YANGON UNIVERSITY OF ECONOMICS

MASTER OF ECONOMICS

A STUDY ON PADDY PRODUCTION IN MYANMAR

(From 2007/2008 to 2016/2017)

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ABSTRACT

In Myanmar, paddy is an essential crop not only for local daily consumption but also for foreign earnings. The government has given a high priority to the expansion of paddy production because rice is a staple food for Myanmar people.The objective of the study is to analyze the sufficient condition of paddy production in Myanmar for the period 2007/2008 to 2016/2017. It is mainly based on descriptive method .The delta regions were found to be having the large area of paddy than central dry zone, costal and hilly regions due to the cultivable lands are plentiful across its region. The sown acreage and production of paddy is reduced statement during the studies period but Myanmar still can produce the sufficient amount of paddy production for its consumption and thus remains one of the world's largest producers of rice today. The production of paddy has the potential for rapid growth by using high yielding varieties including adoption of Good Agricultural Practice, utilization of good quality high-yielding seeds, application of agricultural inputs such as irrigation water, agro-chemicals and natural fertilizers and promotion of farm machineries utilization as technology intervention. Well qualified person and the successive policies to create incentive for farmers are also required to enhance the paddy production.

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LIST OF ABBREVIATIONS

ASEAN	The Association of Southeast Asian Nations
AMD	Agricultural Mechanization Department
APIPNM	Asia-Pacific network on Integrated Plant Nutrient Management
BPH	Brown Plant Hopper
CSO	Central Statistical Organization
DOA	Department of Agriculture
DOP	Department of Planning
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HYV	High Yielding Varieties
HRD	Human Resource Development
INGO	International Non-Governmental Organization
IRRI	International Rice Research Institute
LIFT	Livelihoods and Food Security Fund
IPNI	International Plant Nutrition Institute
LCC	Leaf Colour Chart
MOPF	Ministry of Planning and Finance
MAFPT	Myanmar Agricultural and Farm Products Training
MOALI	Ministry of Agriculture, Livestock and Irrigation
MADB	Myanmar Agriculture Development Bank
MRSDS	Myanmar Rice Sector Development Strategy
MIS	Management Information System
MHYVs	Modern High Yielding Varieties
NRP	National Rice Policy
NCDP	National Comprehensive Long-term Plan
NES	National Export Strategy
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation
R&D	Research and Development
SAB	State Agricultural Bank
SAMB	State Agricultural Marketing Board
SDGs	Sustainable Development Goals
SMEs	Small and Medium Enterprises
SSNM	Site Specific Nutrient Management

Chapter I

Introduction

1.1 Rationale of the Study

Myanmar is rich in natural resources, land and water together with favorable weather conditions for crop production. Moreover, it is also an agricultural country and the agriculture sector is the backbone of its economy. Myanmar agriculture sector contributes 26 percent of GDP and 27 percent of total export earnings.[1] In Myanmar, 70% of the country's population live in rural areas depending on farmland and almost of them are participate in agriculture. Among the agricultural crops, paddy is sown on 34 percent of net sown land and is the most common choice for farmers and also accounted for nearly 43 percent of the production value.[2] Thus, growth in paddy productivity has directly involved in raising real incomes of the rural poor and reducing poverty. Paddy production can not only provide employment opportunities but also give to diversification in such job opportunities especially in rural areas.

The population in Myanmar is 52.92 million in 2017[3]. In Myanmar, rice is staple food consumed by all of the population. Unlike in other countries, rice consumption in Myanmar reaches highest level. Per capita consumption of rice in Myanmar is 154 kg per year[4] .Rice is one of the source of foreign exchange earnings and its consumption is highly related to the level of income. Therefore, paddy is designed as national crop to highlight its great importance. It is continues to play a central role in Myanmar's agricultural production and food consumption .The Ministry of Agriculture, Livestock and Irrigation has laid down the most important target to achieve a surplus in paddy production so as to meet the requirements of the country.

[1] Agricultural Guide 2018
[2] Planning Department
[3] Statistical year book, 2017
[4] IRRI, 2017

The paddy production will be greater than the consumption, it will boost to export for needs of world market and changes in consumption pattern of rice, it will boost to export for needs of world market. According to the historical experience, Myanmar was the world's largest exporter of rice in the pre-World War period and remains one of the world's largest producers of rice today. So, the increase production of paddy is the most important factor in GDP growth and socioeconomic development. This study intends to analyze the sufficient condition of paddy production in Myanmar.

1.2 Objectives of the Study

The objective of the study is to analyze the sufficient condition of paddy production in Myanmar.

1.3 Method of Study

This study is mainly based on descriptive method based on secondary data sources from the Ministry of Agriculture, Livestock and Irrigation, Department of Planning, various issues of Statistical Year Books from Central Statistical Organization, books, library and relevant websites.

1.4 Scope and Limitation of the Study

This study focuses only on the production of paddy among the major crops in Myanmar for the period from 2007/2008 to 2016/2017.

1.5 Organization of the Study

This paper is organized into (5) chapters. Chapter I is Introduction. It includes rationale of study, objectives of the study, method of the study, scope and limitation of the study and organization of the study. Chapter II contains literature review. Paddy Cultivation System and Utilization of Major Inputs are presented in Chapter III. Chapter IV contains the situation of paddy production in Myanmar. Chapter V describes the findings of this study and suggestions.

Chapter II

Literature Review

2.1 Agricultural Development Theories

Many agricultural development theories have explained how the basic sources of growth (labor, natural, resources capital, specialization, improved efficiency, and technological progress) can be stimulated and combined to generate broad-based agricultural growth. It is also clear that institutional arrangements such as marketing system, price and credit systems, and property right can play an important role in stimulating or hindering development.

2.1.1 Resource Exploitation and Conservation Theory[5]

This theory is to expand the use of abundant resources such as land and labor to produce agricultural products. But it was known that expansion of unutilized land resources provides few opportunities for sustainable growth in developing countries because other factors such as disease, insects and soil problems prevent its use in agriculture. Another related theory is conservation theory. It refers to intensive use of resources such as crop rotations, forage livestock systems, drainage and irrigation. In many developing countries, the existing resources are prepared to increase land productivity. While agricultural scientists are trying to gain additional knowledge of new technologies, expanding resource exploitation and conservation effort simultaneously play an important role for future agricultural development till now.

2.1.2 Location and Diffusion Theory[6]

The Location theory of agricultural development is that countries should encourage decentralized industrial development, particularly in the middle and late stages of development. During these stages, strong linkage between agriculture and markets for inputs (such as fertilizer and pesticides) and output can help stimulate the

[5] Agricultural Economics, Department of Economics, Yangon University of Economics,p.170
[6] Agricultural Economics, Department of Economics, Yangon University of Economics, p.172.

local economy. Developing countries should mainly improve transportation infrastructure in rural areas. This location theory of agricultural development pointed the notion that market linkages are important.

A Related theory, the diffusion theory, stresses the importance of linkage among peasants themselves. The basic idea is that transfer of existing technologies and economic knowledge from the more progressive to the lagging peasants can increase productivity. So, the diffusion theory has led to attempts to directly transfer knowledge and technologies from more-developed regions to less-developed regions.

2.1.3 High-Payoff Inputs Theory[7]

This theory has emerged, building on the conservation, location and diffusion theories. But, it adds the important dimension that the process of agricultural development can be accelerated through provision of new and improved inputs and technologies (particularly improved seeds, fertilizer, pesticides and irrigation systems).The basic idea of this theory is applying new high-payoff inputs and technologies to increase productivity. It has been widely accepted because of the success achieved by modern wheat, corn and rice varieties in the 1950s and 1960s. These varieties are highly responsive to fertilizer, pesticides and water management and have resulted in substantial growth in agricultural output in many developing countries.

2.1.4 Theory of Induced Innovation[8]

Induced innovation theory explains the mechanism in which a society chooses an optimal path of technical and institutional change in agriculture. This theory hypothesizes that technical changes is induced by change in relative resource endowment and by growth in product demand, and institutional change is induced by changes in relative resource endowments and by technical change.

Technologies can be developed by the substitution of relatively abundant and low cost factors of production for relatively scarce and high cost factors. A rise in

[7] Hayami and Ruttan , op.cit.,p.62.
[8] Induce Innovation Theory was significantly developed by John R. Hicks, Theory of wages,(London) Mac Millan and Co; 1932). Hagami and Ruttan during the 1960s were the first to apply this theory of agricultural development. Their underlying assumption is that technological and institutional changes are vital to agricultural development.

the price of one factor relative to other will induce technical change that reduces the use of that factor relative to other. For example, if the price of land goes up relative to labor and fertilizer, indicating that land is becoming relatively scarce, technologies such as improved seeds will be developed, combining with labor and fertilizer to increase production per unit of land. This process of induced technical change can be illustrated graphically.

2.1.5 Production Theory[9]

Production theory is the study of production, or the economic process of converting inputs into outputs. Production uses resources to create a good or service that is suitable for use, gift-giving in a gift economy, or exchange in a market economy. This can include manufacturing, storing, shipping, and packaging. Some economists define production broadly as all economic activity other than the final purchase as some form of production.

Production is a process, and as such it occurs through time and space. Because it is a flow concept, production is measured as a "rate of output per period of time".

There are three aspects to production processes:

1. The quantity of the good or service produced,

2. The form of the good or service created,

3. The temporal and spatial distribution of the good or service produced

A production process can be defined as any activity that increase the similarity between the pattern of demand for goods and services, and the quantity, form, shape, size, length and distribution of these goods and services available to the market place.

[9] http://en.wikipedia.org/wiki/production.theory p-3 (Accessed on August 2010).

2.2 Top ten paddy production in the World

According to the study, the following countries are top ten paddy production countries in the world (2017).

Table (2.1) Top Ten Paddy Production in the world (2017)

Rank	Country Name	Total Paddy Production (in million metric tons)
1	China	210.1
2	India	165.3
3	Indonesia	74.2
4	Bangladesh	53.1
5	Vietnam	44
6	Thailand	33.3
7	Myanmar	28.3
8	Philippines	18.6
9	Brazil	11.9
10	Japan	10.7

Source: https://www.statista.com

According to the table (2.1), China was the leading country with a production volume of some 210.1 million metric tons in 2017. India followed on rank second with a paddy production with a paddy production volume of approximately 165.3 million metric tons. Moreover, paddy production in ASEAN was 220.30 million tons in 2017, increasing from 211.86 million tons in 2016 (crop year 2015/16). The increase was due to a rise in both planted area and yield. Additionally, the increase in production was found in most of the countries except Myanmar and Vietnam according to FAO published in July 2018 and USDA published in June 2018. Asia is expected to drive the global production expansion of 2018, especially positive for India. Thus, current prospects also point to Cambodia, Indonesia, the Philippines, Myanmar and Thailand producing more in 2018. In other regions, Latin America and the Caribbean are projected to decrease due to untimely rains at planting time and unseasonable temperatures. And then the production outlook is also unfavorable for the European Union and Russia.

(1) China

China lead in the paddy production across the world. The country mainly farms its paddy under irrigated farms that account for more than 90% of the total country's produce. With its stand at the top position , China produces approximately

35% of the total paddy produced all over the world, Its success in paddy production is attributed to use of hybrid rice that produces higher yields when compared to traditional crops. Annual production of paddy in China currently stands at 195.714 million metric tons. 29.493 million hectares of land are under paddy cultivation.

(1) India

Traditionally, India has been large paddy producer when the area of land under cultivation is considered. Paddy production in the country accounts for more than 40% of the total food products in the country. With rice being a staple diet in country, the country is also a major rice consumer but has an advantage in its surplus production. It is estimated that paddy farming in the country employs more than 50 million households and is carries a major impact on overall country's economy. The total paddy production in India currently stands at 148.26 million metric tons where over 44.1 million hectares of land are under paddy cultivation.

(2) Indonesia

Indonesia leads in rice consumption with estimates from International Rice Research Institute indicating that every head consumes over 139 kg of rice each year. With its growing population, the country is expected to increase its current consumption rates by up to 38% in the next 25 years. With these findings the country requires to increase its yields to more than 6 tons to cater for the expected demand. Currently, Indonesia's annual paddy production stands at 64.399 million metric tons. 12.884 million metric hectares of land are under paddy cultivations in the country.

(3) Bangladesh

Bangladesh is a major paddy producer taking the forth position on the globe among the countries with largest paddy production capacities. Unlike most other countries, Bangladesh paddy farming is practiced by small scale farmers who normally produce just enough for domestic consumption. It is estimated to be among the countries with highest per capita consumption rates. It is further estimated that more than 70% of the country's population engage in some form of paddy farming. Annual production of paddy in the country is currently estimated at 47.7 million metric tons where an area covering 113 million hectares of land are estimated to be under paddy farming.

(4) Vietnam

The economy of Vietnam is largely dependent on paddy production. Over 82% of the country's arable land is under paddy farming. Red River and Mekong are the two main deltas that mark the main paddy growing areas in the country. Mekong Delta region is the highest producer contributing over 52% of paddy yields to the national basket. Red River Delta produces 18% of paddy while the rest of the produce comes from the other regions of the country. Vietnam's paddy production capacity stands at 38.725 million metric tons annually. The country has dedicated over 7.414 million hectares of land to paddy farming hence ensuring its massive production.

(5) Thailand

Thailand currently tops among the biggest rice exporters in the world. The country is home to the Jasmine Rice a coveted and highly acclaimed brand locally and on international standards. Rice forms the staple food of the country meaning consumption is equally highly but it does not exceed the production. Annual production of paddy in Thailand is estimated at 30.467 million metric tons. Of this production, the country consumes a total of 10.4 million metric tons leaving over 20 million tons for the export market. Over 2.48 million hectares of land are under paddy farming and this account to over 55% of the total arable land in the country.

(6) Myanmar

Myanmar is a leading paddy producer with dominance in being among the top producers for over a century. In early 1990s, Myanmar was the leading rice producer on the globe but this was reversed after World War II. More than half of the country's arable land is under paddy farming and this trend continues to ensure there are high yields realized by the farmers in this country. Annual production of paddy in Myanmar currently stands at 32.6 million metric tons where a total of 8.1 hectares of land are dedicated to this product.

