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Production and Economic Efficiency of Farmers and Millers in Myanmar Rice Industry

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1. INTRODUCTION

1.1. Background

Rice is the second largest produced cereal crop in the world. Annual rice production was around 350 million tons at the beginning of 1990, and by the start of 20th century it had reached 410 million tons. Rice production is geographically concentrated in Asia where more than 90 percent of world output is producing. International rice trade is estimated between 25 to 30 millions tons per year which corresponds to only 5 to 6 percent of world production (UNCTAD). The UNCTAD has also projected rice trade in global market will increase three percent per year.

Rice is the staple food of more than 50 percent of world population. The food security of rice consumers depends on greater national, regional and international efforts and investments toward achieving sustainable production increases. Policy makers around the world are trying to formulate the appropriate policies for supporting rice production. Improvements in income distribution and food distribution are important for most vulnerable of the world population while increased food production and lower food prices alone will not be sufficient to eliminate malnutrition. Rapid population growth multiplies the problems concerning food and other fundamental human needs. Increasing food production is itself a complex process involving more intensive and extensive use of land and water, increased availability of basic agricultural inputs such as fertilizers, appropriate agricultural policies and rural institutions, and strengthened agricultural research. However, if effort is made, the potential for increasing food production in every country in the world would be substantial.

The productivity of rice cultivation in Myanmar remains low while there is still a high potential for production increase. The country's average yield is about 3 tons per hectare while the yield of East Asia countries like in Japan has about 6 metric tons per hectare. The variation in the yield of rice is reflecting the uneven current distribution of agricultural inputs and skills. The major factors affecting increased rice productivity include the use of modern high-yielding varieties, fertilizer, agricultural chemicals, irrigation, and the improvement of rural institutions. Another important factor that reduces the country's rice production is the waste in the entire food system from production at the farm to final consumption which requires substantial improvements in post-harvest processing, transportation and storage systems, and control of

pests and diseases. The history of the success of Japan rice cultivation provides four stages: (1) the first and longest stage is that of primitive farming in which relied on traditional implements and practices and rainfall; (2) the productivity of land is improved by irrigation; (3) introduction of scientifically developed techniques; and (4) the establishment of full range of institutions needed to support a high productivity.

Myanmar has large potential to produce more rice by improving rice yields on existing production areas, building new and maintaining irrigation infrastructure, converting land to rice cultivation, and converting natural ecosystems into rice production. The extensive adoption of modern and improved production technology is accelerated through favorable recent government policy, expansion of irrigated areas, accessibility to agricultural credit, intensive extension services and the availability of agro-chemicals especially fertilizers and herbicides. The productivity of rice does vary among regions within the country based on the different agro-ecological zones and production systems used. However, the gap between the farmers' yields and those obtained by research stations is still large indicating that the various limiting factors affecting rice productivity and production ranging from land development to marketing. Rice production limitations are closely interrelated. Stronger seedlings from high quality seeds, for instance, will not increase yield without using adequate fertilizer, and likewise rice crop cannot respond to fertilizer application if weed infestation is intense and water supply is inadequate.

1.2. Research Focus

Rice is the country' most important food and total population depend on it for calories and protein. The country population is increasing 1.6 percent per year (ADB, 2010), and reached to about 60 million in recent years. On the other hand, the world will also need about 760 million tons of paddies at the year of 2025 in order to meet the growing demand. The country's rice production had steadily increased during previous decades mostly due to land development program and crop intensification. However, crop intensification has exerted tremendous pressures on natural resources and the environment. Given globalization of the world economy, on the other hand, farmers in the country are exposed to fierce competition not only among

themselves but also with producers of other crops. Therefore, future potential of rice production requires improvement in productivity and economic efficiency of from farmers to all stakeholders who are involved in the industry. But, there is still yield gap between research stations and farmers' fields. Narrowing these gaps hopefully could not only improve the productivity but also the efficiency of farmers. The ministry of agriculture and irrigation (MOAI) is trying to increase rice yield through various schemes such as extension of good agricultural practices, distributing of increased amount of loans, encouraging to form rice specialization companies, and etc.

