located next to Bawditataung Nature Reserve; and (b) those who have never visited the Bawditataung Nature Reserve. Altogether 300 respondents were interviewed consisting of 150 visitors and 150 non-visitors from five cities, which are not very far from the site. As they may get a hold the benefits of the reserve, they are chosen in this study. All respondents are household income earners who are responsible for household expenditure decision making.

The following figure shows the cities which are collected the data for the analysis of non-use value of the nature reserve.

Figure 1.2. The Cities for the Analysis of Non-use Value of the Nature Reserve



Source: Author's Sketch from Google Map

2. METHODOLOGY

2.1 Scenario

In order to investigate the willingness to pay for the analysis of use value and non-use value of the nature reserve, people will be asked questions concerning their willingness to contribute in the conservation of Bawditataung Nature Reserve. Before asking research questions, respondents are explained about the current situation of Bawditataung Nature Reserve and the current benefits which is received due to this reserve, potential benefits, and scenario including proposed activities for the improvement of the nature reserve.

The following is "Scenario" of the research.

Scenario

 Current Situation DZGD & FD are conserving Bawditataung Nature Reserve. - Mountain range plantation yearly	 Current Situation DZGD & FD are conserving Bawditataung Nature Reserve. Reforestation & Nature conservation yearly
 However, even with these efforts, this is how the Bawditataung Nature Reserve look like at this moment. You can see that the trees could not still cover the whole area at present	 More efforts are needed to improve the condition within the Bawditataung Nature Reserve. We need to plant more trees, restore the forest. By doing this, the expected benefits will be Protection of soil, water, biodiversity and environment, These benefits will not only be for the people in our generation but also for future generations.
To implement this purpose, The government will need finances more for - More plants - More workforce   	These are proposed activities to be Green Space. ➢ At the moment, trees are being cultivated by a rate of 100 acre per year. In order to be thickly forested area as soon as possible, it is intended to cultivate more trees by a rate of 200 acre per year. ➢ As this area is dry and hot, there are

	some places which trees are not developed. Therefore, it is intended to replant trees in those places annually.
➢ At the moment, there is not enough labor in this area. Therefore, it is intended to increase workers more not only for cultivating trees but also for watching out continuously trees ➢ In order to do these activities, a coordinating body of Nature Reserve management is intended to establish. ➢ It is intended to include all stakeholders such as township government, nearby villages, offices of the nature reserve management and the third party in a coordinating body of Nature Reserve management	➢ In order to manage funding efficiently and effectively in implementing these activities for the improvement of nature reserve, it is intended to establish finance committee. ➢ It is important to know how funding which is contributed from people will be used effectively and efficiently, so fund balance sheet will be shown transparently to the people through newspaper or newsletter
➢ However, it is not easy that the government alone could provide enough money to implement the purpose, ➢ -Therefore this survey is being carried out to investigate whether visitors and non-visitors have willingness to pay for the conservation of this Nature Reserve.	➢ Before you answer, I would like to tell you that…. ➢ Past studies have found that many people say that they would donate for a program like this when they are asked their opinion in a survey, but then they do not donate for the program when they are proposed. In other words, respondents seem to have a tendency to say they would donate for the program even if they do not really mean it.



Researchers are not sure why people do this. It may be because it feels good to say yes in a survey when people do not actually have to pay. Or it may be to please the interviewer.



- Please note that the information presented in the survey **is not yet in existence**. The Program is presented only for the purpose of this survey in order for us to get your opinion on this matter.







- While payment of money is hypothetical, **we ask that you think that if this were real, would you be willing to make this donation?**
- Ask yourself do you really want to support the fund for the Bawditataung Nature Reserve enough that you would be willing to spend the money?
- Remember that the money you are willing to pay will mean less money that you can spend on something else



2.2 Questionnaire design

There are three parts in the CVM questionnaire for this research. The first part includes people's perceptions on the Bawditataung Nature Reserve. Contingent valuation questions are in the second part. The third part is concerned with socioeconomic characteristics of respondents.

The first part aims to recognize respondents' awareness and attitudes on Bawditataung Nature Reserve, and to find out the ways which people could contribute in the conservation of nature reserve.

The second part is about contingent valuation questions. Before asking contingent valuation questions to respondents, the scenario about the nature reserve is explained in detail. Especially, the proposed activities to be green space are included in this scenario. The followings are the proposed activities;

(1) At the moment, trees are being cultivated by a rate of 100 acre per year. In order to be thickly forested area as soon as possible, it is intended to cultivate more trees by a rate of 200 acre per year.

(2) As this area is dry and hot, there are some places which trees are not developed. Therefore, it is intended to replant trees in those places annually.

(3) At the moment, there is not enough labor in this area. Therefore, it is intended to increase workers more not only for cultivating trees but also for watching out continuously trees

(4) In order to do these activities, a coordinating body of Nature Reserve management is intended to establish.

(5) It is intended to include all stakeholders such as township government, nearby villages, offices of the nature reserve management and the third party in a coordinating body of Nature Reserve management.

(6) In order to manage funding efficiently and effectively in implementing these activities for the improvement of nature reserve, it is intended to establish finance committee.

(7) It is important to know how funding which is contributed from people will be used effectively and efficiently, so fund balance sheet will be shown transparently to the people through newspaper or newsletter.

The third part is on information of respondents such as age, gender, occupation, education, marital status and income.

2.3 Elicitation Method

In order to measure the individual willingness to pay for the analysis of use value and non-use value of the nature reserve, the contingent valuation method is used in this research. People are asked their willingness to pay for a hypothetical improvement of the Bawditataung Nature Reserve. Regarding the willingness to pay (WTP) questions, a single-bounded dichotomous choice contingent valuation method is employed with five bids in this research.

With the intention of establishing five bids, draft questionnaire was firstly constructed based on the information from the Forest Department. After a couple of pretesting with visitors, five bids: 100 Ks, 300 Ks, 600Ks, 900 Ks, and 1,200 Ks were confirmed. Here, if some respondents give the negative response for the proposed bid, they will be asked the amount they would like to pay.

2.4 Payment Vehicle

In order to implement the activities which could be done to improve the Bawditataung Nature Reserve, the respondents were asked whether they have willingness to pay as an entrance fee for visitors and trust fund per month for non-visitors.

2.5 Pre-tests

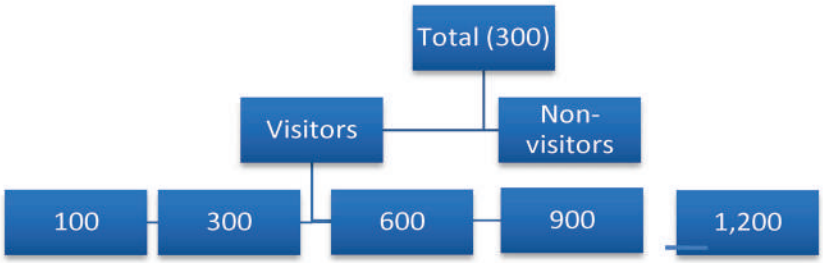
In order to achieve the objectives of the research, it was conducted in-depth interviews of the Forest Department (FD) under the Ministry of Environmental Conservation and Forestry to collect information regarding the current situation and existing management of Bawditataung nature reserve, and the activities could be done to improve the Bawditataung nature reserve.

Based on the above information, the Draft CV scenario and questionnaire was secondly constructed. Then, it was conducted FGDs with visitors in Bawditataung area to discuss the CV scenario, payment vehicle and the contents of the draft questionnaire. Then, face-to-face interviews were conducted with respondents in order to understand properly.

Next, the questionnaire was pretested on 20 respondents as first time. Then, it was conducted a second round of pretesting on 30 more respondents. Finally, the five bids were chosen based on pretest. They are MMK 100, 300, 600, 900, and 1,200.

2.6 Sampling

It is divided into two groups – visitors and non-visitors to collect the data regarding people's willingness to pay for conservation of nature reserve. There are 150 respondents in each group, and total respondents are 300 in this survey. 150 visitors who come to the site are randomly chosen and asked with structured questionnaire regarding the conservation of Bawditataung Nature Reserve. The rest 150 respondents are non-visitors who live in other places, namely Shwebo, Taze, Butalin, Pakokku and Pyinoolwin. They are also asked with structured questionnaire whether they have willingness to pay for the conservation of the Nature Reserve.



3. RESULT AND ANALYSIS

3.1 Socio-demographic and Economic Characteristics of the Respondents

In this section, socio-demographic and economic characteristics of the respondents in both groups are presented. As can be seen in Table 3.1, the mean values of age and household size of respondents in both groups are not so different. Most of respondents in visitors group are male, and accounts for 51.3 %. Most of respondents in non-visitors group are female, and accounts for 53.3 %. Most of respondents in visitors and non-visitors groups are married, accounts for 55.3 % and 66.0 % respectively. Education levels of most respondents in both groups are in graduate level. Monthly incomes of most respondents in visitors group (44 % of 150 respondents) are between 200,000 and 300,000 MMK. Monthly incomes of most respondents in non-visitors group (34 % of 150 respondents) are between 100,000 and 200,000 MMK. The occupations of most respondents in both groups are self-employed, and accounts for 26 % and 30 % respectively.

Table 3.1. Demographic Characteristics of Visitors and Non-Visitors

Charac-teristics	Particular	Visitors			Non-Visitors		
		Mean	Frequency	Relative Frequency	Mean	Frequency	Relative Frequency
Age	Age	36.37			36.21		
Household Size	Household Size	4.51			4.81		
Gender	Male		77	51.3		70	46.7
	Female		73	48.7		80	53.3
Marital Status	Married		83	55.3		99	66.0
	Single		67	44.7		51	34.0
Level of Education	less than high school level		35	23.3		33	22.0
	High school level		29	19.3		47	31.3
	University student level		2	1.3		6	4.0

	Graduate		77	51.3		57	38.0
	Master		7	4.7		7	4.7
Monthly Income of respondent	<100,000 MMK		6	4.0		40	26.7
	between 100,000 & 200,000MMK		49	32.7		51	34.0
	between 200,000 & 300,000MMK		66	44.0		28	18.7
	between 300,000 & 400,000MMK		14	9.3		9	6.0
	between 400,000 & 500,000MMK		12	8.0		7	4.7
	between 500,000 & 600,000MMK		2	1.3		1	0.7
	between 600,000 & 700,000MMK		-	-		3	2.0
	between 800,000 & 900,000MMK		-	-		1	0.7
	between 900,000 & 1000,000MMK		-	-		1	0.7
	> 1000,000 MMK		1	0.7		9	6.0
Occupation	Government Employee		37	24.7		19	12.7
	Private Enterprise Staff		19	12.7		22	14.7
	Craftsman		5	3.3		13	8.7
	Self-employed		39	26.0		45	30.0
	Retired		1	0.7		5	3.3
	Seller in market		23	15.3		15	10.0
	Others		26	17.3		31	20.7

Source: Calculation from Survey Data

3.2 Perception of Respondents on Bawditataung Nature Reserve

In order to identify the perception of people regarding Bawditataung Nature Reserve, it is given a scale of 1 to 5 on different points (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree). Table 3.2 shows the results of survey concerning the perception of visitors and non-visitors on the Nature Reserve.

Table 3.2. Perception of Visitors and Non-Visitors regarding Bawditataung Nature Reserve

S.N	Particular	Visitors			Non-Visitors		
		No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People	No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People
1	The existence of this Nature Reserve provides water conservation.	62	41.33	150	78	52.00	150
2	The existence of this Nature Reserve reduces CO2 and air pollutants.	52	34.67	150	59	39.33	150
3	Visitors are likely to be satisfied if trees and forests are greening around the Bawditataung Pagoda next to Bawditataung Nature Reserve.	76	50.67	150	89	59.33	150
4	When we glance away from the place of Pagoda, some places within the Nature Reserve area are still needed to be cultivated a lot of trees.	70	46.67	150	55	36.67	150
5	Only DZGD & FD are undertaking reforestation, mountain range plantation and nature conservation yearly. Therefore, people should also contribute in the improvement of Bawditataung Nature Reserve.	53	35.33	150	63	42.00	150
6	Conserving Nature Reserve upgrade the quality of natural environment, and then it will help improve socioeconomic condition of local residents.	47	31.33	150	48	32.00	150

Source: Calculation from Survey Data

Based on this table, it is found that over 50 % of visitors strongly agree only the fact "Visitors are likely to be satisfied if trees and forests are greening around the Bawditataung Pagoda next to Bawditataung Nature Reserve". For the non-visitors, over 50 % of all respondents strongly agree the facts "The existence of this Nature Reserve provides water

conservation" and "Visitors are likely to be satisfied if trees and forests are greening around the Bawditataung Pagoda next to Bawditataung Nature Reserve".

3.3 Awareness and Attitudes of Respondents regarding Bawditataung Nature Reserve

In order to determine the awareness and attitude of people regarding Bawditataung Nature Reserve, it is also given a scale of 1 to 5 on different points (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree). Table 3.3 shows the results of survey concerning the awareness and attitude of visitors and non-visitors on the Nature Reserve.

According to the results, it can be said that less than 50 % of visitors strongly agree on each factor which is stated in the table concerning Bawditataung Nature Reserve. However, over 50 % of non-visitors strongly agree on the particulars "Soil erosion preventing, litter, dead wood composition from the forest, which also improves fertility"," If the trees in the Bawditataung Nature Reserve are thicker than current situation, people are likely to enjoy the shade of trees and forests, and the beauty of nature", " Greening Nature Reserve is crucial for environmental conservation", and " Conserving Nature Reserve could reduce natural hazard such as flood, drought, storm and so on".

Table 3.3. Attitude towards Bawditataung Nature Reserve

S.N	Particular	Visitors			Non-Visitors		
		No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People	No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People
1	Root systems of trees and forests prevent soil erosion.	61	40.67	150	67	44.67	150
2	Landslides can be prevented by trees and forests.	58	38.67	150	61	40.67	150
3	Moist content in the trees serves the function of fire prevention.	57	38.00	150	68	45.33	150
4	Soil erosion preventing, litter, dead wood composition from the forest, which also improves fertility.	60	40.00	150	83	55.33	150
5	If this nature reserve will be greening more than current situation, it can be developed into ecotourism industry and bring another household income source for local residents.	35	23.33	150	40	26.67	150

6	If the trees in the Bawditataung Nature Reserve are thicker than current situation, people are likely to enjoy the shade of trees and forests, and the beauty of nature.	60	40.00	150	88	58.67	150
7	Greening Nature Reserve is crucial for environmental conservation.	65	43.33	150	78	52.00	150
8	Many workforce and funds are still needed to green the Nature Reserve.	40	26.67	150	41	27.33	150
9	Conserving Nature Reserve could reduce natural hazard such as flood, drought, storm and so on.	53	35.33	150	77	51.33	150
10	People should contribute for greening the whole area of the Nature Reserve.	40	26.67	150	73	48.67	150

Source: Calculation from Survey Data

3.4 Ways to integrate the society in the Conservation of Bawditataung Nature Reserve

Aiming at exploring ways to integrate the society in the conservation of Bawditataung Nature Reserve, both visitors and non-visitors were asked with the questionnaire design which is given a scale of 1 to 5 on different points (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, and 5: strongly agree). The results of survey are shown in Table 3.4.

Table 3.4. Recommendation on Ways to integrate the Society

S.N	Particular	Visitors			Non-Visitors		
		No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People	No. of People who "strongly agree"	Percentage of People who "strongly agree"	Total No. of People
1	Apart from DZGD & FD, local authority should also cooperate for the improvement of Bawditataung Nature Reserve.	41	27.33	150	63	42.00	150
2	NGOs should cooperate in the conservation of Bawditataung Nature Reserve.	26	17.33	150	44	29.33	150

3	Regarding how important conserving nature reserve is for protecting environmental degradation, media such as newspaper, television and journal should be used to give knowledge to the public.	37	24.67	150	59	39.33	150
4	In order to encourage nearby communities to participate voluntarily management of the nature reserve, a coordinating body of Nature Reserve management should be established and involve all stakeholders such as township government, nearby villages, offices of the nature reserve management and the third party.	29	19.33	150	63	42.00	150
5	Development activities such as ecotourism and the processing of wild plants and animals should be encouraged in order to transform local resources into economic advantages for villagers	36	24.00	150	38	25.33	150

Source: Calculation from Survey Data

As shown in Table 3.4, it can be said that less than 50 % of both visitors and non-visitors strongly agree on each factor which is stated in the table concerning the ways to integrate the society. Based on above studies, it is found that percentage of non-visitors who "strongly agree" is greater than that of visitors who "strongly agree".

3.5 Respondents' Willingness-to-Pay for the Conservation of Bawditataung Nature Reserve

Regarding respondents' willingness-to-pay, a question about how certain they are when they said they were willing to pay is used in this research. How they respond is shown in the following table.

Table 3.5. Respondents' Certainty about Willingness to Pay

S.N	Types of Respondents	No. of respondents who say "very certain"	No. of respondents who say "somewhat certain"	No. of respondents who say " certain"	No. of respondents who say "not so certain"	No. of respondents who say "not certain at all"
1	Visitors	51	18	23	1	0
2	Non-visitors	51	18	24	5	0
	Total	102	36	47	6	0

Source: Calculation from Survey Data

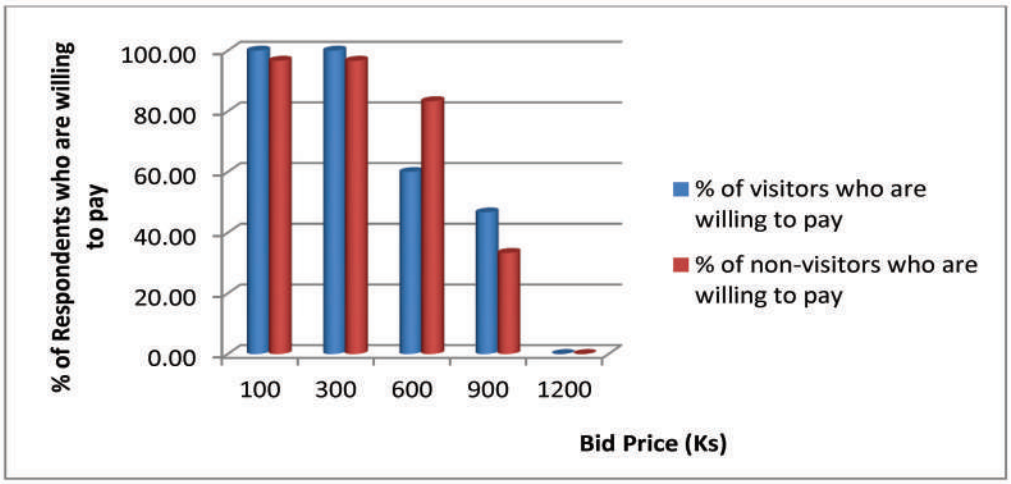
Based on the above information, the number of visitors and non-visitors who want to pay for the conservation of the Bawditataung Nature Reserve are presented as shown in Table 3.6. As can be seen in table, it is found that visitors are willing to pay if the entrance fees are 100 MMK and 300 MMK, and no one want to pay if the entrance fee is 1,200 MMK. Similarly, most non-visitors are willing to pay if the trust funds are 100 MMK and 300 MMK, and no one wants to pay if the trust fund is 1,200 MMK.

Table 3.6. Number of Respondents who want to pay

Bid (MMK)	Visitors	% of visitors who are willing to pay	Non-Visitors	% of non-visitors who are willing to pay	Visitors & Non-Visitors	% of visitors & non-visitors who are willing to pay
100	30	100.00	29	96.67	59	98.33
300	30	100.00	29	96.67	59	98.33
600	18	60.00	25	83.33	43	71.67
900	14	46.67	10	33.33	24	40.00
1200	0	0.00	0	0.00	0	0.00
Total	92		93		185	

Source: Calculation from Survey Data

Figure 3.1. Percentage of Respondents who want to pay



Source: Table 6

3.6 Reasons for Willingness and Unwillingness to Pay for Conservation of Bawditataung Nature Reserve

Table 3.7 shows the reasons why visitors and non-visitors are willing and not willing to pay in the conservation of Bawditataung Nature Reserve.

Table 3.7. Reasons why Respondents are Willing or Unwilling to Pay

Reasons	Frequency	
	Visitors	Non-Visitors
Willing to Pay		
To support environmental conservation program	44	38
To provide a steady source of fund for the management of Bawditataung Nature Reserve	11	10
To reduce natural hazard	28	29
To be green forest	9	16
Unwilling to pay		
Government should do this program	-	1
Villagers near this site should contribute	-	1
My income is limiting my ability to pay	4	9
The proposed entrance fee is not reasonable price	32	25
The proposed entrance fee is too high	21	16

Source: Survey data

Based on Table 7, it can be said that most visitors and non-visitors are willing to support environmental conservation program. The main reason why most visitors and non-visitors are not willing to pay is the proposed entrance fee is not reasonable price. Another factor they do not want to pay is the one that they feel the proposed entrance fee is too high.

3.7. Logit Regression Results

Based on literature, the following models are employed for visitors, non-visitors, and both visitors and non-visitors respectively.

For visitors,

$$Pr(Yes) = \beta_0 + \beta_1 Distance + \beta_2 Bid + \beta_3 Age + \beta_4 Gender + \beta_5 Edu + \beta_6 Marital + \beta_7 F\ Income + \beta_8 Attitude$$

For non-visitors,

$$Pr(Yes) = \beta_0 + \beta_1 Bid + \beta_2 Age + \beta_3 Gender + \beta_4 Edu + \beta_5 Marital + \beta_6 F\ Income + \beta_7 Attitude$$

For both visitors and non-visitors

$$Pr(Yes) = \beta_0 + \beta_1 Bid + \beta_2 Age + \beta_3 Gender + \beta_4 Edu + \beta_5 Marital + \beta_6 F\ Income + \beta_7 Attitude$$

Description of variables used in this research is as follow.

Variable	Description	Expected Coefficient Sign
Bid	The 5 bids used 100 Ks, 300 Ks, 600 Ks, 900 Ks, 1200 Ks	-
Distance	measured by mile	-
Age		±
Gender	1 = male 0 = female	±
Edu	1 = less than high school 2 = high school 3 = university student level 4 = graduate 5 = Master 6 = Ph.D	+

Marital	1 = married 0 = single	±
F income	1 = < 100000 2 = bet 100000 & 200000 3 = bet 200000 & 300000 4 = bet 300000 & 400000 5 = bet 400000 & 500000 6 = bet 500000 & 600000 7 = bet 600000 & 700000 8 = bet 700000 & 800000 9 = bet 800000 & 900000 10 = bet 900000 & 1000000 11 = > 1000000	+
Attitude	SA = 5, A = 4, N = 3, DA = 2, SDA = 1 Taking average the answer from respondents	+

Table 8. Logit Regression Result

		For Visitors	For Non-visitors	For Visitors and Non-visitors
Variable	Description	Coefficient	Coefficient	Coefficient
Distance	Distance	0.001 (0.747)		
Bid	Bid	- 0.009*** (0.00)	-0.022*** (0.00)	-0.010*** (0.00)
Age	Age of respondent	0.021 (0.571)	0.075 (0.152)	0.027 (0.255)
Gender	Gender of respondent	- 0.554 (0.389)	-2.346 (0.118)	-0.958* (0.054)
Edu	Education level of respondent	0.722** (0.011)	-0.313 (0.512)	0.406** (0.038)

Marital	Marital status of respondent	- 0.647 (0.385)	1.222 (0.419)	0.054 (0.927)
F income	Family Icome	0.399** (0.038)	0.818*** (0.006)	0.366*** (0.001)
Attitude	Attitude toward conservation	0.226 (0.794)	- 1.564 (0.421)	-0.265 (0.674)
	Constant	1.331 (0.757)	17.90* (0.068)	5.670* (0.067)

Source: Calculation from Survey data

Note: Values in parenthesis are p-value.

***, ** and * significant at 1 %, 5% and 10 % level.

As can be seen in table, the coefficients of bid, education and family income are significant in the model used for visitors. Other variables are not significant. Therefore, it can be said that the higher the bid price, the lower the probability that the respondents will be willing to pay. The higher education level of respondent, the higher is the probability that the respondents will be willing to pay. Similarly, the higher family income increases the probability that the respondents will be willing to pay.

Regarding the result of model used for non-visitors, the coefficients of bid and family income are significant. Constant is also significant. Other variables are not significant. Accordingly, it can be said that higher bid price discourages respondents' willingness. Higher family income increase respondents' willingness to pay.

For both visitors and non-visitors, the results say that the coefficients of bid, gender, education and family income are significant. Constant is also significant. Others are not significant. Therefore, it can be said that these results support what the theory said.

4 ESTIMATION OF MEAN WILLINGNESS TO PAY

With the aim of estimating the mean willingness to pay, this study uses the parametric and non-parametric approach.

4.1 Parametric Estimate for Visitors

The formula employed in this study is as follow:

$$\text{Mean WTP} = -\beta_0 / \beta_2$$

where β_0 is constant, and β_2 is the coefficient of the bid.

According to the result shown in the table, the β_0 is equal to 1.331 and β_2 is -0.009. Therefore, Mean WTP = - 1.331/(-0.009) = 147.89 Ks

Total use value = Mean WTP * Number of Visitors per year

= 147.89 Ks x 7,000

Total use value = 1,035,230 Ks per year

(It is noted that about 7000 visitors per year come to this site according to local residents.)

4.2 Parametric Estimate for Non-visitors

According to the result shown in the table, the β_0 is equal to 17.9 and β_2 is -0.022. Therefore, Mean WTP = - 17.9/(-0.022) = 813.64 Ks

In order to have some idea of the non-use values, the MWTP estimated by using the parametric method was used to multiply with 50% of the number of households in each city where the survey was conducted. The ratio of 50% of the number of households in each city used is based on the results of the distribution of percentage of 'yes' responses in Table (4.6).

Average WTP = Mean WTP * 50 % of Number of Household in each city

Average WTP for Shwebo = 813.64 Ks x (50 % of 50247)

= 813.64 Ks x 25123.5

= 20,441,484.54 Ks = 20.44 million Ks

Average WTP for Butalin = 813.64 Ks x (50 % of 28616)

= 813.64 Ks x 14308

= 11,641,561.12 Ks = 11.64 million Ks

Average WTP for Taze = 813.64 Ks x (50 % of 35937)

= 813.64 Ks x 17968.5

= 14,619,890.34 Ks = 14.62 million Ks

Average WTP for Pokokku = 813.64 Ks x (50 % of 66340)

= 813.64 Ks x 33170

= 26,988,438.80 Ks = 26.99 million Ks

Average WTP for Pyinoolwin = 813.64 Ks x (50% of 53382)

= 813.64 Ks x 26691

= 21,716,865.24 Ks = 21.72 million Ks

Total non-use value = 95,408,240.04 Ks = 95.41 million Ks

4.3 Parametric Estimate for both Visitors and Non-visitors

According to the result shown in the table, the β_0 is equal to 5.670 and β_2 is -0.010. Therefore, Mean WTP = - 5.670/(-0.010) = 567 Ks

4.4 Non-Parametric Estimate for All Respondents

The following tables show non-parametric estimate for visitors, non-visitors, and both visitors and non-visitors.

Table 4.9. Non Parametric Estimates of Mean Willingness to Pay Using: Visitors

Bid price (Ks)	% of people saying Yes	Total respondents	Lower bound	Amount(Ks)
less than 100	0.00	150	0	
100-300	0.00	150	100	0
300-600	0.40	150	300	18,000
600-900	0.13	150	600	11,997
900-1200	0.47	150	900	63,005
more than 1200	0.00	150	1200	0
	1.00			93,002
			Mean Willingness to pay lower bound	620

Source: Calculation from Survey data

Non parametric estimate for visitors

Total use value = Mean Willingness to pay lower bound * Number of Visitors per year

= 620 Ks x 7,000

Total use value = 4,340,000 Ks per year

(It is noted that about 7000 visitors per year come to this site according to local residents.)

Table 4.10. Non Parametric Estimates of Mean Willingness to Pay Using: Non-Visitors

Bid price (Ks)	% of people saying Yes	Total respondents	Lower bound	Amount(Ks)
less than 100	0.03	150	0	
100-300	0.03	150	100	0
300-600	0.17	150	300	7,502
600-900	0.50	150	600	45,000
900-1200	0.33	150	900	45,000
more than 1200	0.00	150	1200	0
	1.00			98,002
			Mean Willingness to pay lower bound	653

Source: Calculation from Survey data

Non parametric estimate for non visitors

Mean Willingness to pay lower bound = 653 Ks

In order to have some idea of the non-use values, the MWTP estimated by using the non parametric method was used to multiply with 50% of the number of households in each city where the survey was conducted.

Average WTP = Mean WTP * 50 % of Number of Household in each city

Average WTP for Shwebo = 653 Ks x (50 % of 50247)

= 653 Ks x 25123.5

= 16,405,645.50 Ks = 16.41 million Ks

Average WTP for Butalin = 653 Ks x (50 % of 28616)

= 653 Ks x 14308

= 9, 343,124.00 Ks = 9.34 million Ks

Average WTP for Taze = 653 Ks x (50 % of 35937)

= 653 Ks x 17968.5

= 11, 733,430.50 Ks = 11.73 million Ks

Average WTP for Pokokku = 653 Ks x (50 % of 66340)

= 653 Ks x 33170

= 21, 660,010.00 Ks = 21.66 million Ks

Average WTP for Pyinoolwin = 653 Ks x (50% of 53382)

= 653 Ks x 26691

= 17, 429,223.00 Ks = 17.43 million Ks

Total non-use value = 76,571,433.00 Ks = 76.57 million Ks

Table 4,11. Non Parametric Estimates of Mean Willingness to Pay Using: All Respondents

Bid price (Ks)	% of people saying Yes	Total respondents	Lower bound	Amount (Ks)
less than 100	0.02	300	0	
100-300	0.02	300	100	0
300-600	0.28	300	300	25,497
600-900	0.32	300	600	57,000
900-1200	0.40	300	900	108,000
more than 1200	0.00	300	1200	0
	1.00			190,997
			Mean Willingness to pay lower bound	637

Source: Calculation from Survey data

The parametric and non-parametric mean willingness to pay for visitors, non-visitors and all respondents are shown in the following table.

Table 4.12. Comparison of Mean Willingness to Pay

Respondents	Parametric Mean willingness to pay (Ks)	Non-Parametric Mean willingness to pay (Ks)
Visitors	147.89	620
Non-Visitors	813.64	653
All Respondents	567	637

Source: Calculation from Survey data

Based on the above table, non-parametric mean willingness to pay for visitors, non-visitors and total respondents are not much different. However, parametric mean willingness to pay for each type of respondents is somewhat different.

4. CONCLUSION AND POLICY IMPLICATION

The study found that most respondents (both visitors and non-visitors) are willing to pay for the conservation of Bawditataung Nature Reserve to support the proposed environmental conservation program and to reduce vulnerability to natural hazards. Results indicate that the higher the bid price, the lower the probability of respondents' willingness to pay. It was also found that the higher the respondent's education level and family income, the higher the probability of willingness to pay.

It was also found that non-visitors are willing to give a bigger contribution compared to those who have visited the reserve if looking at the parametric mean willingness to pay; visitors are willing to pay MMK 147.89 whereas non-visitors are willing to pay MMK 813.64. Overall, the parametric mean willingness to pay for all respondents is MMK 567.

If the non-parametric mean willingness to pay for visitors, non-visitors, and for the total respondents is considered, however, they are not very different—MMK 620, MMK 653, and MMK 637, respectively. Regardless of which mean is considered, it is clear that people are willing to contribute to improve the reserve.

It is also useful to note that there was no significant difference between visitors' and non-visitors' perception, awareness and attitude towards the nature reserve.

These results point to respective authorities with relevant information on how to proceed with getting additional resources for the conservation of Bawditataung Nature Reserve. For

example, the respective authorities may collect the fund as an entrance fee for visitors who come to the Bawditataung Pagoda for the conservation of Bawditataung Nature Reserve which is next to Pagoda, and as a trust fund for non-visitors. A coordinating body of Nature Reserve management should be established and involved all stakeholders such as township government, nearby villages, offices of the nature reserve management and the third party to encourage nearby communities to participate voluntarily management of the nature reserve. A finance committee should be established in order to manage funding efficiently and effectively in implementing these activities for the improvement of nature reserve. A fund balance sheet should be shown transparently to the people through newspaper or newsletter, intending how funding which is contributed from people will be used effectively and efficiently.

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THE IMPACT OF PESTICIDE USE ON HUMAN HEALTH: A CASE STUDY FROM MYANMAR

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Abstract

Myanmar is an agricultural country. Increasing production in agricultural sector plays a crucial role in development of the country. Pesticides and fertilizers are used to increase the production of crops and vegetables. Over the years, however, studies have found that agricultural pesticides cause several health problems and environmental pollution despite their usefulness. Therefore, this study was conducted to determine whether there is a strong relation between health impacts and the use of pesticides. The objectives of the study are: to examine health impacts caused by applying pesticides, to identify the knowledge level of the farmers related to the utilization of pesticides and their attitude towards the negative effects of pesticides on the health and environment and to inform the policy makers through the results of the research. We applied descriptive analysis and multiple linear regression analysis. Altogether 300 households in Nyaungni village situated in the western part of Thongwa Township, Yangon Region were interviewed. The results revealed that there is a strong relation between health impacts and the use of pesticides. The level of impact is influenced by the distance between the farm and house, the frequency of applying pesticides, the use of protective equipment and the area under cultivation. The research showed that most pesticide-users usually suffered from dizziness, headache, vomit, fever, shortness of breath and eye-irritation most while they are using pesticides during crop seasons. In addition, it was found that people who live nearer to the farm more suffer from health impact than those who live far away from farms since there was pesticides/ herbicides/ chemical fertilizer odour in the air during crop seasons. Moreover, it was also found that the farmers suffer from health impacts because they do not use the equipments properly. Overall, the study also suggested that training and education on proper use of protective equipment and disposal of pesticides bottles should be given to the farmers on a regular basis.