(7) Philippines

Rice is a staple food in Philippines. It ranks in the ninth position among the largest paddy producers across the globe. Current production of paddy on the country stands at 16.2 million metric tons annually. A total of 4.53 hectares of land in

the country are dedicated to paddy production. Despite the high production yields of paddy in Philippines, the consumption is relatively high and supersedes the production. To meet for its high demand of rice, the country imports over 1.8 million tons of rice every year making it the largest rice importer in the globe as a single country.

(8) Brazil

A country that is gaining popularity for modernized farming, Brazil managed to reach its food self-sufficiency in 2004 and has continued to increase its production to be among the leading exporters today. Brazil produces paddy estimated at 12.65 million metric tons of paddy annually. This is cultivated on 2.9 million hectares of land. Africa leads in the list of importers from Brazil.

(10) Japan

Japan has a rich culture of paddy faring that dates back to around 300 BC when the crop was introduced in the country from China. It stands as one of the most industralized countries with deep attachment to paddy farming where the country's farmers have resulted to use of mechanized farming methods in keeping track with time. Consumption of rice in Japan currently stands at 8.797 million metric tons annually making the country an importer of rice to curb the shortage from its

2.3 Top ten rice export in the world

From a continental perspective, three quarters 75% of global rice exports originated from Asian countries with shipments amounting to US$15600 million .North American exporters supplied top ten rice export in the world 8.8% of global rice export followed by Europe at 8.6% then Latin America plus the Caribbean at 6.1%. Smaller percentage came from Oceania at 0.8% and Africa at 0.5%. The below table (2.2) showed the countries that exported the highest dollar value worth of rice during 2017.

Table (2.2) Top Ten Rice Export in the World (2016 /2017)

Rank	Country Name	Total export value (US$)
1	India	5,500 million
2	Thailand	5,200 million
3	United States	1,800 million
4	Pakistan	1,700 million
5	Vietnam	1,600 million
6	Italy	597.5 million
7	China	596.8 million
8	Uruguay	474.3 million
9	Cambodia	333.1 million
10	Myanmar	320.6 million
11	Brazil	244.6 million
12	Belgium	243.1 million
13	Netherland	214.1 million
14	Paraguay	194.2 million
15	Argentina	179.0 million

Source: https://www.statista.com

According to the table (2.2), rice export of India was projected to amount to US$ 5,500 million. Thailand is US$ 5,200 million, United States is US$ 1,800million, Pakistan is US$ 1,700 million, Vietnam is US$ 1,600 million, Italy is US$ 597.5 million, China is US$ 596.8 million, Uruguay is US$ 474.3 million, Cambodia is US$ 333.1million and Myanmar is US$ 320.6 million . Therefore, Myanmar stands tenth position in the highest dollar value getting from rice export in 2016/2017. The decrease in rice export is forecasted in Thailand, Vietnam, Myanmar and Indonesia due to a substantial crop recovery. The significant increase of rice import is expected in Indonesia and Philippines. (OECD, 2014).

2.4 Reviewing Previous Literatures

T.A.A. Naing et.al (2002) studied about a survey of Myanmar rice production and constraints during the wet seasons of 2001 and 2002. The objectives of this paper is to identify yield constraints, input intensities and the general practices of rice cultivation. It was found that a recent decrease in the overall average rate of fertilization application, an increase in the prevalence of rice-legume cropping system and only localized insect pest or disease problems. Additionally, rice yield were found in the Upper Myanmar likely the results of more suitable weather conditions, better irrigation and ready market access.

Win Lae Lae Kyaw (2008) emphasized about the agricultural production in Ayeyarwaddy region for the period 1988-89 to 2007-2008. The main objective of this paper was to analyze the growth of agricultural products. It can be seen that the Ayeyarwaddy region is known as rice pot due to geographical location, the cultivable lands are plentiful across its delta region and rice is the dominant crop. Both sown acreage and production of paddy are significantly increased during the studied period. It can be expected that this situation will persist in the future because there is ample scope for increase in rice yields, so that total output can still grow. Since rice is the main source of foreign exchange for importing capital goods, the Ayeyarwaddy Region plays an important role in the Myanmar economy.

Khin Mar Htwe (2008) studied about the export of rice in Myanmar from 1962-63 to 2007-2008. The objectives of this paper are to analyze the export of rice and to express about the rice markets. It mention about Myanmar as a favorable opportunity for rice sector. It analysis Myanmar rice production and export condition during the central planned economy and market-oriented economy. Therefore, all members of institutions related to rice promotion must be taking active participation. The factor that caused of increase in rice production are to utilize the right amount of fertilizer, to use quantity seed and natural fertilizer, to increase the percentage of irrigation area, technical support of government assistance , the usage of tractors , the percentage of farm labor to labor force. Gaining capital, inputs and technology for farmer must also be provided continuously. Moreover, the including percentage of broken rice was reduced in order to promote the quality of rice and the standard of rice mill improved to receive the better quality of rice. These suggestions, rice export will reach to the higher level among the countries.

Pann Myat Mon (2010) studied about the summer paddy production of Myanmar during the period from 1990-91 to 2009-10. This paper is to analyze the condition of summer paddy cultivation and production of the Myanmar. In 1992-93, summer rice production was introduced with the provision of irrigation facilities such as diesel, small scale irrigation pumps, irrigation canal and dams was provided to farmers in major summer rice growing areas. The whole idea was to increase rice production for both domestic consumption and export. The Ayeyarwaddy, Bago and Yangon regions were found to be having the large area of summer paddy. Kayar, Kayi, Kachin states and Tanintharyi region had least area of summer paddy. In 1988-

89, the agricultural reforms initiated by the government, the most significant feature is allowing the private sector (local and foreign) to become engaged in agricultural marketing. So, the state can achieve better performance in the agricultural sector in collaboration with the private sector. Under the agricultural reform, rice production sharply increased as a result of new technology.

Sandar Maung Maung (2013) studied about the rice export in Myanmar during the period from 2000 to 2013. Objectives of this study was to identify the factors for rice export feasibility and potential of Myanmar. It could be founded that factor condition in Myanmar rice export is still undeveloped in. In term of natural resources (land and water) and favorable climate condition, factor condition is satisfied except water scare areas of Myanmar. In sum up, Myanmar's rice export relies on relatively low quality rice rather than quantitative one. However, Myanmar still has the opportunity to revitalize to be the top rice exporter in the region. It is necessary to take the opportunity efficiently.

Thin Thin Swe (2014) studied about the rice production in Ayeyarwaddy Region for the period 2004-2005 to 2014-2015. The objective of this paper is to analyze the current situation of rice production in Ayeyarwadddy region and to be sufficient foods in adequate public provisions. It was found that Ayeyarwaddy region has eached its full use of available agricultural lands and a small area of 70 thousand acres is left unexploited as cultivatable waste land. Crop intensification such as rice after rice or pulses after rice is being practiced so much on a large extensive scale. Crop intensification can only be feasible if there are sufficient supplies of major inputs like irrigation water, fertilizer, seeds, machinery and farm credit. In this area, Natural rainfall is heavily supplement by weir, diversions and flood control schemes which tend to contribute to intensified land-use in agriculture. Even into the extended future, Ayeyarwaddy will still continue going on with its famous name 'The rice bowl of Myanmar. Therefore, the region has its own potential of growth and importance in Myanmar economy.

Myat Hsu Naing (2016) attempted to analyze the rice production pattern in Hlegu Township in the period 2006-2007 to 2015-2016. This paper analyzed the condition of rice production in Hlegu Township, Yangon Region. It was found that Hlegu Township is a vast agricultural area which specialization in rice farming. As

the production of paddy rose sharply has been little increased year by year in the region. In this region, social and economic conditions mainly depends on the agricultural production. It found that the utilization of machine power has been increased year by year, widely-use chemical fertilizer and used advanced technology in growing paddy in Hlegu Township. In order to increase rice export earning, government should have to support the essential inputs for the development of rice industry.

Chapter III

Paddy Cultivation System and Utilization of Major Inputs

3.1 Strategic of Paddy in Myanmar

After 1988, Myanmar adopted a market oriented economy and farmers were allowed freedom of choice on crop cultivation and production. Myanmar also adopted the rice liberalization policy in 2003. After forming the new government in 2011, the Government undertook some relaxation on the export tax for agricultural products and tax exemption on the import of agricultural inputs and machineries in order to support agricultural development. The Government of Myanmar has developed the National Comprehensive Development Plan with a vision to enter into a global community as a modern developed industrial country. It is envisaged that, by implementing the Plan, two long-term objectives, namely, continuous economic development and inclusive development will be achieved.

The strategies under the Plan were implemented, starting from 2011/2012 to 2015/2016, with first- five year short-term plans, expected to increase average per capita income to 3,000 US dollars in 2030.The second five-year short-term plan for the development of agriculture sector has been developed based on Sustainable Development Goals (SDGs) beyond 2015, Myanmar Rice Sector Development Strategy (MRSDS) and objectives of agriculture sector development of the Ministry of Agriculture, Livestock and Irrigation .The second five-year short-term plan, which is to be implemented from 2016/2017 to 2020/2021, aims to enhance socio-economic and social status of rural people including rural farmers through increased productivity in agriculture sector, while sustaining the importance of agriculture sector and supporting the economy of other sectors.

In Myanmar, MOALI is leading role in Agriculture sector that duties are plantation of crops, production of crops, consumption of crops and exporting of crops. Government sector laid down policy and strategic crops mainly rice and others. The

Ministry has laid down the following vision, mission, policy, objectives and strategy to develop the agriculture sector of Myanmar.

The vision is achieving 'Per capita income' and 'Standards of living' of rural populace relying on agriculture higher than the neighboring countries and keep abreast with developed nations.

The missions are **(** 1) attain maximum market share in regional and global markets for agro-based value-added agriculture and specialty food products, (2) improve food security and poverty alleviation particularly in rural areas and (3) manage Green Growth.

The policies are (1) to emphasized production and utilization of high yielding and good quality seeds , (2) to conduct training and education activities for farmer and extension staff to provide advanced agricultural techniques, (3) to implement research and development activities for sustainable agricultural development , (4) to encourage transformation from conventional to mechanized agriculture , production of crops appropriated with climate and extension of irrigated area and (5) to amend existing agricultural laws and regulations in line with current situation.

Long Term Objectives are (1) create and sustain competitive advantage on agro-based and food products, (2) level the knowledge and technology know-how of rural people with neighboring developed countries and (4) improve rural industrial and social infrastructure.

Short Term Objectives are (1) increase primary productivity at farm level , (2) improve environment for establishment of rural agro-based SMEs, (3) create inflow of FDI in the agriculture sector, (4) assure local and export market access and MIS, (5) develop pure and applied research and (6) increase efficiency in the agricultural supply chain.

The Strategies are (1) secure the linkages among R&D, Extension and Market, (2) development of efficient supply chain and industry clusters, (3) assure sustainable and tenure, (4) establish an efficient system of inputs, credit, guaranteed purchase and prices and insurance on crops and climate, (5) establish efficient buffer policy and system, (6) promote contract farming and (7) develop infrastructure.

According to those basic measures carrying out in the agriculture sector. The MOALI is emphasizing on the main three tasks: (1) seed production, (2) training and education, (3) research and development.

Rice Sector in the National Export Strategy (NES)[10]

The vision of NES is high-quality and environmentally sustainable growth in rice production and export for rural development and income generation.

The objectives are;

(1) Increase rice production and quality substantially
(2) Increase efficiency and reduced costs through expansion of sector infrastructure
(3) Diversify export products and export markets
(4) Growth the rice sector in a way that promotes health, equitable growth and environmental sustainability

The purpose of the above, the development of rice strategy is undertaken cooperatively by the Ministry of Commerce, Department of Agriculture and Myanmar Rice Federation annually.

Moreover, the main objectives of the Myanmar Rice Sector Development Strategy are;

(1) Increase rice productivity and improve rice quality and nutritional value
(2) Adapt to , and mitigate the effects of, climate change and reduce risks, while protecting rice ecosystems and the environment
(3) Promote Myanmar rice as a quality brand to enhance its competitiveness in international trade
(4) Improve the well-being and capacity of smallholder farmers
(5) Enhance efficiency in the rice value chain and reduce postharvest losses

Justification between conservation of natural environment and the current economic development/ socio-cultural development will be required when working for the socio-economic development of Myanmar. Natural resources and human resources would be able to utilize effectively and efficiently only when social development between sectoral and regional, and, urban and rural could be carried out proportionately. Socio-economic development has to be carried out through unity of the people and development of democracy based on strong macro-economic

[10] Rice division, Department of Agriculture.

management and good governance. Myanmar will be able to participate in regional and international economic integration by combining potentials of the country with global opportunities.

3.2 Method of Paddy Cultivation[11]

At present, farming systems of Myanmar can be classified according to the type of cultivation systems. There are five systems and these are as follow;

(1) Rain fed lowland cultivation

(2) Irrigated cultivation

(3) Alluvial land cultivation

(4) Upland dry cultivation and

(5) Upland cultivation

Moreover, there are two types of summer paddy cultivation: dry cultivation and wet cultivation. In dry cultivation, it should firstly powder the ground and level the ground with harnessed log and form groove spacing on feet or eight inches wide with a plough. Then cast one and a half bushel of good-quality paddy seeds onto the grooves uniformly and press the grooves with a hard-nessed log contrarily or slantingly. Irrigate water to the cultivated land slightly. Five days after casting, it could be seen that paddy grown in rows.

The other type of cultivation is using Dum seeder to cast paddy. By using a Dum seeder, two people can finish casting of paddy up to 4-6 acres. In wet cultivation, the ground is made to wet so the paddy seeds should cast in rows by wetting paddy seeds. Dum seeder which could cast eight rows in the same time. Pulling straightly the Dum seeder by two people, paddy seeds will fall into the wet grooves in rows. By stepping gradually the foot-steps of the two people, the falling of paddy seeds will be uniform. By using this method, it could finish 4-5 acres of land within a day. Three days after casting, it could be seen that paddy grown in rows. Irrigated two inches of water when paddy reach to 4-5 inches.

To cultivate summer paddy, the life-span of paddy should be between 90-120 days. The type of paddy called thee-htat yin is the most appropriate type to cultivate

[11] Zaw Myint, " Method of Summer Paddy cultivation, " Myanmar Agricultural Services, Department of Agriculture , Yangon, Myanmar (2010).

summer paddy.[12] When cultivation summer paddy, it must finish cultivation between from November to December third week.