However, some specialists have expressed their concerns about the economic gain of increasing rice yield to narrow down the yield gap accompanied with additional cost of new technology. They have claimed that by reducing the waste occurred at harvesting, drying and storage would increase net profit for farmers. Other specialists believe that the yield gaps are economically exploitable for increasing gross profit. They are standing by saying that good farmers will generally reap more benefits from improved technology than those farmers who do not want to adopt it even in the same location. Thus, the challenges for policy makers, scientists, agricultural economists, farmers, processors, traders, and all persons in the rice industry would be how these efforts to reduce yield gaps can effectively and economically be narrowed at farmers' level.

Accordingly, this report set two specific objectives as follows:

(1) To examine the economic and technical efficiency of rice farmers, and

(2) To analyze the cost and benefit of rice mills.

The report is started with introduction in the first section. Agricultural and economic policy changes are reviewed in the second section. The section 3 deals with rice policies and reforms followed by agricultural efficiency of rice farmers, and cost and benefit analysis of rice mills, in next sections, respectively. And it is concluded in final section.

2. AGRICULTURAL AND ECONOMIC POLICY CHANGES

2.1. Introduction

Myanmar is agriculture-based country. About 40 percent of the gross domestic product (GDP) comes from agricultural sector and more than 60 percent of the people live in rural areas. Agriculture sector contributes major source of foreign exchange, and supplies of the bulk of basic food. Agricultural output of the country rose starting from 1990 at an annual average rate of one percent per year. The linkage between agriculture sector and other sectors of the country' economy stimulates for growth and income generation.

According to the Asian Development Bank (ADB), Myanmar's population for year 2000 was nearly 48 million and it reached 51 million in year 2005 and nearly 60 million in 2010 (CSO). The population was composed of 29.48 percent in the 0-14 age group, 65.58 percent in the 15-64 age group and 4.94 percent in the 65 and above age groups in 2005. It is indicating that nearly 66 percent of the population can be considered as potential human resources for the economic development of Myanmar. The demographic structure of the country's population has changed overtime. The economically active group, between 15 and 64 years old, accounted for 55.31 percent of the population in 1980, and 25 years later this cohort comprised nearly 66 percent of the total population.

Nearly 63 percent of the population was engaging in the agriculture sector in 2010. It was about 67 percent in 1980. These figures are indicating that Myanmar economy is still much depending on agriculture sector. At the same time, employed labor force in service sector stands within 20 to 25 percent from 1980-2010. This is also implying that sectored contribution of services remains unchanged for 30 years. If we also look at the industry sector, we will see not much change during this time. It was nearly 10 percent in 1980 and 12.2 percent in 2010. Generally speaking, the employment distribution of the different sectors reflects their respective contribution to GDP. The share of the agriculture sector in total GDP was 46.54 percent in 1980 and it was increased to 60.1 percent in 1995 and decreased again to 57.23 percent, 42 percent and 36 percent in 2000, 2005 and 2010, respectively. This figure also indicating that the sector plays still important for Myanmar economy.

Steadily declining of agriculture's contribution, from 1995 to 2010, to job creation is to be expected as the economy moved to development, but the industry share in total GDP was declining from 1985 to 2010. Thus, industry sector failed to absorb the labor force of agriculture sector. On the other hand also, share of service sector in total GDP was declining from 1980 to 1995. But it was increasing from 1995 to 2010 indicating that labor force in agriculture sector moved to the service sector after 1995. In overall, agriculture sector is still the largest provider of jobs in Myanmar economy.

According to the ADB data, per capita GDP in Myanmar has been growing since 1980. In 1980 per capita income was Kyat 3726 while in 2005 it was Kyat 167205. However, if we divide the per capita income in 2005 by market exchange rate, which is about Kyat 1200 per one US dollar in average, it is about US$ 160. This income is far less than if comparing with other developing countries those are neighbor to Myanmar (ADB).

The share of agricultural export of some commodities (for example, rice) from Myanmar to the world market has fluctuated from 185 million US dollars in 1980-1982 to about 84 million US dollars in 2000-2002, and 400 million US dollars in 2010. But market share of other products such as peas and beans and shrimps and prawns has increased because of rapid expanding demand of beans from India and shrimps and prawns from Japan. But Myanmar' agricultural export largely consists of a few low value-added primary commodities. On average, these two export items, which are predominantly primary agricultural commodities, account for more than 60 percent of total agricultural export earnings. Moreover, because of the sanction practiced by EU and US, Myanmar' exports are concentrated particularly on only a few markets of which Thailand is by far largest, followed by China, India, and Japan. Intra-ASEAN trade is not so much in volume compared with trade of those countries.