Key words: Health impacts, pesticides use in agriculture, economic costs

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1. INTRODUCTION

Myanmar has a largely agriculture – based economy contributing about 50% of the National GDP. The per capita GDP was equivalent to USD 1,324 (2011 est.). According to 2014 census, there are over 51 million of people who are living in the country. About 70% of population is actively engaged in agriculture. Nearly three-fourths (75% of people) of the country's population live in rural areas and almost the same percentage of people are dependent on land as the primary means of livelihood. They grow rice, jute, wheat, corn, peanuts, beans, cotton, sugar cane, rubber, vegetables and other crops which give a lot of income.

Paddy rice has long been the major food crop in Myanmar, covering around 65 % of the cultivated area. Export commodities are rice, pulses and beans, natural gas, wood products, fish, clothing, jade and gems. Among the exported crops, rice, pluses and beans are the most popular export items. In order to increase the production of these items, people cannot avoid using pesticides. Although pesticides are beneficial for cultivation, there are serious drawbacks brought by them such as health problems like headache, dizziness, shortness of breath, diarrhea, eye irritation, etc., and environmental problems such as land degradation, the death of fish and insects living in the water since the farmers do not dispose of the used pesticide bottles properly.

Therefore, we wanted to undertake this research project in order to investigate how much the use of pesticides affect the health of users and their neighbors. We have conducted a survey in Nyaungni situated in the western part of Thongwa Township, Yangon Region, with a population about 4599 and 1260 households.

According to our survey, it was found that people in Nyaungni village has been experiencing problems using pesticides in cultivating crops. The use of pesticides poses environmental problems such as the death of fish and other insects, air pollution caused by obnoxious odours from pesticides, and water pollution caused by toxic waste of pesticides. The containers of pesticides are left carelessly in the fields leading to the death of other living things that we don't mean to destroy. The harmful substances remaining in the containers kill weeds (herbicides), insects (insecticides), fungus (fungicides), rodents (rodenticides), and others. These pesticides affect mainly to human health.

According to WHO, the signs and symptoms of pesticides poisoning are: dermal and ocular irritation (or allergic response), upper and lower respiratory tract irritation, allergic responses and asthma, gastrointestinal symptoms usually vomiting, diarrhea and abdominal

pain, neurological symptoms (excitatory signs in the case of exposure to organochlorines, lethargy and coma; also polyneuritis, specific syndromes such as cholinergic crisis, bleeding and caustic lesions and pulmonary fibrosis (www.who.int/ceh). The symptoms described by FAO are detected in people of the three villages.

Although the agriculture sector causes several health problems and environmental pollution caused by agricultural pesticides, herbicides and fertilizers, there has been no other prior study in Myanmar which looked into the impacts of agricultural pesticides on human health. Therefore, we chose this topic and studied influencing factors on human health and environmental pollution problems.

1.1 Research Problems

Many researches revealed that pesticides have been linked to a wide range of human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm, and endocrine disruption. Acute dangers - such as nerve, skin, and eye irritation and damage, headaches, dizziness, nausea, fatigue and systemic poisoning - can sometimes be dramatic, and even occasionally fatal. Pesticides can cause many types of cancer in humans. Some of the most prevalent forms include leukemia, non-Hodgkins lymphoma, brain, bone, and breast, ovarian, prostate, testicular and liver cancers.

The use of pesticides poses an environmental problem too as the toxic substances released into our environment ended up killing other living things. Pesticides are used almost everywhere -- not only in agricultural fields, but also in homes, parks, schools, buildings, forests, and roads. In addition, pesticides can be found in the air we breathe, the food we eat, and the water we drink.

According to the reports on the environmental management programme in Myanmar, agriculture sector causes several health problems and environmental pollution through agricultural pesticides, herbicides and fertilizers. What the health problems and environmental pollution are and, whether there is a strong relation between human damages and the use of pesticides or not become important questions for this study.

Therefore, we would like to survey "The Impact of Pesticides Used in Agriculture on Human Health of Nyaungni village situated in the Western part of Thongwa Township, Myanmar". We have chosen Nyaungni village in the Western Part of Thongwa Township has been experiencing problems using pesticides in cultivating crops because it is the only place

in Yangon Region to cultivate crops (including rice, pluses and beans) the whole year that utilizes all of its vacant land to cultivate crops. Generally, they grow 90 %, paddy, pulses, beans and vegetables whereas the rest, 10 % other crops. So it can be assumed that the use of pesticides is higher than any other places in Myanmar.

1.2 Objectives of the Study

General Objective - The general objective of the study is to estimate the costs on human health that will result from improper use of pesticides in Nyaungni Village.

Specific Objectives are:

1. to examine health impacts caused either by applying pesticides
2. to examine the costs of human health affected by improper application and disposal of pesticides in the farms,
3. to identify the level of knowledge of the farmers on the adoption of preventive measures when dealing with pesticides, storage, and disposal of pesticides and the damages to the environment and its components, and
4. to provide information to policy makers how to control environmental problem about using chemical pesticides and how to modify existing policy to promote safe use of pesticides.

1.3 Scope of the Study

We have chosen Nyaungni Village among the villages in the Western Part-Thongwa Township to participate in our survey. Because it is assumed that Nyaungni Village highly represents the population of the villages in the western part since the villages have similar characteristics. There is population about 4599 and 1260 households in Nyaungni Village. The number of households from Naungni Village that we surveyed is 300.

We used survey to obtain information on socio-economic conditions, working environment and health history (amount & frequency of pesticides and fertilizers applied, and symptoms after applying pesticides/ and the cost of illness from pesticides-related health problems. The survey took place over four months in 2014-2015.

2. LITERATURE REVIEW

The literature search identified several health-monitoring studies carried out after aerial sprayings of Btk pesticides conducted in Canada, United States and New Zealand.

Exposure rates after a spraying may differ according to whether a person stays indoors or outdoors, as concentrations are different between these two settings. Studies have found that the concentration rates of spray are initially higher outdoors than indoors, but the spray also disperses faster outside, compared to inside (*Teschke et al*, 2001).

Investigating differences in health status via an interview with direct sprayers showed evidence of eye, skin, cardiovascular, and neurological effects. The farmers' interview revealed that each person can get simultaneously more than one acute poisoning symptom. Among the poisoning symptoms caused by exposure, the impact of chemical pesticides on the eyes and neurological system (headache, dizzy) and dermal effects were the most discernible to farmers. (*Nguyen Huu Dung and Tran Thi Thanh Dung*, 1999)

Incorrect pesticide use results not merely in actual yield loss but also in health and environmental damages such as destroying rice-fish culture, killing useful animals, causing air and water pollution. The farmers' health aspect, when farmers have to take working days off because of pesticide induced ailments; rice yield would not be obtained at the expected rate. Therefore, the problem of farmers' health is important concern for policymakers when looking at the economic efficiency of rice production (*Nguyen Huu Dung and Tran Thi Thanh Dung*, 1996-97).

Based on an estimation of health costs to Vietnam's Mekong Delta farmers from pesticides exposure in the 1996-97 winter-spring rice season, health costs per farmer can reach up to VND 46, 390 (US $ 2.75) per year. This estimation reflects only those the farmer would spend in recovering at home. If opportunity costs of medical treatment for curing the poisonous symptoms were added, this estimated cost can reach as much as VND 91,390 (US $ 5.40) per farmer. This can be further aggravated if the farmer smokes and drinks (*Nguyen Huu Dung and Tran Thi Thanh Dung*, 1996-97).

Pesticides can enter the human body through inhalation, ingestion, or by dermal penetration through the skin. Those who work with agricultural pesticides are the most at risk if they are not properly dressed or if there are broken and leaking equipment. The majority of average citizens who are affected by the pesticides intake the pesticide through consumption of a food that was been contaminated with a pesticide."In 1958, all members of the family of a local chief who is a prominent cocoa farmer at Okebode in southwestern Nigeria were hospitalized after eating a leaf vegetable undergrowth of a cocoa farm that was earlier sprayed by lindane.

Pesticides cause headaches, blurred vision, vomiting, abdominal pain, suppress the immune system, lead to blood and liver diseases, depression, asthma, and nerve damage. The issue with these effects is that they may wait appear until a while after being ingested so tracing the symptoms back to the pesticide can prove to be quite difficult. Many of the symptoms can be mistaken for the flu and therefore not properly treated. The inactive ingredients such as chloroform can also cause serious risks to the liver and nervous system. These effects can also be experienced by the animals living around the streams where the pesticides accumulate. The pesticides bioaccumulate within the animals as they are not easily soluble, as that animal is eaten by another animal the pesticide then biomagnifies and obtains an even higher concentration as it moves further up the food chain. *(Bridget Hicks, 2012).*

2.1 Pesticide Regulation Policy Context

The National Commission for Environmental Affairs (NCEA:) was formed in 1990 by the government of Myanmar for environmental management to serve as the focal point and coordinating agency for environmental programmes, plans and projects for both public and private sectors. Four specialized committees are formed also under the NCEA for the following areas: - (i) Conservation of Natural Resources (ii) Control of Pollution (iii) Research, Education and Information (iv) International Cooperation.

2.2 Laws and Regulations:

Myanmar has own pesticide regulations and procedures regarding environmental preservation. The Pesticide Law was enacted in 1990 in line with the FAO Code of Conduct and in 1991; the Ministry of Agriculture and Irrigation prescribed the procedures relating to the pesticide law. A Pesticide Registration Board (PRB) which is responsible for granting registration, banning and limiting registration was formed with the Managing Director of the Myanmar Agriculture Service (MAS) as Chairman and the Head of the Plant Protection Division as the secretary. All pesticides are hence registered and regulated under the Pesticide Law (1990). The status of POP pesticides in Myanmar is as follows: -

a. Aldrin, Dieldrin, Chlordane, Endrin and Toxaphene are banned since 1/8/1996.
b. Heptachlor Mirex and Hexachlorobezene are never registered and never been used.
c. DDT is in restricted use since 23/3/94 for malaria vector control programme
d. Dioxin and Furans are not manufactured or utilized.

Apart from the above POPs, the following pesticides have restricted use in Myanmar; Methyl Bromide and Phosphine of fumigants; Bromodiolone and Brodifacoum as coumarin; Fenthion and DDT as organo phosphate and organochlorine respectively; and zinc phosphate as inorganic pesticides.

Totally banned other pesticides in Myanmar are : the organachlories BHC, EPN, the phthalimide captafol; the formamidine chlordimeform; the organotin cyhexatin; the inorganic and organic mercury compounds; the EDB; the organophosphate parathion ethyl; the phenoxy 2,4, 5-T; and strobane and dinosed.

There are four types of registration such as experimental, provisional, full, amended registration and Special Use Permit and they are needed for import and export purposes. Until March 2010, 1266 registration certificates have been granted.

Analysis for quality control is carried out by pesticide analysts who are either graduate in BSc, MSc (Chemistry) or Agricultural Chemistry. There is a need for capacity building of analysts due to limited number of trained persons available at present.

Myanmar is signatory to International Conventions and Agreements, such as Rotterdam, Stockholm and Basel conventions, the WTO/SPS agreement and RENPAP. So far, 19 pesticides have been banned and 7 pesticides are categorized as restricted pesticides. In addition, both local consumption and export commodities are being analyzed for pesticide residues.

3. METHODOLOGY

This study investigated the impacts of pesticide used in agriculture on human health of Nyaungni Village situated in the western part of Thongwa Township. In addition, this study examines the relationship between the human damages and the use of pesticides. Also, we asked questions about Socio-economic Characteristics, Working Environment and Health History (amount & frequency of pesticides and fertilizers applied, and symptoms after applying pesticides/ eating vegetables contaminated by pesticides.) of Nyaungni village. The overall goal of this paper is to have a better understanding of both positive and negative impacts of farm pesticide use on rice, pulses and beans production and human health.

We have chosen Nyaungni Village in the Western Part of Thongwa Township because they exit in the nearby town, more accessible and have similar characteristics such as socio-economic factors – their income per month, education, and period of illness, etc.,

working environment and health history – the distance between the house and farm, pesticides/ herbicides/ chemical fertilizer odor in the air during crop seasons, duration of utilizing and spraying, using spraying equipment, and symptoms after applying pesticides according to explaining by Village Administrators about current and historical conditions of three villages.

In this study, the estimation of health damage cost per season covers doctor bills, medicine bills, travel costs to hospital or clinic, and loss of income due to taking days off as a consequence of the health impact of pesticides from its. For example Health damage per incident = doctor bills+ medicine bills + travel costs to hospital or clinic + loss of income due to taking days off.

We analyzed data obtained from survey questionnaire with multiple linear regression model using in equation (1)

$Y= \beta0+ \beta1X1+ \beta2X2+ \beta3X3+ \beta4X4+ \beta5X5+ \beta6X6+ \beta7X7+ \beta7X8…+E$ .....Eq (1)

Where,

Y = Health Care Cost and Loss of Income (Ks per season)

We can substitute the values of coefficients according to the results of regression analysis in the equation (2).

$\hat{Y} = \beta0+ \beta1X1+ \beta2X2+ \beta3X3+ \beta4X4+ \beta5X5+ + \beta6X6+ + \beta7X7+ \beta8X8$ .....Eq (2)

Where:

$\hat{Y}$ = Predicted Health Care Cost and Loss of Income (Ks per season)

X1 = the distance between the house and farm

X2 = frequency of applying pesticides

X3 = the use of protective equipment

X4 = the place of mixing pesticides

X5 = the mode of mixing pesticides

X6 = the place of keeping used pesticide bottles

X7 = acre of land

In hypotheses testing of our research linear regression model, we have (6) steps:-

Hypotheses:

(1) Hypothesis

There are not Health Care Cost and Loss of Income due to applying pesticides.

$H0 : \beta1= \beta2= \beta3= \beta4= \beta5= \beta6= \beta7= 0$

There are Health Care Cost and Loss of Income due to applying pesticides.

H1 : At least one β is not equal zero.

(2) Test Statistics

F = MSR/MSE

(3) Critical Value

At $\propto$= 0.05, the critical value is

$K = F_{(\propto, k, n-k-1)}$

(4) Decision Rule

If F> K, reject H_0

Otherwise accept H_1.

(5) Decision

F > K, reject H_0

(6) Conclusion

By substituting the values of coefficients in equation (2), we can interpret the values of the eight regression coefficients and mentioned interpretation with inferential statistics for research objectives.

3.1 Data collection methods:

Primary data:

After using the proportional method, we got 300 households of Naungni Village from three villages in the Western Part of Thongwa Township.

Table 3.1 Number of Households, Population and Sample Size of Nyaunhni village in the Western Part, Thongwa Township

Villages	Population	No. of Households	Sample Size
Nyaungni Village	**4599**	**1260**	**303.79**

Source: Village Administered Office

Population Proportion

Regarding the Determination of Sample Size (n), the required sample size (n) will be computed on the estimation of population proportion (P) with a desired bound (B) of error on estimation of P. The formula for n is given,

n= NPQ/ (N-1) D + PQ

where, N is number of population of Nyaungni village

P is population proportion of a characteristic of interest

Q= (1-P) and $D= B^2/4$

Where B is 95% bound on the error of estimation.

Here, in this survey, N=1260 households of Nyaungni Village, P and Q are taken to be 0.50 to allow for the maximum sampling errors of the estimate. Putting the corresponding values of N, P, Q, B and D in the above formula, the required sample size (n) turned out to be n.

Households Proportion of Nyaungni Village

$$n = \{(1260)\,(0.5)\,(0.5)\}/\{(1260-1)\,(0.05)^2/4 + (0.5)\,(0.5)\} = 303.79$$

Systematic Sample

In a systematic sample, the N individual or items in the population frame are partitioned into k groups by dividing the size of the population frame N by the desired sample size n. That is

$k = N/n$

where k is rounded to the nearest integer.

Systematic Sample of Nyaungni Village

$k = 1260/303.79 = 4.15$

Therefore, we have conducted 1 survey in 4 households of Nyaungni Village for 300 households by using the systematic sampling method. We analyzed data obtained from survey questionnaire with multiple linear regression model.

Secondary data:

Secondary data refers to information collected from government offices such as the department of agriculture and Nyaungni Village administered office on data on agricultural production, inputs, area, etc…and department of health on reported cases of pesticide poisoning, etc,. Other needed information obtained from business statistics reference books, online website, and literature review from different researches that describe the relationship between pesticides utilization and human health.

3.2 Descriptive Analysis of the Data

We analyze data with descriptive statistics and then we mention interpretation with inferential statistics for objectives.

3.2.1 Respondents by Gender

As mentioned in Table 3.2, there are 252 male respondents and 48 female respondents. The majority of farmers are male in the farm industry in Thongwa Township since farming is mainly a male occupation.

Table 3.2 Respondents by Gender

Gender	Number of Respondents	
	Number	Percent
Male	252	84.00
Female	48	16.00
Total	300	100 %

Source: Survey Data (June, 2015)

3.2.2 Respondents by Age Group

Table 3.3 shows respondents by age group according to survey data. Twenty nine percent of the respondents belong to the age group of 41 to 50 followed by 26.30 % having age of 51 to 60. A quarter of the sample is older than 60 years old. Majority of respondents are older than 30 years of age.

Table 3.3 Respondents by Age Group (2015)

Age Group	Number of Respondents	
	Number	Percent
10-20	4	1.30
21-30	15	5.00
31-40	40	13.30
41-50	87	29.00
51-60	79	26.30
61+	75	25.00
Total	300	100 %

Source: Survey Data (June, 2015)

3.2.3 Households by Income per Month

According to table 3.4, it is found that most of the respondents, 142 out of 300 respondents earn between 100,000 KS (US $ 83) and 150,000 KS (US $ 125) per month that stands as the highest rate 47.30 %., followed by 20.70 % or under 100000 Ks (US $ 83) received by 62 respondents. Twenty seven percent of the respondents earn between 160,000 KS (US $ 133) and 350,000 Ks (US $ 291). In the following table it is found that the highest wage over 350,000 Ks (US $ 291) earned by only five percent (5 %). Since each of the respondents is the bread winner of his or her family, the salary he/she earns cannot be sufficient for his/ her family.

Table 3.4 Households by Income per Month

Income Per Month (Ks)	Number of Respondents	
	Number	Percent
<100,000	62	20.70
100,000-150,000	142	47.30
160,000-200,000	40	13.30
210,000-250,000	24	8.00
260,000-300,000	13	4.30
310,000-350,000	4	1.30
>350,000	15	5 %
Total	**300**	**100 %**

Source: Survey Data (June, 2015)

Moreover, it is found that most of their family members do not have any income: this is because they are students, housewives and some family members who help in their farms but do not get any money.

3.2.4 Respondents by Education

Table 3.5 shows respondents by education according to 2015 survey data. Most of the respondents i.e. 148 respondents are at primary school level in which children still going to primary school and primary school dropouts are included which accounts for 49.00 % of the whole sample, whilst 39.30 % or 118 respondents are at the secondary school level and 6.70 % or 20 respondents are at the high school level. There are eight respondents are at

college and university school level and six respondents are illiterate in this survey. According to this survey, most people do not get enough salary for their living, so it is hard for them to spend money on their education. Therefore, it is concluded that most people in Nyaungni Village are not well-educated due to their low investment in their education.

Table 3.5 Respondents by Education

Education	Number of Respondents	
	Number	Percent
Primary School	148	49.30
Middle School	118	39.30
High School	20	6.70
University	8	2.70
Illiterate	6	2.00
Total	300	100 %

Source: Survey Data (June, 2015)

3.2.5 Respondents by the Utilization of Pesticides, Herbicides and Chemical Fertilizers

Majority of respondents are farmers themselves who spray on their farms stand in the highest position by 58.7 % followed by 26.30 % hired workers whereas 15.00 % family members who are asked to spray their farms with them by the utilization of pesticides, herbicides and chemical fertilizers in their farms.

Table 3.6 Respondents by the Utilization of Pesticides, Herbicides and Chemical Fertilizers

Who Spray Pesticides	Pesticides		Herbicides		Chemical Fertilizers	
	Number	Percent	Number	Percent	Number	Percent
Farmers	176	58.70	58	19.33	171	57.00
Hired Workers	79	26.30	34	11.30	81	27.00
Family Members	45	15.00	7	2.30	48	15.90
Other(s), Not Applying of Herbicides	-	-	201	67.00	-	-
Total	**300**	**100 %**	**300**	**100 %**	**300**	**100 %**

Source: Survey Data (June, 2015)

3.2.6 Respondents by Protection Equipment

Farmers ignored using protective equipment such as headwear, eyewear, respirators, facemask and chemically resistant apron during the spray time. Among 300 households, 96 households wear the protective equipment during the pesticides spray time whereas 204 households do not. Among three types of chemical substances such as pesticides, herbicides and fertilizers, most of farmers in three villages normally use pesticides and fertilizers in their farms. However, only few are using protective gears during the application of these chemicals. Therefore, it is concluded that most people in Nyaungni village are exposed to the health hazards posed by these chemicals, particularly, pesticides and chemical fertilizers.

After analyzing the data, we have found that among pesticides users, 96 people who use protective equipment spent (343100) Ks for the health cost while 204 people who do not use protective equipment spent (784500) Ks. It can be seen that the more they use protective equipment, the less they suffer.

There are more health damages and health costs in those who did not use protective equipment compared to those who did. It is also found that the farmers suffer from health impacts despite the use of protective equipment, because they do not use the equipment properly. They do not often use them and they hardly ever wear a complete set of equipment but only facemask.

Table 3.7 Respondents by the use of protective equipment

Use of Protective Equipments	Pesticides		Herbicides		Chemical Fertilizers	
	Number	Percent	Number	Percent	Number	Percent
Yes	96	32.0	33	11.0	97	32.3
No	204	68.0	66	22.0	203	67.7
Never Utilization of Herbicides	-	-	201	67.0	-	-
Total	300	100 %	300	100 %	300	100 %

Source: Survey Data (June, 2015)

Table 3.7.1 Respondents by the use of protective equipments and Health Cost

Use of Protective Equipments	Pesticides			Herbicides			Chemical Fertilizers		
	Respondents	Health Cost (Ks)	Mean	Respondents	Health Cost (Ks)	Mean	Respondents	Health Cost (Ks)	Mean
Yes	96	343100	3573.96	33	162300	4918.18	97	411500	4242.27
No	204	784500	3845.59	66	313500	4750	203	775550	3820.44

Source: Survey Data (June, 2015)

3.2.7 Respondents by Distance between the House and Farm

According to table 3.8, it is found that 226 people (75.33 %) live within 5 meters away from farm(s) have suffered most in this analysis. The nearer to the farm, the more impacts on human health because there was pesticides/ herbicides/ chemical fertilizer odor in the air during crop seasons that cause the health risk, the increase in health care cost and loss of income due to days off. We have had the assumption that the health cost of those whose farms are closer to the house would be higher. According to our analysis, people who live nearer to the farm cause more health damages so they spend more on health costs.

Our survey shows that people who live near the farms spend more money on health than those who live far away from farms. As most of the farmers live in their farms, their health is affected both by the pesticides they use and also from the use of pesticides of the adjacent farms. According to the survey, the farthest distance between farm and house is 16 meters, so the average health cost for within 5 meter far away from farms is 4031 Ks (US $ 3.4), 10 meters 3990 Ks (US $ 3.2) and 16 meters 3683 Ks (US $ 3.0) respectively.

Table 3.8 Respondents by Distance between the House and Farm

Distance between the House and Farm (Metre)	Number of Respondents	
	Number	Percent
Within five meters	226	75.33
Within ten meters	50	16.67
Within 16 meters	24	7.99
Total	**300**	**100 %**

Source: Survey Data (June, 2015)

Table 3.8.1 Respondents by Distance between the House and Farm and Health Costs

Distance between the House and Farm (Metre)	Number of Respondents			
	Number	Percent	Health Costs (Ks)	Mean (Ks)
Within five meters	226	75.33	911,100	4031
Within ten meters	50	16.67	199,500	3990
Within 16 meters	24	7.99	88400	3683

Source: Survey Data (June, 2015)

3.2.8 Respondents by Frequency of Applying Chemical Substances

According to table 3.9, most of the number of respondents applied pesticides/ herbicides/ chemical fertilizers in their farms normally in winter season. The number of farmers who utilize pesticides four to six times per season in their farms is at the highest rate. The utilization of herbicides in winter season is seven to twenty times in their farms. The number of farmers who utilize chemical fertilizers one to three times per season in their farms is at the highest rate. Therefore, it can be seen that the farmers who possess many acre of land and apply pesticides more frequently suffer from the impact of pesticides.

Table 3.9 Respondents by Frequency of Applying Chemical Substances Per Season

How many times?	Pesticides		Herbicides				Chemical Fertilizers			
	Winter		Rainy		Winter		Rainy		Winter	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1-3	21	7.00	57	19	10	3.30	285	95	290	96.60
4-6	211	70.3	6	2.00	5	1.70	5	1.67	4	1.30
7-20	68	22.6			285	95				
Never Apply			237	79.00			10	3.30	6	2.00
Total	**300**	**100 %**	**300**	**100 %**	**300**	**100 %**	**300**	**100 %**	**300**	**100 %**

Source: Survey Data (June, 2015)

3.2.9 Respondents by Period of Illness (days)

We asked questions to respondents about whether their sickness is related to the use of pesticides during crop seasons. According to the answers of respondents, we analyzed that their sickness is highly related to the use of pesticides. Table 3.10 shows that during the

cultivating season, 201 respondents, that stands for 67 %, has suffered from illness for one day; 46 respondents, 15.3 %, for two days and there are 53 lucky respondents who have never been ill per cultivating season (17.70 %). However, that 17.70 % includes people who do not work in the farms. The rest (82.30 %) work in the farms and help in spraying pesticides, so they have suffered from illness.

When they suffer sickness such as severe diseases of dizziness, headache, vomit, eye irritation, convulsion, shortness of breath, skin irritation and fever caused by spraying pesticides, they have to go to doctor and they cannot work. Therefore, they cost doctor bills, medicine bills, travel costs to hospital or clinic, and loss of income due to taking days off as a consequence of the application by pesticides. Although most of the family members have smelled the pesticides, the number of victims confessing to having illness is low at the moment and the rest have not noticed the symptoms yet.

Table 3.10 Respondents by Period of Illness per Season

Period of Illness (days)	Number of Respondents	
	Number	Percent
one day	201	67.00
two days	46	15.30
> 3 days- no sick	53	17.70
Total	**300**	**100 %**

Source: Survey Data (June, 2015)

3.2.10 Respondents by Health Care Cost and Loss of Income Due to illness related to Pesticide Application Per Season

According to table 3.11, it is found that there are 210 (70 %) respondents take medicine at home and 90 (30 %) respondents went to hospital or clinic to cure their illness. The highest amount of health care cost per season by applying pesticides is 200000 Ks and the lowest 200 Ks. That is because the respondents cannot afford to go to physicians and hospitals when they are ill and so they buy some medicine from the nearest shops- doing so does not cost a lot of money. If they went to clinics or hospitals, the cost per time would be about 4000 Ks that would be too expensive for them.

In this study, to get the estimation of health damage cost per season, we add up doctor bills, medicine bills, travel costs to hospital or clinic, and loss of income due to taking days off as a consequence of the application of pesticides. However, they have to cost

only medicine bills for people who buy some medicine and did not go to hospital as health damage cost per season.

Table 3.11 Respondents by Health Care Cost and Loss Income Applying Pesticides Per Season

Health Care Cost and Loss Income (Kyats)	Number	Percent
< 5000	210	70.00
5000-10000	67	22.33
11000-15000	19	6.33
16000-20000	4	1.33
Total	**300**	**100 %**

Source: Survey Data (June, 2015)

3.2.11 Which Month could they smell that odour is worst Per Season by Household

In this study, 300 households got the smell of pesticide in December, January, February and March very much per season whereas they do not get odour at all in the rest months. That is because December, January, February, and March are the cultivating season (winter season in Myanmar) so farmers use pesticides more than the other times. It can be said that most of the households were annoyed by the odour of pesticide in the air for approximately 280 respondents during crop seasons.

Table 3.12 Which Month could they smell that odor is worst Per Season by Household

Month	Scale					
	No odour at all	Very little	Little	Much	Very much	Total
January			29	148	123	300
February	1	1	62	132	104	300
March	68	27	192	11	2	300
April	269	30		1		300
May	270	30				300
June	276	24				300
July	272	28				300
August	273	27				300
September	269	30				300
October	272	26	2			300
November	271	27	1	1		300
December	10	9	85	169	27	300

Source: Survey Data (June, 2015)

3.2.12 Symptoms related to Pesticide Application for Households Per Season

In table 3.13, it was found that they have suffered from 10 types of symptoms caused by spraying pesticides for households according to the discussions of village administrators with regard to the use of pesticides, survey queries related to pesticide application and the answer of respondents, and medical recommendation statements when they go to clinic. Dizziness is the symptom suffered by most of the households (56.66 %) which is followed by headache suffered by 121 households (40.33%) and vomit by 33 households (11.00 %). Eye Irritation, Diarrhea, Convulsion, Shortness of breath, Heart trouble, Skin Irritation, fever and others symptoms occur in some households. Each household consists of one to eight members – both men and women with different ages. Especially, those who use pesticides suffer the most.

However, it was found that they did not go to the hospital or clinic becoming a sick and headache after applying pesticides. They treated with some medicines to cure an illness at home. They afford to go hospital when they suffer severe diseases such as eye irritation, vomit, diarrhea, shortness of breath and fever caused by spraying pesticides. Also, there are health costs for all of 300 households during cultivating season this is because they all suffer from health impacts due to applying pesticides.

Table 3.13 Symptoms Caused by Spraying Pesticides for Households Per Season

Types of Symptoms	Yes	Percent	No	Percent
Eye Irritation	7	2.33	293	97.66
Headache	121	40.33	178	59.33
Dizzy	170	56.66	129	43.00
Vomit	33	11.00	267	89.00
Diarrhea	14	4.66	286	95.33
Fever	16	5.33	284	94.66
Convulsion	3	1.00	297	99.00
Shortness of breath	11	3.66	289	96.33
Heart trouble	1	0.33	299	99.66
Skin Irritation	2	0.66	298	99.33
Others	3	1.00	297	99.00

Source: Survey Data (June, 2015)

3.2.13 Types of Pesticides Used by Household

Since the Pesticide Law was enacted in 1990 in line with the FAO Code of Conduct, all pesticides are hence registered and regulated under the Pesticide Law (1990). Agricultural pesticides were used in Nyaungni village nearly 30 years. Villagers and farmers apply pesticides/ herbicide/ chemical fertilizers to increase their output and to protect pests harmful in their farms. Some farmers utilize dangerous pesticides without brand affordable. Pesticides famous companies were distributed registered and regulated brand names under the Pesticide Law (1990) since the days of their parents and grandparents. The types of pesticides these are registered brands used by the majority of farmers are described on the following table.

According to the survey, all of the 300 households utilize 11 brands of chemical substances namely Weesara, Awba, Shwe Lion, Comet Beta, Shwe Naga, Pearl, Armo, TIsuper, Comet Plus, Theesone, and Compound. They are the popular brands in Myanmar. The survey also shows that 300 households apply five brands of pesticides to kill pests and increase yields more successfully. The five brands include Weesara, Awba, Shwe Lion, Comet Beta, and Shwe Naga. And also 300 households apply six brands of fertilizer to make paddy and beans grow more successfully. The six brands include Pearl, Armo, Tsuper, Comet Plus, Theesone, and Compound.

Educational talk about the risks of pesticide has been conducted by INGOs organizations to farmers only twice according to discussions of village administrators. Therefore, it is needed to educate farmers to be handled correctly, use the equipment properly and prevent it often urgent since the risk of pesticides to human health is large.

Table 3.14 Types of Pesticides Used by Household

Brands of Chemical Substances	Number of Respondents Pesticides		Number of Respondents Herbicides		Number of Respondents Chemical Fertilizers	
	Number	Percent	Number	Percent	Number	Percent
Weesara	43	14.33	14	4.66		
Awba	154	51.33	48	16.00		
Shwe Lion	61	20.33	9	3.00		
Comet Beta	15	5.00	5	1.66		
Awba and Comet	5	1.66	1	0.33		

Shwe Naga	22	7.33	4	1.33		
Pearl					163	54.33
Armo					54	18.00
TIsuper					57	19.00
Comet and Comet Plus					20	6.66
Theesone					1	0.33
Compound					4	1.33
Never apply			219	73.00		
Total	**300**	**100 %**	**300**	**100 %**	**300**	**100 %**

Source: Survey Data (June, 2015)

4. 4. EMPIRICAL ANALYSIS OF THE DATA

A regression analysis was carried out to examine relationship among the variables being investigated. In the Multiple Linear Regression Analysis, our research objective is to examine whether there is the relationship between health cost and the following independent variables: the distance between the house and farm which is measured in kilometer—your table shows meters? (X1), Frequency of Applying Pesticides which is measured in times (X2), the use of protective equipment (X3), the mode of mixing pesticides (X4), the place of mixing pesticides (X5), the place of keeping used pesticide bottles (X6), and Acre of Land (X7). The dependent variable Y is Health Care Cost and Loss of Income (Ks per season).