Two cultivation methods are used 1) sowing direct rice seeds directly to the land and 2) using nursery. Before cultivation, farmers prepare small canals between kazin and distribute fertilizer or animals waste or manure on their lands. Some farmers cultivate their lands near to the water resources but some farmers cannot get water. So land owners or farmers who cannot get water, work for other farmers who can get water. Farmers contributed labor on a reciprocal basis.

For nursery preparation, land preparation comprises of two stages; ploughing and harrowing. The ordinary plough consists of stock plough, plough beam and knee of plough. The plough is driven by two cattle using a yoke. The later includes a lot to which the teeth or harrow are attached; the shaft of a harrow, tooth of harrow and handle bar.

Generally, the harrow is like a plough with two cattle and driven round over the plough fields using spiral curve, about eight time in different directions, but the number of times depend on the nature of soil, the water supply condition and many other situations. If ploughed and harrowed soil is in good conditions, the farmers can estimate the amount of paddy to forecast and how much of the land shall be transplanted, it depends on the types of paddy and nursery cultivation is used by small tractor in some areas.[13]

Nowadays, the rice farming system of farmers in some parts of Upper Myanmar, particularly where irrigation was available and farmers in lower Myanmar traditionally practiced some double cropping. Factors that contributed to higher cropping intensity were as follows:

1) Increase irrigation
2) Increased use of modern varieties (MYVs) with short growth duration
3) Increased harvest mechanization and tractor tiller facilities and
4) Higher crop prices, eg - for edible oil-bearing crops, to make double-cropping more profitable

[12] Zaw Myint, " Method of Summer Paddy cultivation , " Myanmar Agricultural Services, Department of Agriculture , Yangon , Myanmar (2010) .
[13] Aung Twin Kyaw, A Study on rice specialization in Ayeyarwddy Region, (2011), p-131

The innovation in rice production include multiple rice cropping rice rationing, rice gardening and rice-fish farming in-deep water areas. These innovation have helped to intensify rice production.

There are two dominant rice production systems: rain-fed lowland and irrigated low-land .The rain-fed lowland and irrigated rice systems are dominated about 90% of Myanmar's rice area.

There are nine intervention areas in the rice production cycle where improvements in productivity and profitability can be achieved. Each of these intervention areas has relevance to both the rain-fed lowland and irrigated rice systems.[14]

1. Seed selection
2. Land preparation
3. Crop establishment
4. Water Management
5. Soil Fertility Management
6. Pest Management
7. Harvesting and threshing
8. Drying and storage
9. Crop rotation

1. Seed Selection: There are two components to seed selection: choice of variety and quality of seed. The choice of variety is made by farmers based on a combination of factors that include: (1) adaptation to the growing environment, (2) eating/cooking preferences of the consumers, (3) market preference/price, and (4) cost of seed.

Hybrid seeds are costly to produce. Moreover, grain quality is poor, resulting in a low market price. All of these factors suggest caution in promoting hybrid paddy on a wide scale without more thorough agronomic and economic assessment. Most of Myanmar's paddy farmers use their own seed from year to year. There is a national seed certification system in Myanmar.

The Government advocates the use of high-yielding certified seeds. However, the private seed sector is poorly developed. Although the production of hybrid paddy seed is actively promoted by the MOALI, the broader impact of Government seed

[14] Glenn denning , Kye Baroang, Tun Min Sandar and Other MDRJ and MSU colleges, " Rice Productivity improvement in Myanmar (2013)", Background Paper No.2.

distribution systems was not clear and requires further study. Field observations in the delta and in the dry zone suggest good scope for improving the uniformity of seed, which may increase yields by 5-20% as well as improve grain quality and market acceptability.

A well-managed public sector seed system is essential for non-hybrid paddy varieties. Once well adapted named varieties are made available to farmers, the seed can be readily multiplied and distributed through informal farmer-to-farmer mechanisms. A nation-wide varietal evaluation system must be linked to seed production and distribution programs.

2. Land preparation: Lowland paddy fields in Myanmar were traditionally plowed with cattle or water buffalo, the latter being more common in lower flood-prone landscape positions. Two wheel tractors, most imported from China, are increasing in importance. For most paddy-growing areas, two-wheel tractors currently appear to be the best solution for reducing the land preparation time and enabling a short-turnaround between crops.

In rain-fed paddy fields of the delta, farmers seek a short-turnaround time after paddy harvest before establishing black gram (*Vigna mungo*) and other high-value post-monsoon crops grown mainly on residual moisture. Four-wheel tractors are less common, but are used where fields are large. In some locations, the Government runs tractor “stations”, renting out services to farmers. This is also practiced in consolidated farm areas managed by the Specialized Rice Companies. The main challenge in using four wheel tractors is restricted field access and maneuverability within fields. Complementing the use of four-wheel tractors, attempts have been made by the MOALI and IRRI to introduce laser leveling as a means of improving land preparation and crop establishment.

Laser leveling achieves a more level field which, in turn, results in a more even distribution of water and more uniform germination of seeds, more effective weed control, and higher yields. Reductions in seed, fertilizer and fuel use. Laser leveling was introduced by IRRI in 2006 for demonstration purposes. It has not been widely used to date. The high cost of equipment, the need for skilled operators, and the irregularity of field shapes all constrain adoption. However, there is scope for laser leveling as part of a broader initiative to consolidate paddy fields for operational

efficiency. With relatively large fields and reported labor shortages in rural areas, it is likely that mechanization of tillage will grow rapidly in Myanmar.

3. Crop establishment: In Myanmar, paddy is usually established through transplanting or direct wet seeding. Transplanting is the most common method for monsoon crop establishment, giving the paddy plant competitive advantage over weeds. For the transplanting method, paddy seedlings grown in a nursery are pulled and transplanted into puddled and leveled fields 15 to 70 days after seeding. This operation can be done manually or using a machine. Manual transplanting is well suited to situations where the land is uneven, the water level is variable, and labor costs are low. Mechanized transplanting methods should be explored in Myanmar drawing on regional experience.

In Myanmar, wet seeding is more common for the summer paddy crop. This is because of the lower likelihood of submergence and related mortality of young seedlings. Wet seeding involves the sowing of pre-germinated seeds onto a puddled soil. The seed may be broadcast by hand or less commonly using a seeder. For best results, a level field surface is required, and herbicide is used to control weeds.

The drum seeder was widely distributed in Myanmar through LIFT and implementing partners with mixed results (Barca *et al*, 2012). While having the potential to save seed and reduce labor costs, adoption rates remain low. Farmers reported that drum seeders consumed more time than direct broadcasting, and required a greater investment in hand weeding. According to the LIFT evaluation report, maintenance of the drum seeders was also identified as a constraint to adopt on a sustained basis.

4. Water management: Myanmar has extensive water resources available for irrigated agriculture including for paddy farming. Surface water from the Ayeyarwady and Sittaung River Basins has been developed for paddy irrigation over the past century. Naing (2005) reports high potential for groundwater development in the Ayeyarwady River Basin. The area of paddy under irrigation is unclear. We estimate that at least 14% of the planted paddy area is irrigated. However, more research is needed to determine the extent and reliability of existing irrigation systems. Optimal water management requires that paddy grows in a saturated soil for most of the growing season. Surface water is not required except for its utility in suppressing weeds.

In most settings in Myanmar and elsewhere in South and Southeast Asia, farmers seek to maximize water flow to their fields to reduce the yield-reducing effects of water deficit. In irrigated paddy, farmers are concerned about their access to adequate water from canals. Competition for water is common during the dry season, especially where there is limited regulation and an absence of cooperative water management. With this in mind, Myanmar would benefit from testing and evaluating alternative models for participatory water resources management.

Improvements in water use efficiency would likely be achieved through: (1) farmer organization through water user groups, (2) improved extension support, (3) infrastructure to support storage, processing and marketing, (4) improved paddy varieties and associated agronomic management practices, and (5) crop diversification to high value (non-paddy) crops during the summer season.

5. Soil fertility management: Overall the paddy soils of Myanmar appear relatively fertile. Alluvial and swampy soils dominate in the delta, while vertisols are more important in the irrigated paddy lands of the dry zone. Information on current fertilizer use by farmers is limited. It appears that fertilizer use on paddy is common, though farmers apply at relatively low levels. Nitrogen (N) fertilizer as urea is often applied during the dry season, while little phosphorus (P) or potassium (K) is used in either season. However, the high cost and low paddy price constrain its use. Asia-pacific network on Integrated Plant Nutrient Management (APIPNM).

Vertisols are clayey soils that have deep, wide cracks for some time during the year. They shrink as they dry and swell as they become moist. According to FAO, although their high natural fertility and positive response to management make Vertisols attractive for agriculture, some of their other properties impose critical limitations on low-input agriculture. Vertisols are suitable for paddy production. They are relatively easy to puddle and retain water well. For further information: Fertilizer consumption in Myanmar has declined sharply over the past few years and lags behind its regional neighbors Low fertilizer use on paddy and modest yield levels suggest moderate to high responses to increased fertilizer use in Myanmar.

Site Specific Nutrient Management (SSNM) improves nutrient use efficiency and matches fertilizer use and crop needs based on a target yield. SSNM is a sound approach and deserves attention by extension services in Myanmar. As connectivity improves in rural areas, SSNM approaches can be transmitted to farmers through

IT-based tools such as Nutrient Manager for Paddy, a computer-based decision support tool developed by IRRI that enables rapid access to fertilizer guidelines for specific paddy fields.

6. Pest management. There are a large number of insects that feed on the paddy crop. Morris and Waterhouse (2001) documented 29 species of insects and crabs that feed on paddy in Myanmar. Of those, 9 species were considered significant Naing *et al* (2008) reported a low incidence of pests and diseases in the main paddy growing areas of upper and lower Myanmar. The most commonly found paddy pests were stem borer (*Scirpophaga incertulas*), rice gall midge (*Orseolia oryzae*), Jassid (*Nephotettix apicalis*) and rice ear bug (*Leptocorisa* spp.). Only rice gall midge was reported causing a large yield reduction in a particularly heavy rainfall year. Naing *et al* reported sheath blight as International Plant Nutrition Institute (IPNI) Research Database Buresh *et al* (undated) define SSNM as "a plant-based approach for managing the nutrient needs of paddy in intensive production systems. It provides principles and tools for 'feeding' paddy with nutrients as and when needed to achieve high yields while optimizing use of nutrients from indigenous sources."

The main paddy disease in terms of incidence in fields that grain yield losses due to diseases and pests were for the most part "insignificant. Despite the apparent low level of damage by insect, there has been a recent sharp increase in the use of pesticides in Myanmar (Barrion et al 2011). This has raised concerns of misuse and related negative environmental and health impacts.

In addition, there is clear evidence from several countries in Southeast Asia that inappropriate use of pesticide can lead to worsening of pest problems, most notably plant hoppers. Farmers, were widely used pesticides; however, farmers were uniformly unclear about their efficacy and risk. Farmers relied heavily on agro-dealers for advice on pesticide use. Most commonly used pesticides were organophosphates and organochlorines , particularly dimethoate, phenthoate and endosulfan, all of which are banned or under restricted use in most countries.

Without regulation and sound extension advice, Myanmar's rice farmers are likely to experience the disastrous effects of crop damage caused by the brown plant hopper (BPH). BPH resurgence is associated with the killing of natural BPH

enemies through inappropriate use of pesticides. An additional concern associated with increasing pesticide use is the impact on fish grown in or adjacent to paddy. Ecologically-based approaches to pest management have been developed and deployed in several countries of Southeast Asia.

Heong is concerned that even with formal registration of pesticides, there needs to be licensing and advertizing restrictions, coupled with training and awareness programs, in order to avoid overuse. Overall, farmers in all regions expressed only very basic knowledge about chemical weed control methods. However, with rising labor costs and increasing use of direct seeding in place of transplanting, it is likely that herbicide use will increase.

7. Harvesting and threshing: Paddy is generally harvested manually using family and/or hired labor, the balance of which depends on farm size. This trend is driven by the high labor cost and grain losses associated with traditional manual harvesting methods .After harvesting, farmers usually stack their stalks un-threshed on the paddy field bunds. This practice is undertaken to focus labor on land preparation to enable a quick turnaround to either a second paddy crop or pulse crop such as green gram.

Early crop establishment is associated with higher yield, and pulses attract a much higher price than paddy. The downsides of stacking on bunds are losses through rat damage and shattering, and deterioration in grain quality, especially if there are rain showers. Threshing is done traditionally through trampling by cattle.

However, mechanical threshing is increasing in importance. The combination of hand harvesting and mechanical threshing is the intermediate step to combine harvesting in response to higher wage rates. However, it is reasonable to anticipate widespread use of combine harvesters in Myanmar over the coming 5-10 years (Gummert, pers. com). Mechanized harvesting and threshing will likely reduce the losses associated with an extended period of field stacking.

8. Drying and storage: Farmers normally sun-dry their grain on any available space, including on roads. The latter practice leads to uneven grain drying which, in turn, results in a higher proportion of broken grains and lower quality of the final product. Stones and other impurities further reduce quality. The basic reason is that farmers are unable to obtain a price premium for well dried grain. A successful model whereby farmers have their grain dried for a fee to a service provider, thus leveraging

economies of scale and eliminating the need for farmers to purchase individual driers (Gummert.per.com).

IRRI introduced a modified flat-bed dryer using a rice husk furnace to Myanmar in 2007. Farmers store unhulled rice for both grain and seed. Paddy for consumption and later sale is normally stored unhulled rather than as milled rice, as the husk provides some protection against insects and helps prevent quality deterioration. Grain and seed is stored on-farm in jute bags and traditional storage granaries, baskets, drums, and other containers. Storage losses and reduced germination can occur through excessive moisture and infestation of insects and rodents.

At the farm level, unhulled rice can be stored in sealed plastic bags. This method controls the moisture content of the grain. Respiration by the grain and insects inside the storage container consumes oxygen and produces carbon dioxide. Oxygen levels are reduced from 21% to less than 10% within a short period of time. Below 5% oxygen, insects are killed and the viability of seed retained. Hermetic storage does not work with milled rice because of the lack of biological activity. A national distributor for hermetic storage systems was recently appointed so the systems should soon be available in Myanmar (Gummert pers. com).