Starting from 1980, with the growing integration of markets due to globalization and trade liberalization, economies of the less developed countries face a more fiercely competitive external trading environment. Myanmar is also not an exceptional country. Myanmar continue to export a limited range of primary commodities that are highly vulnerable to instability in supply, demand and a decline in terms of trade before 1988 under the then centrally controlled Burmese socialist government. Given the context of political and economic reforms, Myanmar could

assess larger and more affluent market like Japan favors growth and development through trade after 1990 but still facing many internal supply side constraints associated with its underdeveloped economy which renders its exports uncompetitive.

But after 1980s, globalization brought outward-looking policies in the world. Since then it became popular policy prescription among economists and policy makers. Many developing countries liberalized their trade and harvested the benefits of such openness. At the same time, another hypothesis related to structural changes of exports and diversification of the exports was used to debate in the trade literature. Many economists have been argued that a more diversified export mix may enable a country to be stable in economic growth (Ali and others 1991; Gutierrez de Pineres and others 1997). In this context, Honma (2003) noted that for a small country, the price elasticity of demand for exports of a homogeneous commodity is large and there is a huge potential to be gained if it is successful in reducing the export price by more efficient production. Therefore, least developed countries and/or developing countries should create markets for their agricultural commodities with large price and income elasticities of demand to achieve sustainable long-term growth by means of export diversification.

For many least developed countries and developing countries, agricultural trade remains an important part of overall economic activity and continues to play a major role in domestic agricultural production employment. But greater reliance on a small number of primary exportable commodities for export earnings is a challenging issue for those countries. Johnston and Mellor (1961) reported that expansion of agricultural exports is considered one of the most promising means of increasing income and augmenting foreign exchange earnings, particularly for a country stepping up its development efforts. In the international trade literature, a number of empirical studies have been undertaken in this context (Michaely 1977; Feder 1983; Hsiao 1987; and Dutt and Ghosh 1996).

2.2. Economic Policy Context

2.2.1 The Past Trade Policy Context

The then Myanmar Socialist Government pursued closed-door policy for many years which actually suited the centrally-planned socialist economic system. Many analysts agree that the

economic policy of Myanmar during the socialist period (1962-1988), especially up to the early 1970s, was essentially a policy of agricultural exploitation, with heavy emphasis on rice production (Soe and Fisher 1990; and Thein 1997). Because of the economic and political deterioration of socialist system, popular uprising was happened in 1988. As a consequence, military took the power by coup in the same year.

Starting from the late 1980s and 1990s, Myanmar initiated economic reforms and export-oriented policies. The State Peace and Development Council (SPDC) further encouraged state economic enterprises (SEEs) to form the joint ventures with private entrepreneurs. However, the export growth has declined slightly in the late 1990s and early 2000s because of the heavy reliance on very few commodities and regional financial crisis and deterioration overall macro-economic conditions inside the country. Asian financial crisis leaded to the reduction of the inflow of foreign direct investment into the country. Consequently it increased the trade deficit because imports are increasing while exports are stagnant due to decrease in demand of export.

Myanmar implemented a series of reforms since late 1980s. It liberalized the agriculture sector, expanded the private sector for trade to some extent, opened the border trade and allowed foreign investments to inflow into the country. These were done by the licensing of private bank operations, the legitimizing of foreign exchange transactions in the parallel market, the privatizing of SEEs and the simplifying of the tariff system. The country's GDP grew by more than 6 percent between 1993 and 1996. But after 1997, its economic growth was slowed to 4 percent per annum due to adverse weather conditions, the regional financial crisis and deterioration in overall macroeconomic conditions. Myanmar signed PTA with Malaysia in 1998 whereby Myanmar received crude oil on beneficial terms in exchange for agricultural products.

Foreign trade is engaged in Myanmar both by public and private sector. All public sector exports and imports are recorded using the official exchange rate, even though actual transactions may use one of several exchange rates. Private sector imports require import licenses for each transaction and are financed through the importers' foreign trade account. Private sector trade is transacted at the parallel market rate, although a range of other exchange rates may be applied.