4.1 Multiple Regression Model with Seven Independent Variables

4.1.1 Coefficient of Multiple Determinations (R^2) (r^2)

The coefficient of multiple determinations (r^2= 0.778) indicates that 77.8 % of the variation in Health Care Cost and Loss of Income (Ks per season) (Y) is explained by the variation in the distance between the house and farm (X1), Frequency of Applying Pesticides (X2), the use of protective equipment (X3), the mode of mixing pesticides (X4), the place of mixing pesticides (X5), the place of keeping used pesticide bottles (X6), and Acre of Land (X7).

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-717.782	1212.284		-.592	.554
the distance between the house and farm	-66.209	32.203	-.069	-2.056	.041
Frequency of Applying Pesticides	183.118	69.402	.092	2.639	.009
the use of protective equipment	-493.604	243.547	-.069	-2.027	.044
the place of mixing pesticides	650.486	506.342	.043	1.285	.200
the mode of mixing pesticides	-165.291	169.530	-.033	-.975	.330
the place of keeping used pesticide bottles	57.280	137.101	.014	.418	.676
Acre of Land	404.299	17.580	.797	22.997	.000
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	
1	.825	.680	.672	1920.494	

$Y= \beta0+ \beta1X1+ \beta2X2+ \beta3X3+ \beta4X4+ \beta5X5+ + \beta6X6+ + \beta7X7+\ldots\ldots+E\ldots\ldots$ Eq (1)

Where,

Y = Health Care Cost and Loss of Income (Ks per season)

$\beta0$ = Y intercept

E = random error in Y

In the Multiple Linear Regressions Model with eight independent variables (Equation 1), the slope, $\beta1$, represents the change in the mean of Y per unit change in X1, taken into account the effect of X2, X3, X4, X5, X6, and X7. Equation (1) defines the regression equation for a multiple regression model with eight independent variables.

$\hat{Y} = \beta0+ \beta1X1+ \beta2X2+ \beta3X3+ \beta4X4+ \beta5X5+ + \beta6X6+ + \beta7X7\ldots\ldots\ldots$ Eq (2)

Where:

$\hat{Y}$ = predicted Health Care Cost and Loss of Income (Ks per season)

X1 = the distance between the house and farm

X2 = frequency of applying pesticides

X3 = the use of protective equipment

X4 = the mode of mixing pesticides

X5 = the place of mixing pesticides

X6 = the place of keeping used pesticide bottles

X7 = acre of land

Among eight variables, such variables as when the distance between the farm and house comes nearer (X1), there is a high frequency of applying pesticides (X2), there is the less use of protective equipment (X3) and pesticides users possess many acre of land (X7) are more related to human damages than the rest. On the other hand, X4, X5, and X6 do not significantly affect health cost.

The slope of the distance between the house and farm (b1= -66.209) indicates that, the predicted health care cost and loss of income (Ks per season) are estimated to increase by 66.209Ks per season for each 1 Kilometer decrease in the distance to the farm (their houses come closer to the farm in each 1 Kilometer) when X2, X3, X4, X5, X6, and X7 are held constant.

The slope of frequency of applying pesticides (b2= 183.118) indicates that, the predicted health care cost and loss of income (Ks per season) are estimated to increase by 183.118 Ks per season for each 1 time increase in applying pesticides when X1, X3, X4, X5, X6, and X7 are held constant.

The slope of the use of protective equipment (b3= -493.604) indicates that, the predicted health care cost and loss of income (Ks per season) are estimated to increase by 493.604Ks per month for the farmers do not use the protective equipment once for applying pesticides when X1, X2, X4, X5, X6, and X7 are held constant.

The slope of Acre of Land (b7= 404.299) indicates that, the predicted health care cost and loss of income (Ks per season) are estimated to increase by 404.299 Ks per month for the farmers increase an acre of land once for their family when X1, X2, X3, X4, X5, and X6 are held constant.

It is found in this survey that the more pesticides are used in the farms, the more negative impacts on human health - the health risk, the increase in health care cost and loss of income due to days off, because of being very near to the farm, using pesticides frequently, ignoring the use of protective equipments, and owning more lands. Especially,

the distance between the house and farm (X1), the frequency of applying pesticides (X2), the use of protective equipment (X3), and Acre of Land (X7) play the major role in increasing health care cost and losing income (Ks per season) for a household. In other words they are the most influencing factors on human damages among eight variables.

5. CONCLUSIONS

In this analysis, we examined the practices related to agricultural chemical (pesticides, herbicides, and fertilizers) usage. We then estimate the cost associated with incidence of illness that farmers felt are caused by pesticide application. Finally, we analyzed the factors that affect the health cost incurred by the farming households in Nyaungni Village.

We confirmed our hypothesis that there are a strong relation between health impacts and the use of pesticides especially when the distance between the farm and house comes nearer, there is a high frequency of applying pesticides, there is the less use of protective equipment and pesticides users possess many acre of land according to the regression analysis of the data.

We emphasized the duration of the survey for one period of cultivation/ per season/ four months and the symptoms caused by spraying pesticides and health care cost and loss of income per season. According to survey queries related to pesticide application, the answer of respondents, and medical recommendation statements when they go to clinic, the research shows the symptoms that most pesticide-users usually suffer from dizziness, headache, vomit, fever, shortness of breath and eye-irritation.

Even though farmers may be aware of health impacts, they have not been using protective equipment nor are they interested in using them. According to the data, we have found that among pesticides users, 96 people who use protective equipments spend (343100) Ks for the health cost while 204 people who do not use protective equipments spend (784500) Ks. Therefore, most farmers never use protective equipment, and as expected, the health costs of these farmers are higher than those who use protective equipments. Moreover, we also found that the farmers do not use the equipments properly. Again, those who use the complete set of equipments incur lower health costs, the less they suffer.

It is found in this survey that the farthest distance between farm and house is 16 meters. As most of the farmers live in their farms, their health is affected both by the pesticides they use and also from the use of pesticides of the adjacent farms because there

was pesticides/ herbicides/ chemical fertilizer odour in the air during crop seasons. Therefore, people who live nearer to the farm spend more money on health than those who live far away from farms. Pesticides affect sprayers and villagers around both directly and indirectly.

According to the answers of respondents, it is found that farmers have been utilizing unknown pesticides without a brand name and instruction how to apply, sold in containers with different sizes, and the restricted pesticides that seriously harm health and environment. Although the information available does not allow us to verify whether there is a significant difference in health cost between the farmers who use these 'unknown' pesticides, it does appear that the latter faces greater health risks as no instructions of how to apply those pesticides is provided.

It was found in this survey that the farmers do not have the specific storage space for pesticide bottles although they usually use pesticide. Moreover, they do not dispose of the used it systematically and throw them away in the farms. This is because the farmers lack the education and knowledge. So when it rains, the bottles float in the water contributing to the death of fish and insects living in the water and the negative impact of pesticides such as land degradation. Therefore, the problem of farmers' health is important concern for policymakers when looking at the economic efficiency of agricultural country.

Most of the people in Western Thongwa earn their living by growing paddy, beans and pluses. Although they know how to cultivate well, they lack the knowledge of the safe application of pesticides. As a result, their health and environment are now seriously harmed by the erroneous use of pesticides.

It is evident that the results of analyzing the data are the best solutions because they are likely to be possible from statistical analysis of relationships between Health Care Cost and Loss of Income (Ks per season) and the four variables such as X1: the distance between the house and farm, X2: Frequency of Applying Pesticides, X3: the use of protective equipment and X7: Acre of Land.

5.1 RECOMMENDATION

Through this research, we would like to provide policy makers with information about how to control environmental problem by using chemical pesticides and how to modify existing pesticides laws and regulations.

Farmers should be educated to wear full protective equipment such as headwear, eyewear, respirators and chemically resistant apron during the spray time. However, some farmers cannot afford to buy them. Therefore, it will be advantageous for farmers if they can pay for them in installments. The pesticide dealers should be encouraged to give farmers a piece of protective equipment as a promotion item instead of investing their money in advertising on TV.

In case of farmers ignored using protective equipments and disposing of pesticides bottles carefully and systematically, so training and educating should be provided for them. It is also important to raise public awareness of the hazards of pesticide. Apart from educating the farmers, the study also suggested to share the result with other relevant organizations, to inform public especially the farmers who live nearer the farm and possess many acre of land about the danger of pesticides through different kinds of media and to send practical suggestions to officials concerned.

In addition, as for people can suffer from health problems after eating vegetables sprayed with pesticide, they need to be educated in cooking such kind of vegetables. Before cooking, the vegetables must be washed thoroughly; and they must be eaten when it is certain that they are cooked. In this way, some of the health problems can be avoided.

Moreover, the government is required to prohibit the use of unauthorized pesticides, which are produced locally and internationally, so that farmers and consumers can prevent themselves from health and environmental damages. Warning against the use of pesticides without a brand name and directions should be made through different kinds of media – TVs, radios, magazines, newspapers, journals, etc.

Most importantly, the government should test the level of hazardous substances of the pesticides imported and restrict the import of such pesticides that seriously harm health and environment. They should guide the pesticide retailers not to sell the restricted pesticides. Besides, they should announce the restricted pesticides periodically. Besides, they should monitor the local production of pesticides closely in order to prevent the overuse of harmful substances in producing pesticides. Furthermore, they should hold nationwide educational talks over the impact of the use of pesticides on health and environment. They could also give such information through different kinds of media - radios, televisions, journals, magazines, etc.

One good point about using Myanmar language is that it would be exceptionally useful if the instructions of application and pesticide product labels signaling the level of

toxicity and the level of risk to the user are described in Myanmar language because most of the farmers cannot read in English. For illiterate farmers, the pesticide dealers need to explain how to use pesticides safely. So the dealers should be given the training on safe application of pesticides so that they can share the knowledge to farmers. The Ministry of Agriculture and Irrigation and pesticide companies should do the task.

Therefore, for the sake of pesticide – users, researchers, health care workers and other organizations in respective field should educate them about the danger of using pesticides. Moreover, pamphlets which provide the information on long-term and short-term diseases caused by pesticides should be spread among the pesticide – users.

Consequently, the farmers who have sprayed pesticide for years are now suffering the health problems. Taking days off to cure their illness results in low income, delay in working procedures and low productivity, so it is crucial for the government to pay great emphasis on these consequences of using pesticides. They can become constraints of economic development. In addition, we need to find a careful solution to the environmental problems caused by pesticides such as the death of fish and beneficial insects, the pollution of air and water, etc. It is vital for all manufactures, dealers and users of pesticide to apply it in a safe way without harming the environment. Policymakers should set the rules and regulations about pesticides that are easily comprehensible to the average people.

Through this research, we would like to provide information about the agricultural pesticides can affect human health to policy makers to support future works of our nation basically agriculture. Also, we would like to recommend that public awareness advertising of the effect of pesticides on health should erect on billboards or vinyl near rural agricultural lands. One positive aspect of the information dissemination concerned with the agricultural pesticides can affect human health through the policy makers is that it should be able to support partially the economic development of the nation from the multiplier effects of preventing public health.

To conclude, we believe that the advantages of applying pesticides in the farms to produce high – yielding crops are usually temporary in nature. Also, many of the disadvantages last health impacts on farmers all their lives and environment in a negative way. Besides, we strongly believe that the disadvantages of applying agricultural pesticides far outweigh the advantages. Therefore, we need to ensure that all of pesticide – users, researchers, health care workers and other organizations in respective field should educate them about the danger of using pesticides and share more in the future.

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The Role of Government and Its Development Management Capability
(A Master Key for Political Stability and Sustainable Development of Myanmar)

Dr. Maung Maung Lwin[1]

There has been a numerous studies on the importance of economic and noneconomic factors for achieving sustained economic growth. Particularly, the importance of mobilization and efficient utilization of resources comprising land, labor, capital, technology and entrepreneurs for achieving economic growth are studying widely. However, we still have very limited studies on the role of government and its capability in achieving political stability and sustainable economic development through the progress of industry, business and trade activities which directly addresses the provision of job and income opportunities to the working poor. This is mainly due to the lack reliable data and information as well as limited freedom for doing research especially in the countries which are under the control of military and dictator governments. Particularly, the research works on capability and effectiveness of government, and transparency and accountability of government are strongly prohibited. It is also very important to remind that the failure of sustained economic growth in some developing countries is not simply because of miss management and due to the lack of capability. The high ranking government officials of these countries are consciously operating administration and economic activities with the objectives of maximizing their own personal profit through abuse of political power and illegal business. Myanmar is no exception.

As a result, since the middle of 1980s, especially the international organizations and donor countries began to focus the important role of developing countries' government and its capability in efficient utilization of existing resources, economic aids, technical assistance and foreign investment for achieving sustained economic growth and reducing poverty. This was followed by the increase in studies on noneconomic aspects of development such as politics, governance, gender, women empowerment, education,

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health, ethnic and religious factors. Particularly, since around the early 1990s, the studies on important role of government's capability in economic growth have given priority among researchers. Because, development management capability of government[1/] (DMCG) has begun to recognized widely as *"a master key for achieving sustained economic growth"* which certainly make possible for the provision of macroeconomic stability, and market friendly political and economic environment towards achieving political stability, economic growth and poverty reduction.

Myanmar, relatively rich in natural and human resources, and having favorable geographical and climatic conditions has begun to introduce market oriented policy measures since early 1990s as in other transitional economies of Asia[2/]. Unfortunately, industry, business, trade and investment activities as well as peoples' socioeconomic condition did not progress both the periods of market economy under military rule (1990-2011) and military backed government (2011- March 2016). Accordingly, this study attempts to focus the role of government and its capability in achieving political stability and sustained economic growth of Myanmar. It has three main objectives: (1) Examining the role of government in economic growth, (2) Investigating the important tasks of government for achieving sustained economic growth, and (3) Investigating important tasks of Myanmar's new government for stability and growth.

Section (1) explores the concept of government, the nature of economic growth and development, and determinants of economic growth. Section (2) attempts to examine the tasks of government, development management capability and the main causes of government failure. Finally, the section (3) provides the suggested government's tasks and strategy for stability and growth in Myanmar.

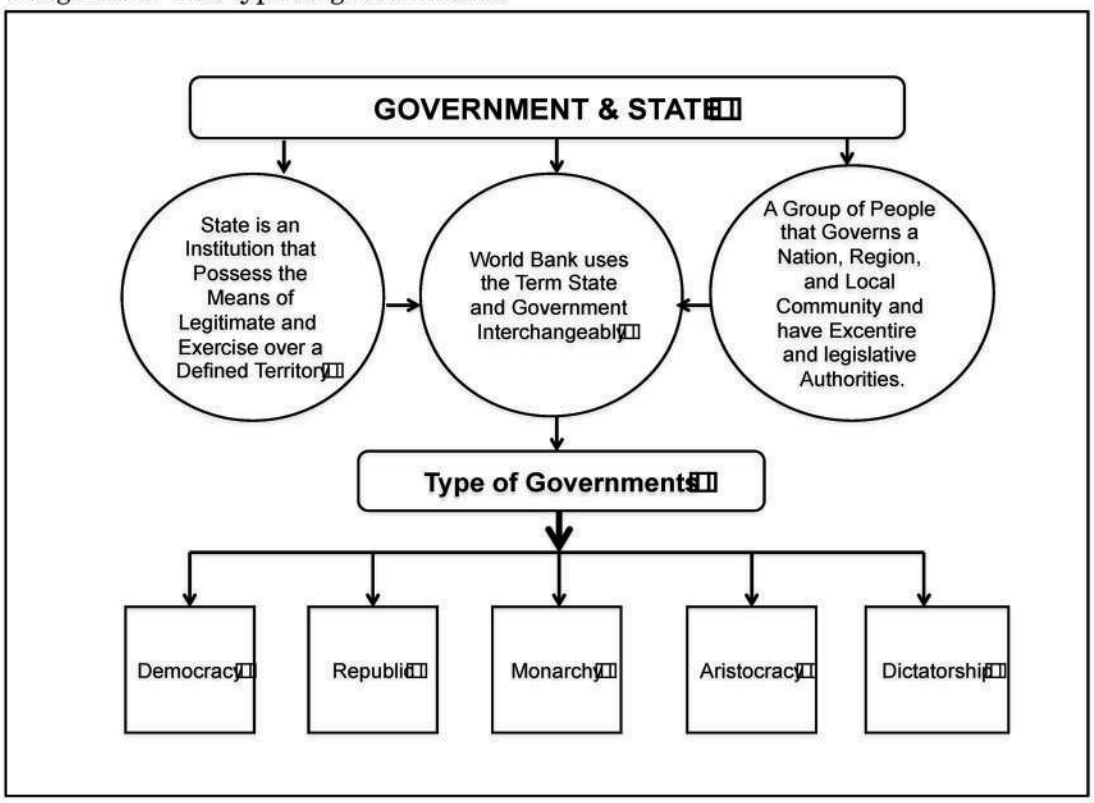
Section (1): Concept of government, the nature of growth and development, and determinants of economic growth.

State and the Government: State refers to a set of institutions that possess the means of legitimate and exercises over a defined territory and its population. Government generally refers a group people who fills the positions of authority in a state. Government is a group of people that governs a community or country. It usually sets and administers public policy, and political and sovereign power through customs, institution, laws and regulations within a state. A government can be classified into many types, such as democracy, republic, monarchy, aristocracy, dictatorship, military and civilian etc. as summarized in diagram (1). The World Bank uses the term state and government interchangeably[3/].

If we examine the type of government in recent Myanmar, it would be appropriate to

label *"military backed so-called semi-democratic government"* for the period from 2011 to March 2016. But, for the new government which took political power from 1st April to present, would be appropriate to label *"civilian dominated semi-democratic government"*. However, nobody knows the "how long does it take for having full-blown civilian democratic government" which has capability to manage the country's economy and politics properly. The constitution of present Myanmar is consciously drafted by a series of army generals for maintaining the military power longer. Therefore, constitutional reform has been the most challenging and hardest task for the new civilian government. According to Lwin (2007), required time length for establishing "democratic society" and "acceptable constitution" in a peaceful way depends on "capability of government" and government's extent of "love the country" (patriotism, aikokushin).

Diagram 1. The type of governments

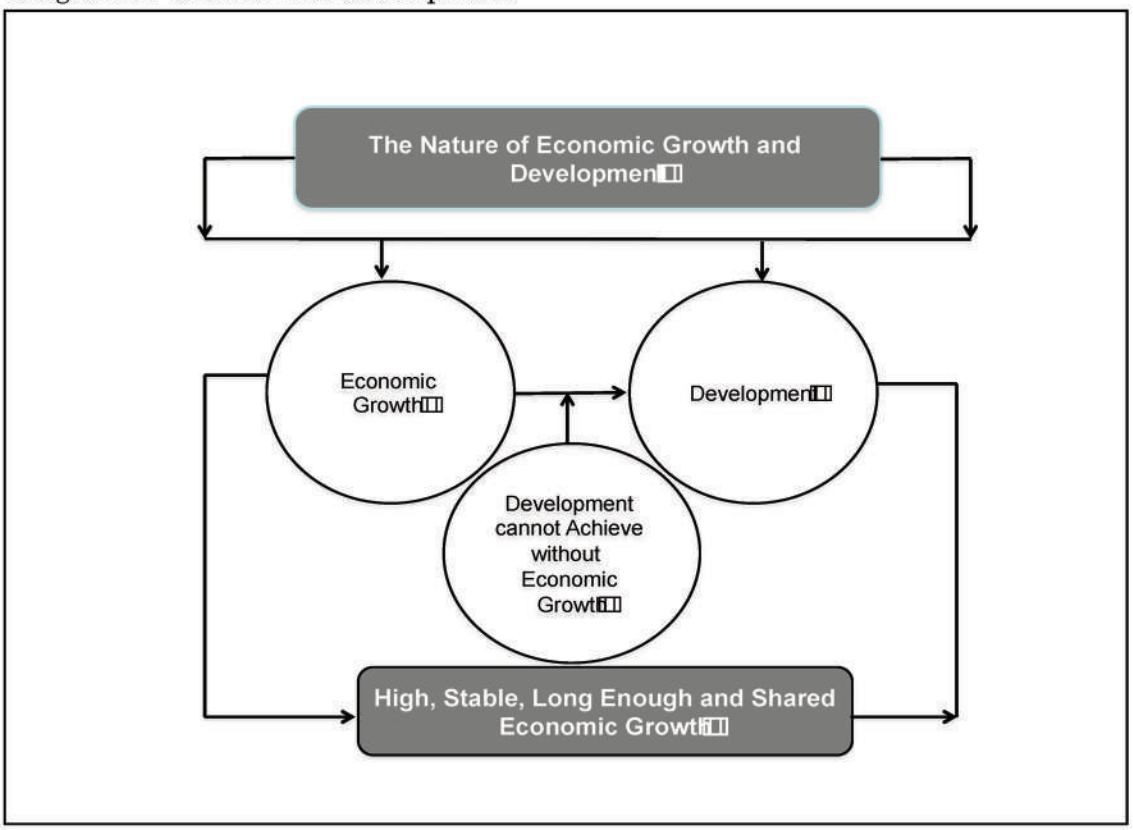


Source: Authors' image diagram based on World Bank Development Report 1997

Growth and development[4]*:* The progress of "peoples' income and gross domestic product" of a country during a certain period is known as economic growth. Development means "growth of peoples' income and GDP" as well as "progress of social and economic condition of the people", "change in social and economic structure", and "having acceptable income

distribution and poverty". Therefore, as stated in diagram (2), economic growth is an important integral part of development and, development cannot achieve without economic growth. However, high, stable, long enough and shared economic growth is required for achieving sustainable development[5/] as depicted in image diagram (3). It is very important to keep in mind the differences and relationship between economic growth and development in order to judge properly the capability and effectiveness of government.

Diagram 2. Growth and development



Source: Authors' image diagram

Determinants of achieving economic growth and sustainable development: Achieving sustained economic growth and development of a country generally depends on the following economic and noon-economic factors.

(1) Existence of acceptable geographical and climatic conditions

(2) Existence of acceptable natural resources (land, water, mineral, sea, river, mountain, forest, rain fall, sun shine hour, wild life etc.)

(3) Existence of appropriate human resource (healthy, educated and skilled labor force)

(4) Existence of acceptable political stability and tranquility

(5) Existence of acceptable peaceful ethnic and religious situation

(6) Existence of appropriate social and physical infrastructure

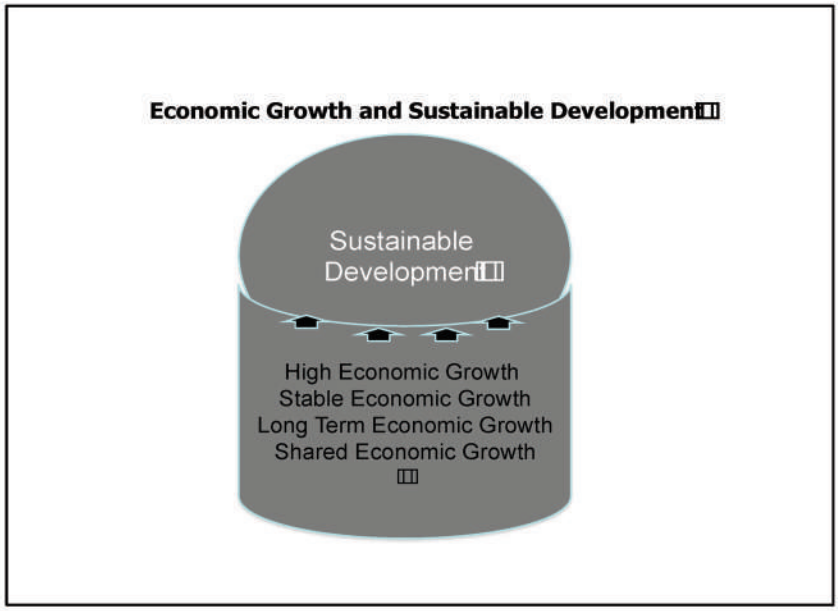
(7) Existence of market friendly political and economic environment

(8) Existence of internationally recognized government which is gradually reforming towards democracy and freedom economically and/or politically

(9) Existence of government which has acceptable development management capability and effectiveness

According to the past experiences of newly industrializing economies (NIEs) and today developing and emerging economies Asia, it is widely recognized that the above mentioned three out of nine factors viz. political stability, market friendly political and economic environment, and capable government「No. 4, 7, and 9」have been playing most important role in achieving high economic growth and sustainable development through the efficient utilization of official development assistance (ODA) and foreign direct investment (FDI). Generally, the economies of Asia such as Singapore, Hong Kong, Taiwan and Korea of 1980s, Malaysia and Thailand of 1990s, China, Vietnam, Philippines, Indonesia, India, Cambodia, Laos of 2000s and Myanmar of 2010s are known as obvious examples.

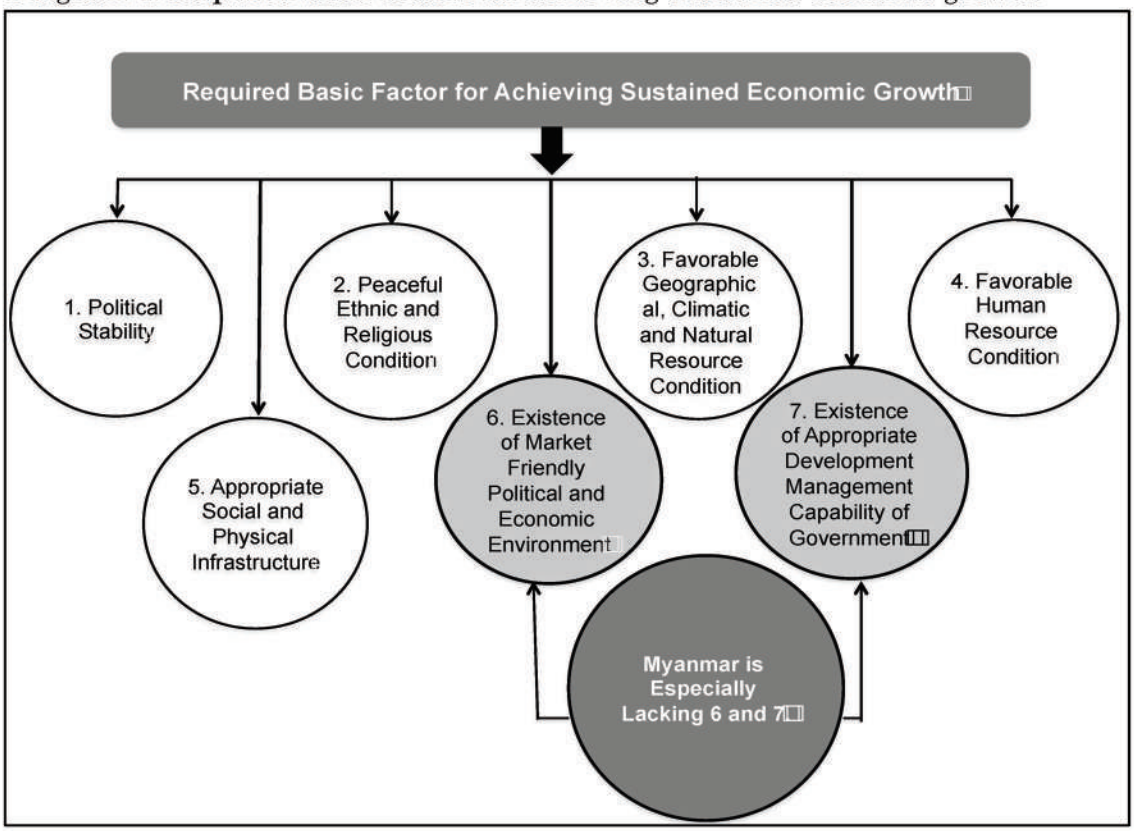
Diagram 3. Economic growth and sustainable development



Source: Authors' image diagram

The required basic factors for achieving sustained economic growth in the context of Myanmar is depicted in figure (4).

Diagram 4. Required basic factors for achieving sustained economic growth

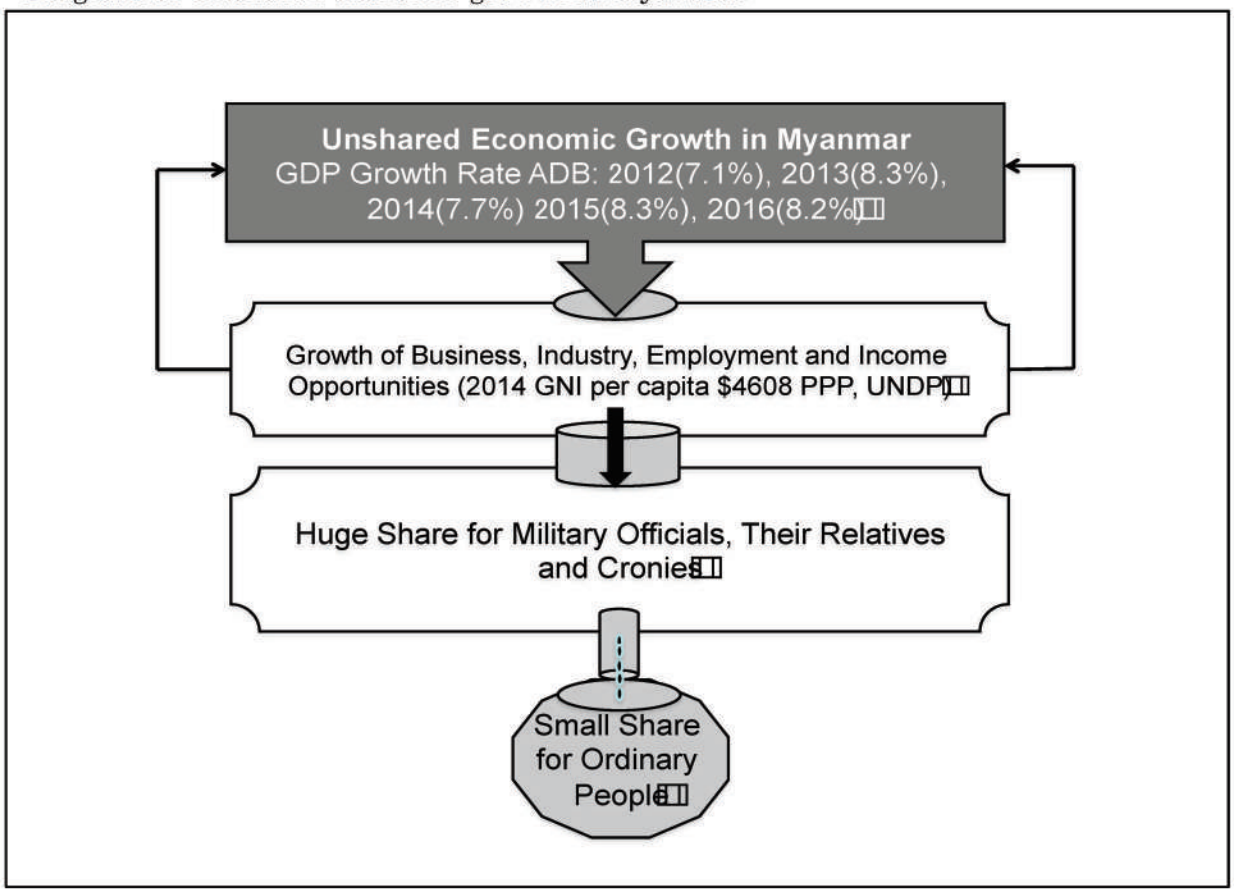


Source: Authors' image diagram

As stated in diagram (4), Myanmar is especially lacking market friendly political and economic environment, and development management capability of government. The new democratic government of Myanmar should give priority in building its capability and introducing market friendly policy measure timely for achieving ADB estimated growth rate of 8.2% for 2016.

Moreover, Myanmar which is under the military regime for about more than a half century, is suffering severe problems of unfair distribution of wealth, business, and employment opportunities, as well as lacking free and fair competition in industry and business society. That is the major source of the unshared economic growth, and increasing number of very rich high ranking military officials and their cronies on the one hand and increasing number of working poor on the other in Myanmar.

Diagram 5. Unshared economic growth in Myanmar



Source: Authors' image diagram

As stated in diagram (5), recent Myanmar is achieving remarkable economic growth of about 7% to 8% during 2012 and 2015. It is also estimated to achieve GDP growth rate of 8.2% in 2016 by Asian Development Bank (ADB). But, unfair huge share of business, employment and income opportunities as well as illegal profit and wealth are grab by high ranking military officials and their cronies. Only a small share is left for ordinary people as a result of unshared economic growth under military and military backed government during the period from 1962 to March 2016. It is also very important for new civilian government to introduce the effective policy measures for eradication of abuse of political power and public sector corruption as well as for achieving fair distribution of wealth and income opportunities *wisely and timely*.

Section (2): The tasks of government, its development management capability and causes of government's failure

Since the age of Adam Smith, Keynes and、Meier and Baldwin, the important role and tasks of government in economic growth was widely discussed in their famous books of

The Wealth of Nations (1760), The General Theory of Employment, Interest and Money (1936), and Economic Development (1957) respectively. Adam Smith (1760) explained that development of a country requires an economic environment which could provide free and fair competition in investment, production and trade for the growth of industry, business and trade. This kind of economic environment is widely known as Smith's "*laissez faire policy*" and it can be found only under the government which has appropriate economic management capability. Keynes (1936) also threw the light on importance of appropriate government's banking, monetary and fiscal policies for managing market economy that leads to the growth of industry and business as well as the progress of employment and income. Moreover, Meier and Baldwin (1957) advocated the important role of various degrees of government's initiations and directions in achieving successful economic growth by using different development experiences of Japan, Germany, USSR and United States[6/].