9. Crop rotation. Rice is well suited to flooded fields, as long as the plants are not submerged for more than a few days. In some areas during the 1990s, the Government promoted double cropping of rice during the monsoon season as a way of boosting production. However, farmers found it difficult to harvest and dry the first crop at that point in the monsoon season (usually in September/October) and this practice has been largely discontinued (Garcia *et al*).

For more than 20 years, farmers have been strongly encouraged by the Government to intensify rice cropping through a summer rice crop. Recent policy changes have signaled opportunities to diversify production after harvesting the monsoon crop**.** Pulses, oilseeds and vegetables are now widely grown in rain-fed areas and where summer irrigation is insufficient for a second paddy crop. In irrigated areas, early maturing pulses are sometimes grown between the monsoon and the summer seasons. The growing demand for livestock feed suggests there may be opportunities to expand production of yellow corn and soybean, both of which require much less water than paddy. Soybean has the added value of breaking the cereal

rotation with benefits to soil fertility and pest and disease management. We saw little evidence of soybean in the field, but see promise in exploring its yield and income potential.

More than 2,000 different rice varieties have been based used in Myanmar. Many varieties are identical although they are called in various names in different areas of the country. Traditional varieties were segregated according to their life length or maturity period, including the following:

(1) Short-duration early rice (seed to see in 100 to 150 days)
(2) Medium-duration rice (150 to 170 days)
(3) Long-duration rice (170 to 200 days)

The cultivated area of ten most monsoon paddy varieties were Manawthuka, Sinthukha, Ayarmin, Pawsannyin, Shwewahhtun, Sinthwelatt, Sinakayi, Ngasein, Meedone and Hnankar. Moreover, the cultivated area of ten most summer paddy varieties were Theehtutyin, Shwethweyin, Sinthukha, Manawthukha, Yadanartoe, 90-days, Palethwe, IR-747, Yadanaraung and Shweyinaye.[15]

3.3 Utilization of Major Inputs for Paddy Production

Paddy production is a function of major inputs like land, quality paddy seeds, fertilizer, pesticides, irrigation water and farm machinery. The present growth in paddy production in Myanmar has been closely correlated with the intensive use of such inputs in order to achieve more yields and outputs. Before 1988, the state supplied nearly all agricultural inputs where some of them are imported and some of them are locally produced. After the economy reform in 1988, there was a change of the supply source from the state supply source from the state supplying everything the hard of the private sector along with cooperatives. There is still the existence of a minimized role of the state but could still be counted as very important. The production and distribution of seeds is managed by the state alone throughout the long successive period from the socialist era up to the present day. Under the market economic system, in addition to the state sector, private sector participation is increasing in utilization the farm machineries and equipment for various activities of agricultural production

[15] Myanmar Agriculture Sector in Brief, 2016, DOP, (MOALI)

3.3.1 Land Utilization in Myanmar

Myanmar is favored in land resources for agricultural development. Several million hectares still remain to be developed. To assist in this effective development for these land resources, the government has made several concessions and also laid down long term and short term program for land development .The soil of Myanmar is different depending upon the different climates, topography and location. Generally types of soil are grouped into 3, namely the alluvial soils 50 percent, the clayey soils 30 percent the red literates soil 20 percent.

Land consolidation is also being undertaken in the existing agricultural land with proper drainage, irrigation and farm roads. Apart from the traditional small-scale crop cultivation, development of modernized large scale agricultural business by the private sector is being encouraged. Development works of agricultural land includes reclamation of fallow and cultural waste land, development of farmers' embankment and paddy-fish, integrated farming in deep water areas and protection of soil erosion and development of terrace farming in high-land and slope land areas.

Table (3.1) Area Classified by Type of Land in Myanmar (2007/2008 to 2016/2017)

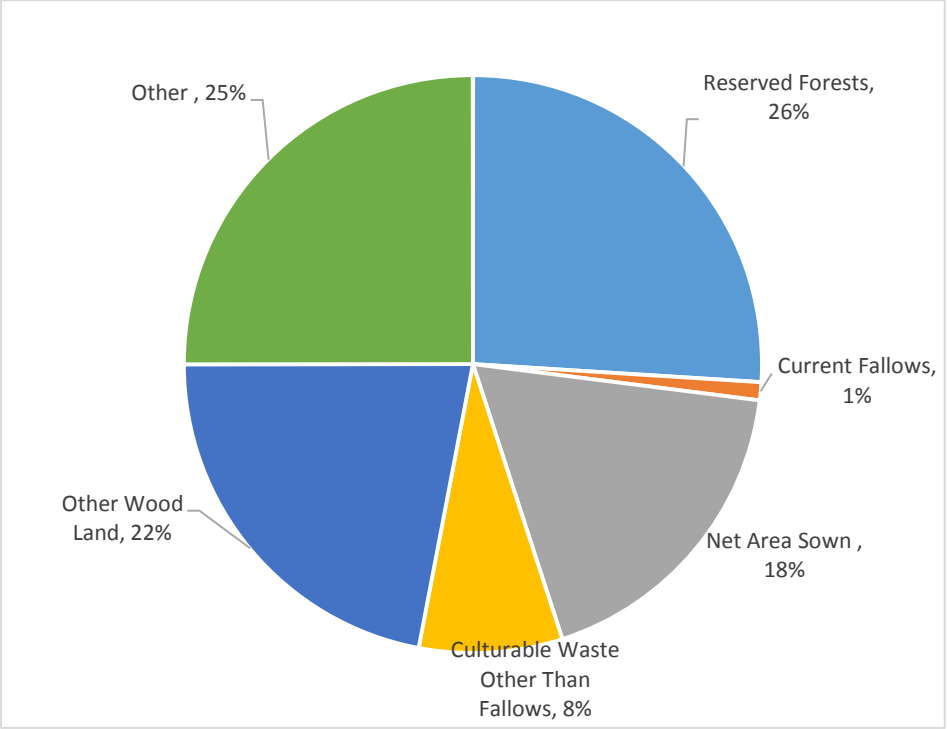
(Thousand Acres)

Year	Reserved Forest	Current Fallow	Net Sown Area	Cultural Waste Other than Fallows	Other Wood Land	Other	Total Area
2007/2008	41,404	653	28,930	14,304	40,891	41,004	167,186
2008/2009	41,604	634	29,351	14,011	40,570	41,016	167,186
2009/2010	41,752	597	29,591	13,861	40,166	41,219	167,186
2010/2011	44,271	569	29,703	13,333	38,621	40,689	167,186
2011/2012	45,058	795	29,454	13,279	37,926	40,674	167,186
2012/2013	45,232	1,086	29,258	13,246	37,577	40,787	167,186
2013/2014	45,950	1,129	29,328	13,058	36,675	41,046	167,186
2014/2015	45,896	1,094	29,617	13,014	36,409	41,156	167,186
2015/2016	45,848	1,111	29,671	12,964	36,427	41,165	167,186
2016/2017	46,100	1,165	29,746	12,946	36,107	41,122	167,186

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

The land area of Myanmar is estimated to be approximately over 167186 thousand acres in which the net sown area in 2016/2017 was only about 29746 thousand acres (or about 18% of the total land). The net sown area in 2007/2008 had been 28930 thousand acres (or about 17 % of the total land area) so that 816 thousand acres had been increased over ten year period. Because of the developing vacant fallow and waste land into new crop land .The area of cultivable waste land decreased from 14304 thousand acres in 2007/2008 to 12946 thousand acres in 2016/2017. Similarly, the area of other wood land significantly decreased from 40891 thousand acres in 2007/2008 to 36107 thousand acres in 2016/2017. The area of current fallow land was increased after the 2010-2011. The area of reserved forest land was increased 10.2% from the year 2007/2008 to the year 2016/2017. The remaining 1165thousands acres of current fallow land and 12946 thousand acres of cultural waste land can be used for the expansion of new agricultural land.

Figure (3.1) Area Classified by Type of Land (2016/2017)



Source: Department of Agricultural Land Management and Statistics, (CSO, 2017)

At present, available cultural waste land as the area under cultivation and with a view to accelerate land development being increasingly granted in localities allover Myanmar. However, the productivity of land depends not only in its area but also on

man's ability to apply his labor, management, capital and technology to it. One-forth of total area is culturable land in Myanmar.

3.3.2 Irrigation Area (Paddy field under irrigation system)

Water is a scare resource throughout most of the developing countries and farmers must compete for it with other users. Most agricultural production depends on rainfall. Irrigation investments enable farmers to supplement rainfall and to gain some control over climatic conditions. Irrigation is the application of controlled amounts of water to plants at needed intervals. Irrigation helps to grow agricultural crops, maintain landscapes and revegetate disturbed soils in dry areas and during periods of less than average rainfall. Food production and rural community is the largest water user, using as much as 70% of total fresh water supply and most of the water is used for irrigation. With 40 % of food grown from irrigated lands, irrigation is of significant to food security, economic development and social ability.

Successful crop production depends on availability of stored water. The four principal rivers in Myanmar namely, the Ayeyarwaddy, Chindwin, Sittaung and Thanlwin and their tributaries can be considered national water assets. At present, the government pays consequences efforts to construct irrigation facilities wherever feasible in area throughout the country. Up to the end of March, 2016, 786 numbers of irrigation facilities have been completed by the department at respective regions and states throughout the countries and further increasing the irrigable areas and irrigation coverage to 23 % of net sown area in 2016/2017. It is very low compared to other neighboring countries.

Irrigation systems vary with the nature of the water source (surface water of ground water), the scope of the irrigation program, new projects or rehabilitation projects and the agent under whose control each part of the irrigation system lies (public or private sector). Proper management of irrigated water in all parts of system is essential to obtain the full benefit of the investment made. The government has also been paying adequate attention to other requisites and water resources remain an important aspect. If new forms of irrigation such as pump irrigation, ground water irrigation were also increased and irrigated areas have increased significantly for paddy. Type of net irrigation are four categories. These are government irrigation, private irrigation, wells and other sources. Irrigation project in Myanmar mainly supply water for paddy cultivation. The measure for irrigation development are:

1. The construction of new irrigation facilities
2. Proper management for the storage and utilization of run-off water from the watershed areas.
3. Renovation of existing reservoirs for raising storage capacity and efficient delivery of irrigation water;
4. Diversion of water from streams and rivulets, during high water levels into adjacent ponds on depressions and for storage with sluice gates;
5. Lifting of water from rivers and streams through pump irrigation and
6. Efficient utilization of ground water.[16]

The area of paddy crop production under irrigation had stood at only about 16 % of net sown area for many years. The availability of adequate water for agriculture is a critical factor and remains crucial in enhancing per unit yields. More important, irrigation water makes it possible both to expand the area formed and to intensify land use through double cropping .Myanmar paddy field can be found mostly in the delta and central dry zone areas. Irrigated paddy is cultivated mainly in the Mandalay, Sagaing and Magway regions which are located in the central dry zone of Myanmar. The major infrastructure improvement of the agricultural sector including irrigation, flood protection and drainage.

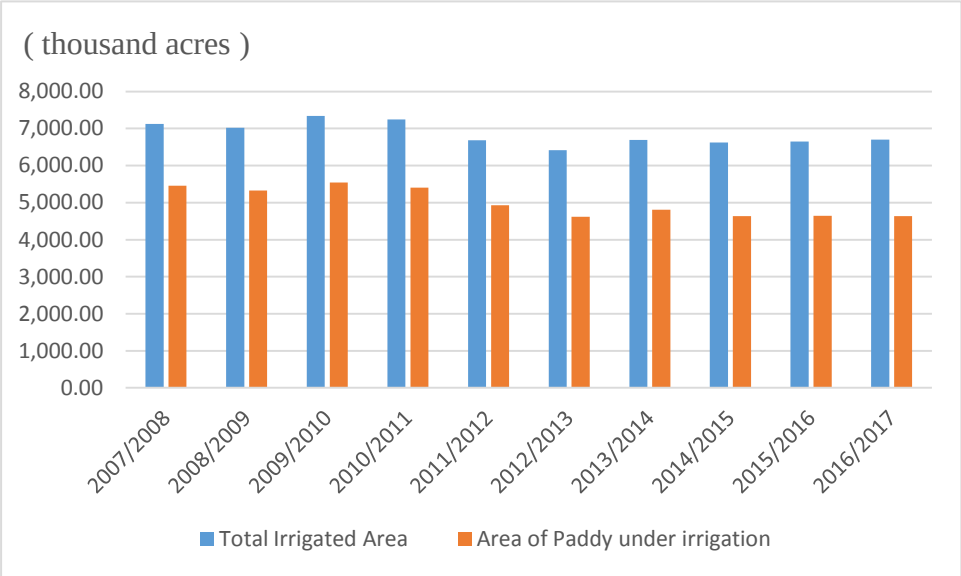
Table (3.2) Area of Paddy under Irrigation (2007/2008 to 2016/2017)

Year	Total Irrigated Area (Thousand Acres)	Total Area of Paddy under irrigation (Thousand Acres)	Share of total area for Paddy under irrigation (%)
2007/2008	7,122.57	5,453.48	76.57
2008/2009	7,020.55	5,323.18	75.82
2009/2010	7,337.02	5,545.69	75.59
2010/2011	7,249.47	5,402.3	74.52
2011/2012	6,681.78	4,927.12	73.74
2012/2013	6,419.25	4,618.81	71.95
2013/2014	6,695.86	4,805.28	71.76
2014/2015	6,626.09	4,632.88	69.92
2015/2016	6,651.84	4,640.51	69.76
2016/2017	6,705.1	4,636.13	69.14

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

[16] Myanmar Agriculture Sector in Brief (2016), Department of Planning

Figure (3.2) Area of Paddy under Irrigation (2007/2008 to 2016/2017))



Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

In 2007/2008, 5453.48 thousand acres of land wed irrigation to cultivate paddy and other crop irrigated is 1669.09 thousand acres. In 2009/2010, the irrigated area reached to 5545.69 thousand acres and other crop irrigated is 1791.33 thousand acres. In 2016/2017, other crop irrigated 2068.97 thousand acres and summer paddy irrigated area reached to 4636.13 thousand acres showed in table (3.2). The area of paddy under irrigation decreased a little yearly. Summer Paddy Cultivation depends mainly on irrigation. So, the government should carry out to conduct water resources development, perform operation and maintenance of the existing irrigation facilities, undertake construction, rehabilitation, operation and maintenance of flood protection dikes and polders and supply more irrigation water from pumped irrigation projects and ground water tube wells in Central Dry Zone, especially in Sagaing Region, Magway Region and Mandalay Region.