Myanmar entered AFTA on January 1998 a year after being a membership in ASEAN. Under this scheme, imports are classified under several lists: the inclusion list, temporary exclusion list, sensitive list and general exception list. About 43 percent of all imports were on the inclusion list which consisted of commodities on the fast track (0-5 percent tariff rate within 5-8 years) and normal track (0-5 percent tariff rate within 10 years). Products on the temporary exclusion list (about 55 percent) were phased into the inclusion list by 2015.

The government practiced an unrealistic official exchange rate to overvalue the Kyat. Although the official rate has remained fixed at Kyat 8.5 per Standard Drawing Right (SDR) since 1977, the market rate of the Kyat has significantly depreciated and business transactions are conducted at market rate. SEEs are required to record their transactions at the official rate as well as foreign firms are also. This practice distorts the accounts and reduces transparency. In 1993, the government introduced foreign exchange certificates which have been used in external trade and selected invisible private sector transactions (means unrecorded business transactions).

Despite moves to encourage foreign trade and investment, extensive regulations and procedures tend to hinder commercial activities in the country. The procedure for requesting permits that required for exports, imports and other business activities has been cited as not being transparent and the list of prohibited exports has been frequently changed. Commercial disputes are handled solely under the arbitration among the persons involved in the disputes. As a result, business involved in disputes tend to seek settlement informally rather than legal system.

The government partially liberalized rice production in 1996 and encouraged the farmers to diversify the crop production away from so-called industrialized crops such as pulses, sugarcane and cotton. However, the restrictions on rice export made the domestic prices far lower than international prices. In 2004, government announced that domestic rice marketing and export of rice are freed. But unfortunately, export of rice has been again prohibited to stabilize the rice prices inside the country. As a result, the export capabilities in Myanmar are restrained by the unintended effects of agricultural and trade policies as well as by political situations in the past.

2.2.2 Recent Economic Policy Changes

According to the Asian Development Bank (ADB) data, the country's economy was decreased from 5.5 percent in 2007 to 3.6 percent in 2008 (Table 2.1). Myanmar's economy was hurt due to its neighboring countries' economies slowdown by global financial crisis and the impact of Cyclone Nargis in 2008. Economic growth was recovered to 5.5 percent in 2010 as FDI inflow into the country and as domestic investment, construction and services increased up. The ADB said that the country needs to reduce its poverty rate based on the joint survey made by United Nations Development Program (UNDP) and Integrated Household Living Conditions Assessment (IHLCA, 2007) done by Myanmar government. The overall poverty rate for the country was 32 percent though the rural poverty rate was 36 percent and urban poverty was 22 percent in 2007. The country's poverty rate was decreased to 26 percent in 2010 from its level of 36 percent in 2004. There were also positive indicators such as increases in net school enrollment rate, vaccination of under 5 years children against measles, births given with skilled medical staff, and access to safe water, and decrease in lack of food supply and death toll of pregnant women.

Table 2.1. Myanmar's Economic Indicator

Economic Indicator	2006	2007	2008	2009	2010
GDP growth (% change per year)	7.0	5.5	3.6	5.1	5.3
CPI (% change per year)	26.3	32.9	22.5	8.2	7.3
Unemployment rate (%)	4.0	4.0	4.0	-	-
Fiscal balance (% of GDP)	-4.3	-3.8	-2.4	-5.4	-5.7
Export growth (% change per year)	47.4	23.9	15.5	4.4	4.8
Import growth (% change per year)	48.0	88.0	25.6	1.9	10.0
Current Account Balance (% of GDP)	7.1	0.6	-2.2	-1.3	-2.2

Source: ADB

Starting from late 2010, the country's currency was much appreciated than the previous years that squeezed traders and exporters who were trying to struggle to get breakeven level as inflation pushed up the costs. The Kyat appreciation problem was a big challenge for the newly formed civilian government of the Republic of the Union of Myanmar. The country's currency

strength against US dollar alarmed the government to address the rising food cost around the country. One of the main reasons for Kyat appreciation was weakness of US dollar all over the world though other factors such as increased foreign currency flows from selling of timber, gems and energy exports which boosted the demand for Kyat. Rice export was also hindered by the strength of currency as it became uncompetitive and unprofitable in international market though the government wanted to boost the export of rice.