Diagram 6. The duties of government (Adam Smith)

Source: Authors' image diagram

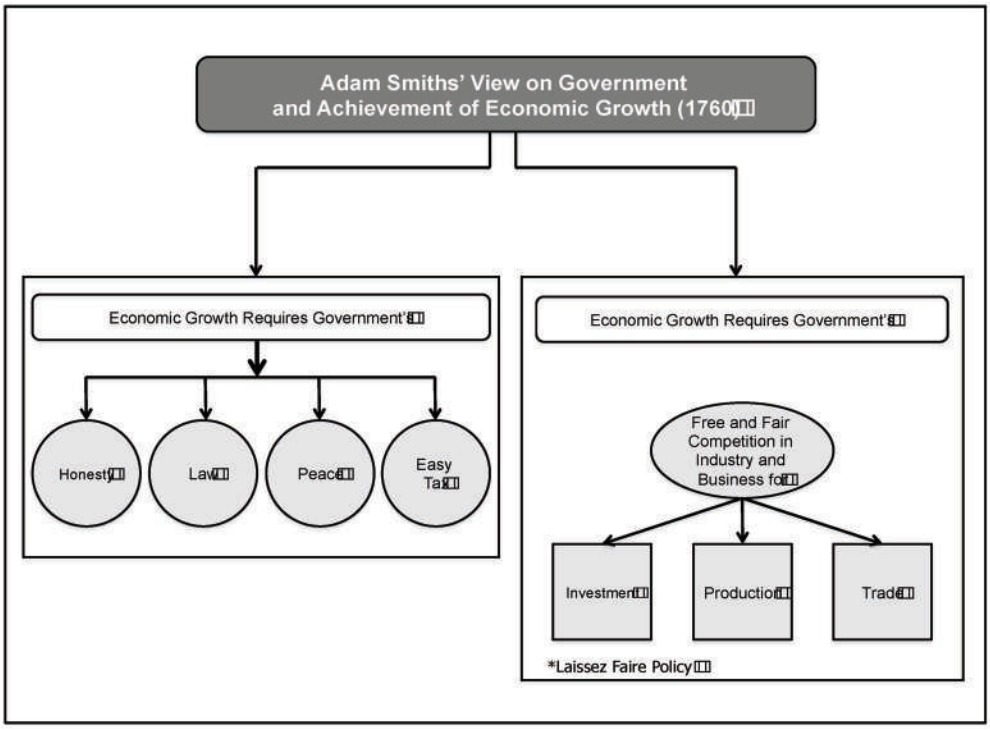
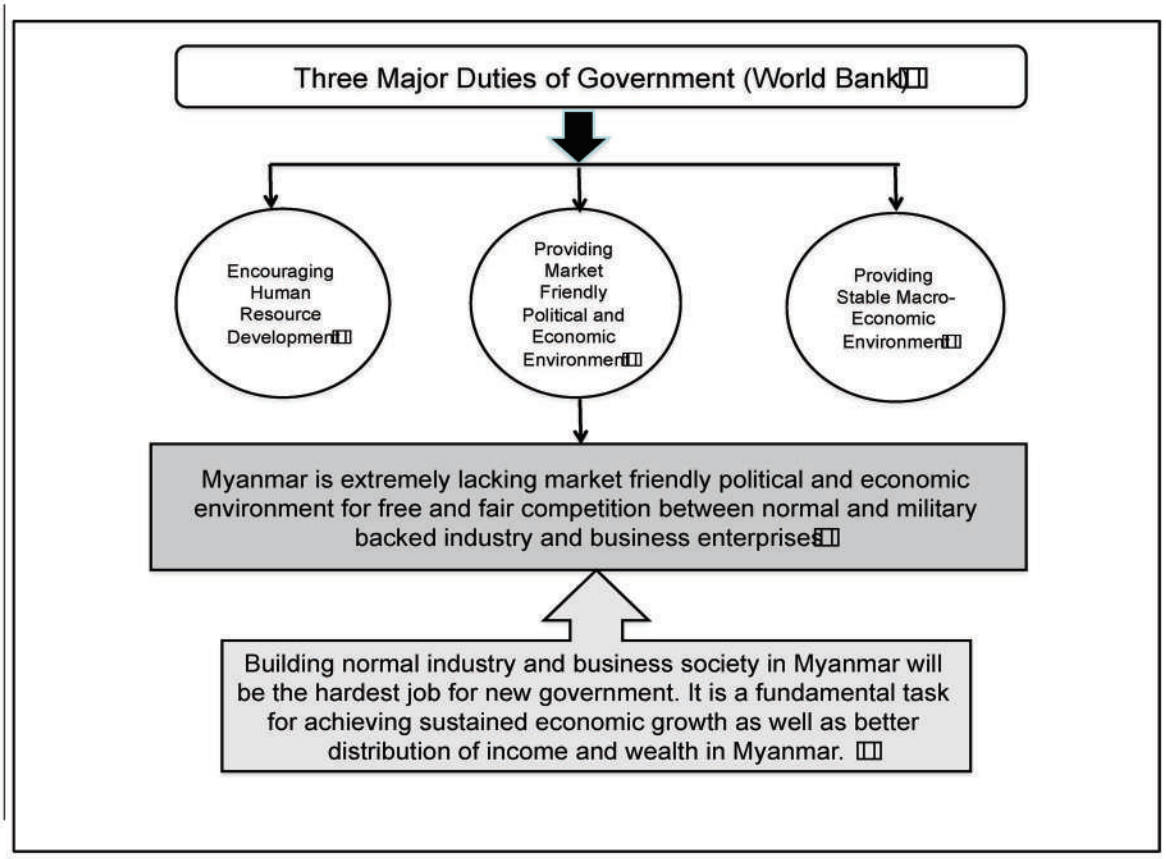


Diagram (6) explains that economic growth requires government's honesty, law, peace and easy tax as well as provision of free and fair competition in industry and business society for the growth of investment, production and trade. Moreover, it is worthy to

introduce the important duties of governments for achieving economic growth partly based on the views of World Bank.

The duties of government: (1) Providing education, training and skill development programs for encouraging human resource development, (2) Providing market friendly political and economic environment, (3) Providing free and fair competition in industries and business societies and (4) Providing stable macroeconomic environment. Moreover, governments are responsible to examine always- (1) What should do (2) How should do and (3) How can do better for achieving economic growth that addresses the progress of industry, business, employment and income of ordinary people[6].

Diagram 7. The duties of government (World Bank and Lwin)



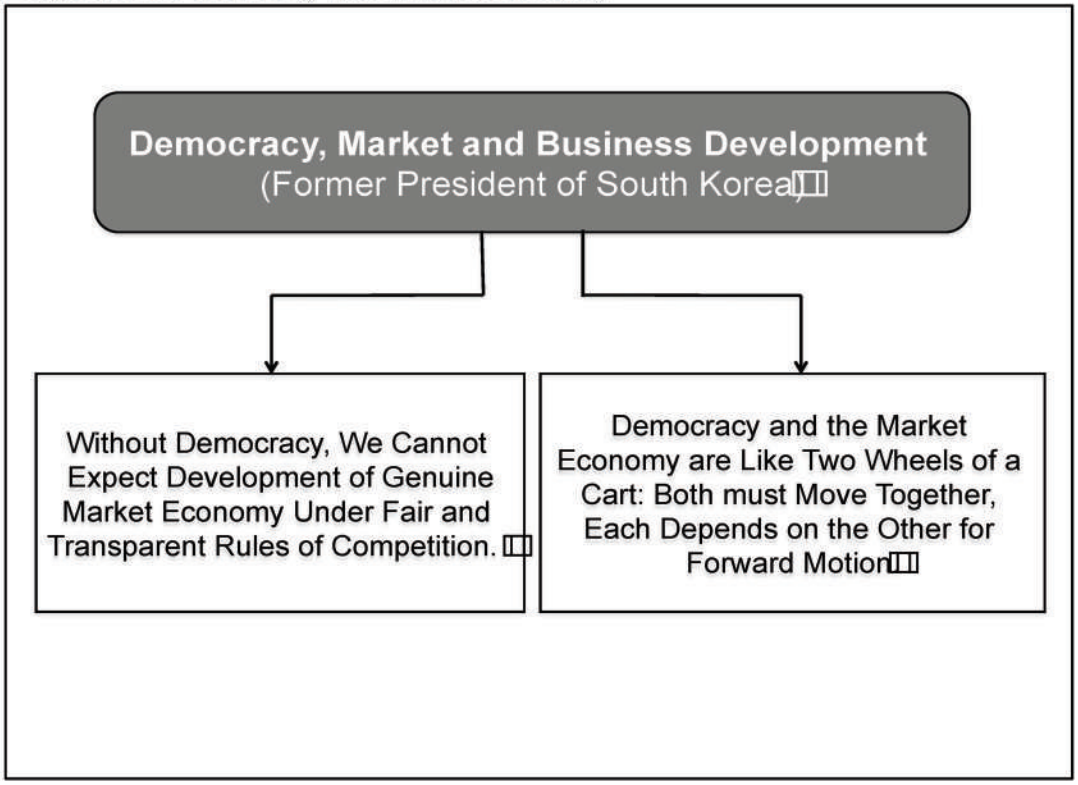
Source: Authors' image diagram partly based on World Bank Development Report 1991, 1997 and Lwin, 2007.

As stated in diagram (7), Myanmar is lacking market friendly political and economic environment as well as free and fair competition between normal enterprises and military backed enterprises. Building normal industry and business society which is operated by civilian business people is also a hard job for the new government. It can be

expected that the growth of civilian business and industrial society would lead to the reducing uneven distribution of wealth, employment and income opportunities gradually.

The former Presidents of South Korea Kim Dae-jung expressed that "Without democracy, we cannot expect development of a genuine market economy under fair and transparent rules of competition." Democracy and the market economy are like two wheels of a cart: both must move together, each depends on the other for forward motion."(Democracy and the Market Economy: Two Wheels of a Cart; Kim Dae-jung, 1999). World Bank also expressed that the success of public and private sectors industry and business activities is the result of investing in human resource development, a much reduced economic role of government, openness to the rest of the world and macroeconomic stability. This is widely known as the "Market Friendly Approach to Development". Successful establishment of market friendly political and economic environments is largely relied on existence of democratic government which has appropriate development management capability[8/].

Diagram 8. Democracy and market economy

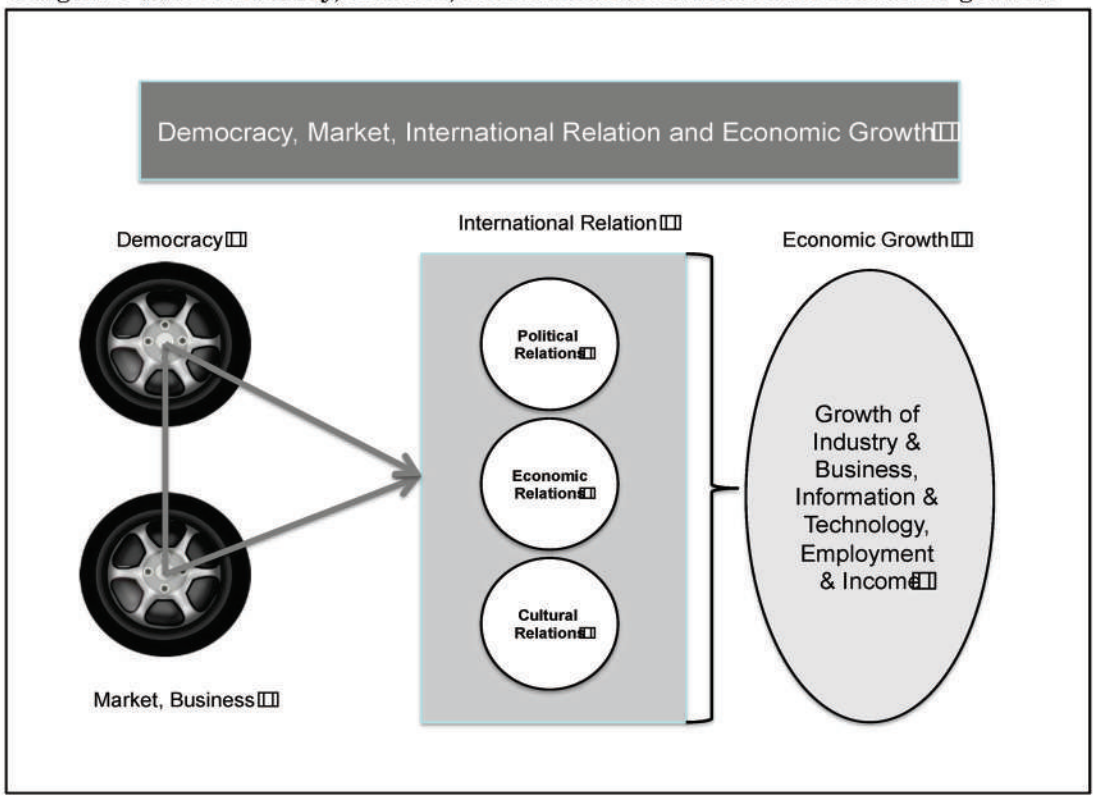


Source: Authors' image diagram based on Kim Dae-jung (2001).

The above mentioned relationship between democracy and market economy, depicted in diagram (8), is possible to modify by introducing the importance of international

relation comprising political, economic and socio-cultural relations (Lwin 2012) for achieving economic growth. This extended version is depicted in diagram (9).

Diagram (9). Democracy, market, international relation and economic growth



Source: Authors image diagram based on Kim Dae-jung (2001).

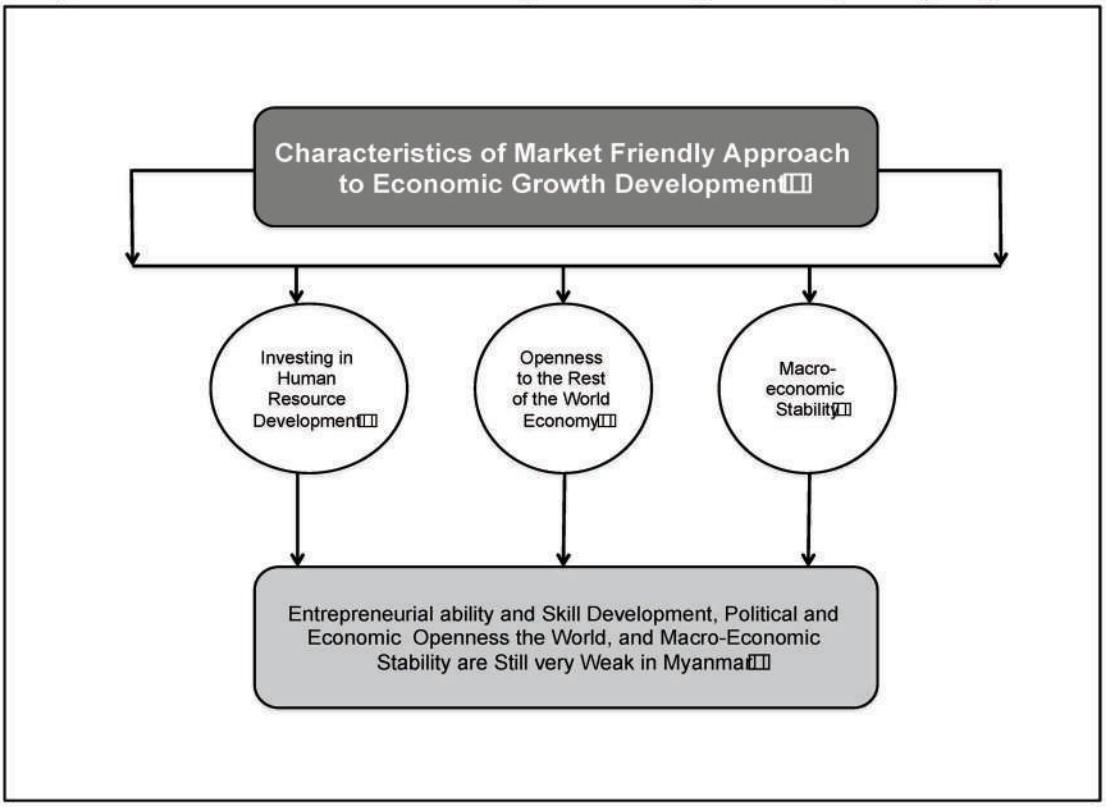
Moreover, democratic way of political and economic management is a fundamental requirement for building of free and fair competition in investment, production, and trade which could lead to sustained economic growth of a country. The Burmese view on democracy is not merely as a form of government but as an integrated social and ideological system based on respect among individuals. Moreover, regarding Buddhist view on responsibility of kings, the "Ten Duties of Kings[9]" is widely known and accepted among the people of Myanmar as a standard yardstick of good governance. These duties of kings also can be compared with the governments of Myanmar during the period after independence (1948) to March 2016.

It is worthy to note that keeping peace and tranquility, eradication of poverty, building democratic society gradually are the fundamental tasks of developing countries governments before achieving a developed country status. The main causes of government failure or failure in sustained economic growth and poverty reduction in today's developing countries has been basically the poor development management

capability of governments rather than the lack of land, labor, capital, technology, natural resources, and appropriate infrastructure.

Development management capability of government: It refers to the ability of government in managing improvement of socio-economic wellbeing of the people through the growth of industry, business, investment and trade as well as the employment and income opportunities. Without the existence of democratic way of political and economic management, we could not achieve the sustainable development of human society in a global scale. (Lwin 2007). Capability is the ability to undertake and promote collective actions efficiently– such as law and order, public health, education, and socioeconomic infrastructures. Effectiveness is a result of using that capability to meet peoples' needs. A government may be capable but not very effective if its capability is not used in society's interest (World Bank 1997). The general characteristics of development management capability of government is depicted in diagram (10).

Diagram 10. Characteristics of development management capability of government



Source: Authors' image diagram based on World development Report 1997 and Lwin 2007

As stated in diagram (10) all the characteristics of appropriate development management capability of government were lacking in Myanmar under military rule (1962-2011) and military backed government (2011- March 2016). This bitter experiences

of Myanmar during the period from 1962 to early 2016 provide the hints for important *tasks of Daw Aung Sun Suu Kyi leads U Htin Kyaw government. It needless to point that new civilian government must have not only "strong characteristics of patriotism and democracy" but also the "appropriate development management capability and effectiveness" in political and economic management.*

If we examine the appropriate characteristics of development management capability of government (DMCG) in the context of current political economy of Myanmar, the followings should be given priority.

(1) Having strong spirit of patriotism (Aikokushin)

(2) Having capability of keeping peace and tranquility in a democratic way

(3) Having capability of building national unity, democracy and freedom gradually

(4) Having capability of eradication of public sector corruption and abuse of political power

(5)Having accountability and transparency in political and economic management

(6) Having capability of providing free and fair competition in industry and business society

(7) Having capability of promoting investment, production, trade, employment and income through the growth of ODA, FDI

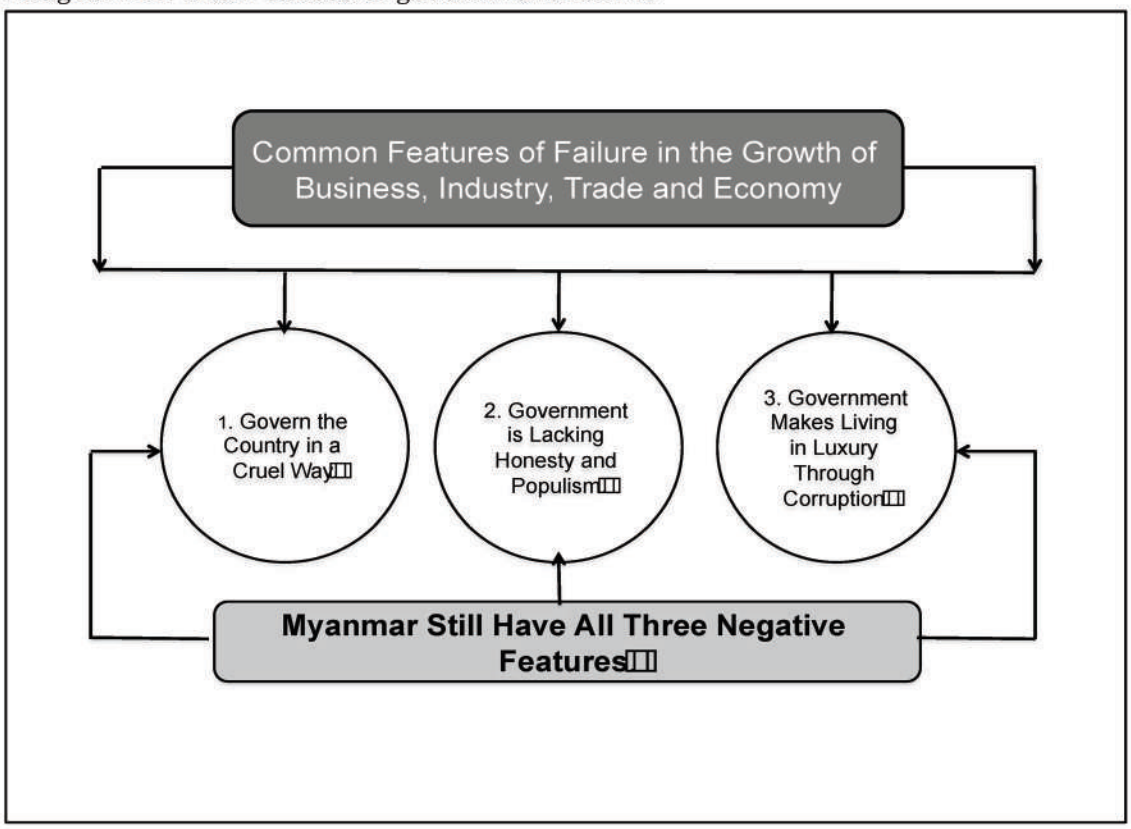
(8) Having capability of providing general education, training and skill development program, and healthcare opportunities for the working poor of urban and rural areas

(9) Having capability of promoting peoples' knowledge, way of thinking, cultural values, and language ability in line with the rapidly changing internationalization and globalization

(10) Having capability of introducing administrative and economic reform measures in line with the changing political and economic environment, domestically and internationally

Main Causes of government failure: The studies on the role of state in economic growth found that excessive government intervention in industries, business and trade as well as abuse of political power and corruption are the main causes of government failure. As depicted in diagram (11), most of the top level government officials in developing countries make their living in luxurious way due to the lacking honesty and populism. Some of them govern the country and manage the economy and business in a cruel and corrupted way.

Diagram 11. Main causes of government failure



Source: Authors' image diagram.

The main causes of failure in growth of industry, business and trade in the context of Myanmar, from 1962 to early 2016, can be summarized as follows.

1. Lack of integrated policies for investment, production, trade, money & banking, taxation, finance, and exchange rate
2. Lack of market friendly political and economic environment for the growth of industry, business, trade, employment and income through effective utilization of existing resources, official development assistance (ODA) and foreign direct investment (FDI),
3. Lack of transparency and accountability in political and economic management
4. Lack of free and fair competition in industrial and business society
5. Lack of administrative and economic reform measures which address the eradication of deep-rooted nationwide public sector corruption as well as smooth running of industry, business and trade activities.

The failure of industrialization and sustainable economic development during the period between 1962 till early 2016 was mainly due to a series of military juntas[10/] who are generally lacking development management capability. According to the World Bank Development Report (1997), the survey result of 69 countries found that failure of

business development was due to lawlessness syndrome covering corruption, unpredictable judiciary and crime as well as due to wasting time especially for negotiation with the government officials.

Section (4): Suggested government's tasks for achieving political stability and sustainable economic growth.

This section and conclusion provide a brief political economy of Myanmar in retrospect in order to have clear understanding on suggestions and policies hints for new civilian government of Myanmar.

Political economy Myanmar in retrospect: In January 1948, Myanmar gained her independence from British rule and had the chance to establish the parliamentary democracy system of its own as well as to continue the free market mechanism along with economic nationalism. The "Two-Year Plan" of economic development drown up under the auspices of General Aung Sun (father of Aung Sun Suu Kyi) was announced on 1st April 1948[11]. As this plan advocated a strong socialistic ideas, it stipulated all the basic industries were to be established and developed on a state-owned basis. The development strategy and policy of free market mechanism and economic nationalism were applied during the period between 1948 and 1962. It would be appropriate to label this period as "*Market Economy under Democratic Civilian Rule*", However, unfortunately, there was no political unity among the leaders of the country's ruling party. The lack of political unity, growing ethnic conflict and nationwide insurgency problems, made Myanmar impossible to establish required socioeconomic infrastructure, institutions and basic industries and business for strengthening economic growth. Finally, General Ne Win staged the military coup in March 1962. This was the beginning of Myanmar which became under military rule.

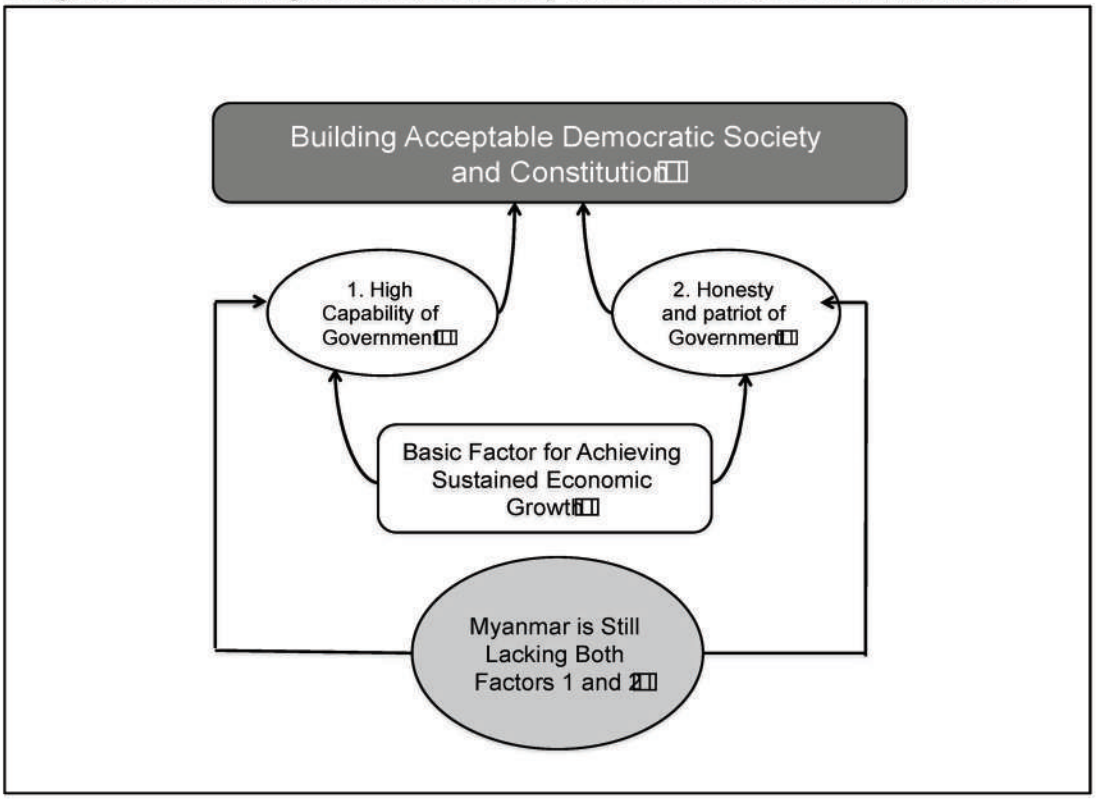
Soon after the military coup "Revolutionary Council" was formed and cabinet post were also distributed among high ranking military officers. Then, military government annulled the parliamentary system and established the socialist economy of one party system, known as "Burma Socialist Program Party" (BSPP) which governed Myanmar from March 1962 to September 1988. It would be relevant to label this period (1962~1988) as "*Socialist Economy under Military Rule*". Military government followed the "*Inward-looking Self-reliance Policy in Isolation*" during this period. All the industries, businesses, domestic and foreign trade, electricity supply, banks, hospitals, schools, transport and communication, mining, forestry, and fishery were also nationalized and kept under the control of army generals and high ranking military officials. Due to the over practicing of bureaucracy and brutal law in economic

management and public administration simultaneously with the nationwide corruption during this period, the whole political and economic system became lopsided and unmanageable especially after 1985. Finally, the socialist government formed by ex-military and military officials, label themselves 'socialist heroes', which governed the country nearly three decades, chose the second best solution. That was, transferring the political and economic power to the young obedient military generals and officials in 1988. This new military junta who are loyal to and protect the welfare and wealth of army and ex-army officials, established the "State Law and Order Restoration Council" (SLORC). Then, immediately declared that a market oriented system will be adopted in the place of socialist planned economic system. Therefore it is appropriate to label this period (1988 to 2011) "*Market Economy under Military Rule*". The SLORC (1988-1997), then changed its name to State Peace and Development Council (SPDC, 1998-2011), the second generation of army led by Senior General Than Shwe governed the country more than 20 years. This new military regime also followed the old style of political and economic management which is over practicing of nationwide brutal law and corruption. Mainly due to the unmanageable economic problems under semi-open market economy, power struggle among generals, and remarkable changing world political environment towards democracy and freedom, military backed Thein Sein, a former general, government appeared on political scene. It ruled the countries from 2011 to March 2016 by introducing new style of political and economic management that was more democratic way than ever before. The members of Thein Sein government was a blend of second and third generation of army general and officials. The most distinguishing and respectable action under Thein Sein administration was the allowing free and fair national election of 2015. It would be appropriate to label the period of (2011 to early 2016) as "*Beginning of Market Economy under Semi-democratic Military Backed Government*". But unfortunately, as stated in diagram (11), the cabinet members of civilians and generals under Thein Sein government were also lacking capability of governance, honesty and patriotism.

As a result of landslide victory of National League for Democracy (NLD) party in 8 November 2015 election, the leader Daw Aung Sun Suu Kyi could take over power in April 2016 and U Htin Kyaw, a civilian was elected as President of Myanmar. The present political economy of Myanmar, as of May 2016, would be appropriate to label as "*Market Economy under Semi-democratic Civilian Rule*". Currently, Aung San Suu Kyi leads Htin Kyaw civilian government is introducing the administrative reform measures as expected by domestic and international societies. But, due to the long lasted political and economic management under military regime, many of the newly assigned civilian

ministers and top level authorities are still lacking expertise and knowledge although they are rich in patriotism and honesty. Therefore, the new government has to find the best shortest way to learn and operate the society and economy effectively and timely. This would be also one of the most challenging tasks for the new government.

Diagram 12. Building democratic society under Thein Sein administration



Source: Authors' image diagram.

As stated in diagram (11), building acceptable democratic society and constitution requires honesty and patriotism of government as well as high capability of government. These factors are also considered as basic for achieving sustained economic growth. But, under the Thein Sein government which govern the country from 2011 to March 2016, almost all the generals and civilians at the ministry level are basically lacking above mentioned import factors and it is really impossible for building democratic society as well as promoting socioeconomic wellbeing of ordinary people. President Thein Sein has noticed very well about the limitations and difficulties of his military backed administration. Probably, this would be the one of the major factors which made President Thein Sein to make decision to transfer the political power to civilian government through the result of November 2015 national election.

We can look back and summarize the important movements of President Thein Sein related to paving way towards transferring political power and building democratic society successfully during his administration. Thein Sein, a retired general of Myanmar army, previously served as Prime Minister from 2007 to 2011 and became the 8th President of Myanmar from 2011 to March 2016. He took over political power in March 2011, after the military backed election of November 2010. He is considered as moderate and reformist by domestic and international societies. Because, Thein Sein government freed hundreds of political prisoners, held peace deals with ethnic minority groups, allowed flexible media censorship, released of Aung Sun Suu Kyi from house arrest and undertook good relationship, and brought NLD party back into the political scene, Myanmar had opportunity to chair ASEAN meeting in 2014, and improved relationship with US. Thein Sein also made the pledge to the UN General Assembly in New York in 2012, saying Myanmar was on a path from which it would not backtrack. All these actions of President Thein Sein during his administration (2011~ March 2016) give the impression that he was trying consciously to transfer the power to Daw Aung Sun Suu Kyi leads civilian government. It would be appropriate to evaluate that President Thein Sein could successfully build a bridge for transfer of military backed political power to democratic civilian government. It needless to point that Daw Aung Sun Suu Kyi and President U Htin Kyaw are most the responsible persons for the success of building democratic society peacefully and achieving sustainable progress of socioeconomic wellbeing of ordinary people in Myanmar.

Accordingly, this study attempts to provide the following important points and diagram (13) regarding "What should government do" for building peace, unity, democracy and achieving sustained economic growth.

First: Government should try to maintain law & order restoration as well as peace through democratic way.