Area of Paddy under Irrigation by States and Regions (2016/2017)

Table (3.3) Area of Paddy under irrigation by States and Regions (2016/2017)

States and Regions	Total irrigated Area (Thousand Acres)	Area of Paddy under irrigation (Thousand Acres)	Area of Paddy under irrigation (%)
Union	6,705.1	4,636.13	69.14
Nay Pyi Taw	102.7	91.37	88.99
Kachin State	148.3	104.25	70.28
Kayah State	61.8	47.01	76.05
Kayin State	98.4	69.35	70.46
Chin State	34.1	23.93	70.22
Sagaing Region	1,717.6	1,178.85	68.63
Tanintharyi Region	11.7	1.77	15.09
Bago Region	352.8	230.45	65.32
Magway Region	609.7	383.63	62.92
Mandalay Region	779.2	460.92	59.15
Mon State	73.2	29.86	40.78
Rakhine State	70.2	9.39	13.39
Yangon Region	213.8	164.81	77.08
Shan State	786.3	514.04	65.38
Ayeyarwady Region	1,645.3	1,326.51	80.62

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

According to the table (3.3), the area of paddy under irrigation are shown by states and regions from 2016 to 2017. In Myanmar 69.14 percentage of irrigated areas were used to grow paddy. 28.61 % of paddy irrigation areas were grown in Ayeyarwaddy region, 25.43 % in Sagaing region and 11.09 % in Shan State. These three regions and state are the top the largest paddy grown by irrigation. Moreover, 9.94 % in Mandalay region, 8.28 % in Magway region, 4.97 % in Bago region, 3.56 %in Yangon region,2.25 %in Kachin State, 1.97 % in Nay Pyi Taw,1.49 % in Kayin State, 1.014 % in Kayah State,0.64 % in Mon State, 0.52 % in Chin State, 0.20 % in Rakhine State and the last is Tanintharyi about 0.04 % .

3.3.3 Utilization of farm machinery and animal implements

Since the colonial era, research activities for the utilization of farm machineries were made to reduce manpower and use of draught cattle. However, it was not completed successfully due lack of experience. After gaining independence, agricultural mechanization scheme was made through distribution of machineries,

production of farm machineries adaptable to Myanmar agricultural land for land expansion and development in planned cropped area. Utilization of farm machineries and equipment for various activities of agricultural production has been increased in both State and private sectors in attempts to boost the agricultural production.

Increased cropping intensity has also expanded the use of machineries from land preparation to harvesting and post-harvest activities. Required machineries are being produced and assembled locally or imported for distribution to the farmer. Efforts are being made to totally eliminate the traditional ways of threshing paddy on the threshing ground and to mitigate post-harvest losses through introduction of threshers and combined harvesters.

Farmers are facing constraints in mechanization due to its high initial investment and lack of maintenance capacity. Some farmers increased production area through the introduction of machinery. The farm machinery factories under the Agricultural Mechanization Department (AMD), Ministry of Industry and many small scale private factories are producing and distribution agricultural machineries and implement. Two years installment plan for agricultural machinery distribution to the farmers is being offered by the AMD in order to have easily access and affordability by farmers.

Moreover, Cooperative Societies should encourage and support the development of machineries and implements used in agriculture through innovative financing and existing microfinance credit programs. The increase use of well adapted quality farm machineries and equipment are required to transform into a more modern mechanized agricultural system. In addition, it has contributed to increased cropping intensity of the country. Formally, land preparations by departmental tractors were purely departmental operations. Farm tractors are now available on hire services to user-farmers or as out-right contracts. It has resulted in progressive annual mechanized land preparations. With a view to assist and to achieve rapid development of the agro- based industry in the country, a “Myanmar Agricultural Development Bank” was established in 15th February 1996. Industrial exhibitions have been hold in appropriate locations and 21 Model villages have been established at the industrial zones. Yearly distribution of farm machinery and implements produced by government factories can be seen in table (3.4).

Table (3.4) Utilization of farm machineries (2007/2008 to 2016/2017)

Particulars	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017
Tractors no.										
AMD	2,530	2,478	1,772	1,466	1,314	1,257	1,380	1,680	1,847	2,461
Farmers	8,556	8,900	9,457	10,323	10,490	11,119	11,839	14,265	18,524	25, 708
Power Tiller no.										
AMD	-	-	-	-	-	-	-	-	-	-
Farmers	110,024	137,217	145,548	173,132	206,263	227, 989	257,971	286,097	300,247	467,872
Mechanized Tillage(000' acre-turn)										
AMD	299	347	173	275	291	287	327	484	743	1,209
Farmers	4,579	6,824	8,897	10,540	14,503	14,163	18,956	17,367	20,030	25,450
Combined harvester no.										
AMD	-	-	-	-	11	11	36	89	131	546
Farmers	-	-	-	20	209	307	668	1,680	1,972	4,759
Power Thresher no.										
AMD	-	-	-	-	-	-	-	-	-	-
Farmers	18,692	20,671	24,560	25,980	41,289	48,520	55,104	61,793	61,997	80,667
Hydro-Tiller										
AMD	-	-	-	-	-	-	-	-	-	-
Farmers	664	865	1,981	2,250	4,522	5,008	5,401	6,065	7,467	13,319
Power Reaper no.										
AMD	-	-	-	-	-	-	-	-	-	-
Farmers	153	287	1,208	1,501	1,569	1,939	2,116	2,513	2,551	2,253

Source: Agricultural Mechanization Department, Myanmar Agricultural Statistics (MOPF, 2017)

In farm machinery, farm machineries were used everywhere as village. Farmers were used machineries from State own and their-owns to cultivate the paddy. Farmers are buying farm machineries from government sector, private sector, INGO, NGO aids. The distribution of power tiller threshing machine and thresher are 467872 and 80667 numbers in 2016/2017 were used by farmers. The total number of tractors and combined harvester were 28169 and 5305 used by farmers in 2016/2017. Hydro tiller was increased half of the previous year. The number of power reapers were increased to 2551 until 2025-2016. But in 2016/2017 decreased about 12% than the previous year. The utilization of farm machineries in paddy field were increased to enhance the farmer's economy and social livelihood by increasing qualified farm products and reducing losses due to the utilization of farm mechanization system. Farm mechanization has benefited the farmers in terms of time saving, labour saving and human energy saving. The first priority is to make complete provision of farm machinery and services on land preparation, harvesting and threshing .The distribution of machine increased by yearly, these are invented modern technology.

Animal Implements

Nowadays in any agricultural crop production system, humans, draught animals and engines or motors provide the motive power in various proportions for crop production, harvesting, transport and processing (Rijk, 1989; FAO, 2003; Pearson, 2005). Pearson (2005) estimated draught animals and humans provide 80% of the power input on farms in developing countries. High levels of tractorization are generally associated with relatively well-developed economies, the production of cash crops, profitable agriculture, operator skills, appropriate equipment and timely and cost effective repair and maintenance services (Rijk, 1989).

Due to rising global fuel cost and the past failures of tractor mechanization projects in many developing countries, there is renewed interest in research and extension activities on efficient use of animal traction especially, for ploughing and carting. Developing durable ploughshares and promotion of draught animal welfare programs that can increase food production and security among resource-poor farmers. The durable locally produced ploughshare will accelerate the rate of gain in food production capacity and crop yields at local and national levels due to reduction in timeliness costs and savings in crop production.

Myanmar agriculture is considered as a major enabler for economic development. However, the industry still use traditional agricultural techniques. In Myanmar, draft cattle were the main source of labor for paddy production in past. Cattle were used at several stages in paddy production such as threshing and transportation. The success of paddy production in Myanmar was once depend highly on owning healthy draft cattle. Agricultural implements and animals are the essential part in the farming operation. As in many other parts of the country, farmers have to rely on draught animals for power in agricultural operation. Traditional implements are still in use during the transitional period marching towards mechanized farming. Table shows the utilization of farm implements and animals in Myanmar.

The utilization of agricultural implements and animals have been increased year by year can be seen in table (3.5). As for today. Cattle are still used but mainly for harrowing. Hand-pushed tractors are being used widely for harrowing, transportation and irrigation. Agricultural technology has obviously not improved throughout history and farmers still have to rely on livestock, such as cattle and oxen. Thus, the lack of agricultural technology affects farmers' ability to grow and transport rice in bulk. It also affects irrigation and storage. Myanmar is still using primitive method and only recently developing agricultural technologies.

Table (3.5) Using animal implements in paddy field (2010/20111 to 2016/2017)

Particulars	2010/2011	2011/12	2012/13	1013/14	2014/15	2015/16	2016/17
Draught							
Cattle	8,868	10,316	10,458	10,490	10,596	10,698	10,811
Tractors Spike	11	11	12	13	14	17	19
Harrow s inter	3,126	3,182	3,183	3,200	3,196	3,211	3,217
Cultivator Plough	179	190	195	197	198	199	200
Share rotary	3,018	3,085	3,072	3,064	3,077	3,078	3,081
Harrow	571	632	623	628	626	622	605
Cart other	1,795	1,769	1,780	1,776	1,769	1,763	1,758
Harrow seed	479	492	496	497	496	503	505
Drill [harrow] seed	93	94	95	96	97	98	98
Drill[plough] water	21	23	23	23	23	23	23
Pump	179	208	221	231	242	262	267
Power Tiller	97	160	197	218	243	275	305
Harvester	3	2	2	2	2	3	3
Thresher	29	42	52	52	55	62	75
Combines harvester	0.1	0.23	0.31	0.64	0.76	1.78	2.61

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural (MOPF, 2017)

3.3.4 Seed Distribution System

Ministry of Agriculture, Livestock and Irrigation (MOALI) provides registered seeds to contract farmers to produce certified seeds which were redistributed to other farmers. For each varieties, the certified seed require to substitute every three years to prevent deterioration of seed quality. In practice, MOALI cannot provide certified seeds to rice farmers all over the country. At present, the quality seed of rice production and marketing is very sluggish in Myanmar rice economy.

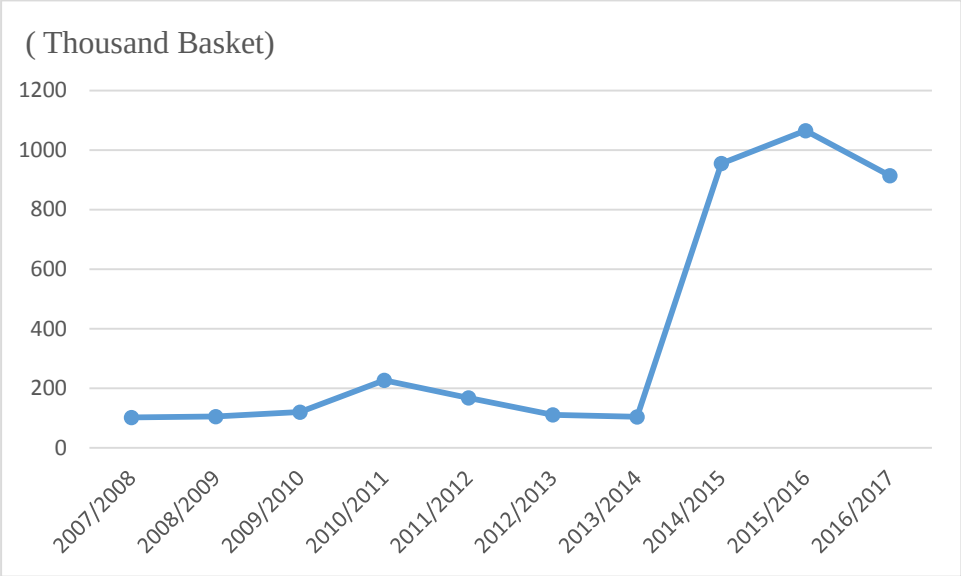
The current level of quality seed provision is also well below the desired level. In this area also, the harmonization of the private and state sector is necessary in enhancing the capacity of supply. Due to considerations in the seed industry, development policy should be to international standards in intellectual property rights and plant variety protection. The increase availability of rice seed of improve varieties to the vulnerable rice farmers throughout direct distribution of seed or a market-based option are required.

Table (3.6) Quality Seed Distribution for Paddy (2007/2008 to 2016/2017)

Year	Amount of Paddy Quality Seeds (Thousand Basket)
2007/2008	102
2008/2009	105
2009/2010	120
2010/2011	227
2011/2012	168
2012/2013	111
2013/2014	104
2014/2015	955
2015/2016	1,065
2016/2017	914

Source; Department of Agriculture, Myanmar Agricultural Statistics (MOPF, 2017)

Figure (3.3) Amount of quality seed distribution for paddy (2007/2008 to 2016/2017)



Source: Department of Agriculture, Myanmar Agricultural Statistics(MOPF, 2017)

In table (3.6), the distribution of paddy quality seed by DOA is 102 thousand baskets in 2007/2008. In 2014/2015 is 955 thousand baskets. The distribution amount of quality seed is increasing gradually than the early period .So, the amount of paddy quality seed is distributed about 914 thousand baskets in 2016/2017. The use of quality seeds are required to enhance the production and improve the quality of paddy. To improve rice quality, quality seeds are essential. Rice farmer need to be aware of the value seed and grain to improve the yield and quality of produce. Apart from this, private seeds company should be encourage for the long-term. Use of high yielding varieties (HYV) are encouraged to obtain higher rice yields.

3.3.5 Chemical Fertilizer and Pesticide

Chemical Fertilizer had imported and distributed to farmers since 1958. In 1980's, demand of chemical fertilizer increased because of the widely adoption of fertilizer-responsive high yielding varieties in paddy major growing areas. Due to the encouragement of government policy, private sector involved in fertilizer marketing, importing, distribution and sale promotion after 1988. Fertilizer policy includes instruments that government can use to achieve economic outcomes that reduces fertilizer costs, guarantee product quality, improve availability and improve use by

farmers. Government policies and actions are intended to change the behavior of traders and farmers with regards to fertilizer supply and use. However, quantity of chemical fertilizer supplied to the market was low compared to quantity demanded. The primary objectives of Myanmar has an open, well developed, unsubsidized, highly competitive private sector import fertilizer supply and distribution system are;

1. Improved farmer access to high quality fertilizers
2. Improved farmer access to sound advice on soil nutrient management
3. Improved fertilizer sector efficiency

During the socialist regime (1962-1987), the State controlled the whole economy including agriculture but progressive liberalization since 2002 for the whole economy had led to a relaxation on the import and distribution of agricultural inputs such as fertilizer and pesticides, seeds and agricultural machinery and implements and subsidies and import tariffs on these items were removed to expand the role of private sector. The private sector responded quickly and today there are 270 registered fertilizer importer, distributors and almost 3,100 licensed fertilizer dealers.

The Government of the Union of Myanmar seeks an improvement in the productivity and profitability of agriculture and envision a high level of agricultural productivity that will ensure equity in household food security, income, employment and sustainable utilization of natural resources. The Ministry of Agriculture, Livestock and Irrigation is implementing the mission for promoting the country's economic growth by raising farm incomes, employment and household food security through the development of partnerships and promotion of private sector investment for increased agricultural productivity, diversification, commercialization and sustainable use of natural resources.

The constraints of farmer ability to use the optimum level of fertilizer are lack of sufficient incentives, lack of credit and inappropriate technical support services. The private sector is permitted to import and distribute fertilizer but its ability to do so is constraint by a lack of distribute network, prevailing import and export regulations and a scarcity of foreign exchange.

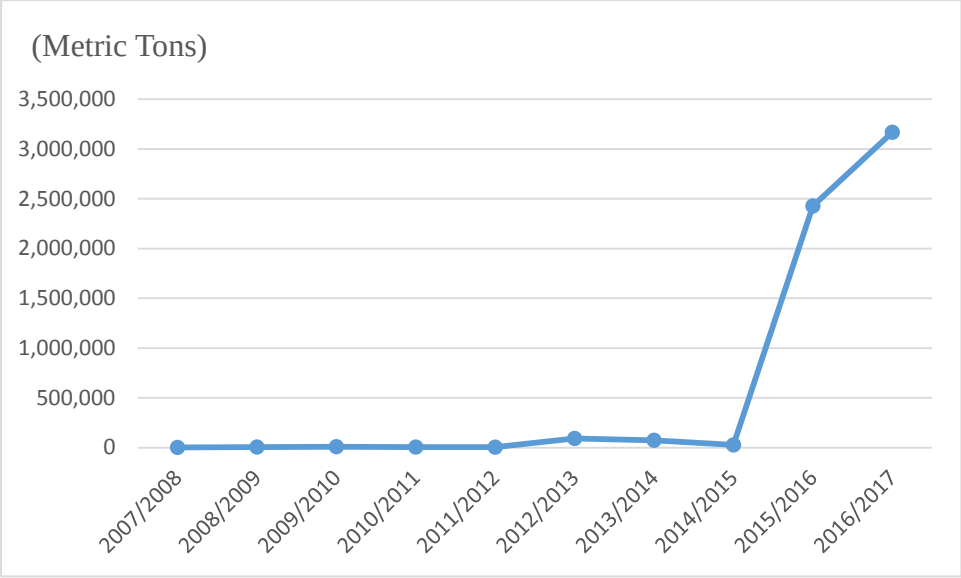
Table (3.7) Utilization of Fertilizer (2007/2008 to 2016/2017)

(Absolute values in metric ton)

Year	Total Fertilizer (Metric Tons)
2007/2008	3,116
2008/2009	7,324
2009/2010	10,570
2010/2011	6,866
2011/2012	5,707
2012/2013	93,455
2013/2014	74,968
2014/2015	28,442
2015/2016	2,427,473
2016/2017	3,167,342

Source: Department of Agriculture, Statistical Year Book (2017)

Figure (3.4) Utilization of Fertilizer (2007/2008 to 2016/2017)



Source: Department of Agriculture, Statistical Year Book (2017)

In Myanmar, fertilizers are used to get higher yield and hence the total production of paddy in table (3.7). Fertilizers are mainly compounds containing

nitrogen, phosphorus or potassium. The most widely used of chemical fertilizers were Urea, T-super, Potash and compound. In 2007/2008, fertilizer used for paddy was 3116 MT and significantly increased to 7324 MT in 2008/2009. In 2009/2010, the fertilizer usage was 10570 MT and decreased to 5707MT in 2010/2011. In 2012/2013, fertilizer usage immediately reached to 93455 MT but it is high reached to 74968 MT in 2013/2014. And then the usage of fertilizer obviously increased in the year 2015/2016 about 2427473 MT. In 2016/2017, the amount of fertilizer usage is about 3167342 MT. Therefore, the amount of fertilizer used in Myanmar significantly increased.

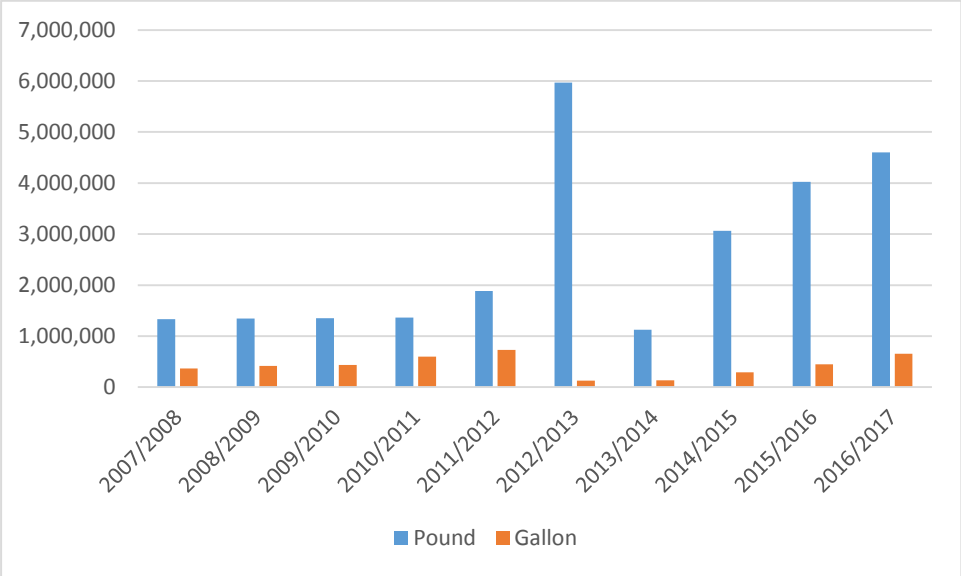
However, fertilizer use in Myanmar is still low by South East Asia standards and very low by world standards. In Myanmar, it could recommend the amount of fertilizer usage for the type of cultivated land, the type of paddy and the nourishment of land. To pass such a problem, by the Reaching Toward Optimum Production Program which can calculate the amount of the nourishment of land, the extra amount of fertilizer needed to get expected yield and using Leaf Colour Chart (LCC) to use the amount of urea fertilizer for the nourishing of paddy. The government of the Union of Myanmar seeks an improvement in the productivity and profitability of agriculture and envisions a high level of agricultural productivity that will ensure equity in household food security, income, employment and sustainable utilization of natural resources.

Table (3.8) Pesticides Utilized For Paddy Production (2007/208 to 2016/2017))

Year	Unit	Total	Paddy	Paddy (%)
2007/2008	Pound	1,584,719	1,331,813	84.04
	Gallon	518,001	366,830	70.82
2008/2009	Pound	1,601,701	1,342,174	83.80
	Gallon	621,934	413,781	66.53
2009/2010	Pound	1,619,697	1,352,514	83.50
	Gallon	660,113	438,680	66.46
2010/2011	Pound	5,380,705	1,362,281	25.32
	Gallon	1,283,183	595,716	46.42
2011/2012	Pound	2,619,267	1,883,762	71.92
	Gallon	1,527,083	732,086	47.94
2012/2013	Pound	8,239,873	5,970,961	72.46
	Gallon	1,121,715	129,514	11.55
2013/2014	Pound	2,337,714	1,125,917	48.16
	Gallon	1,161,840	133,429	11.48
2014/2015	Pound	5,947,372	3,062,964	51.50
	Gallon	1,113,634	292,979	26.31
2015/2016	Pound	17,616,223	4,026,112	22.85
	Gallon	3,160,986	450,467	14.25
2016/2017	Pound	25,106,124	4,602,258	18.33
	Gallon	5,814,480	654,582	11.26

Source: Department of Agriculture, Myanmar Agricultural Statistics(MOPF, 2017)

Figure (3.5) Pesticides Utilized for paddy production (2007/2008 to 2016/2017)



Source: Department Of Agriculture, Myanmar Agricultural Statistics(MOPF, 2017)

In table (3.8), the amount of pesticides used in Myanmar was 366830 gallon in 2007/2008 and it reached to 129614 gallon in 2012/2013 and again raised to 654582

gallon in 2016/2017. The type of insects which could suffer paddy cultivation. Nowadays, farmers sometimes have to use pesticides to kill pest or insects destructive to crop. Thus, contemporary pesticides should be used if larvae and eggs were found and needs daily awareness on insects. Moreover, pesticide has side-effect so there is needed to find another way to protect insects.

3.3.6 Agricultural Loan for Paddy

The provision of seasonal crop loans for different cultivation seasons i.e pre-monsoon, monsoon and winter season crops are made by the MADB. The MADB is state owned and successor to the State Agricultural Bank (SAB) established in 1953 which latterly became the MADB in 1976. It has a countrywide network of 14 regional offices, 169 branches and 44 agency offices with 3357 staffs providing short term and long term credit to over 2 million farmers. The MADB Law enacted in July 1990 grants the Bank a broad mandate to effectively support the development of agriculture, livestock and rural socio-economic enterprises in the country by providing banking services. The MADB is authorized to make loans to state owned agricultural organizations, livestock organizations, corporations, private entrepreneurs, village banks, farmers and farm labourers. Loans are classified as:

1. Annual loans (up to 12 months) which are mainly for crop cultivation
2. Short term loans (2 to 4 years) and
3. Long term loans (5 years and above) which are mainly for purchase of farm implements , draft cattle , bullock carts , pump sets, power tillers etc as well as for integrated farming project.

Due to the limited availability of formal credit producers especially those who have not a solid financial background, they have to rely on informal lending sources such as relatives, friends and traders and pay high interest rates ranging from 5 to 15 percent per month. The repayment of the interest for those informal loans often squeezes the small profits that farmer can earn from production. Along with the improvement of MADB operations, promoting the involvements of private banks in agricultural financing and designing small-scale credit schemes for agriculture-related financing would benefit rural people. MADB has increased step by step the amount of seasonal loan for paddy from 20,000 kyats to 100,000 kyats per acre during four years from 2010 to 2014. Nowadays, MADB has increased seasonal loan for paddy from

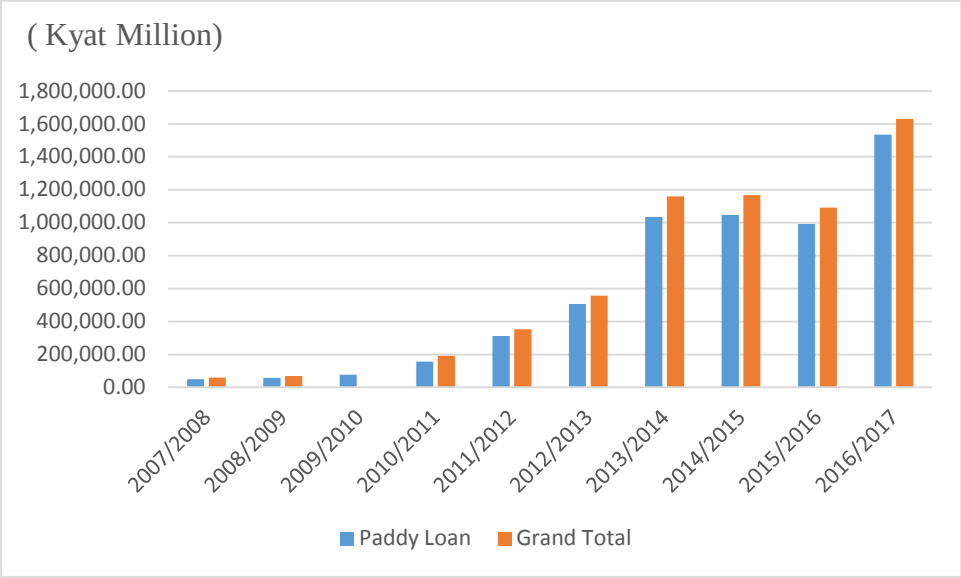
100,000 to 150,000 kyats per acre in 2016/2017 financial year. Therefore, MADB which plays the leading role in the loans disbursement to peasant farmers. The table (3.9) shows agricultural loans by paddy crop during a ten- year period from 2007/2008 to 2016/2017.

Table (3.9) Loan for paddy (2007 /2008 to 2016/2017)

Year	Paddy Loan (Kyat Million)	Other Crops Loan (Kyat Million)	Grand Total (Kyat Million)	Paddy Loan (%)	Other crops loan (%)	Grand total (%)
2007/2008	50,092.96	9,534.88	59,627.84	84.01	15.99	100
2008/2009	57,917.72	11,052.35	68,970.07	83.98	16.02	100
2009/2010	76,124.72	17,364.56	934,89.28	81.43	18.57	100
2010/2011	156,494.46	34,185.43	190,679.89	82.07	17.93	100
2011/2012	311,530.22	41,191.53	352,721.75	88.32	11.68	100
2012/2013	507,130.31	50,716.23	557,846.54	90.91	9.09	100
2013/2014	1,035,840.6	122,888	1,158,728.58	89.39	10.61	100
2014/2015	1,047,681.7	119,803.7	1,167,485.44	89.74	10.26	100
2015/2016	993,009.8	98,395.08	1,091,404.88	90.98	9.02	100
2016/2017	1,535,351.1	95,272.78	1,630,623.88	94.16	5.84	100

Source: Myanmar Agriculture Development bank, Myanmar Agricultural Statistics (MOPF, 2017)

Figure (3.6) Loan for Paddy (2007/2008 to 2016/2017)



Source : Myanmar Agricultural Development Bank, (MOPF, 2017)

Chapter IV

Situation of Paddy Production in Myanmar

In basic economic condition, people cultivate cash crops for the subsistence of their families; they produce food, weave clothing and construct shelters for their families. Depending on the types of soil, the cultivable lands are classified by conditions of water available for cultivation. The area under temporary cropping includes all land used for crops with a growing cycle of less than one year which need to be sown or planted for further production after the harvest. Crop production is the major agricultural activity in Myanmar. It is almost completely dependent on monsoon rains. Paddy is the major crop.