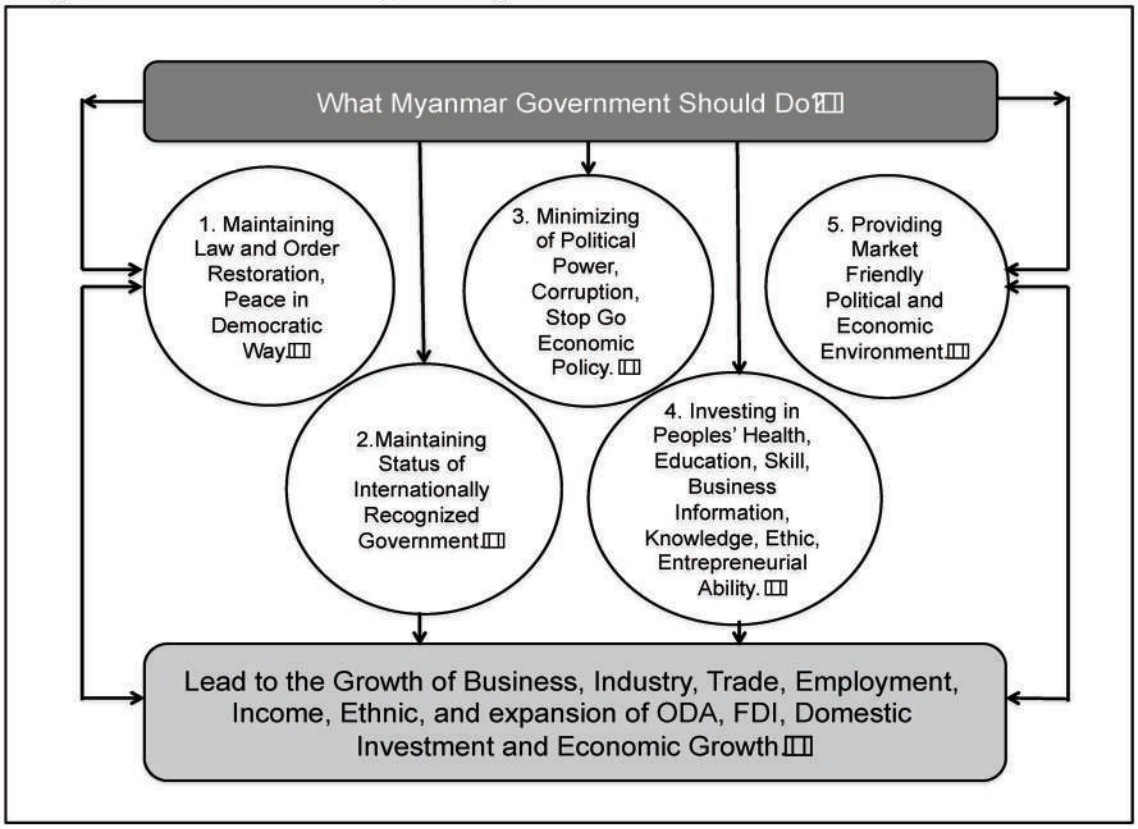
Second: Government should always try to be an internationally recognized and respectable government.

Third: Government should try to minimize the abuse of political power, corruption, stop-go economic policies

Fourth: Government should provide "market friendly political and economic environment"

Fifth: Government should give priority to "investing in people" for the progress of peoples' health, education, knowledge, skill, business ethic, and entrepreneurial ability

Diagram 13. The tasks of Myanmar government



Source: Authors' image diagram.

Moreover, basic government's tasks for achieving sustainable economic development in the context of Myanmar can be examined as follows:

1. Building national unity, strength and democratic society as well as maintaining peace and tranquility in all states and divisions
2. Providing reform measures for fair allocation of resources (financial and human), balancing revenue and expenditure, and decentralization of authorities among all states and divisions
3. Building development management capability of government timely with the help of domestic and foreign experts
4. Building appropriate social and economic infrastructures in all states and divisions
5. Providing market friendly political and economic environment for domestic and international firms
6. Providing free and fair competition in industrial and business society as well as degree of economic openness towards world market, ODA, FDI, and business information timely
7. Providing urgent and effective policy measures for agriculture, rural and regional development

8. Providing macroeconomic stability through money, banking, finance and foreign exchange rate
9. Providing education, training and skill development programs for the working poor of rural and urban areas
10. Promoting peoples' social & cultural values in line with the rapidly changing internationalization and globalization

Conclusion

The constitution of present Myanmar is consciously drafted by former army generals for maintaining military power and to rule the country as long as possible. According to the May 2008 enacting new constitution, the army could retain 25% of the parliamentary seats with unelected military representatives. This is what the generals called "*disciplined democracy*". It makes possible army to hold veto power on constitutional change and keeping key ministerial portfolio related to security and part of administrative power. Moreover, Aung Sun Suu Kyi could not become the President of Myanmar, although her political party, National League for Democracy (NLD) won in the national election of 2015. Therefore, constitutional reform has been the most challenging tasks for the new civilian government.

Myanmar could learn many things from her lost decades under military rule and military backed government (1962~ March 2016), and from the experiences of transition from planned to market in Soviet Union, Central and Eastern Europe, and the Asia during early 1990s as well as from the recent experiences of Arab Spring which broke out in 18 December 2010 in Tunisia and then spread to Egypt, Libya, Yemen, Bahrain, and Syria. The major source of these problems were mainly due to the issues such as dictatorship, absolute monarchy, human rights, public sector corruption and extreme poverty. It is extremely important for Myanmar to overcome the negative outcomes of transition from military to civilian government. Accordingly, this study attempts to examine the *suggested political and economic management strategies* in the context of Myanmar for achieving successful transition and sustained economic growth as follows.

First: *Regular approach strategy:* Civilian government should choose step by step administrative reform strategy rather than shock treatment approach for building full blown democratic society and successful constitutional reform.

Second: *Friendship approach strategy:* Civilian government should follow the shake hands governance strategy towards old and new high ranking military officials in order to maintain the peace as well as law and order restoration in all the states and divisions.

It is needless to point that cooperation and support of army is very important for building national unity and peace.

Third: *Gentle approach strategy:* Civilian government should choose the well-behaved political and economic management strategy wisely for minimizing the deep rooted abuse of administrative power and public sector corruption. It should be aware that favoritism, nepotism, power abuse and corruption can be found not only within the army society but also in civilian.

Fourth: *DMCG approach strategy:* Civilian government should try to improve its development management capability timely in order to minimize the distorted economic policies and providing market friendly political and economic environment for the progress of industry, business, trade, employment and income through the efficient utilization of existing resources, FDI and ODA.

Fifth: *Investing in people approach strategy:* Civilian government should implement timely the effective human resource development strategy for the progress of peoples' health, education, skill, business information, business knowledge, business ethic, and entrepreneurial ability.

As explain above, maintaining peace and tranquility in all the states and divisions of Myanmar would become the hardest job for civilian government, if the army generals do not loyal, cooperate and support enough to the new government and/or if the recent reform measures impact too much on wealth and power of generals and high ranking army officials. Moreover, the most important issue for present Myanmar is that civilian government must have not only the capability of keeping good relationship with army but also the avoiding power struggle with army generals. Peace, stability and prosperity of Myanmar is solely relied not only on political and economic management capability of civilian government but also on the extent of generals' spirit of patriotism, cooperation and support.

Finally, we would like to express again that the role of government and its development management capability will be continued to play as a "*master key*" for achieving sustainable development both in developing and developed countries of this century. And we also strongly hope, this study on "The Role of Government and Its Development Management Capability" could provide a "*fundamental guide lines*" for the present and forthcoming governments of Myanmar.

Notes:

1. Nagamine, H. and Lwin, M.M., the former members of establishment of Graduate School of International Development (GSID), Nagoya University, Japan, also chiefly

used the term Development Management Capability of Government (DMCG) since early 1990s.

2. For the details on transitional economies including Myanmar, please see in Lwin (1996, 2000).

3. Regarding the type of government, please see in Lwin 2007, p. 294, and World Development Report 1997, pp. 19-21.

4. The main differences in characteristics between economic growth and development is briefly discussed in Lwin 2007, pp.292-293.

5. For the importance of shared economic growth, please see the World Bank 1993, Policy Research Report, pp157-167.

6. Concerning the role of government during the process of development in Japan, Germany, USSR and United States of America, please see in Meier, G.M. and Baldwin, R.E. (1966).

7. Regarding tasks of government, please see in World Bank, World Development Report 1997, and for the changing concept of development and the task of government is referred to Lwin (2007, p.292-297).

8. An explanation on market friendly approach is given in World Bank, World Development Report 1991: pp.6-10.

9. For detail explanation related to Burmese view on democracy and The Buddhist view of "Ten Duties of Kings", please see in Aung Sun Suu Kyi 1991, pp.170-173.

10. A series of military juntas of Myanmar: General Ne Win (1962-1988), General Saw Maung (SLORC 1988-1992), Senior General Than Swe (SPDC, USDP, 15, September 1993 to 2011), President Thein Sein, former general and military backed government, (2011- march 2016), then Htin Kyaw civilian government leads by Aung Sun Suu Kyi (April 2016~present), for a chronology of political events in Burma and Myanmar is given in Lwin (2007) and Myint San & Than Than Aung (2014).

11. For details, please see in Two-Year Plan of Economic Development of Burma. Government Press, Rangoon, Burma, 1948.

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Economic Dependency of Local Communities on Mangrove Resources and Their Role in Mangrove Conservation in Myanmar

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Abstract

Among the environmental resources, mangrove ecosystem is essential to live in our planet and supports the livelihood of people living and depending on mangrove resources. Mangroves are highly productive ecosystems and they generate a number of direct and indirect goods and services. However, their usefulness has often been undermined due to undervaluation. At the same time, mangrove resources are increasingly disappear over time in the world including Myanmar due to higher population, easier accessibility to the forest, conversion to alternative uses. The main objectives of the research are to measure the economic contribution of the mangrove resources to the livelihood of the local community and households and to evaluate the potential role of the local community in mangrove conservation. To investigate the interaction of mangrove resource and socioeconomic conditions of local communities, valuation of mangrove resources that utilizing by local households are estimated in the villages of Ayeyarwady region which is relatively greater in depletion and degradation of mangroves than in other areas. This paper applies the total economic value (TEV) approach which is the most commonly used methodology in economic valuation of mangroves. This study focuses on the economic valuation of mangrove forest products collected by sample of 250 households from the mangrove area. These include fuelwood, construction materials, fish and prawn and crabs. Total value of mangrove products (net income generated) per household per year is US 1497.60433 $ per household in average. Most of the respondents have awareness the importance of mangrove, their knowledge is on the mangrove products. They have lack of knowledge and perception in services of mangroves such as aesthetic appeal, cultural/ religious, and recreation values, ecology and natural disasters. Thus, it is required that more awareness and attention to the importance of mangrove resources by local community to conserve mangrove resources. To fulfill this requirement, some incentives and education programs need to implement to be broader participation of local communities in the mangrove conservation activities.

Keywords: mangrove resources, total economic value, conservation

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1. INTRODUCTION

The mangroves usually occur in the intertidal zone within tropical and subtropical coastal rivers, estuaries and bays of the world where they may receive organic materials from estuarine or oceanic ecosystem. Mangroves generally grow in loose, wet soils, saltwater and are periodically submerged by tidal flows along sheltered coastal, estuarine and riverine areas in tropical and subtropical latitude.

The mangroves are essentially forest-based systems that tolerate salt and occupy the intertidal zone between land and sea. Mangroves are very important to many tropical and subtropical countries, as they serve to protect coastlines from tidal waves, sea erosion and hurricanes. Furthermore, they are highly productive natural ecosystems, and also provide nutrients and shelter for many commercially important aquatic organisms. They generate a number of direct and indirect goods and services. These include products like timber, fuel wood, honey and wax, fish, fish fingerlings, forages, etc., and services like flood control, erosion control, storm surge protection, shoreline protection, ground water recharge, nutrient recycling, micro climate regulation, ozone layer stabilization, and recreation. If managed incorrectly, removal of mangroves can result in shoreline erosion and mobilization of marine sediments. This can cause sedimentation resulting in the shallowing of estuaries and waterways and a reduction in water quality and ultimately lead to decline fishery productivity.

Mangroves are considered as a natural barrier protecting the lives and property of coastal communities from storms and cyclones, flooding, and coastal soil erosion. The main concern over mangrove loss worldwide is that it results in severe disruption to the important ecological and economic functions normally performed by undisturbed mangrove systems. In order to fulfill important socio-economic and environmental functions, the issues concerning mangrove forest functions and their biodiversity have become the main topics in conservation biology and biological diversity all over the world.

Regardless of their monetary value, mangrove ecosystems are important habitats, especially in developing countries, and play a key role in human sustainability and livelihoods, being heavily used traditionally for food, timber, fuel, and medicine.

In the current world scenario, the economic value of natural products and ecosystem services generated by mangrove forests is generally underestimated. The undervaluation of socioeconomic and ecological/environmental services provided by mangrove ecosystems is a major driving force behind the conversion of this system into alternative uses.

Mangroves are disappearing at an alarming rate in many countries today and Myanmar is no exception. Mangrove resources in Myanmar have rapidly declined at a rate of approximately 1% per year in average during 1975 to 2005 Ministry of Environmental Conservation and Forest (MOECAF). The depletion and degradation of mangroves is relatively greater in Ayeyarwady region than in other areas due to higher population, easier accessibility to the forest, conversion to salt producing land, and the devastated impacts of Cyclone Nargis. Moreover, low economic valuation of natural resources from mangrove forests compared to over-evaluation of the forests' food and fuelwood production is also one of the causes of mangrove depletion rapidly. Therefore, it is needed to recognize the importance of mangrove resources and to estimate the more comprehensive valuation of goods and services provided by mangrove ecosystem, and thereby, contribute to more informed decision-making.

1.1 Research Objectives

The main objectives of this research are to measure the economic contribution of the mangrove resources to the livelihood of the local community and households in the study area, to analyze the local community's perception on mangrove resources and to evaluate the potential role of the local community in mangrove conservation.

1.2 Research Method

This study uses the total economic value (TEV) approach which is the most commonly used methodology in economic valuation of mangroves. Firstly, direct use value of mangrove products is estimated by local use value. Secondly, Cobb-Douglas Production Function Approach is applied for fishery products to estimate the volume of fish collected, which is determined by capital, labor, other material used in fishing and

mangrove forest characteristics. For these works, household survey based on socio-economic conditions is conducted in villages which are dependent on mangrove forest.

The research intends to use both primary and secondary data for the proposed area. Primary data is collected through household survey, focus group discussions, and direct community observation. Collection of secondary data such as mangrove area, conservation activities, and participation of local community is focused on records and reports from the forest department, NGOs, and/or local community. Moreover, back ground information of villages, geographic and climate conditions in the study area are gathered.

The benefits from the mangrove are estimated in terms of timber, fuelwood, other materials and products for housing construction, and animal products such as birds, and crabs collected directly from the mangrove swamp. Direct use value is estimated by household surveys of the types of products collected times the market prices

Cobb-Douglas Production Function Approach is used to analyze the volume of fish catch by respondents and which factors can determine the value of fish in the study area. For this calculation, fishing vessel and fishing gears as capital, number of crew as labor, cost of fuel as other material used in fishing and distance from shore, frequency of trip, and time consuming for one trip as mangrove forest characteristics and respondents' characteristics are considered.

Perception of local community on mangroves is analyzed by questions concerning knowledge on mangroves, their usefulness and importance, awareness and participation in conservation activities on mangroves.

2. LITERATURE REVIEW

The total economic value (TEV) approach is probably the most commonly used methodology in economics to measure the economic value of the environment and natural resources (R. Rosales, 2005). Conceptually, the total economic value (TEV) of a resource consists of its use value (UV) and non-use value (NUV). Use values are further classified into direct use values (DUV), the indirect use values (IUV) and the option values (OV).

Direct use values refer to values derived from actual use of the good either for direct consumption or production of other commodities. Market prices are used for valuing goods that are traded. Value of the goods or services that are not traded without market prices are more difficult to estimate. In the case of mangroves, direct use values would include the value of fuel wood, timber, wild vegetables, herbs, crabs, shellfish species and fish species directly being collected from mangroves.

Indirect use values are benefits derived from ecosystem functions, such as the mangrove's functions for shoreline protection, breeding ground for fish and shellfish species, carbon sequestration, habitat for birds and other wild animals and biodiversity conservation. These are values derived from resources and services that are not consumed.

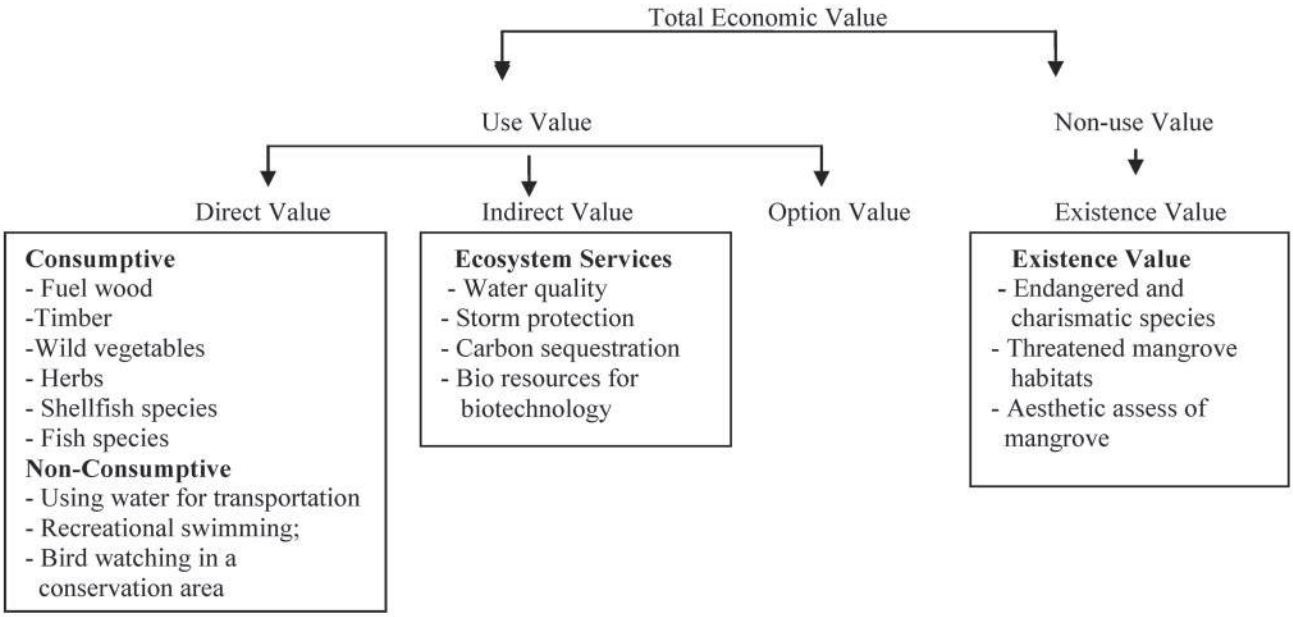
Option values are those that approximate an individual's willingness to pay (WTP) in order to ensure that the goods can be accessed at a later date. OVs are some sort of insurance values, in which people assign values to risk aversion in the face of uncertainty. Mangroves provide potential insurance for future natural disasters like sea level rise and other natural threats associated with climate change. Forests provide an option for potential discoveries of microorganisms or genetic resources that may prove beneficial in the future.

Economic valuation of environmental resources such as mangroves should be done on neoclassical economic welfare analysis (Grigulas & Congar 1995; Gregerson 1995; Dixon et al 1997; Bann 1997). The concept of 'economic value' is defined in the standard economic theory as the measurement of changes in personal well-being. The theory has been further extended to measure changes in the prices and quantities of marketed goods as well as public and other non-market goods and services.

The Total Economic Value framework is the monetary measure of the incremental change in an individual's well being due to an incremental change in environmental quality. It is not environmental quality that is being measured, but people's preferences for changes in that quality. Economic valuation of environment is anthropocentric and it tries to assess the preferences held by people, and the value determines by an exchange or transactions in the market. The TEV of the mangrove ecosystems is the sum of direct use value, indirect use value, option value and non-use value (bequest value and existence value). The Total Economic Valuation

(TEV) framework below highlights the full range of economic goods and services that mangroves provide. (Figure 2.1)

Figure 2.1. Total Economic Value



Regarding the mangrove valuation studies, there are many studies that valuing the importance of mangrove products in international experience. According to a case study of Surat Thani, South of Thailand (by Suthawan Sathirathai, 1998), she studied valuation of mangroves to assess the foregone benefits of mangroves compared to the net returns from converting the area into shrimp farms and the benefits of mangroves to the villagers were also be assessed. This study applied the Total Economic Value and emphasized only the "use value". In assessing the economic value of mangrove, this study emphasizes only on the use value which comprises direct and indirect use values.

The World Conservation Union (IUCN) (2006) studied in Panama village in south eastern coast of Sri Lanka for measuring and comparing various benefits of ecosystem. The project name is Environmental and Socio Economic Value of Mangroves in Tsunami Affected Areas. The direct use value of the mangrove based on local use was assessed form the gross income generated by community, from mangrove in terms of shellfish, fish, timber and poles, herbs and vegetables, fuelwood and other products. Market prices

were used to calculate the gross income generated. The indirect use values considered in this study include value in terms of coastline protection and stabilization and value in terms of providing breeding ground for fish.

In the " Mangrove Dependency and the Livelihoods of Coastal Communities in Thailand " by E.B. Barbier, it is found that households in the study areas depend directly on mangrove forests for fish and wood collection and/or benefit indirectly from the mangroves' support to coastal fisheries. Mangrove loss also affects the decision of households to look for outside employment.

A study of "Mangroves protected villages and reduced death toll during Indian super cyclone" by Saudamini Das and Jeffery Vincent (2009) used data on several hundred villages to test the impact of mangroves on human deaths during a 1999 super cyclone that struck Orissa, India. It found that villages with wider mangroves between them and coast experienced significantly fewer deaths than ones with narrow or no mangroves.

A Review of Mangrove Value and Conservation Strategy by Local Communities in Hormozgan Province, Iran by Saber Ghasemi et al., (2010) provided the values, functions, and attributes of mangrove ecosystem and the importance of the local people in biodiversity conservation in the mangrove of Gas and Hara Rivers Delta (GHRD) in the Iranian coastline of Oman Sea. This study indicated that mangroves of GHRD are greatly influenced by the coastal environment and fulfill important socio-economic and environmental functions. The Total Economic Values of GHRD mangroves can be estimated and the state of key guidelines for protecting biodiversity of mangrove by the local people is also provided. Furthermore, this study highlighted the role of awareness-raising in local communities in GHRD biodiversity conservation.

The study of " Valuing mangrove benefits: contributing of mangrove forests to local livelihoods in Bhitarkanika Conservation area, East Coast of India" written by S.A Hussain and R. Badola, quantified the value of provisioning services of mangrove forests to local livelihoods in terms of forestry and fishery products. It suggested that provisioning services provided by the mangrove forests are of significant importance to the coastal communities as they increase resilience and sustainability of the local economy.

According to the study of "Socio-economic Importance and Various Methods for Economic Valuation for Mangroves with special reference to case study of Mumbai, Maharashtra, India" by Asheesh Shrivastava and Rakesh Kumar, they estimated the economic valuation of mangroves in relation to Fisherfolk's livelihood.

Saudamini Das's paper on "Value of Planted mangroves as nursery and habitat for artisanal and commercial fishery" used satellite imagery to assess the mangrove cover and the Difference-to Difference techniques and panel regression estimates to evaluate the regenerated forest's contribution to fishery sector. Its results show the planted mangroves to have increased the inshore and offshore fish catch significantly. The nursery ground and habitat function service of planted mangroves is valued.

However, the economic valuation studies are very limited in Myanmar. Most studies dealing with mangrove have been in the field of biology and ecology while some other studies have been undertaken to identify the mangrove species and mangrove ecosystem. The studies of valuation of mangrove products and services are very rare.

2.1 Mangrove Resource and Conservation in Myanmar

Myanmar possesses eight distinct forest types, which vary in composition and structure, influenced by a wide range of latitude, topography and climate. The actual forest cover is estimated at being 317,730 square km or approximately 47.7% of the total land area of the country in 2012 (World Data Atlas Myanmar, 2014).

Myanmar mangrove forests are included in the tidal, beach and dune, and swamp forest types, which amount to about 13,751 km^2 or 4% of the total land surface area. Myanmar has more than 2000 km coastline along the Bay of bangle which comprises the Rakhine coastal zone, Ayeyarwady deltaic coastal zone and the Tanintharyi coastal zone where mangroves are common and extensive. Total area of mangrove forest in Myanmar was 790, 981 acres in early 1900. However, it has been rapidly denuded and deforested. The main causes were paddy encroachment, over-exploitation, and illegal felling.

Although the Ayeyarwady delta was the most extensive one, it is significantly reduced over the last decades by the indiscrimination of felling for firewood and charcoal for commercially. The present status of Ayeyarwady mangrove is alarming. Not only has

there been a continuous reduction in extent through agricultural encroachment; the surviving mangrove has suffered greatly through uncontrolled repeated felling of trees.

Ayeyarwady delta is in the southern part of Myanmar. The total area of the Ayeyarwady Region (formerly Ayeyarwady Division) (including the whole Ayeyarwady Delta) is approximately 155,795 km^2. Mangrove forests are mainly found in both Bogalay and Laputta townships, which are situated in the south of the Ayeyarwady delta. In the delta, mangroves are found in Bogalay, Laputta, and Mawlamyaing kyun area in Ayeyawady delta. Bagalay mangrove area has accounted for almost 78% of the total mangrove area in Ayeyarwady Region. In Bogalay mangrove area, there are three particular areas as Mainmahlakyun (Wildlife Sanctuary in 1994), Kadonkanin and Pyindaye mangrove forest area. This research study is taken place in three villages of Kadonkani mangrove area.

In the Ayeyarwady region, the general outline of the distribution pattern of mangrove species in similar to that of other better-known large mangrove forests in Southeast Asia and the West Pacific and was also known to foresters relatively early. The type of mangrove forest is essentially controlled by the frequency, duration and depth of inundation and the salinity levels the land is subjected to.

The rapid decline and deterioration of mangrove ecosystems in Myanmar especially Ayeyarwady delta under stress from population growth and economic development implies the need to recognize the importance of conservation management, and restoration of mangrove forest so that productivity may be optimized and the best economic yield obtained on a long term basis without destroying the mangrove ecosystem. This vitally important mangrove ecosystem had rapidly degraded due to over-exploitation and agricultural encroachment, conversion of mangrove forests into shrimp farming, charcoal production, commercial fishing and export of illegal products round out the top threats to the coastal areas of Myanmar, particularly, Ayeyarwady region's mangrove forests.

In Myanmar, recently, there have been some developments in the policy regarding the conservation of mangroves and the participation of local communities in such activities. Forest Law (1995) and other related laws and rules are set by the government. Many conservation and rehabilitation projects have being implemented by the

government such as Forest Department, Ministry of Environmental Conservation and Forestry, NGOs, INGOs, and UNDP together with the local communities in these delta regions since 1990s. They conserve the mangrove forests by natural regeneration with effective protection; regeneration improvement felling (R.I.F) and the integrated approach.

The Government of the Union of Myanmar has promulgated a new Myanmar Forest Policy in 1995, in line with Myanmar's Forest Policies focusing on the protection of nature and sustainability of natural resources, on satisfying the basic needs of the people, and on the participation and awareness of the people in biodiversity conservation. The old Wildlife Protection Act 1936 was replaced with the "Protection of Wildlife, Wild Plant and Natural Area Law" in June 1994 in order to rehabilitate threatened wildlife and sanctuaries. Moreover, National Biodiversity Strategy and Action Plan (2015-2020) is prepared by Forest Department, consulting with IUCN (International Union for Conservation of Nature) in October 2015.

The Myanmar Forest Department in collaboration with FAO implemented the Environmentally Sustainable Food Security and Micro-Income Opportunities in the Ayeyarwady (Mangrove) Project in the towns of Laputta and Bogalay in 1996.

Under the UNDP/FAO food security projects with the development assistance, the villagers were given participatory training in leadership skill, organizational management, operating development activities and financial management of village revolving fund, etc., in the process of participatory development and empowering the grass-root communities.

Moreover, the UNDP/FAO projects had approached and initiated a sustainable management of increasingly degrading mangrove ecosystem in Ayeyarwady region through various means of community participation. It was also coincident with recently regulated community forestry procedures by Forest Department under the Ministry of Environment Conservation and Forestry in 1995 paving the way and legal entity for rural communities in operation of forest plantation and conservation activities. These projects had given technical and material assistance in mangrove nursery, plantation and management techniques as well as promoting environment saving measures such as popularization of benefits of mangroves, mangrove ecosystem, sustainable fishery

practices and introduction of efficient cooking stoves to reduce the fuelwood production from mangroves.

One of the results achieved by these projects includes empowerment of women. Small business run by women in the local communities produce and sell tree seedlings and fuel-efficient stoves as a result of educating and business skills development provided by these programmes. (The stoves cut daily use of wood for cooking by about 40%)

Community forest (CF) has had some success in Myanmar but the model has focused on small areas and is cumbersome to negotiate. Progress has been slow: approximately 80,000 hectares of forest have been brought under formal community management since the CFI were issued in 1995. The National Forestry Master Plan sets a target of 980,000 hectares of CF established by 2030. In the Bogalay area, forest department has established 33,000 protected area (PA) near the surveyed villages. Furthermore, the largest area of intact mangroves of Bogalay in the Ayeyarwady delta is also protected as a Meinmahla Kyun Wildlife Sanctuary which is about 137 square kilometers.

3. STUDY AREA

In this research, three villages are selected namely Kyein Chaung Gyi, Kamalar and Armakan in the Kadonkani area, which situated in the south-west and 16 miles far from Bogalay city by water way. These villages are in the neighborhood of mangrove conservation projects such as working the Action Result Plantation (ARP) by the forest department and the Integrated Mangrove Rehabilitation and Management Project by JICA.

The study area is supported by forest resource with 11,855 acres and water resource with 856 acres. The three survey villages is composed of five small creeks and a river: namely, Kamalar creek (5 miles), Moutsoma Creek (4 miles), Methway creek (3 miles), Kyein Chaung creek (3 miles), Armakan creek (3 miles) and Tabatkyi river. Kyein Chaung Gyi village is far way 23 miles from Bogalay city by car and it takes at

least one hour. It can be used in winter and summer. Other two villages use only by water way.

This research limits the sample of 250 households that comprise three villages by using simple random sampling. Total number of household in these three villages comprises 625 households, with 375 in Kyein Chaung Gyi village, 75 in Kamalar village and 175 Amarkan village respectively. From which, 150 households, 30 households and 70 households are selected and total sample household is 250 which covers 40 % of population size of households in three villages.

3.1 Procedure of Estimations

The direct use value of the mangrove in terms of the local use is equivalent to the net income generated from the mangrove by the local people. The benefits from the mangrove are estimated in terms of timber, fuelwood, other materials and products for housing construction, and animal products such as birds, and crabs collected directly from the mangrove swamp. If the extracted products were sold, market prices will be used to calculate the net income generated (gross income is minus the cost of extraction). If the products were used only for subsistence, the gross income will be estimated based on surrogate price, that is, the market price of the close substitute.

The first approach is to use market prices of the close substitute for such a product. The second approach is to use the opportunity cost of time spent in collecting the product. However, notably, the cost of extraction must be deducted from the gross income to derive the direct use value. The formula for calculation of net income generated from direct use value of mangrove is shown as following:

Local Direct Use Value = Net income generated for local use = $\sum [P_i Q_i - C_i]$

Where, P_i = price of products

Q_i = Quantity of products

C_i = Cost involved in the collection of products

In estimation of the cost, this study uses fuel (diesel) cost for colleting of mangrove products by boat and estimates cost for time spending to collect the mangrove products, depending on the daily wage per person in their villages.

According to above equation,

Net income = Total Income (Gross Benefit) – Total Cost (Gross Expenditure)

To estimate the volume of fish products is estimated by applying Cobb-Douglas Production Function Approach. Volume of fish products is determined by the contribution of resources used in fishing terms of fishing vessels (boats), fishing gears, fishing trips and fisher species.

In general the production function for fishery products is as follows;

$$Y_{it} = f (K_{it}, L_{it}, O_{it}, M_{it})$$

where Y_{it} = log of output

K_{it} = log of capital

L_{it} = log of labour

O_{it} = log of other inputs

M_{it} = log of mangrove forest characteristics

$$yit = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_o o_{it} + \beta_{im} m_{it} + \varepsilon_{it}$$

4. RESULTS AND FINDINGS

4.1 Direct Use Values

The benefits from mangrove forest for local people in the study area are mainly derived by fuelwood, fishes and crabs although other benefits such as bamboo, nipa palm and cane also supported to some extent. Thus, total direct use value from mangrove resources by household is estimated by summing the direct use values from fuelwood, bamboo, nipa palm, cane, crabs, and fish products.

Fuelwood from the mangrove is the main energy source for coastal community. It is used locally for cooking, boiling, and sometimes, small amounts are burned to repel mosquitoes and other insects. On average, the household collected fuelwood from mangrove forest 979.54 kg/year, 441.6 kg/year and 644.07 kg/year in Kyein Chaung Gyi, Kamalar and Armakan villages, respectively. Using the market price of fuelwood, the average net income per household of fuelwood is 163.08 US$/household/year in Kyein

Chaung Gyi village, 116.4 US$/house/year in Kamalar village, and 144.44 US$/household/year in Amakan village.

Bamboo pole (tree) from the mangrove is also important for local households and it is used locally for house construction and sometimes selling for their extra income. On average, the household collected bamboo is about 618 tree/year and they cut 55.89 times/year. Using the market price of bamboo, the average net income per household of bamboo is approximately 292.4 US$/household/year in Kyein Chaung Gyi village, 5.0 US$/house/year in Kamalar village, and 18.5 US$/household/year in Armakan village.