Paddy is not only the dominant crop but also the major earner of foreign exchange. Paddy is grown during monsoon season (June to November) and summer (December to May) seasons. The rain fall during monsoon season is sufficient for growing crops without additional irrigation from dams, river and stream diversions or groundwater. However, when available irrigation coupled with drainage structures, it advances the stability of production and decrease the risks of flooding and stagnant water.

The purpose of irrigation and water supply in Myanmar is for paddy cultivation. In Myanmar most of the regions are cultivated with rain-fed paddy except for the middle part of Myanmar dry zone mainly practice irrigated paddy cultivation system. Supplemental irrigation is used for the monsoon season paddy cultivation in the central dry zone, where there is a shortage of water supply for crops

4.1 Sown Acreage of Paddy

Table-4.1 Net Sown Acreage of Summer Paddy (2007/2008 to 2016/2017)

(Thousand Acreages)

Year	Total Sown Acreage of Paddy	Sown Acreage of Summer Paddy	Sown Acreage of Summer Paddy (%)
2007/2008	19,990	3,136	15.69
2008/2009	20,001	3,160	15.80
2009/2010	19,933	3,182	15.96
2010/2011	19,885	3,100	15.59
2011/2012	18,762	2,628	14.01
2012/2013	17,893	2,343	13.09
2013/2014	17,999	2,615	14.53
2014/2015	17,722	2,325	13.12
2015/2016	17,821	2,455	13.78
2016/2017	17,696	2,456	13.88

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF,2017)

The above table (4.1) shows the summer paddy sown area during ten years .In 2007/2008, 15.69% (3136 thousand acres) of paddy area were grown in summer .In 2008/2009, 15.80 % (3160 thousand acres) of paddy area were used for growing in summer. In 2009/2010, 15.96% (3182 thousand acres) of paddy area were used for growing in summer. In 2010/2011, the area of summer paddy was sown about 15.59% (3100 thousand acres). Beginning 2011/2012, the sown area of summer paddy were decreased gradually due to lack of repair of the dam by farmers claiming to be of little interest, to obtain less of water door entry, to supply insufficient water, to turn to farming other crops with low water needs to earn more profits, being land-sporty and land-sand sporty, lack of desire to grow summer paddy farmers because of water plant, the fear of losing their crops and confrontation , farm labor shortage and the lack of cost-effective in getting farmers to grow summer paddy interest .So, need to more effort of summer paddy cultivation and find the ways of increase method for summer paddy cultivation.

Table-4.2 Net Sown Acreage of Monsoon Paddy (2007/2008 to 2016/2017)

(Thousand Acreages)

Year	Total Sown Acreage of Paddy	Sown Acreage of Monsoon Paddy	Monsoon Paddy (%)
2007/2008	19,990	16,854	84.31
2008/2009	20,001	16,841	84.20
2009/2010	19,933	16,751	84.04
2010/2011	19,885	16,785	84.41
2011/2012	18,762	16,134	85.99
2012/2013	17,893	15,550	86.91
2013/2014	17,999	15,383	85.47
2014/2015	17,722	15,397	86.88
2015/2016	17,821	15,366	86.22
2016/2017	17,696	15,239	86.12

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

In 2007/2008, total sown acre of paddy were 19990 thousand acres in which 84.31% of total paddy (16854 thousand acres) were sown area of monsoon paddy. In 2008/2009, 84.20 % (16841 thousand acres) were used to grow monsoon paddy .Sown areas of monsoon paddy decreased continuously from 2009/2010 to 2016/2017. The reasons of decreasing sown acres were heavy rains , the time of growing monsoon paddy in July and August was less than normal rainfall, lack of adequate water, destruction of dykes, without planting the flooding in the rings, less acres of cliff collapsed, turned to farming as garden, getting to the construction of factories and village land, less Br Slash, without land expansion, turned to farming other crops, fruit jam plant to grow in areas of perennial plants, forest farming (teak and hardwood), labor shortage and displaced farmers could not be planted the areas of battlefield area.

4.2 Sown, Harvest, Yield and Production of summer and monsoon paddy by States and Regions (2016/2017)

Paddy is grown in almost every States and Regions in Myanmar. They are Kachin State, Kayah State, Kayin State, Chin State, Mon State, Rakhine State, Shan

State, Sagaing Region, Tanintharyi Region, Bago Region, Magway Region, Mandalay Region, Yangon Region, Ayeyarwaddy Region and Nay Pyi Taw.

4.2.1 Sown, Harvest, Yield and Production of monsoon paddy by States and Regions (2016/2017)

Table-4.3 Monsoon Paddy Production in Myanmar by States and Regions (2016/2017)

States and Regions	Sown (Thousand Acreages)	Harvest (Thousand Acreages)	Yield (Basket)	Production (Thousand Baskets)
Nay Pyi Taw	169	168	85.98	14,441
Kachin State	443	443	68.72	30,439
Kayah State	91	91	67.19	6,093
Kayin State	468	468	68.32	31,950
Chin State	83	83	45.1	3,722
Sagaing Region	1,809	1,802	82.25	148,217
Tanintharyi Region	246	246	70.67	17,354
Bago Region	2,743	2,667	77.43	206,539
Magway Region	689	689	82.86	57,094
Mandalay Region	534	533	80.87	43,091
Mon State	690	690	66.67	45,975
Rakhine State	1,104	1,104	65.27	72,043
Yangon Region	1,182	1,160	67.16	77,874
Shan State	1,281	1,279	75.98	97,166
Shan (South)	560	560	66.35	37,163
Shan (North)	438	437	86.91	37,954
Shan(East)	282	282	78.17	22,049
Ayeyarwaddy Region	3,709	3,582	69.23	247,951
Union	15,239	15,002	73.32	1,099,949

Source: Rice Division , (MOALI , DOA 2016/17)

Ayeyarwadydy is the top-most monsoon paddy sown regions in Myanmar and 3709228 acres were used to grow paddy in 2016/2017. It has been producing 247950483 baskets and the yield per acre was 85.98 baskets .Bago region is the second-most monsoon paddy cultivating acres grown in 2016-2017 were 2742500 acres and the yield per acre was 77.43 baskets. Therefore, 206538500 baskets were produced in that year.

Although Sagaing region is the third-most paddy cultivating region, it has the second highest yield among the States and Regions of Myanmar. In 2016/2017, 1809310 acres were grown and 148216952 baskets were produced. Shan State is the fourth-most monsoon paddy sowing state. In 2016/2017, 1280682 of sowing acres were grown and 97165875 baskets were produced. The yield per acres is 75.98 baskets. Moreover, Shan State includes all Shan (South), Shan (North) and Shan (East).

Yangon is the fifth-most monsoon paddy sowing region of Myanmar. In 2016/2017, 1182079 acres were grown and 77874094 baskets were produced. It has 67.16 baskets per acres. Rakhine State is the sixth-most monsoon paddy sowing acres grown in 2016/2017. 1103762 acres were grown and 72042546 baskets were produced in that year. The yield per acre is 65.27 baskets. Therefore Ayeyarwaddy Region, Sagaing Region, Bago Region , Yangon Region, Rakhine State and Shan State are sowned monsoon paddy over 1000000 acres.

And then Nay Pyi Taw, Kachin State, Kayin State, Tanintharyi region, Magway region, Mandalay region and Mon State are sowned monsoon paddy over 100000 acres. Kayah State and Chin State are grown the least monsoon paddy acres in Myanmar about 90679 acres and 82789 acre.

The major paddy-producing regions of Myanmar are in the delta. Ayeyawady, Bago and Yangon regions make up almost half of the country's harvested rice area (MOAI, 2016). Among them, Ayeyarwaddy Region is the top paddy producer in the country as such is commonly known as the granary of Myanmar. Agriculture is the main occupation of the people. The fertile all uveal soil of delta region enables sowing of paddy.

4.2.2 Sown, Harvest, Yield and Production of monsoon paddy by States and Regions (2016/2017)

As the population is increased, summer paddy is sown besides rain paddy in Myanmar. The sown acres, the rate of per acre and the production amount of summer paddy is shown below by each States and Regions during 2016/2017.

Table-4.4 Summer Paddy Production in Myanmar by States and Regions (2016 /2017)

States and Regions	Sown (Thousand Acreages)	Harvest (Thousand Acreages)	Yield (Basket)	Production (Thousand Baskets)
Nay Pyi Taw	16	16	98.6	1,577
Kachin State	5	5	62.05	311
Kayah State	5	5	89.13	401
Kayin State	115	115	77.00	8,824
Chin State	63	63	76.29	5
Sagaing Region	321	319	94.66	30,202
Tanintharyi Region	9	9	69.50	622
Bago Region	218	218	85.94	18,731
Magway Region	59	57	90.65	5,120
Mandalay Region	111	110	99.71	11,010
Mon State	44	44	77.99	3,459
Rakhine State	10	10	77.32	730
Yangon Region	178	177	84.42	14,961
Shan State	39	39	100.49	3,934
Shan (South)	21	21	94.91	2,002
Shan (North)	7	7	149.51	978
Shan (East)	12	3	82.85	953
Ayeyarwaddy Region	1,328	1,328	95.93	127,396
Union	2,456	2,451	92.73	227,282

Source : Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

In table (4.4), Ayeyarwaddy Region is still the top-most summer paddy sowing like the monsoon paddy. 11327971 acres were used to grow summer paddy production and 127396303 baskets were produced. The yield per acre was more than the monsoon paddy yield. Sagaing is the second largest summer paddy sowing region in Myanmar. About 320914 acres were grown for summer paddy and 30202321 baskets could be produced. The yield per acre is 94.66%. Bago is the third largest summer paddy sowing region. It has 217955 acres of summer paddy. Moreover, 18730766 baskets could be produced because of 85.94 % yield per acre. Yangon is the most-fourth summer paddy sowing region. In 2016/2017, 177446 acres of summer

paddy sown acres were grown and 14961243 baskets were produced. The yield per acre was 84.42%. Kayin is the most-fifth summer paddy sown state .It could be sown 114598 acres and 8824254 baskets were produced in 2016/2017. It has 77 % of the yield per acre.

Mandalay stands the largest sixth position in sowing summer paddy and the second largest yield per acre about 99.71 %. It has 110506 acres of summer paddy sown acres and 11010117 baskets could be produced. Magway stands the most-seventh summer sowing region and 59197 acres were sown. The yield per acres was 90.65 % and total summer production was 5119846 baskets. Mon State is the most-eighth summer sown acres and the total sown acres is 44355 acres and 77.99 % of yield per acre. The total production was about 3459273 baskets. Shan state is the ninth-largest summer paddy sowing in Myanmar but it is the largest summer paddy yield per acre. So, the total production is about 3933730 baskets Nay Pyi Taw is the last summer paddy sowing among top ten summer paddy sowing in Myanmar. The total sown acres was 15943 and 1576559 baskets were produced since the yield per acre was 98.6 baskets.

The other region and states such as Tanintharyi region, Kachin State,Kayah State and Chin State were sown less than ten thousand acres. Among them, Chin State is the least summer paddy sowing State. 63 acres were grown and 4806 baskets were produced. It has 76.29 yield per acre. In addition, the yield per acre of monsoon paddy is lower than that of summer paddy.

4.3 Monsoon and summer Paddy Production

4.3.1 Monsoon paddy production

Monsoon paddy is grown during monsoon season (June to November) and it is almost completely dependent on monsoon rains. The production amount of monsoon paddy shown below by each year.

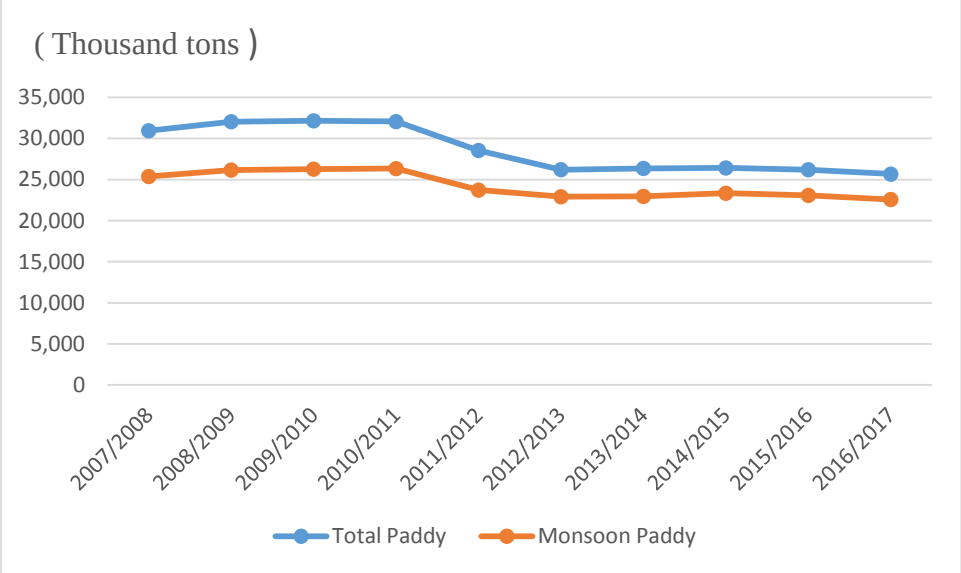
Table-4.5 Monsoon Paddy Production (2007/2008 to 2016/2017)

(Thousand Ton)

Year	Total Paddy	Monsoon Paddy	Monsoon Paddy (%)
2007/2008	30,954	25,389	82.02
2008/2009	32,059	26,169	81.63
2009/2010	32,166	26,283	81.71
2010/2011	32,065	26,346	82.16
2011/2012	28,552	23,731	83.12
2012/2013	26,217	22,925	87.44
2013/2014	26,372	22,964	87.08
2014/2015	26,424	23,349	88.36
2015/2016	26,210	23,088	88.09
2016/2017	25,673	22,588	87.98

Source : Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics(MOPF, 2017)

Figure-4.1 Monsoon Paddy Production (2007/2008 to 2016/2017)



Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF,2017)

In 2007/2008, the monsoon paddy 25389 thousand ton or 82.02% of total paddy could be produced. In 2008/2009, the total production of monsoon paddy was increased about 780 thousand acres than the previous year so reached to 26169

thousand tons or 81.63 % of total paddy production. The year 2009/2010 is the highest paddy producing during the period of the study about 32166 thousand ton and 81.71 % of the total or 26283 thousand ton of monsoon paddy could be produced. In 2010/2011, the amount of monsoon paddy production was slightly increased about 63 thousand ton then the previous year. The total production of paddy was 32065 thousand tons and 26346 thousand acres of monsoon paddy could be produced in that year. In the latter 2010/2011, the production of monsoon paddy declined due to lack of incentives as well as other factors such as unfavorable weather, insufficient supply of quality seeds, rise in fertilizer prices, lack of knowledge on soil nutrient management and lacks of success in the introduction of technical innovation. So, the better use of land, improved technology and improved institutions along with farmer's participation enabled farmers are needed to raise the production level.

4.3.2 Summer Paddy Production

Summer paddy is grown during summer season (December to May) by supplemental irrigation. The following table described the production amount of summer paddy for each year.

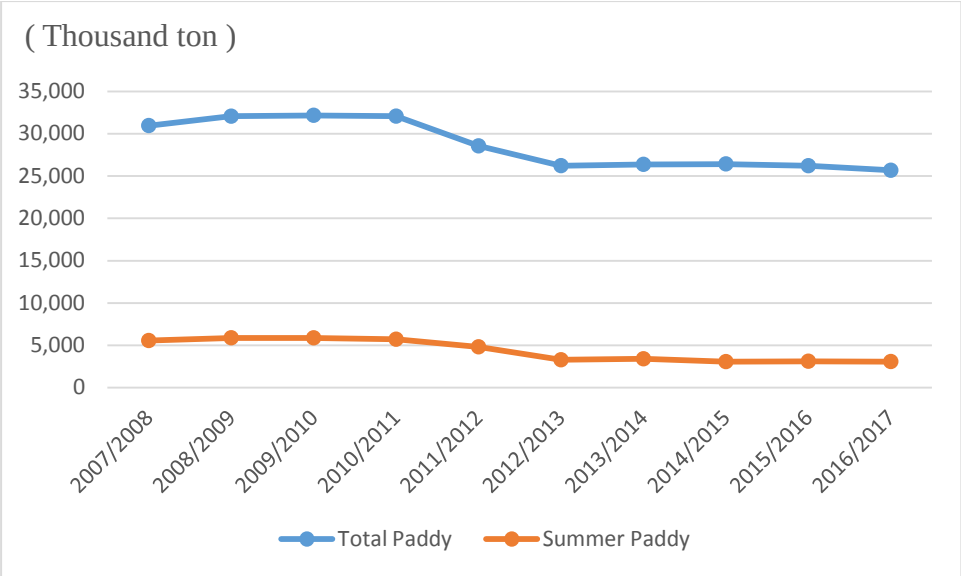
Table-4.6 Summer Paddy Production (2007/2008 to 2016/2017)

(Thousand Ton)

Year	Total Paddy	Summer Paddy	Summer Paddy (%)
2007/2008	30,954	5,565	17.98
2008/2009	32,059	5,889	18.37
2009/2010	32,166	5,883	18.29
2010/2011	32,065	5,719	17.84
2011/2012	28,552	4,821	16.88
2012/2013	26,217	3,292	12.56
2013/2014	26,372	3,408	12.92
2014/2015	26,424	3,075	11.64
2015/2016	26,210	3,122	11.91
2016/2017	25,673	3,085	12.02

Source : Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

Figure-4.2 Summer Paddy Production (2007/2008 to 2016/2017)



Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics(MOPF, 2017)

Table (5.6) showed the production of summer paddy for the year (2007/2008 to 2016/2017). In 2007/2008, production of summer paddy was 17.98%. In 2008/2009, the production of summer paddy increased about 0.39% so its production was 18.37 %. The production of summer paddy in 2009/2010 was less than about 0.08 % than the previous year. In 2010/2011, its summer paddy production was little less about 0.45% than that of the previous. After the year 2011/2012, the production of summer paddy is reduced statement because of climate changes, slow pace of mechanization, natural disasters, the successive policies clearly lack of incentives for farmer, insufficient irrigation facilities, personal inefficiency of the farmer, lack of finance and good marketing arrangements and incentive of summer paddy price. In order to increase summer paddy production considered focus on the cultivation method, harvesting method, seed distribution system, cleaning and storage. The summer paddy production supporting for the total paddy production and people consumption.

4.3.3 Yield per acre of paddy

The yield per acre of paddy shown the following table for each year.

Table- 4.7 Yield per acre of paddy (2007/2008 to 2016/2017))

Year	Yield per acre (46 lb , basket)
2007/2008	76
2008/2009	78
2009/2010	79
2010/2011	79
2011/2012	79
2012/2013	74
2013/2014	75
2014/2015	76
2015/2016	76
2016/2017	75

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

In table (4.7) showed the yield per acre from 2007 to 2017.Athough the farmers used the high yielding rice varieties (HYVs) instead of traditional rice varieties, average grain yields have stagnated around 76 baskets per acre due to soil degradation, overuse of fertilizer and pesticides, the climate change and natural disasters in the consequences, including damage to crops and decrease to yield.

4.3.4 The growth rate of sown acreage and production for paddy

Table (4.8) The growth rate of sown acreage and production for paddy (2007/2008 to 2016/2017)

Year	Sown Acreage ('000 Acres)	Growth Rate of Sown Acreage (%)	Production ('000 ton)	Growth Rate of Production (%)
2007/2008	19,990	-0.43	30,954	1.71
2008/2009	20,001	0.06	32,059	3.57
2009/2010	19,933	-0.34	32,166	0.33
2010/2011	19,885	-0.24	32,065	-0.31
2011/2012	18,762	-5.7	28,552	-10.96
2012/2013	17,893	-4.63	26,217	-8.18
2013/2014	17,999	0.56	26,372	0.59
2014/2015	17,722	-1.5	26,424	0.2
2015/2016	17,821	0.56	26,210	-0.81
2016/2017	17,696	-0.7	25,673	-2.05

Source: Department of Agricultural Land Management and Statistics, Myanmar Agricultural Statistics (MOPF, 2017)

The table (4.8) showed the sown acreage and production of paddy for the years (2007/2008 to 2016/2017). In 2007/2008, declined growth rate of sown acreage 0.43 % of the last year 2006/2007. In 2008/2009, the growth rate was little high 0.06 % and then very low level of growth rate were 5.7 % in 2011/2012 and 4.63 % in 2012/2013. In 2013/2014, growth rate was little high 0.56 %. In 2016/2017, declined continuously growth rate of sown acreage 0.7 %. So, need to effort of paddy cultivation and find the ways of increase method for paddy cultivation.

The production of paddy for the year (2007/2008 to 2016/2017) also showed in table (4.8). In 2007/2008, growth rate of paddy production was 1.71 %. Growth rate return raised 3.57 % in 2008/2009 and in 2009/2010, growth rate of paddy production was little high 0.33%. In 2010/1011, declined growth rate of paddy production was 0.31 %. Very low level of growth rate for paddy production reached to 10.96 % in 2011/2012 and 8.18 % in 2012/2013. In 2013/2014, the growth rate of

paddy production was a little high 0.59% and 0.2 % in 2014/2015. In 2015/2016, the growth rate of paddy production reduced 0.81 % and reduced continuously amount was 2.05%. Because today paddy production is reduced statement, considered focus on the cultivation method, harvesting method, seed distribution system, cleaning and storage. On the other hand, climate changes and incentive of paddy price.

4.3.5 The Sufficient Condition of Paddy Production in Myanmar

Table (4.9) The sufficient condition of paddy production in Myanmar (2008/2009 to 2016/2017)

Year	Total Paddy Production (Thousand Ton)	Total Paddy Consumption (Thousand Ton)	Surplus/Deficit (Thousand Ton)
2008/2009	32,059	16,882	15,177
2009/2010	32,166	17,099	15,067
2010/2011	32,065	17,286	14,779
2011/2012	28,552	14,547	14,005
2012/2013	26,217	14,695	11,522
2013/2014	26,327	14,844	11,483
2014/2015	26,424	15,082	11,342
2015/2016	26,210	15,212	10,998
2016/2017	25,673	15,344	10,329

Source: Department of Planning, Ministry of Agriculture, Livestock and Irrigation

According to the table (4.9), the surplus amount of paddy declined yearly due to population growth and the productivity also declined. Myanmar still can produce the sufficient amount of paddy production for its consumption every year and surplus amount of paddy can be exported. So, it remains one of the world's largest producers of rice today. And then the more surplus amount of paddy production is necessary for the country's growing population and for more export earnings.

Chapter V

Conclusion

5.1 Findings

Myanmar is agricultural country and agriculture sector is the backbone of its economy. Agriculture sector accounting for more than 26 percent of GDP and 70 percent of the population resides in rural area and all most of them are engaged in agriculture sector. Compared to any other sector within an economy, growth in agriculture productivity has directly involved in raising real incomes of the rural poor and thus reducing poverty. Paddy production can not only provide employment opportunities but also give to diversification in such job opportunities especially in rural areas. Therefore, increase in paddy production is the most important factor in GDP growth and socioeconomic development.

In Myanmar, rice is staple food consumed by all of the population and thus it is defined as a national crop. Rice is one of the source of foreign exchange earnings and its consumption is highly related to the level of income. Unlike in other Asian countries, rice consumption in Myanmar reaches highest level. The quantity of paddy demanded showed increasing trends as population increased and rice consumption.

Myanmar government is dedicating significant efforts towards developing a sustainable development plan with specific objectives of improving the export sector and the agricultural industry. Myanmar developed a National Export Strategy with a focus on increasing production and value-added of paddy. Thus, the increase in paddy production is necessary to meet the requirement of basic consumption and to increase export.

According to the studied result, Ayeyarwaddy, Bago, Sagaing and Yangon regions are the largest area of paddy production and Tanintheryi region, Kachin, Kayah and Chin States are smaller areas than others and costal and hilly regions. Manawthuka, Sinthukha, Ayarmin, Pawsannyin, Shwewahhtun, Sinthwelatt,

Sinakayi, Ngasein, Meedone, Hnankar, Theehtutyin, Shwethweyin, Yadanartoe, 90-days, Palethwe, IR-747, Yadanaraung and Shweyinaye are the most paddy varieties have been used in Myanmar.

The utilization of farm machineries in paddy field were increased yearly, these are invented modern technology. But, draught, cattle are still using in the farming operation due to unskill operator, rising fuel cost, cost effective repair and maintenance services. Although the MOALI cannot provide certified seeds to farmers all over the country, the distribution amount of quality paddy seed is increasing gradually than the early period. The quality seed of paddy production and marketing is very sluggish in Myanmar. The amount of fertilizer and pesticides used for paddy significantly increased. Farmers do not systematically use fertilizer with the correct nutrient balance, overuse of pesticides due to lack of knowledge on soil nutrient management and training .The seasonal loan for paddy is increased yearly but it is insufficient for the purchase of farm tools and equipment.

Myanmar is still using primitive method and only recently developing agricultural technologies. The sown acreage and production of paddy is reduced statement because most of the processing facilities in Myanmar are inadequate in terms of both quality and quantity, which seriously affects competitiveness and the prices obtained by farmers as well as export earnings. Myanmar still can produce the sufficient amount of paddy production for its consumption and thus remains one of the world's largest producers of rice today.

5.2 Suggestions

At present, farmers' the socioeconomic status has been adversely affected by the effects of climate change and natural disasters. In particular, the unpredictable weather changes that have taken place almost annually in the wake of Cyclone Nagis in 2008 and Cyclone Komen in 2015 have led to tremendous crop damage and losses in agriculture. Most farmers live on small holdings of land in rural areas and also lack of information on the global supply and demand conditions that affect local prices. The price of paddy are mostly declined at the harvest time. They have limited access to crop management knowhow and weather forecasts that impact agricultural operations.

Making matter worse, farmers are at the receiving end of an expensive, highly fragmented supply chain with underdeveloped infrastructure. Largely controlled by unscrupulous middlemen, these value chains plough back only a small share of the consumer prices to the farmers. As a consequence, most farmers have not been able to break out economic down town they have experience from chronically low productivity, low income and raising indebtedness. Most landless households are doing temporary migration to seek non-farm jobs. So, the effective ways of improving productivity are required.

The production of paddy has the potential for rapid growth by using high yielding varieties including adoption of Good Agricultural Practice, utilization of good quality high-yielding seeds, application of agricultural inputs such as irrigation water, agro-chemicals and natural fertilizers and promotion of farm machineries utilization as technology intervention. The government should support the transforming from traditional farming to mechanized farming. Land improvement from the traditional small-scale crop cultivation to modernized large scale agricultural farming should be encouraged by private sector is being undertaken in the existing agricultural land through proper drainage, irrigation and farm roads. There are also needed to support the education and training programs for effective use of pesticides and fertilizer to farmers by local governments. Human resource development program is essential for the productivity improvement. Well qualified person are required to undertake the effective development of research activities, technologies and human resources.

Utilization of good quality seeds is vital to increase paddy production. The government should expand seed production farms and quality seed zones, on-farm demonstration plot for farmers between government agencies and private organizations in order to sufficiently supply locally adaptable seeds and disseminate proven technologies. It is needed to encourage private/ public sector to implement farm machine’s rent and share programs to increase better utilization of machines. The successive policies are also required to enhance the paddy production, to create incentive for farmers and also had impact on rice export at the world market in term of quality and quantity. Several million hectares still remain to be developed in

Myanmar. If the sufficient quality and quantity of processing facilities are used in paddy production, Myanmar will return reach to the world's largest exporter of rice.

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Appendix

Location of Agriculture Production Sites in Myanmar

Agriculture products mainly come from five regions: Ayeyarwady, Sagaing, Bago, Magway and Mandalay. About 70 % of the cultivated land in Myanmar is found in these five regions.

The following map shows major crops by zones