Nipa palm is one of the mangrove products and is the main source of house construction in coastal community. In the survey villages, many houses are made by nipa palm and traditionally stitched its leaf flips to be used for roofing. The average nipa palm cut by household is about 5222 stick/year. Using the local market price of nipa palm, the net income per household of nipa palm 119.87 US$/household/year.

Number of households in Kyein Chaung Gyi, Kamalar and Amakan villages cut nipa palm from mangrove areas is 2.67%, 6.67% and 12.86% respectively. In some household, women are working at home for their household income by stitching nipa palm, at the rate of 0.83 US$ for one hundred nipa palm stitched. On average, the household cut nipa palm from mangrove forest 6600 stick/year, 400 stick/year and 8667 stick/year in Kyein Chaung Gyi, Kamalar and Armakan villages, respectively. The average net income per household from nipa palm is 174.58 US$/household/year in Kyein Chaung Gyi village, 6.67 US$/house/year in Kamalar village, and 178.15 US$/household/year in Armakan village.

Cane/Rattan is a tropical climbing plant and a long stick. These stems use as a material for making furniture. Based on survey information, households who collect the cane is very rare. There are only two households who collect it, one from Kyein Chaung Gyi village and other from Kamalar village. The local market price of it is about 0.042 US$ per stick. The net income per household from cane is approximately 16.67 US$/household/year.

On average, the household catch *crabs* approximately 261.41 kg/household/year. Using the local market price of crab of 1.71 US$/kg, the net income per household of crab is about 223.99 US$/household/year. Household catch crab from mangrove forest

372.94 kg/household/year, 184.89 kg/household/year and 226.4 kg/household/year in Kyein Chaung Gyi, Kamalar and Armakan villages, respectively. Based on price, the net income earned per household for crabs is approximately 322.43 US$/household/year in Kyein Chaung Gyi village, 134.82 US$/household/year in Kamalar village, and 214.75 US$/household/year in Armakan village.

Fish resources from the mangrove is the main source of food for coastal community and local people greatly depends on fish resources. The household caught a variety of fish is in average 753kg/year and they go fishing about 177.64 times/household/ year. The household involves in catching fish is 62.67 % in Kyein Chaung Gyi village, 83.33% in Kamalar village and 81.43% in Armakan village respectively. In Kyein Chaung Gyi village, the household catch fish from mangrove forest is about 1052.43 kg/household/year, 373.44 kg/household/year and 834.81 kg/household/year in Kamalar and Armakan villages, respectively. The average net income per household form fishing is 830.75 US$/household/year in Kyein Chaung Gyi village, 608.8 US$/household/year in Kamalar village, and 670.47 US$/household/year in Armakan village.

Based on the benefits from activities of households, total value of mangrove products by households is estimated. Among three villages, total value of mangrove products per household per year is 2289.829 US$ per household per year in Kyein Chaung Gyi village, 928.348 US$ per household per year in Kamalar village and 1274. 636 US$ per household per year in Armakan village respectively. The direct use vale of mangrove forest is in average at US 1497.6 $ per household per year.

Table 4.1 Direct Use Value from Mangrove Resources by Household

Village	Gross Income (US$) (a)	Cost (US$) (b)	Value/year (US$) (net income) (a-b)
Kyein Chaung Gyi	2815.2611	525.3421	2289.829
Kamalar	1198.356	270.0074	928.348
Amarkan	1617.113	342.4769	1274.636

Source: Survey data

As can be seen in Table, difference in gross income by household per year in three villages is due to availability mangrove products such as fuelwood, bamboo, nipa palm, crab and fish, and their prices.

Regarding the cost estimates, costs for mangrove products are higher in Kyein Chaung Gyi village than those in other two villages. It is because Kyein Chaung Gyi village is a little far from mangrove area and pass through Kyein Chaung and Kamalar creeks. They use boat for collecting mangrove products and they incur cost of fuel oil for boat. Another reason is that households in Kyein Chaung Gyi village collect a larger amount of mangrove products than that of other two villages.

When respondents collect fuelwood, some use boat and some use to go by foot. In Kyein Chaung Gyi, respondents' collected amount of fuelwood is more than those in Kamalar and Armakan villages and frequency of collecting in Kyein Chaung Gyi village is also more than in other two villages. According to some respondents, in Kamalar and Armakan villages, they go frequently to collect fuelwood – everyday or once in two days, and they collect by themselves (by foot) without any boat.

For the case of bamboo, respondents from Kyein Chaung Gyi village cut many bamboo trees and go frequently to cut them and resell them. In Kamalar village, respondents just go to cut bamboo trees for their own use. In the whole year round, they cut only 40 trees and only 4 times in a year. On average, they collect about 10 trees per trip and sometimes they may use boat. In Armakan village, however, respondents cut 84 trees in 38 times and mostly they go by foot.

For cutting Nipa Palm, households in Kyein Chaung Gyi and Armakan villages cut a large amount of stick and they use boats. For crab catching, respondents from Kyein Chaung Gyi village go frequently than those from other two villages. So, they cost fuel oil for boat. The same condition is in catching fish. But, in Armakan village, some households catch fish near their houses and some use boats without engine. Overall, larger the amount of mangrove products collected, higher the cost of collecting them, because respondents use boats and incur cost of fuel oil. Especially, Kyein Chaung Gyi village is a little far to collect mangrove products than that of other two villages.

4.2 Volume of Fish Products

The production function analysis that used in this research can estimate the coefficients of variables that determine the volume of fish.

Table 4.2 The Estimated Coefficient of Ordinary Least Square Regression Analysis

lnfishcatch	Monsoon		Rest of the Year	
	Coef.	Std.Err.	Coef.	Std.Err.
Constant	10.96114	9.145742	2.687844	10.31016
Lncapital	.0000312	.0000281	.0001141	.0000312
Lnlabor	.0000771	.0000589	.0001587	.0000646
Lndistance	-2.049775***	0.640824	-5.243015**	0.8136129
Lntrip	1.256998***	0.3007769	1.965408***	0.2057696
lnfuel	0.0006733***	0.0000896	0.0006786***	0.0000978
timespend	-4.483559*	4.176272	7.452072*	4.198788
lnmangarea	0.0392683*	0.0489885	0.08834303*	0.0544371
no. of obs	248		248	
Adj R-squared	0.7885		0.7792	

Note: ***, **, * indicate statistical significance levels at 1%, 5% and 10%

Result from the calculation, volume of fish catch in monsoon is greater than that in rest of the year as shown in the table. The mangrove characteristic value, distance from shore (miles), is significant both in monsoon and in rest of the year, but negative relation to volume of fish catch. It means 1% increase in distance from the shore decrease 2% and 5% of fish catch in both seasons, and closer to the shore, the greater the fish catch. Fishing effort variable such as time spend is significant in monsoon is inversely related to the volume of fish catch, but it reverses in rest of the year. Number of crew (labor) is directly related to volume of fish catch. However, in both seasons, there is a significant relation in number of trip and volume of fish catches. In the both seasons, mangrove area is significantly related to volume of fish catch. The result indicates 1% increase in larger the mangrove area, fish catch increases 0.03% and 0.08% in both seasons respectively. It means that the larger the area of mangrove, the more productive local fisheries is.

4.3 Perception on Mangroves and Conservation

Regarding the utilization of mangrove resource, about 95% of respondents in three surveyed villages well know about the importance of mangrove. They answer that mangrove is important for food (77.6%), housing materials (81.9%), climate change (42%), medicinal products (17.3%) and ecology (25.4%) respectively. Mostly view they have right to use mangrove resources. They mention that mangrove ecosystem services are directly important to them with respect to their experience and knowledge. About 59.3%, 55.3% 49.3% and 21.8% of respondents answer mangrove ecosystem services are very important for supporting offshore and near shore fishery production, source of wood, fuel and building materials, fish habitat and source of food.

On the contrary, their answer shows they don't know about importance of aesthetic appeal, cultural value and recreation value, and these benefits do not affect on their livelihood because, perhaps they cannot enjoy natural aesthetic and recreation. Again, no respondents know importance of carbon store which provides by mangrove resources. More than 80% of respondents are also not aware the services of water quality maintenance and wildlife habitat from mangrove resources. However, 73% of respondents mention that shoreline protection is important for them. Based on the survey results, respondents in three villages acknowledge mangrove resources that serve as source of wood, fuel and building materials, and food are very important because they always heavily operate their daily life in collection and cutting of fuelwood and fishing activities. The fact that mangrove services provide shoreline protection is viewed by 28.6% of respondents as very important and 71.3% of respondents as important.

About 65.6% of respondents are aware that some mangrove trees have medicinal properties and some are used to them, but they are just traditional ones and not using extensively and impressively, and thus these are not found by commercial basis or marketable practice.

On the views on importance of mangrove products and services, more than 60% of respondents from Kamalar and Armakan villages view that mangroves are very important source of wood, fuel and building materials. In Kyein Chaung Gyi village, however, only one third of respondents' views that mangroves are very important and about 52.7% view neither important nor unimportant.

Most respondents from all three villages have similar view on mangrove services as supporting offshore and near show fisheries production which is very important. Similarly, many respondents from three villages mention mangroves are important for source of food. About 41.3%, large share of people, of respondents in Kyein Chaung Gyi answer mangroves are important for fish habitat although approximately 56% of respondents from Kamalar village and Armakan villge answer mangroves are very important to fish habitats. Regarding medicinal properties, 65.6% of respondents from all three villages have similar view that it not significant for them.

All respondents from three villages do not mention the mangrove services are important for aesthetic appeal, cultural value and recreation value. Many respondents from thee villages feel aesthetic appeal from mangroves is not important for them while some of respondents answer it is not significant in their daily lives. More than 90% of respondents from all villages do not aware cultural value of mangroves. As recreational value, some answer they aware it, but it is indifferent and not important for them.

Almost all respondents in survey villages have not any knowledge about carbon store as advantage for ecosystem that provide from mangroves. As water quality service, 100% of respondents in Kyein Chaung Gyi know nothing about it. In Kamalar and Armakan villages, 20% and 10.7% of respondents mention it is important. Only about 8% of respondents mention that mangroves are important for wildlife habitats and about 74% of respondents don't know about it in Armakan village. Conversely, all respondents from three villages know very well about the importance of mangrove services for shoreline protection.

According to their mention, more than 50% of respondents view that mangrove forests have been decreased a little, within five years. Again, many respondents view changes in mangrove forest can affect change in volume of fish (68.8%), availability of fuelwood (70.3%) and diversity of fish species (62.2%). They feel that they are facing insufficient benefits from mangrove resources due to loss of mangrove areas.

Many respondents realize the main purposes for mangrove conversion are for cropping, wood and fuelwood, and housing and living land in their local areas. Especially, most respondents in three villages answer mangroves are destroying for cropping.

Secondly, more than 65% of respondents have similar view that mangrove conversion is due to exploitation of wood and fuelwood.

Many respondents realize the main purposes for mangrove conversion are for cropping, wood and fuelwood, and housing and living land in their local areas. Especially, most respondents in three villages answer mangroves are destroying for cropping. Secondly, more than 65% of respondents view that mangrove conversion is due to exploitation of wood and fuelwood. According to survey information, about 66% of respondents feel their local community always suffered from salt water intrusion. That flood occurs frequently is viewed by 57.5% of respondents while 76.13% of them answer their community is sometimes affected by storms. Due to these events, the local community has been experienced by infrastructure damages such as roads, bridges and schools.

Most of respondents are aware that the mangrove conservation activities in their local community have been undertaken. However, they haven't deeply involved the activities of establishment for local supply reserve forest and protected public forest, community forest, and formation of user groups and so on. Instead, they participate in nursery and mangrove gardens and tree planting programs by the forest department and JICA project of Royal Tree as general workers. This is a partly support to their family income because these programs do not employed permanent workers for all and some local people just work for the program even at the free time of their work, such as off-farm season, lack of job, and lack of fishing activities and so on. According to respondents, they earn 2.5 US$ per day from the JICA project and 2.08 US$ per day from the forest department.

Members from some households work in these activities just like casual workers. As perception on mangrove conservation, 86.7%, 86%, 59.16%, and 52.7% of the respondents view it is important for protecting storm, producing wood and fuelwood, supporting fish habitat, and preventing salt water intrusion.

For the better and effective protection and maintaining mangrove forest, most of respondents prioritize to mangrove planting, on-ground works (fencing), community education and community engagement.

5. CONCLUSION AND RECOMMENDATIONS

This research mainly focuses on estimating the use value from mangroves and factors that influence fish catches in mangroves. Mangrove products in the surveyed villages are fuelwood, bamboo, nipa palm, rattan, medicinal products, fish, and prawn. Based on the local market prices, the total direct use value of these product collected by household per year. This research estimates the use value derived from the mangrove resources, according to survey result. Thus, total direct use value from mangrove resources by household is estimated by summing the direct use values from fuelwood, bamboo, nipa palm, cane, crabs, and fish products. Total value of mangrove products per household per year is 2289.829 US$ per household per year in Kyein Chaung Gyi village, 928.348 US$ per household per year in Kamalar village and 1274. 636 US$ per household per year in Armakan village respectively. The direct use vale of mangrove forest is in average at US 1497.6 $ per household per year. It reflects the economic dependency of local community on mangrove resources and highlights the importance of mangrove and conservation efforts to sustainable ecosystem.

Moreover, as expected, the research finds that the distance from the shore to fishing site has a significant effect on amount of fish catch. This result indicates that increase in the distance from a mangrove area to fishing site decreases the amount of fish catch. And, the increase in the size of mangrove area increases the amount of fish catch. This finding states that the larger the area of mangrove, the more amount of fish catch. Thus, it is indicated that it is important to conserve mangrove forests and needed to implement effective mangrove conservation activities in the local community.

According to respondents in the surveyed villages, most of local people notice provision services from mangrove ecosystem and some are aware of supporting services. However, many local people don not know very well about the regulation and especially cultural services which include recreation, aesthetic, science and education, spiritual and historic point of view. Thus, it is needed to promote education and awareness of local people to understand the actual and important values of mangrove resources and to participate actively in mangrove conservation activities in their local communities. On

the other hand, the government requires the profound changes in how local communities are incentivized to cooperate in protection and managing the mangrove resources.

Loss of biodiversity leads to degradation and depletion of ecosystem services and then affects to livelihood of local people in coastal region because the livelihood of community dwellers depends heavily on ecosystem services.

According to results, the total direct use value of mangrove products is high to some extent, regardless of other services from mangrove resources and local community mainly depends on mangrove resources for their livelihood. It points out there needs to more attention to conserve mangrove forest by the local people and the policy makers for the sustainable development of the country. Moreover, valuing the mangrove products for other useful mangrove species and ecological services are needed to be undertaken in the future. Detail research and studies on different use and non-use value of mangrove resources should encourage estimating benefits that derived from mangrove products and services. Some advantages of mangrove products such as medicinal properties are needed to explore and identify extensively.

Moreover, community's awareness and knowledge on ecological services provided from mangrove resources are to be promoted to avoid underestimation of value of mangrove resources. Simultaneously, it is required that more awareness and attention to the importance of mangrove resources by local community to conserve mangrove resources. To fulfill this requirement, some incentives and education programs need to implement to be broader participation of local communities in the mangrove conservation activities.

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Land Degradation and the Effect of Sustainable Management Practices on Crop Profitability in Myanmar (Case Study: Taung Tha)

Dr.Thida Htoo[1]

Abstract

This study attempts to identify how land degradation adversely affect the farming households and how land management practices positively affects on crop profitability. Primary data for the study were collected through constructed questionnaire, focus group discussions, and personal observations while secondary data were collected from relevant ministry and department's reports and records. The findings of the research showed that land degradation is indirectly caused by lack of support, lack of organization and poverty and shortage of rural labor while direct cause of land degradation such as missing or insufficient soil conservation, irrigation with salty water, and natural causes. Farmers got land management practices through the information from ministry of agriculture and irrigation, and from their relatives and friends. They made decision to invest in land management practice of use of gypsum. Due to the land management practices, farmers gain crop profitability in their farming.

Keywords: *land degradation; land management practices, use of lime/gypsum*

1. INTRODUCTION

Land Degradation is influenced by natural factors and human-induced factors. According to the natural factor, wind erosion is very serious problem which cause extensive soil degradation and loss of soil fertility in the dry zone central plain of Myanmar. In the dry zone, hot and dry wind normally destructed the natural vegetative cover. In the dry zone, heavy intensity of rainfall and runoff made the loss of water. Most human-induced Land Degradation occurs as a result of the interactions between the land and land users. Under certain conditions, the rural poor can find themselves perpetuating patterns of land degradation, because they have no alternative ways to ensure their survival in such hostile environments. These "asset-less" poor are most likely to suffer from land degradation, resulting in a "poverty environment trap". Thus sustainable land management need to be practiced. Sustainable land management means the adoption of land use systems that enhance the ecological support functions of land with appropriate management practices, and thus enable land

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users to derive economic and social benefits from the land while maintaining those of future generations. Better land management must provide immediate beneficial effects on crop profitability.

2. HOW FARMING HOUSEHOLDS ARE AFFECTED BY L AND DEGRADATION IN STUDY SIDE

Currently Taungthar Township in Mandalay region is seriously caused by land degradation because physical features of land in Taungtha Township have sandy soil that cannot hold the water capacity because of water erosion during the raining season. In addition low and uneven rainfall distribution and a degree of soil erosion, all of which result in severe land degradation. The form of sheet, rill occurred on the cultivated land and thereby effecting yields and income level. Furthermore, saline ground water evapotranspiration mainly caused salinization. This made soil surface salted crust. On the other hand, utilization of saline irrigation water also caused salinization. Because of the dry zone, scanty rain is not enough to wash out the accumulated salts. Salinization is also cause of land degradation. Decrease in soil productivity cause the lesser amount of biomass, loss or less vegetative cover to the soil, low organic matter and thereby causing biological and physical degradation of the soil and in turn lead to reducing water holding capacity of soil as well as reducing average crop yields and increasing crop failure. Rehabilitating and reclaiming land in the Dry Zone were viewed as a priority by all stakeholders involved in rural development. This study is intended to identify the causes of land degradation in Thaugtha and to identify land management practice and to examine the effect of land management practice on crop profitability.

3. DATA COLLECTION

Sampling of households was achieved in two stages: sampling of the villages and then sampling of the households. A village namely Hle Pwe Kone was randomly selected for the study from the list of village tract. At village level, 140 households are randomly selected from those areas which have experienced moderate soil erosion. Data collection occurred between October and November 2016 using structured questionnaire and analytical method is used for analyzing the data.. Primary data for the study were collected through household questionnaire surveys, focus group discussions, and personal observations while secondary data were collected from relevant ministry and department's reports and records.

4. FINDINGS OF THE STUDY

4.1 Profile of the Farm Households

The study revealed that the majority of the sample households were male headed accounting for 85.2 percent while female headed were 14.8 percent. It can be seen that there are more male households than female households in study area. According to the age group, 0.71 percent of the household heads are at the aged under 20 years. And 15.71 percent are at the aged between 21 to 40 years old and 52.14 percent are at the age between 41 to 60 years, 30.71 percent of the household heads are at the aged between 61 to 80 years and 0.71 percent is at the aged of 80 years and above. It can be seen that most of the household head are aged between 41 to 60 years in the study areas. The average age of household head is 54.16 years.

According to the marital status, 7.86 percent of the household head are single, 79.29 percent of the household head are married, 0.71 percent of the household head are divorced, and 12.14 percent of the household head are widowed in the study area. It can be seen that most of the household head are married. According to the household size, the average household size is 5.4. I the study area, there are two to four dependent person on the family accounting for 71.43 percent.

According to the total land holding, 58.57 percent of the household head have one to 10 acre of total land holding, 31.43 percent of the household head have 11 to 20 acres of land holding, 9.29 percent of the household head have 21 to 30 acres of land holding. The average land holding is 10.65 acres.

According to the farming experience, the majority of the sample household have farming experience with 20 to 40 years. 17.14 percent of the household head has farming experience with 41 to 60 years, 24.29 percent of the household head has farming experience under 20 years. Only 0.71 percent of the household head has farming experience over 60 years. It can be seen that most of the household heads have farming experience between 20 to 40 years. The average farming experience of household head is 28 years in the study areas. In the study area, all household had tenure security due to land certification and they access land from parent's inheritance.

In terms of the level of education attained by the household head, it can be seen that 55.6percent of the household heads were primary level and 25.4 percent were secondary level. The other 19 percent were illiterate, graduate, and no read and write. According to the survey data, education level of household head is primary level. The profile of the household can be seen in Appendix Table (1).

4.2 Causes of Land Degradation by Farmers' Perception

The findings of the research showed that according to the farmers' perception, land degradation is direct cause of land degradation such as missing or insufficient soil conservation, irrigation with salty water, and natural causes (change in temperature, change of seasonal rainfall, heavy/extreme rainfall (intensity and amounts), and shortening fallow period. Salinization and rill erosion are common features rendering some areas out of use while it is indirectly caused by lack of support, lack of organization and poverty and shortage of rural labor.

The direct cause of land degradation is classified into five groups. Major direct cause of land degradation can occur due to lack of soil management; lack of crop and rangeland management; deforestation and removal of natural vegetation; over-exploitation of vegetation for domestic use, overgrazing; and natural causes.

According to the survey data, direct cause of land degradation reveals that 20.5 percent of farmers responded insufficient soil conservation practice under the title of lack of soil management. About 17.5 percent of farmers responded utilization of irrigation with salty water under the title of lack of crop and rangeland management. About 4.6 percent of farmers responded that it was caused by excessive use of fuel wood under the title of over-exploitation of vegetation for domestic use. Furthermore, natural causes also led directly to land degradation. About 22 percent of farmers responded that it was caused by change in temperature and 18.3 percent of farmers responded that it was caused by change in seasonal rainfall that led to land degradation. In sum, the land degradation in the study area was caused by human induced practices including insufficient soil conservation due to shortening of the fallow period, irrigation with salty water; and natural causes such as change in temperature, and change in seasonal rainfall. Salinization in this study area caused by use of saline irrigation water and evapotranspiration of saline ground water, where low rainfall is insufficient to wash-out accumulated salts. Irrigation with salty water directly lead to land degradation that caused farmers to reduce crop production, decrease farm income, and temporarily or permanently abandon some plots. In sum, lack of soil management, lack of crop and range land management and natural causes are the main reason for direct cause of land degradation. Farmers' perception on direct causes of land degradation can be seen in appendix table (2).

Indirect causes are more substantial for land degradation because respondents mainly responded the issues on the lack of sufficient support by extension staffs, lack of organization, collaboration and support by local and international organization, no afford to invest in resource conservation practice by the farmers themselves, shortage of labor, high price for agricultural inputs

in the study areas. According to the Parlberg (1994) and Lisa Svenssion, farmers cannot afford to invest in resource conserving practices so instead they continue to plough as they cannot wait for rangelands to recover and thus these practices will lead to increased land degradation and worsen poverty. Due to the fact that only existing old farmers are continuously working in agriculture with their traditional management practice and on the other hand, their generation (young people) migrated with their herb to better off areas and seeking for temporary /blue collar job at border areas and abroad. That is why the shortage of rural young labor appears to be an important constraint to improved land management. Evidence showing that agricultural extension programs are associated with adoption of many improved land management practices was found (Maureen Zulu, MukataWamulume and Johnny Mugisha). In the study area, Lack of social capital especially extension program and training and participations cause farmers to reluctant to conserve their degraded land and thereby leading to land degradation indirectly. Farmers' perception on indirect cause of land degradation can be seen in appendix table (3).

4.3 Land Management Practices of Farming Households to Combat Land Degradation

In spite of low and erratic rainfall and limited number of crops that can grow under dry zone conditions, there are wide range of conservation measures. These are physical conservative measures, biological conservative measure, agronomic conservation measures, and soil management practices. The study area is fourteen miles far from Taungthar which is located in middle part of Myanmar, but farmers get land management practices through farmers to farmers and extension staffs to farmers because responsible person at the department of agriculture gave awareness concerning with crop rotation, green manure, use of lime/gypsum and deep tillage to farmers on how to make soil conservation to achieve sustainable land management practices and increase their potential yields. To overcome this problem, farming households made decision to invest in land management practices due to encouragements and their expectation of highest yields and net returns. That is why in the study area, farmers used land management practices such use of lime/gypsum, and deep tillage to combat land degradation.

4.4 Land management practices of Use of lime/gypsum

The result indicate that the parameter for farm size is statistically significant ($p<0.10$) with positive sign. This means that as the farm size increases, use of lime/gypsum practice significantly increased. This is expected that the larger the farm size, farmers will more likely to use lime/gypsum

practice. Gypsum is expensive for farmers but the larger the farm size, the average cost of gypsum decrease. This indicated that larger farms have greater economies of scale. That is why farmers are more likely to use lime/gypsum as the farm size is larger. Age parameter is statistically significant ($p<0.05$) with negative sign. The negative sign of the coefficient of age of the household head implies that older the age of the household heads are, the less likely to adopt the use of lime/gypsum. The old aged farmers know that the use of lime/gypsum practices are necessary to better way for controlling salinization. On the other hand, as older farmers were less likely to change practices due to a shorter planning horizon. It indicated that older farmers need to be take time to adopt land management practices. Education parameter is expected to be positive sign. In the model, parameter for education is positive sign. This means that the more the year of education the household heads have, the more likely to adopt the land management practice of use of lime/gypsum. As a result of more years of schooling, farmers were more willing to adopt land management practice. The older the age of household heads are, the more farming experience they have. The more farming experience they have, the more are likely to adopt the land management practice of use of lime/gypsum. Because of their large farming experience of 28 years, farmers knew that it is the best way to use of lime/gypsum for conserving salinization. The parameter for family labor is expected to be positive. However in the model the parameter for family labor is negative sign. It means that the more the family labor have, the less is likely to adopt the land management practice of use of lime/gypsum. It was the fact that although there are more the family labor in household, adult labor are willing to move to urban area for searching job instead of doing farming and conserving their farm land. Only the women could not participated in land management practices due to their housekeeping work. The parameter for total profit is expected to be positive. Total profit parameter however is statistically significant ($p<0.01$) with negative sign. The negative sign of the coefficient of total profit implies that the more the total profit farmers earn, the less likely to adopt the use of lime/gypsum practice. Instead of reinvesting in land management practice of use of lime/gypsum, farmers reinvest their profit for their generation to get job at border areas or abroad. This is because there is uncertainty for higher earnings gained from land management practices by reinvesting in use of lime/gypsum. Instead, it was certainty for higher earning gained from employing at border areas and abroad. That is why farmers are no longer willing to invest in farming and land management practice. (Appendix table 4).

5. NET RETURN FROM ADOPTION OF LAND MANAGEMENT PRACTICES ON CROP PROFITABILITY

In the study area, farmer mainly produced groundnut and seseme. However during the study time, farmers had loss of seseme due to natural causes like draught. To estimate the net return from adoption of land management practices on crop profitability, it estimates the unit cost per acre, yield per acre, revenue per acre and net income per acre of groundnut. In growing groundnut, farmers who use such land management practices of apply residue could produce groundnut yield of 28basket per acre compare to using other land management practices such as green manure, use of gypsum, deep tillage and apply mineral for which yields are over 30 basket per acre. Unit cost per one acre for using the land management practices of apply residue is 62270 kyats. Revenues per acre for apply residue is 224000 kyats. The net incomes for this practices is around 150000 kyats.

Farmers who use land management practices of apply residue get net profit of 2.5 time for incurring one unit of cost.

Farmers who apply mineral as fertilizer improvement practice could get yield of 37 baskets per acre. The unit cost per acre is kyats 65850. Revenue per acre is 296000 kyats and net profit is 230150 kyats per acre. Applying mineral can get 3.5 time profits for farmers for incurring one unit of cost. The study area which is under the dry zone is necessary to apply fertilizers for supporting and enhancing a growth of crops. Farmers know that applying mineral fertilizer is better response for high yield but they can afford it only when they have money in their hand.

Farmers who use land management practice of deep tillage get yield of 47 baskets per acre. The unit cost per acre is 106827 kyats and revenue per acre is 376000 kyats. The net profit is 269172.1 kyats per acre. Deep tillage can get only 2.5 time profit for farmers for incurring one unit of cost. Profit with deep tillage is less than profit with applying mineral although practice of deep tillage get higher yield than yields for applying mineral. This is because it requires mechanical traction and ripping which are expensive for rent even it has a long lasting effect. On the other hand it needs to supplement with mulching. It needs the right guidance for optimum utilization. That is why majority of farmers do not enthusiastically use the practice of deep tillage though they get higher yields.

Farmers who use green manure could get yields of 40.4 basket per acre. The unit cost per acre is 83811.54 kyats and revenue per acre is 320000 kyats. The net profit is 236188.46 kyats per acre. Green manure can get nearly three time of profit for farmers for incurring one unit of cost. Per unit cost is rather high due to requirements of local or improved seed. Moreover, this practice is labor and time consuming. Because of labor and time consuming, farmers may be reluctant to use this

technique because of labor shortage.

Farmers who use gypsum could get yields of 41 basket per acre. The unit cost per acre is 95256 kyats and revenue per acre is 328000 kyats. The net profits is 232744 kyats per acre. The practice of gypsum get profit of 2.4 time for farmers for incurring one unit of cost. Due to the fact that the calcium involves in gypsum make strong for soil and facilitate the sustainable technique, it response sufficient yields for farmers, but the net profit cannot give good response for them. (Appendix Table.5).

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Appendix Table (1) Demographic characteristics

	Number of respondents	percentage
Age of farmers (years)		
1-20	1	0.71
21-40	22	15.71
41-60	73	52.14
61-80	43	30.71
80 and above	1	0.71
Total	140	99.98
Marital status	Number of respondents	percentage
Single	11	7.86
Married	111	79.29
divorced	1	0.71
widowed	17	12.14
Total	140	100
Household size (unit)	Number of respondents	Percentage
2-5	78	55.71
6-9	58	41.43
Above 10	4	2.86
total	140	100
Number of dependent (unit)	Number of respondents	percentage
0	25	17.86
1-4	100	71.43
5-8	15	10.71
Total	140	100
Total land holding (acre)	Number of respondents	percentage
0	1	0.71
1-10	82	58.57
11-20	44	31.43
21-30	13	9.29
Total	140	100
Farming experience (year)	Number of respondents	percentage
Under 20	34	24.29
20-40	81	57.86
41-60	24	17.14
60 and above	1	0.71
Total	140	100

Source; Survey data

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Appendix Table (2) Farmers' Perception on Direct Causes of Land Degradation

	Numbers of Respondents	Percent
Over exploitation of vegetation for domestic use		
Excessive gathering of fuel wood	14	5.3
Removal of fodder	12	4.6
Deforestation and removal of natural vegetation		
Expansion of urban settlement areas and industry	0	0
Inadequate agriculture practice on steep slop	8	3.0
Natural causes		
Change in temperature	58	22.1
Change in seasonal rainfall	48	18.3
Heavy extreme rainfall intensity	17	6.5
Wind storm	11	4.2
Flood	0	0.0
Topography	1	0.4
Lack of crop and rangeland management		
Reduction of plant cover and residues	4	1.5
Shortening of the fallow period	49	18.6
Irrigation with salty water	46	17.5
Over irrigation	3	1.1
Excessive soil evaporation and runoff	9	3.4
Bush encroachment and bush thickening	7	2.7
Occurrence and spread of weeds and invader plants	17	6.5
Inappropriate use of manure, fertilizer	18	6.8
Lack of soil management		
Cultivation of unsuitable soils	24	9.1
Missing or insufficient soil conservation	54	20.5
Heavy machinery use	0	0.0
Tillage practice	16	6.1

Source: Survey data

Appendix Table (3) Farmers' Perception on Indirect Cause of Land Degradation

	No. of respondents	Percent
Lack of law	5	1.9
Population pressure	5	1.9
Inaccessibility to infrastructure	8	3.0
Poorly defined land tenure security	22	8.4
Lack of access to markets	28	10.6
High price for agricultural inputs	48	18.3
Lack of education	50	19.0
Lack of awareness and knowledge for conservation	55	20.9
Shortage of labor	73	27.8
Not afford to invest in resource conservation practice	83	31.6
Lack of organization, collaboration and support	85	32.3
Lack of support by government	90	34.2

Source: Survey data

Appendix Table (4) Regression result of the land management practices of Use of lime/gypsum

Variable	Parameter	t-statistics
Farm size	0.177*	(1.92)
Age	-0.0351**	(-2.14)
education	0.0250	(0.49)
Farming experiences	0.00565	(0.42)
Family labor	-0.0261	(-0.36)
Total profit	-0.000000546***	(-2.62)
Constant	0.381	(0.50)
Pseudo R^2 = 0.136		
chi^2 = 11.82		

** p<0.05 *** p<0.01"

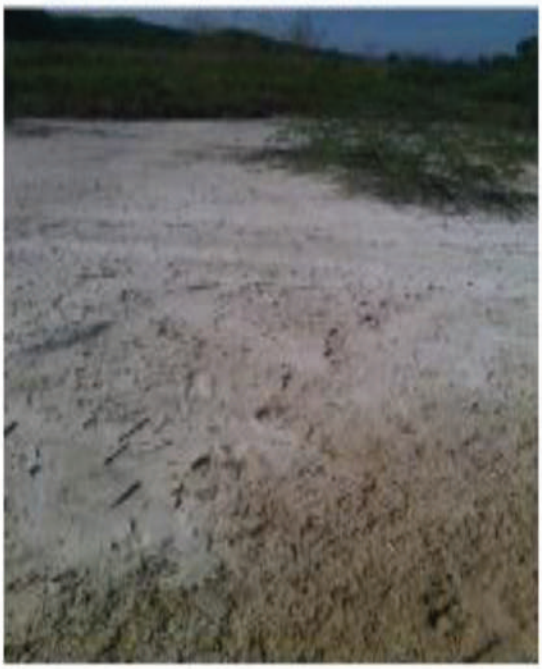
Source: survey data

Appendix Table (5) Net Return from Adoption of Land Management Practices on Crop Profitability for Groundnut

measure	Unit Cost (Ks/acre)	Yield (basket/acre)	Revenue (kyats/acre)	Net income(kyats)
Green manure	83811.54	40.4	320000	236188.46
Use of gypsum	95256	41	328000	232744
Deep tillage	106827.9	47	376000	269172.1
Apply mineral	65850	37	296000	230150
Apply residue	62270	28	224000	161730
Gypsum+ deep tillage + green manure	124287	47	376000	251713

Source: Survey data

Figure of Salinization in Affected Area



Soil Condition in Affected Area



Conservation measure



Pilot field for Soil Conservation



Pilot field for Soil Conservation



Economic Losses to the Agricultural Sector from Water Pollution (A Case Study on Meiktila Industrial Zone)

Tin Tin Htwe[1]

Abstract

This study identified the economic losses on the farmlands from the water pollution of the weaving businesses in Meiktila Industrial Zone. Farmers from the polluted areas and non-polluted areas having the similar demographic and socio-economic and farm condition were included in the survey.The production function of the farm's output (paddy yield) is developed by applying regression analysis. The explanatory variables include *farm condition* such as farm paddy culture, location of the farmlands, type of soil, and the level of waste water and *farm inputs* such as seed, fertilizer, pesticide, labor and capital for the paddy cultivation. The results showed that the distance of farmland from the waste water channel and the fertile soil of the farm had positive effect on the paddy yield and the water pollution had negative effect. With regard the use of the input for the cultivation, *all the inputs* used in the farming except pesticide are positively related with the paddy yield, Thus, the study found that in spite of having the same socio-economic background of the farmers and same experience on the farming work, the difference in distance to the waste water channel, the soil condition and the level of the waste pollution determine the yield of the farm production and economic impact on the output. The study estimated that the polluted-farm faced the economic losses about half per cent of the income of the non-polluted farmland due to the adverse effect. The estimated total economic losses is approximately 13.50 million Myanmar Kyats during the studied year 2015. Finally, it is suggested to reduce the avoided cost, the farmers should investigate the ways of removing the waste water by implementation a dye treating facilities to improve the waste water which could be used again in agricultural production.

Keywards : Pollution, polluted areas, non-polluted areas, waste water farmlands.

1. INTRODUCTION

Agriculture is one of the most important economic sectors of developing countries. Today some emerging countries are changing their directions to develop their economy and to keep abreast of the other competitive countries through diversification strategies for the industrial development of the countries. Hence, the change of the strategies cause to some constraints for the agriculture sectorwhich are weather changes, price fluctuation, water pollution, over-use of

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chemical fertilizers, soil degradation , shortage of farmers etc. Some of them are natural threats, and some are man-made challenges.

Whereas that engine has contributed to the growth of the economies to some extent, there are unavoidable environmental threats generated from the industrial development which are air pollution, water and soil pollution causing negative effects to the stakeholders of neighbouring community. For example, the free flow of the untreated industrial firms to the agricultural farms and fish pond causes the damaged to the farm produce, death of the fish and health of the farmers.

There are many cases about water pollution problems generated from industrial sites of the countries especially in developing economies. According to research study, Jolly et al.,(2012) found water effluence fromdyeing industry affects negatively on agricultural sector with soil degradation, slow growth pattern, and decrease in the yield of wheat crop. The effects of the different dilution of the treated and untreated effluent water on the chemical position of soil and the crop yield are compared in their study. The wheat plants in the untreated soil grew up with fewer nutrients from the soil which was the reflection to the yield of the crop seed and its food value. One study of Vietnam is concerned with the water pollution from the industrial parks in Can the city, there are financial problems from the reduced crop yields, and also incidence of health problems of the farmers due to the water pollution.

There are several economic researches studying on the agriculture issues of Myanmar; majority of them are studies upon the country's agriculture policy, the role of agriculture in the economic development of Myanmar, study on the situation of food and agriculture statistics, impacts of pesticides used in agriculture etc. A few researches studying environmental impact on the agriculture sector in Myanmar is seldom. This endeavor to do the research on the losses in the agriculture sector due to the industrial pollution is needed which could encourage the increase in the productivity of the agricultural products.

The paper is to analyze the economic impacts from the water pollution problems generated from Meiktila Industrial Zone which is situated in the middle part, hot and dry region of Myanmar. Before the establishment of the industrial zone, the water from pond can be used for the faming.After about five- year set-up of the industrial zone, the pond is polluted with industrial dye water which destroys the farmland areas around the pond.

Although almost all of the businesses emit the solid waste, wastewater, bad smell and dust to their environment, the weaving firms is the major polluters for the agricultural farmlands near

the industrial zone. There are a total of 274 manufacturing firms out of which weaving firms is the largest portion with its contribution ratio about 64% of the total number. Thus, the emitted waste water from the weaving businesses damages their environment including agricultural farms around the industrial zone. The total water consumption of weaving firms is a huge amount ranging from 10,000 gallons to 16,000 gallons per day (Report of the industrial zone committee, 2015). However, almost all of these firms emit the dyed water without making treatment.

As the consequence of these conditions, the yield of the crops changes negatively: decrease in the yield of crops, low quality in the farm produce and unfavorable health conditions from the consumptions of these crops. Moreover, the farmers could not rely on their farming business as the major source of income and change their way of living to other attractive jobs. Considering the impacts above, this study was conducted by the following objectives.

1.1 Objectives of the Study

The main objective of the research is to explore how farmland and farming household are affected by water pollution. Specific objectives are as follows:

1. To identify the impacts on farmland and the ways farmers cope with the problems, and
2. To quantify and estimate the economic losses from the damage.

The study seeks to answer the following questions:

1. What are the impacts on farming in the village?
2. What are the measures that farmers are adopting to cope with those impacts?
3. What are the determinants affecting the paddy yield of the farmland?
4. What are the economic losses of the polluted farmlands?

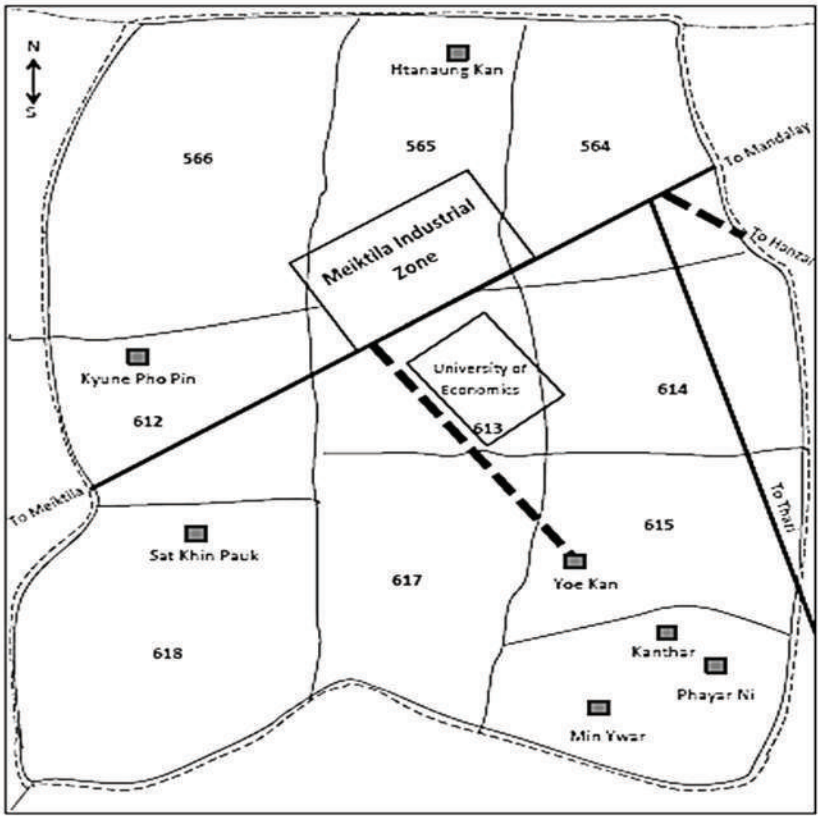
1.2 Scope and Method of the Study

The study focused the impacts of the farmlands and farming households affected by the weaving businesses from Meiktila Industrial Zone. In the neighbouring of the industrial zone, there are seven villages among which the nearest villages groups of Kyune Pho Pin and Hta-naung-kan were selected as studied areas. From the areas, the farmlands plot no. 564 and 565, which location is at the lower land compared with others in the area, are badly polluted, It is situating near Kokko Pond and the waste water channel of the industrial zone. However, the

farmlands of plot 566 are situated a far distant oppositely about one-mile away from direction of the flow of the wastewater channel and are considered as control group.

Figure 1.1

Picture showing the location of Industrial Zone and Farms



Source: Land Accounting Department,2017

Figure 1.1 shows the locations of the farmlands and the industrial zone. The study selected the plot 564, 565 and 566 from the Hta-naung-kan Village group. The plot 566 site is used as the control area because it is located further away from the polluted water. For the objective of the study, primary data as well as secondary data relevant to this research were used. For the primary data, interview with the farmers from the farm sites were conducted by using structured questionnaire in which personal interview and personal observation methods were performed.

The questionnaire asks and investigates the demographic background of the farmers and farming, the crop cultivation condition, the water pollution and the impact of the waste water on the farm work, the methods of soil treatment and the cost incurred and the health condition for the

use of the water. The detail research design is presented in the following section. The first time interview including with 20 farmers was conducted at the beginning of the month of January 2016.

For the secondary data, the literature review of the study was made by accessing the online website, reviewing the reference books, and similar researches regarding the water pollution from the industrial waste effluence to agricultural farms. Frequent meetings and discussionswith the focus groups were held during the period of the whole research process to obtain the required information about the farms and water pollution. Focus group includes the stakeholders of the industrial zone such as chairman of the industrial zone committee, the chairman of the administration of the Hta-naung-Kan Village group, agricultural planning department and the responsible persons from water laboratory department.

To explore the characteristics of the respondents of two groups of farms and the land conditions, t-testis is applied and the similarities and differences of the characteristics of the groups are identified. Then the damage or impact of the polluted farm is explored by t-test upon the crop yield of the two groups.

Accordingly, the study explored the differences between the average yield of rice in non-polluted area μ_0 and the average yield of rice in polluted area μ_1.The following hypotheses is tested for the existence of difference in quantity due to water pollution.

$$H_0: \mu_0 \leq \mu_1$$

$$H_1: \mu_0 > \mu_1$$

Next, the input cost for the paddy cultivation in the two groups of farm are checked by conducting t-test to investigate the statistical difference between each type of input cost of the farms. The input cost included the cost for paddy plant seed, pesticides, natural fertilizers, chemical fertilizer, and wages for farming work and the capital cost for the farming. Moreover, the polluted farms are needed to adopt the adaption measures on the farms to be able to cultivate by the means of getting rid the waste water outside. The charges incurred are also considered in the calculation of the input cost for the polluted-farmland.

Hence, the production function for the paddy yield output considers the following inputs which are land, labor, capital input, other farm inputs and socio economic condition of the farmer. Farmland condition also affects the farm paddy yield such as farm mono-culture or multi-culture

(cultivation of more than one crop), type of the soil, and location of farm-site or the distance from the waste water channel. They are explicitly described in the following equation.

$$Y=f(L, K, I, Z, E, F, D) \quad (1)$$

where Y is the rice yield of a farmer in the studied year (baskets/acre), L is the number of labors for rice cultivation (man-days/acre), K is capital input (Myanmar Kyats /acre), I is a vector of material inputs as seeds (baskets/acre), chemical fertilizer (bags/acre), natural fertilizer (bullock cart/acre), and pesticides (bottle/acre), Z is a vector of social-economic characteristics of farmers, and E is a vector of farming conditions, and F is the condition of farms' water pollution (polluted site = 1, non-polluted site = 0) and D is the distance of the farmland from the water-polluted channel.

2. LITERATURE REVIEW

Because of the lack of effective environmental control in Myanmar, the water pollution from the factories of sugar, refinery, canning, liquor brewing and leather curing facilities, the weaving firms etc. are mostly incurred in Myanmar. The industrial wastes causes frequently the environment pollutions in rivers, lakes and water which results the negative impacts of the water contamination, land degradation, crop productivity decline andfish-dying problems. The water pollution problem due to the weaving firms in the Meiktila Industrial zone is one of the well-known problems; however weaving work could produce the higher income than the farming work, some young farmers tend to move their living to weaving rather than solving the water pollution consequences.

Industrialization in developing countries could have many benefits, but with many negative impact on the environment. Aragon, Fernando M. and Juan Pablo Rud (2013) argued the modern sectors which have been long linked to the displacement of the agriculture sector. Also, they criticized that most of the economic literature has only focused on the explanation associated with the reallocation of inputs but has neglected other possible mechanism such as the negative externalities of environmental pollution on production. They examined the case of modern gold mining in Ghana and estimated an agricultural production function. As a result of the study, they

found out that the expansion of the mining production has reduced agricultural productivity by almost 40% which is not associated with changes in the use or price of the agricultural inputs. They provided evidence of greater air pollution and increased rural poverty near mining areas.

Chakela Q.K (1999) and Mokuku et al (2002) and the National Environment Secretariat (2005) address the problem of effluents ensuing from the wet industries in Maseru being discharged into water ways. A study conducted by Pasco Waste & Environmental Consulting in 2005 found high levels of salts as well as colour of the water (industrial wastewater in Maseru). However, this study was based on once off sampling of wastewater only (ATPS Water and Treatment Programme).

Pullanikatil, Deepa (nd) presented that industrialization has increased exports from the country and has generated considerable employment for the people (ATPS Water and Treatment Programme). According to his findings, the government and the private sector have set up several wet industries (using more than 2000 cu m of water per day) that generate large amounts of wastewater discharges. Some of this wastewater is discharged either treated or untreated into the environment. His study investigated the extent and impacts of water pollution by industries on water quality and health and livelihoods of communities living near the contaminated waterways.

The study covered the three industrialized areas of Lesotho. The effects of water pollution on communities living near the waterways were studied. One area, which does not have wet industries, was taken as a control point. A combination of desk studies, experimental techniques, focus group discussions and survey methodology were used in collecting both primary and secondary data relevant to this research. Areas for further research have been identified and recommendations are made to prevent water pollution which is biological monitoring, toxic components such as arsenic, lead, cadmium and other heavy metals, fertilizers and pesticides, COD, BOD and faecal coli form count. However, the economic implications of the pollution for the community were not done except the cost of purchasing additional water was recorded and the study suggested to perform the cost benefit analysis of industrialization versus environmental degradation and negative impact on health and livelihoods.

One research study based upon the industrial zone in Vietnam conducted by Khai, Huynh Viet and Mitsuyasu Yabe (2013) addressed the problem of the water pollution from the industrial parks in Can Tho city. The study covers the area within and around TraNoc 1 and TraNoc 2 industrial zones, which are two of the greatest polluters in Can Tho. The problem issue is that

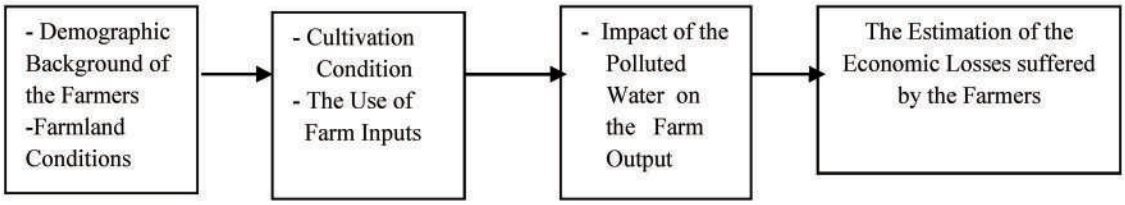
people living in this area have suffered various financial impacts from the pollution: reduced crop yields, the use of cattle and agricultural equipments such as pump sets, contamination of drinking water, and increased incidence of human diseases and deaths directly and indirectly caused by water pollution.

Farmers from two areas of villages (*PhuocThoi* as polluted area and *ThoiAn* as non-polluted area) with similar social and natural conditions (e.g. the same social and farming culture, ethnicity, type of soil) were included in the survey. The selection of the polluted and non-polluted area was based on their distance from industrial zones, and on the recommendation or suggestion of local authorities and farmers.

This study estimated the productivity loss of rice production by the difference in rice yield, cost increase and decrease in the profit (profit loss) between the two regions.The study also explored change in their cultivation management of the farmers because of polluted water. The researchers also highlighted the health problem of the farmers working in the polluted region and estimated that treatment cost for losing working days.

Hence, based upon the review on these previous papers, this paper identifies the damaged of the households of the farmers living near the Meiktila industrial zone and estimates the economic losses of the farmlands. In accordance with these objectives and literature review, the following model (shown in Figure 2.1) is built for the data collection and analysis. The primary data were collected by conducting a survey by face-to-face interview with farmers in Hta-naung-kan village group through the use of the structured questionnaire.

Figure 2.1. Economic Model



Source: Own compilation

3. ANALYSIS AND FINDINGS

This study is based on the Meiktila industrial zone and addressed the problem of the water pollution from the weaving firms in the industrial zone. The study covers the farmlands in Hta-

naung-Kan Village Group. Table 3.1 indicates the water pollution conditions of the study area of the farm site 564, 565 and 566. The cultivable area of farm site 566 is the highest portion (95%) of the total farm area that is not affected by the waste water; the remaining is used for the road construction. In the farm site 565, 76% of the total area is the cultivable land; in which 49% is not affected and 27% has waste water effect.

The paddy area cultivable in the farm site 564 has the least ratio (21%) that is not waste affected, 46% have some level of waste effect and 4% are completely spoiled with dye sludge. Thus, 21% of the farmlands could be grown up with the paddy plants well, the 46% need to be removed the waste water to be cultivable however, the spoiled farms could not be used at all for growing the paddy plants. Hence, it can be seen that 564 farm site is the worst condition for farmers and also the 566 farm site with the best condition.

Table 3.1. Number of Agricultural Firms in Hta-naung-Kan Village Group

Plot No.	Cultivatable land without waste effect*		Farmland with waste effect*		Spoiled farmland**		Other ***		Total	
	Acre	%	Acre	%	Acre	%	Acre	%	Acre	%
564	27	**21**	60	**46**	5	4	37	29	129	100
565	42	**49**	23	**27**	2	2	19	22	86	100
566	284	**95**	-	-	-	-	16	5	300	100
Total	353		83		7		72		515	

Note: * The farmlands are polluted, however it can be cultivated.
** The farmlands are spoiled with waste water and not be cultivated
*** The farmlands are taken over for road transportation and some are used for housing
Source: Hta-naung-kan Village Group Administration Office (2015)

Actually, the villagers' livelihood is traditionally agriculture and weaving business; however, some farmers grow paddy just for their home consumption and have relied on the weaving business. The household who has no capital for the weaving machine go to the near-industrial zone working as daily-waged employees for their earnings; some households own weaving businesses and emphasize on the business mainly which becomes the major living for their earning. The worst is that some farmers left the farm-work and changed their way of living

into weaving and some changed trading business because of the bad weather for their farming, shortage of water, waste-water pollution, insufficient labor, etc.

There were a total of over 200 farmers in the focused area of the village by the farm census. However, because the local authority has taken over some farmlands for the road extension and also some farmers sold out their own farm to others, thus, the number of farmers decreased as the number of the farmland decreased. Now, in the village, only about 185 farmers remain and continue their farm-work.

It is also noted that the farmer household pumped the ground water and used it for their drinking and other uses, however, they don't seem to feel the water quality was bad in terms of the colour, taste and smell except a few percent mentioned the water is not good for drink. Moreover, they didn't feel the use of the ground water could affect their health; however they boiled the water for drinking purpose as prevention for the health.

After reviewing all these conditions, the survey questionnaire was modified andsecond round survey was conducted on March 2016. The survey included 122 respondents (nearly about 65%) of farmers living in the village group.

Table 3.2 Number of Farmer Respondents

Plot No.	Total number of Farmers	No. of Farmers who Responded	Response Rateof the Total (%)
564	63	33	52
565	39	24	62
566	83	65	78
Total	185	122	65

Source: Survey data (2016)

Table 3.2 points out the number of farmers and response rate by each farm site in the interview. The response rate of the farmers from the farm plot 566 is the highest rate, (78%), 565 is the medium and 564 is the lowest (52%).The remaining portion of the farmers from the plot 564 and 565 are left for the interview because they didn't cultivate the paddy due tothe bad weather and their farmland being spoilt with polluted water.

3.1 Background Conditions of the Farmlands

The farmers from the studied area (field 564, 565, and 566) have mostly the same ethnicity, religion, and traditional way of living (as agriculture and weaving). However, there are other similarities and differences among the farmlands from the three plots. According to the discussion with the village administration; the general information about each type of the farmland is summarized as follows. Table 3.3 shows those factors concerning the water polluted condition, types of soil, the types of crops grown in each plot.

Table 3.3 Background Information of the Farmlands

Farm Plot no.	564	565	566
Farmland Condition	Lower land	Lower land	A little higher
Distance from the Waste Water Drainage or Polluted Pond	Approximately one-half mile from the drain	Less than one-half mile from the drain	more than one-half mile from the drain
Water Polluted Condition	Mostly affected	Limited effect	no effect
Types of Soil Condition*	Sandy, Saline & Chalky	Sandy, Saline & Chalky	Sandy, Saline & Chalky
No. of Crops grown	1 or 2	2 or 3	3 or 4
Major Crops grown	paddy, sesame	paddy, sesame, pea	paddy, sesame, onion or pea
Adaption Measure for Waste Water	- Getting rid of the water from the farm - Presenting it to the administration of the village	- Getting rid of the water from the farm - Presenting it to the administration of the village	-

Notes:

**Sandy soils* is one of the worst types of soils to be grown any kind of plants in.

**Saline soil* causes damage to and stall plant growth, impede germination, and cause difficulties in irrigation with high salt contents.

**Chalky soil* is found in limestone beds that have chalk deposits that are deep. Chalky soil has low water content but high lime content.

Source: Focus Group discussion (2015)

Table 3.3 points out that there are similarities in the land condition, soil condition, the types of crop and number of crops of the first two plots. In terms of their location, some of the fields in the plot 565 are closed to the fields of the plot 564. Since the plots are situated near the waste water channel, onion crop could not be grown up well in these plots. However, the farmers from the plot 566 could grow the onion in their field because the farmland is not affected from the polluted water. The soil condition of all the farmlands is nearly the same being sandy, saline and chalky soil.

Normally, since the location of the farmland is very far away from the water dam, almost all of the farmers relied upon the rain water for the paddy cultivation. Therefore, if it is forecasted that the weather condition is unfavorable for paddy cultivation, they only grow other crops; sesame is usually grown at the beginning of the rainy season and peas and onion at the beginning of the winter season.

In the case of the response to the waste water problems, almost all the farmers except the spoilt farmland, adopted the farm adaption practices such as watching the farm and getting rid of the dyed waste water from the field, presenting it to the village administration committee while a few farmers putting the required substance (e.g. lime, and other chemical substance) into the farmland.

3.2 Description of Empirical Survey

As described above, the farmers from the three groups of farmlands have similar social and land characteristics such as ways of living, farming culture, and types of soil except the level of water pollution and soil condition. According to the soil and water test conducted in the year 2016, the plot 564 as the worst area being the highly polluted water and 565 as partly polluted.

After conducting the first pilot survey, the second time survey was done the days after the week. The interviewer group met with the village administration and discussed about the farmer households' culture, their living and the difference between the polluted farm and non-polluted farm area. Table 3.4 pointed out that the number of the respondents included in the survey.

Table 3.4 Number of Farmer Households included in the Sample Survey

Farmland Plot No.	No. of Household		Total Households
	Polluted Farm	Non-polluted Farm	
564 and 565	35	22	57
566	-	65	65
Total	35	87	122

Source: Survey Data (2015)

The survey included a total of 122 farmer household units; (57) respondents are working in the farm site (plot no. 564 & 565) and (65) numbers are working in the plot no. 566 (non-polluted farms site). Out of the 57 persons for the former groups, 35 persons faced the water pollution problem. The 35 farms' output and other condition of these suffering farms were compared with those of the 87 persons from the second group which is determined as the control group for the analysis. The survey questionnaire includes five parts.

The first part is concerned with household information which is personal and family background and ownership property. The second part is related to the data about ownership for farming and other business; the third part is the farm production about the farm input quantity, the cost. The output of the farmland is devoted in the fourth part. The fifth part is concerned with the health aspect of the family members from the use of the ground water.

3.3 Demographic Characteristics of the Farmers

Firstly, the background characteristics of the respondents such as the age and gender of the farmer household, the family size, the number/ ratio of farmers in the households, the cultivated crops, the ownership of the weaving machines etc. are summarized in Table 3.5.

Table 3.5 Demographic Characteristics of the Farmers

Plot No.	Polluted Farmland (564 & 565)(n=35)	Non-polluted Farmland (566)(n=87)	T--value
Average Age(year)	62.06	61.59	-.224
Average Family Size	4.60	4.23	-1.122
Average no. of Farmers in Family	1.14	1.85	4.998***

Percentage of family members who are farmers	26.67%	49.60%	
The number of crops grown	1.69	1.87	2.047***
% of Household with Ownership of cows for farm work	31%	48%	-
% of Household with Ownership of weaving machine	60%	26%	-
% of Household Head as Male person	80%	75%	-

Note: *** indicates that it is statistically significant at the 0.01 level

Source: Survey data (2016)

It can be seen that the variables of age of the farmer and the family size, the percentage of the male person as the head of households are nearly the same among these two groups of the areas; however they are not statistically significant. Oppositely, the average number of farmers in their respective family, the ratio of the farmer to the total member, and the number of crops in the non-polluted farmland are significantly ($P < .001$) higher than those from the polluted farm. Moreover, the condition of the ownership of weaving machines in the farmer households of the polluted is higher (with 60% of the total polluted farmers) while the percent of the ownership of cows for farm work is lower (with 31%). This indicates that the family of the polluted farm is mainly dependent upon the weaving business rather than farming and the opposite is true for the non-polluted farmer households.

The main source of family income of the farmers of the respective farm site is shown in Table 3.6. The main earning activity for the non-polluted farmland (566) is the farming work with the highest portion (nearly 54 %) and weaving work (40%). For the polluted farm households, the main source of income for the majority is weaving work (71%) and farming with (26%) respectively.

Table 3.6 Main Source of Earning of the Farmer Household by Types of Farm

	Types of Farm		
Main Source of Earning	**Polluted 564+565**	**Non-polluted 566**	**Total**
Farming	9 (26%)	47(54%)	56
Weaving work	25 (71%)	35 (40%)	60

Trading	1 (3%)	4(5%)	5
Government Staff	-	1(1%)	1
Total	35 (100%)	87(100%)	122

Source: Survey data (2016)

3.4 Descriptive Statistics for the Farmland Condition

The descriptive statistics for the farming condition such as soil condition, water pollution, yields of the paddy by the type of the farmland polluted and non-polluted, are analyzed in this section. Farmer perception on their farms' soil and water pollution condition are described in the Table 3.7 and Table 3.8.

Table 3.7 Percentage of Soil Condition of the Farmland

Soil Condition (F_S)	Sandy Soil	Saline Soil	Chalky Soil	Total
Polluted Farmland (564 & 565)	1 (4%)	29(83%)	5(13%)	35(100%)
Non-polluted Farmland (566)	8 (9%)	63(73%)	16(18%)	85(100%)

Source: Survey data (2016)

There are three types of soil in the study area: sandy soil, saline soil, and chalky soil. Although sandy soil is found in extremely dry regions having high salt content, this type of soil is the lowest portion in the study area (4% in polluted farmland and 9% in non-polluted farmland). Saline soil is a type of soil commonly faced in the study area with the most farmland being saline: it can cause damage to stall plant if the soil is not renovated. The third type chalky soil is with high lime content.

As regards the waste water impact on the rice yield, farmers who are in Plot 566 think that this water quality is better because there is no effect on yield indicating that 100% saying no effect. On the other hand, paddy yield in 564 and 565 is affected by water quality and possibly also by the salinity effect of the respective farmland.

Table 3.8 Perceptions of Farmers on the Impact of Waste Water on Rice Production.

Types of Farm	No effect	Somewhat effect	High effect
Polluted Farmland (564 & 565)	-	31(88.58%)	4 (11.42%)
Non-polluted Farmland (566)	87(100%)	-	-

Source: Survey data (2016)

3.5 Impact upon Yield of the Paddy and Farming Cost

Table 3.9 depicts the paddy yield of each type of the farmland. The results conforms to expectation that yields of the paddy of the polluted farmland would be lower than in the non-polluted farmland. The averageyield was over 27baskets (71.52- 44.27) lower per acre. The difference is significant at $P < 0.01$.

Table 3.9 Average Paddy Yield and Average Paddy Cultivation Cost

	Polluted 564&565	Non-polluted 566	T--value
Paddy yield (baskets per acre) (Y)	44.27	71.52	13.108***
Total Farming Cost (MM Kyats per acre)	250,760	201,790	-5.512**

Note: *** indicates that it is statistically significant at the 0.01 level and ** is at the 0.05 level
Source: Survey data (2016)

In contrast, the average farming cost of polluted farms was higher than that of the non-polluted farms with the difference being statistically significant at $P < 0.05$. The cost for the paddy production includes those cost for the use of seed, pesticides, natural fertilizer, chemical fertilizer, the labor-hiring charges for the cultivation, and the capital cost incurred for the farming. The breakdown of these costs explains the difference between the polluted and non-polluted farm which is described in Table 3.10.

Table 3.10 Cost of Farm Cultivation Input for Paddy Production (Myanmar Kyats)

Faming Inputs (Myanmar Kyats)	Polluted 564 & 565	Non-polluted 566	T--value
Cost of seed used (MMKs per acre) ($I_{S)}$	13,087#	15,020	.942
Cost of pesticide used (MMKs per acre) ($I_{P)}$	666	218	-1.038**
Cost of natural fertilizer (MMKs per acre)	13,783	11,301	-.941
Amount of chemical fertilizer (MMKs per acre) ($I_{cf)}$)	12,085#	16,410	2.878**

Wages for paddy cultivation (MMKs per acre) (L)	161,655	135,243	-7.445***
Charges for removal of waste water (MMKs per acre)	27,094	0.000##	-8.907***
Capital Cost (MMKs in thousand per acre)(K)	22,390#	22,710	.128

Note: *, **, *** indicates that it is statistically significant at the 0.1, 0.05 and 0.01 level.
These cost are lower in the polluted farm, different from the expected.
The non-polluted farms have no cost for this item.
Source: Survey data (2016)

Table 3.10 points out the t-test results upon the difference between the costs of the each type of the input used for the paddy cultivation for the two groups. According to the results, among all the inputs used, the cost of the pesticide, natural fertilizer, and the wages for farming work in the polluted-farm, are higher than those cost in the non-polluted farm while the cost of the paddy seed, and the cost of the chemical fertilizer and the capital cost in the polluted farm are lower.

T-test result shows that the wages of the polluted farm is significantly higher at the 0.01 level and the cost of the pesticide is higher at the 0.05 level. The charge for the removal of waste water is also higher at the 0.01 level. Thus, it is concluded that the impact of the water pollution reflects the increase in the average farming cost per acre of that area which are especially due to the wages, the charges for the removal of the waste water from the farm and the pesticide uses.

To explain the cost of the farm inputs being different from the expected value, the average *quantity* of each farm input used is analyzed. Table 3.11 shows the average input quantity used for the paddy yield per acre by each type of the farmland.

Table 3.11 Quantity of Farm Cultivation Input used for Paddy Production

Faming Inputs (Quantity)	**Polluted 564&565**	**Non-polluted 566**	**T--value**
Amount of seed used (baskets per acre) (I_S)	**1.890#**	2.330	2.498**
Amount of pesticide used (bottles per acre) (I_P)	**0.18#**	0.21	.220

Amount of natural fertilizer (bullock cart per acre)	4.8059	4.4908	-1.089
Amount of chemical fertilizer (bag per acre) ($I_{cf)}$)	**0.9412#**	0.9582	.265
Man-day for paddy cultivation (Days per acre) (L)	39.18	37.80	- 2.309
The percent of the farmers who own the cows	**31%**	48%	-

Note: *, **, *** indicates that it is statistically significant at the 0.1, 0.05 and 0.01 level
These amounts are different from the expected for the polluted farm
Source: Survey data (2016)

As expected, the quantity usage of the natural fertilizer (per acre) and the labor time (in terms of man-day) in the polluted farm was more than those of non-polluted farm because of the polluted farms needed to make land treatment to become cultivable.

However, the cost of seed, the fertilizer and capital cost for the polluted farm is lower which are different from the expected (Table 3.10); it is because the amount of the paddy seed (baskets), chemical fertilizer (bags) in the polluted farm are used for the cultivation less than those of the non-polluted in which the usage of the paddy seed is significantly different at the .05 level (Table 3.12). It is because farmers with the non-polluted farms more depend upon the farm work for their living rather than the money from off-farm business.

Capital cost of the polluted farmland (it is considered by the interest amount on the by the farmers' investment amount in the farm animals and other equipment used for the farm work) also differs with lower amount from the expected. By the Table 3.11, the ratio of the farmers who owned the cows is much lower for the polluted farms with 31% of the farmers of the total polluted while the 48% for the non-polluted.

For the cost for the pesticide is however much higher in the polluted farm as excepted (see in Table 3.10) in spite of the slightly less use of pesticide quantity in the polluted farm (see in Table 3.11); it is because of its higher purchase price for the usage. All of these explanations would also explain indirectly the reasons of being higher cost in the paddy seed, chemical fertilizer and the capital cost in the non-polluted farm than the cost which is expected.

Factors that Determine the Level of Output

To estimate the economic losses from the water pollution of the farmland, the independent variables which influence the paddy yield of the farm are explored in the production function model. Based on the above findings, the farm input and farm condition are considered as independent variables to develop the model.

The input variable for the model finesses are *the farm inputs* such as the pesticide, natural fertilizer, chemical fertilizer, and capital cost; and *farm condition* such as the type of soil, level of waste-water incoming, and crop-cultivation culture, distance of the farmland from the waste-water channel. The variables with the expected coefficient sign are shown in the (Table 3.12) in which the expected positive sign indicates positive relationship of these variables with the paddy yield and negative sign means negative relationship with the yield.

All the *farm inputs* are positive sign indicating that the more input variables, the higher the paddy yield results, i.e, the more fertilizer, the more pesticide, the more capital, the more the paddy yield. For the *farm condition*, the variable with positive sign means the better condition for the farmland such as fertile soil, more crops and the far distance from the waste water, the higher the paddy yield. E.g If the farm grows more crops, the farmland gets the higher land treatment (such as the treatment with the addition of fertilizer, water channel and cleaning the undesirable natural plants), the more the paddy yield. If the distance from the water–polluted channel is further, the more the paddy yields. However, the negative sign of the farm condition means that the high level of the waste water, the less paddy yield.

Table 3.13 shows the computed results of the regression analysis on the determinant input variables for the paddy yield per acre. As expected above, all the sign (+ or -) of the coefficient of the variables except the sign of one variable (pesticide used per acre), are the same with the expected sign described in the Table 3.12.

Table 3.12 Types of Variables used for Paddy Production Function

Variables*	Definition	Expected Coefficient sign
Level of waste water (0=no, 1=effect)	The degree or level of incoming waste water in the farmland	-
Type of soil (1=fertile, 0=other)	Type of soil being fertility of the farmland	+
Distance from waste-water channel (mile)	The distance of farmland from the waste water channel	+

Rice mono-culture (1=yes, 2=additional crops)	The farmland cultivated with only one crop or more than one crop	+
Pesticide used per acre (1-cc bottle per acre)	The use of pesticide for the paddy cultivation	+
Natural fertilizer per acre (bullock-carts per acre)	The use of natural fertilizer for the paddy cultivation	+
Chemical fertilizer per acre (bags per acre)	The use of chemical fertilizer for the paddy cultivation	+
Capital cost per acre (000)	The cost of the investment for the paddy cultivation (eg, interest incurred for the purchase of the farm-use equipment and animals)	+

Notes: * The variables fitted for statistical relationship with paddy yield from the regression analysis.

The model generated three significant variables among eight variables considered. It is noted that their estimated coefficients had the significant level at 1% level in the model. The estimated R-square for the function was equal to 0.784, revealing the 78 percent change of the paddy yield is explained by the independent variables. The result also shows that there is no co linearity in the independent variables of the production function, since VIF values are less than 10.

Table 3.13 Estimated Values of Coefficient for the Paddy Yield (Baskets per acre)

	B	Std. Error	Sig. (2-tailed)	t	Tolerance	VIF
(Constant)	23.483	6.493	.000	3.617		
Level of waste water (0=no, 1=effect)	-13.071***	2.622	.000	-4.985	.440	2.273
Type of soil (1=fertile, 0=other)	8.251***	2.263	.000	3.646	.654	1.528
Distance from waste water channel (mile)	61.490***	7.327	.000	8.392	.412	2.425
Rice mono-culture (1=yes, 2=additional crops)	.502	1.953	.798	.257	.830	1.205
Pesticide used per acre (1-cc bottle	-.620	1.270	.627	-.488	.951	1.052

per acre)						
Natural fertilizer per acre (bullock carts per acre)	.071	.587	.903	.122	.873	1.146
Chemical fertilizer per acre (bags per acre)	3.735	2.506	.139	1.490	.983	1.017
Capital cost per acre (MM Kyats000)	.010	.066	.875	.158	.914	1.094

Note: Estimated R Square 0.784

***Correlation is significant at the 0.01 level (2-tailed)

Source: Statistical results upon the Survey Data (N=122)

The three significant variables of the functions are water pollution level, the type of soil, and the location of the farm. The waste water pollution level is negative sign meaning that the paddy yield of polluted farm was decreased by the level of waste water pollution in the farmland. The type of soil shows the positive coefficient indicating that the more fertile the soil, the more paddy yield. Lastly, the location variable was positively significant with the paddy yield signing that the more distance from the water drain, free from the water pollution, the higher the paddy yield.

Table 3.14 shows the results on the calculation for the paddy yield by using the model above. It illustrates that the estimated average yield of the paddy in the non-polluted area was about 71.49 baskets per acre and 43.28 baskets per acre for the polluted region. Thus the loss of the paddy yield in the polluted farm was calculated by finding the difference between them and the estimated losses was 28.21 baskets per acre.

Table 3.14 Economic Losses on the Paddy Production

	Amount	**Percent**
Quantity Losses	28.21 (Basket/ acre)	39.44%
Price Decrease	500(MMK/acre)	10%
Total Loss	162,690 MMK/acre**	45.5%

Note** (28.21 basket/acre *MMKyats5000 per basket)+ (43. 28 basket/acre*MMKyats500 per basket)

Source: Own Calculation

Then the economic losses of the polluted farm are obtained by multiplying the paddy price with the loss of the paddy yield of the polluted farm. Moreover, according to interview with the farmers, the paddy of the polluted farm is poor quality with the lower weight compared with the quality of the non-polluted farm thus they have to sell their crops at the low price which is less than 10% of the qualified paddy. The price of the standard quality paddy was MMK 5,000 per basket and the price of the poor quality paddy was MMK 4,500 per basket.

Thus, the total economic losses are calculated and depicted in Table 3.14. The calculation shows the estimated economic losses of the polluted farm was MMK162,690 per acre which includes the 39.44% of the quantity losses and 10% of the price reduced from the sale of thelow-quality paddy.

In addition to the economic losses calculated here, it should be noted that a number of farmers in plot no 564 and 565 have had to allocate part of their time to earn additional revenue to compensate for the lower return from rice. For these farmers, the main purpose of the continuing to produce rice is therefore primarily to meet household consumption.

These studies only considered the quantity losses of the paddy yield and price decrease in the sale of the paddy produced by the polluted farm, leaving thecost function of the production for the study and the cost incurred for the health problem of the farmer household which has possibly arisen from the use of the polluted water. The health cost is excluded because the survey results indicated that there is no health problems among them due to the use of the waste water and the farmer households only drink the purified water. Thus the estimation on the economic losses is underestimated due to the exclusion of the cost differences of the function between the two groups of the farmland.

4. CONCLUSION AND POLICY IMPLICATIONS

The implementation of industrial zones in Myanmar has been performed with the government's long-term industrial development goals and guidance. With the goal achievement on growth in the industrial sector, there are many environment impact of pollution such as air, water, soil and noise problems around the industrial estate. The study on the impact of the dye-polluted waste water released by the weaving firms of the Meiktila Industrial Zone on the agriculture sector proves that there are negative impacts on the paddy production.

In fact, the textile or weaving industry in Myanmar is one of the significant industries of the country and men-wear longyi produced by the studied area is famous among Myanmar people. However, the use of chemical toxic dye used by the businesses has much become very dangerous and annoying for the households nearby and especially, the farmers suffer the losses on the quantity and also quality in the paddy output. Although there have no laboratory tests upon the rice quality produced from this region by the responsible food supervisory committee organized for the health of the public, the appearance of the rice was not up to the normal standard with yellowish colour and lower weight. This can cause the high negative impact upon the consumers' health as well as upon the farmers' income by the loss in the paddy yield and price. The worst would possibly be faced by the farmers because the water pollution causes damage to the natural environment as the soil degradation problem which results in the environment being unsustainable in the future.

The study included the two groups of the farmers with the same socio-demographic background (such as age, gender and education level of the household head), same economic conditions (ie, the farmers' living depends on the agriculture as traditional business together with part-time weaving job), and same farming conditions (farm culture on cultivation of paddy and other crops like sesame, onions, peas etc., type of soil, and weather condition) except the difference in the water pollution, and location distance of the farms from the place of the waste water channel. In this study, the economic losses due to the inflow of the dye waste water were identified and estimated by the unfavorable difference in the paddy yield, and the difference in the price for the low quality paddy of the polluted farmland.

The survey pointed out that the loss on the paddy yield was 28.21 basket/ acre and the loss for price decrease for the low quality was 500 MyanmarKyats/basket which is assumed as opportunity cost due to the polluted water. Thus total loss on the polluted farm production (in terms of the monetary value) was 45.5% of the non-polluted farm yield income. The survey study covered only the cultivatable polluted-farmland in 83 acres in total, the total paddy yield loss was estimated about 2341 baskets (28.21 Basket/ acre multiplied by 83 acre) and the total economic losses was about 13.50 million MMK (162,690 MMK/acre multiplied by 83 acre). If the consideration of the economic losses is extended to the fully spoilt farmland (about 7 acres), the estimated paddy yield losses become as 500.43 baskets (71.49 basket/ acre multiplied by 7 acres)

and the losses would increase by the amount 2.5 million MMK (500.43 baskets multiplied by 5000 MMK kyats per baskets).

For the prevention of the negative impacts on the agricultural farms and reduction on the cost given, the farmers concern of the village should find the ways as following: they should present the impact problems relating to the industrial waste water pollution to the responsible organizations such as the industrial committee, village administration, and the community concerned nearby in time. Since the environmental education of the farmers and industrial owners is important, the meetings, seminars should be frequently conducted to realize the negative impact of the weaving dye upon the agriculture business and also the food quality decline that could cause the health problems of the farmers. Finally, the author suggested to reduce the avoided cost, the farmers should investigate the ways of removing the waste water by implementing a large single pond/ lake or a single dye treatment factory to improve the waste water quality which could be used again in the farm cultivation of the village.

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Role of Treasury Bill and Treasury Bonds in Myanmar

Thurein Lwin

Abstract

CBM issued Treasury Bill and Treasury Bonds to absorb money from the market. But the public does not buy bill and bond because of the low rate of interest. This study, employed narrative analysis methodology based on the CSO data with an aim to suggest CBM's role in the reform of Treasury Bill and Bonds to become as effective monetary tool.

Keywords: Myanmar, Central Bank of Myanmar (CBM), Treasury Bill, Treasury Bonds, Interest Rate

1. INTRODUCTION

Treasury bill and Treasury bonds are one of the monetary tools of Central Bank to stabilize the macroeconomic stability. There is zero risk to buy and sell. CBM has attempted to develop bond market and collaborate with ASEAN Bond Market initiative (ABMI) program and Japan – ASEAN Fund for the Technical Assistance (JAFTA).

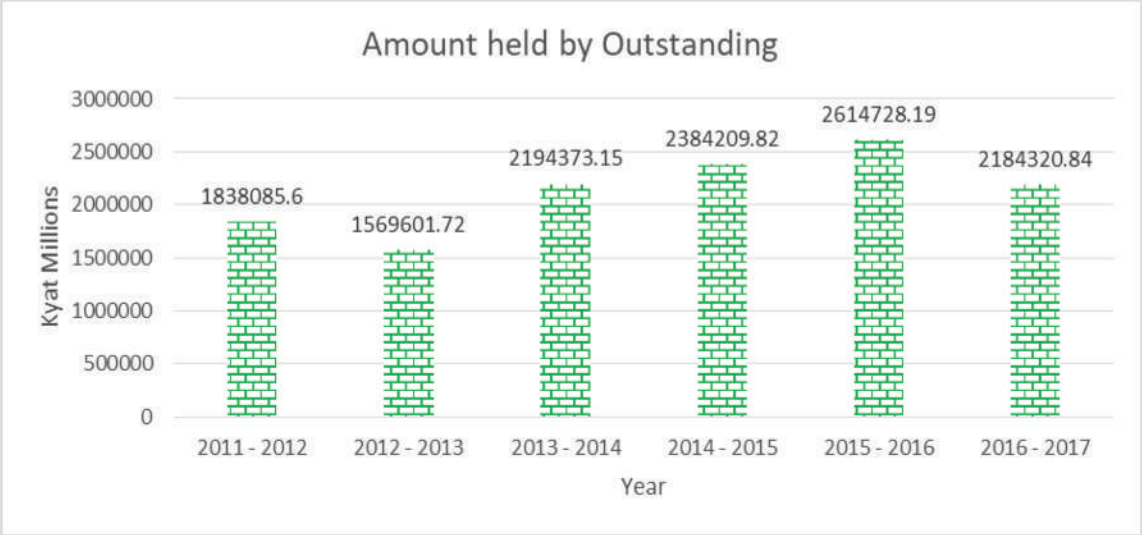
2. TREASURY BILL AND BONDS IN MYANMAR

There are two kinds of bond market types, namely: non – auction market and auction market. In order to encourage investment for public, Myanmar started vending Treasury Bonds since 1993. In 2012, it has also started selling the two-year treasury bonds. The role of treasury bonds is to solve the government's deficit by utilizing public's money through the practice of selling the bonds. According to the following figures, there is a rise in selling and buying bonds since 2009.

To stabilize the inflation rate, CBM tries to put the total reserve money and the separate reserve money into their targets amount framework. The inflation rate in Myanmar is averaged at 9.99 percent in 2015-2016 financial year, 6.81 percent in 2016-2017 financial year, and dropped to 4.61 percent on December 2017. The Governor of the CBM stated that one of the main reasons causing the inflation is the printing of more money currency to justify the deficit government spending. CBM and the Ministry of Planning and Finance thus have cooperated to hold monthly auctions for treasury bills and treasury bonds, with private and state-owned banks (Kyaw Kyaw Maung, 2018).

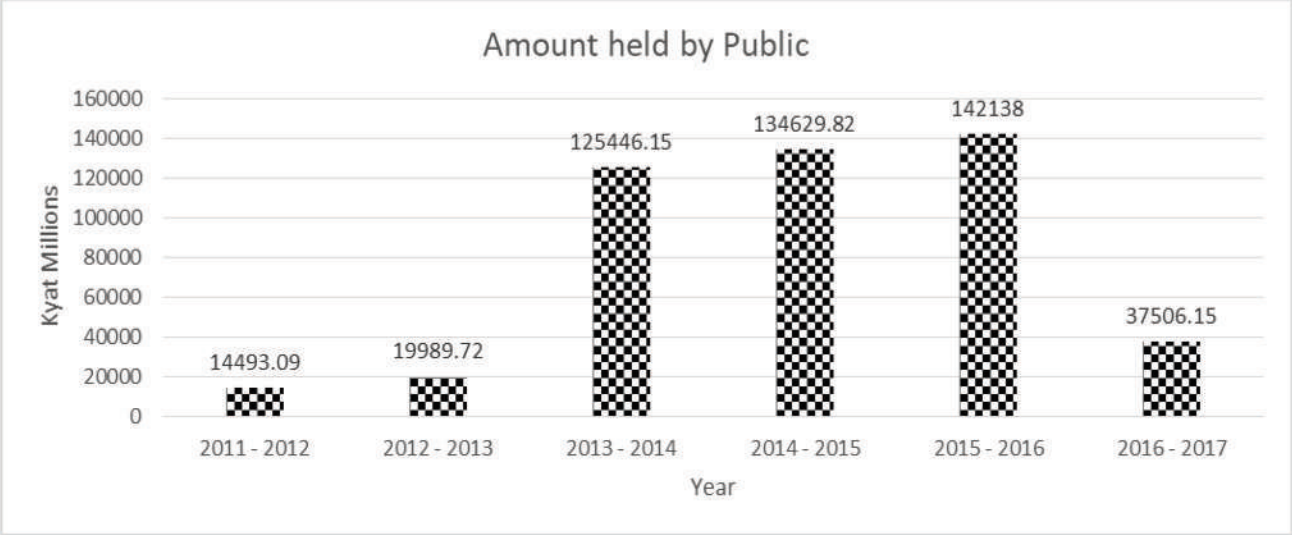
There are three sectors that procure government's Bonds classified as (i) Outstanding, (ii) Public and (iii) Private Enterprises. The following figures (1, 2, and 3) show that public buying on government's bonds increased from the year of 2013 to 2015. Later on, that of 2015, it has decreased.

Figure 1. GOVERNMENT TREASURY BONDS (Non-Auction)



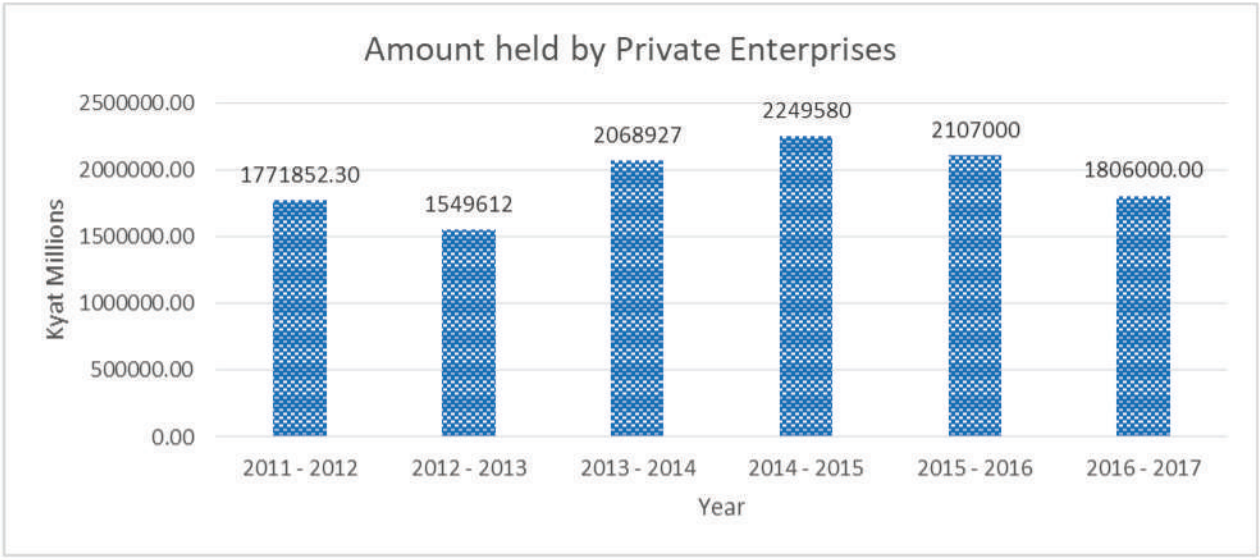
Source: Statistical Yearbook (Various Issues)
Note: Bonds include two-year bonds, three-year bonds and five-year bonds.

Figure 2. GOVERNMENT TREASURY BONDS (Non-Auction)



Source: Statistical Yearbook (Various Issues)
Note: Bonds include two-year bonds, three-year bonds and five-year bonds.

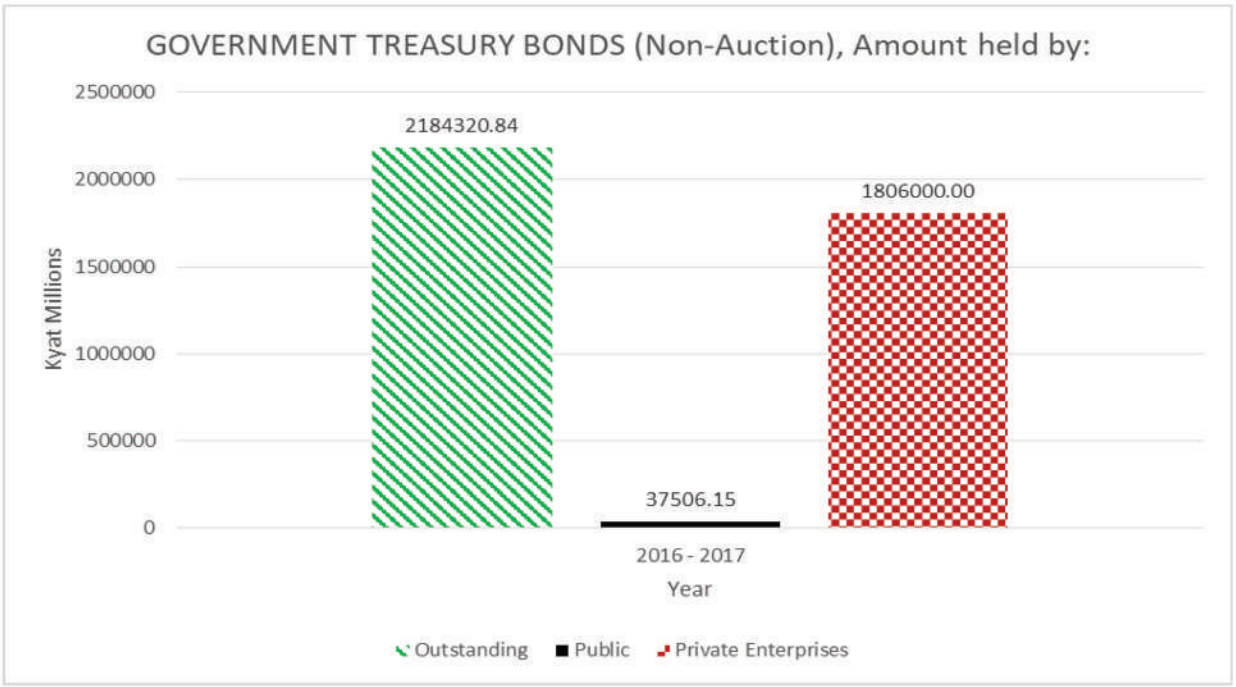
Figure 3. GOVERNMENT TREASURY BONDS (Non-Auction)



Source: Statistical Yearbook (Various Issues)

Note: Bonds include two-year bonds, three-year bonds and five-year bonds.

Figure 4. GOVERNMENT TREASURY BONDS (Non-Auction)

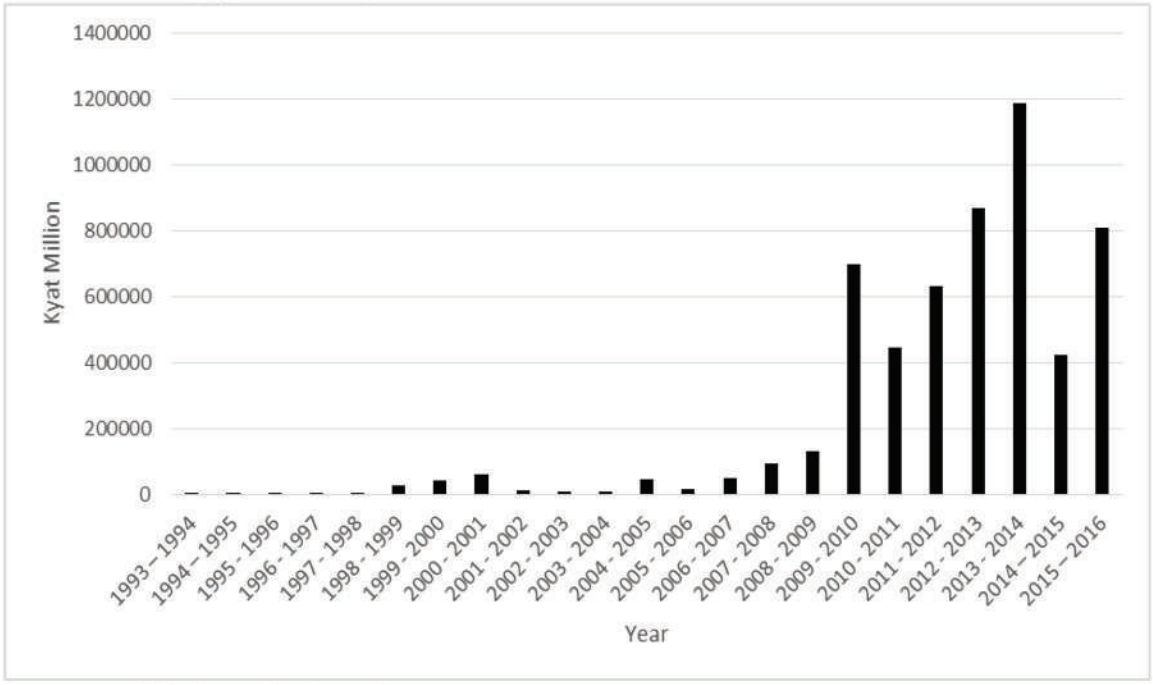


Source: Statistical Yearbook (Various Issues)

Note: Bonds include two-year bonds, three-year bonds and five-year bonds.

In the years of 2016 – 2017, the Outstanding Sector is the most common among three types of buyers while the Public is the least common in buying government's bonds.

Figure (5) Government Treasury Bonds 1993 – 1994 to 2015 – 2016 (Kyat Million)

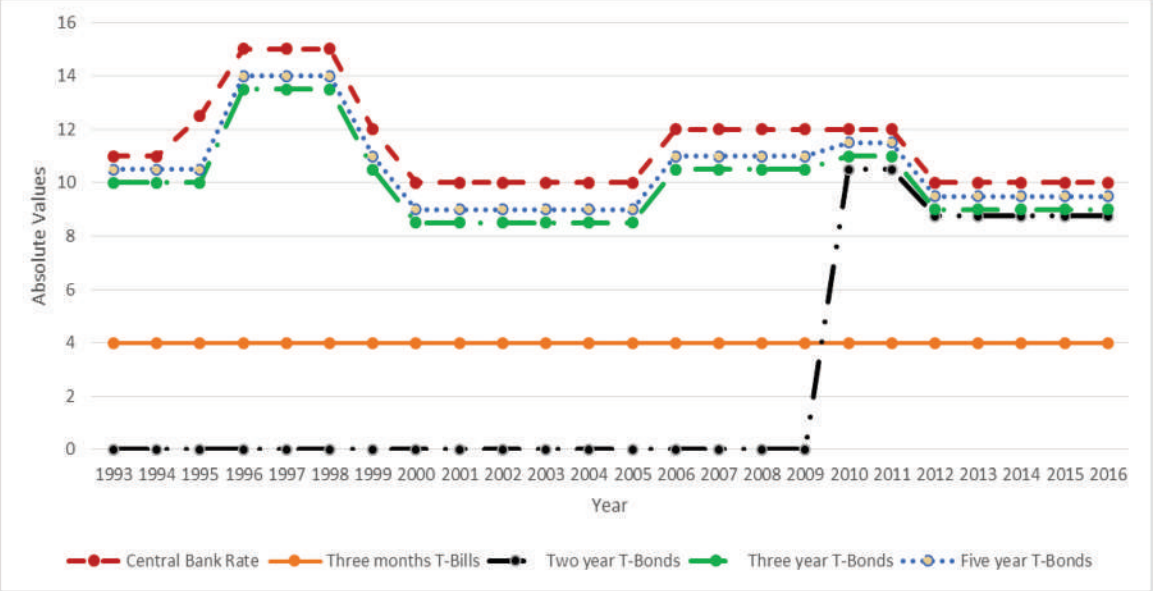


Source: Statistical Yearbook (Various Issues)
Note: Treasury Bonds include two-year, three-year and five year bonds.

Thus, the treasury bills and bonds play a big role in controlling the inflation rate. According to Figure (5), the Treasury Bonds released by the Central Bank are not significantly strong enough to be in their use as the monetary tool. This occurs because their defined interest rate is lower than the average deposit interest rate in private banks. Private domestic banks mainly buy the treasury bonds and treasury bills more than the public principally because of the interest rate. Treasury bills and bonds are one of the effective monetary tools but the difference in interest rate is the key problem. In 2017, Central Bank of Myanmar published Three Month Treasury bills[1] at the interest rate of 4 percent, Two Year Treasury bonds with which the interest rate is 8.75 percent, Three Year Treasury bonds with interest rate of 9 percent and the Five Year Treasury bonds with interest rate of 9.5 percent. The lending interest rate is 13 percent and saving account interest rate is 10 percent. People do not buy the certificates from the central bank or save money in private banks due to such big variation in interest rates. Thus, IMF (2015) also advised Myanmar to allow, at the Treasury bill auction, to increase the interest rate.

[1] The name of three months Treasury bill is the same as for the old treasury bills.

Figure (6) Interest Rates of Treasury Bill and Treasury Bonds 1986 to 2016 (Percent per annum)

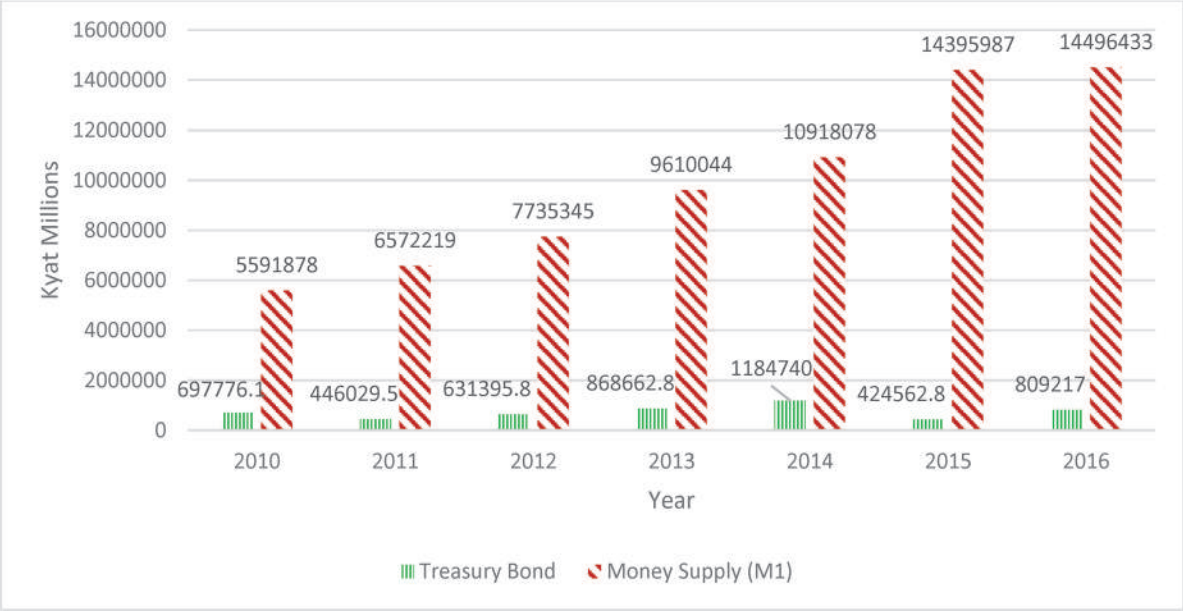


Source: Statistical Yearbook (Various Issues)

Note: The Central Bank of Myanmar has issued two-years treasury bonds since 1st January 2010.

According to the figure (6), the interest rate of 4 percent, for Three Month Treasury bills did not change since 199. Nonetheless the interest rate of other treasury bonds increased the average 4 percent in 1996, decreased the average 4 percent in 1999 after the period of Asian Financial Crisis. It continued to decrease by average 2 percent in Year 2000. During the recovery stage of bank crisis in Myanmar, CBM raised the average 4 percent of treasury bonds' interest rate and reduced it at average 2 percent again from 2012 till 2016.

Figure (7) Comparison of Treasury Bonds and Money Supply (M1) (2010 to 2016)



Source: Statistical Yearbook (Various Issues)

Note:* Money Supply is End of Year and Treasury Bonds is fiscal year. **Government Treasury Bonds does not include auction.

Another possibility is that the public does not seem to have enough awareness to buy these treasury bills and treasury bonds. Also, there may be many difficulties in purchasing and selling them from the standpoint of the public because these activities can only be realized in Myanmar Economic Bank.[2] Thus, there are limitations in selling and purchasing treasury bonds and bills which are distributed by auction method in the bond market. The main reason of this tool, not working well indicates that there is a lack of a weapon to challenge the inflation.

The Governor of the CBM stated that the Central Bank will review its interest rate policy based on inflation and the fiscal deficit (Kyaw Kyaw Maung, 2018).

Central Bank of Myanmar (CBM) stated that Government Treasury Bill auction has been conducted since January 2015 in order to lessen inflationary pressure, due to the bank's direct financing of budget deficit, as well as to facilitate effective public debt management and market determined interest rate on government securities.

[2] Myanmar Economic Bank (MEB), was established on 2 April 1976. MEB opened 307 bank branches, 14 State and Divisional Banking Offices and 6 Head Office Departments across the country.

3. CONCLUSION

The role of Treasury Bills and Bonds is one of the central monetary tools to control economic stability and financial stability. CBM is trying to reduce inflation rate to absorb money by using the practice of buying and selling the treasury bills and bonds in the market, to reach the target. That is, however, a not good enough exercise to control 'inflation rate'. CBM need to reform the role of treasury bills and bonds, as a monetary tool accordingly, to control inflation.

Policy recommendations are as follows;

(i) CBM should promote awareness to buy bonds and bills through media,

(ii) CBM should increase interest rate of bonds and bills instead of saving interest rate; and

(iii) CBM should change the buying and selling process of bonds and bills to become easier by taking advantage of internet use, for instance.

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