Under these circumstances, the government planned to adopt new flexible approach to exchange rate in response to the Kyat appreciation. In the second regular session of the first upper house meeting that was held in August 31, 2011, two MPs raised the questions related to setting up stable exchange rate and amendment of laws of finance and revenue. The government responded their concerns by saying that the unification of foreign exchange rate is a top priority in lighting up the market economic system and thus the government is trying to cooperate with International Monetary Fund (IMF) and measures will be taken to ensure there is no harm to interests of the national and in the everyday life of the people. The IMF technical team came to the country in November, and gave advises and comments on the financial reform. The government also allowed opening private-bank exchange rate centers in Yangon. Because of these moves, the Kyat's became stable around 800 Ks starting from October in 2011.

The government has implemented five-year plan spanning from FY 2011-2012 to 2015-2016 with given economic conditions. They have planned to get nearly 9 percent of growth rate that mainly comes from agricultural and services sector though the national budget allocation for agriculture sector only have 4.97 percent of total budget (Table 2.2) with the aims of retaining the current growth momentum of the economy, solidifying the value of Kyat, reducing the budget deficit, curbing inflation and continuing the current account surplus position in the balance of payments. Total budget allocation was increased nearly 241 percent in FY 2011-12 from FY 2010-11. The largest budget share was given to the defense sector which covers around 21 percent of total. The education and health sectors were allocated from its national budget by 4.97 percent and 1.46 percent only, respectively, though the amount of expenditure in real terms increased from 15.86 percent and 16.15 percent, respectively.

Table 2.2.The Country's National Budget

Sector	FY 2010-11(Ks in Billion)		FY 2011-12 (Ks in Billion)	
	Amount	% of total	Amount	% of total
Defense	1323.066	51.00	1318.578	21.13
Energy	0.232	0.01	1008.640	16.16
Electric power 1 and 2	78.233	3.02	668.520	10.71
Construction	295.963	11.41	578.024	9.26
Finance and revenue	14.683	0.57	479.229	7.68
Communication	.200	0.01	320.930	5.14
Industry 1 and 2	2.810	0.11	419.860	5.73
Education	266.906	10.29	310.020	4.97
Agriculture	199.444	7.69	310.217	4.97
Health	78.387	3.02	90.819	1.46
Other sectors	334.304	12.87	736.771	12.79

Source: Myanmar Gazette

2.3. Agriculture Context

2.3.1 Export Earning from Agricultural Commodities

Traditional and non-traditional agricultural exports of Myanmar are to be instrumental in restoring the country's balance of payments by increasing total export earnings and reducing fluctuations in revenues from exports. This objective has been partly realized. Non-traditional agricultural exports have increased Myanmar's export earnings by US$ 100 to around 1.5 billion starting from 2000. Over the last decade, the growth in non-traditional agricultural exports has been bigger than that of traditional agricultural exports. However, non-traditional agricultural exports have not replaced traditional agricultural exports. Most of Myanmar's export revenue still comes from forest products though export earnings from rice have been fluctuated.

Agricultural exports are expected to provide income for (poor) rural households, either through production or employment. Large numbers of people have indeed benefited: peasant farmers, farm laborers, fishermen, intermediate traders and purchasing agents who deliver to processors and exporters, the processors and exporters themselves, local and international

transporters, input suppliers, government officials, and local and foreign consultants though the total number of beneficiaries is difficult to estimate.

2.3.2 Total Agricultural Export Performance

In this section, I briefly look up the export performance of Myanmar during 1980-2006. Total value of agricultural exports and annual compound growth rate of agricultural products excluding natural rubber and forestry products are summarized in Table 2.3. Growth rates are reported for the nine sub-periods in order to highlight on possible effects of the domestic politics and economic situation. Table 2.3 generally supports the view on how domestic policy orientation is important in explaining export performance.

Table 2.3. Agricultural Export Performance of Myanmar

Three year average of:	Total agri export value (mil US$)	Annual compound growth rate (%)a	Total agri export value at 2000 price (mil US$)	Annual compound growth rate based on 2000 prices (%)
1980-1982	245.15	-0.03	66.88	-0.07
1983-1985	174.02	-0.12	35.62	-0.18
1986-1988	80.05	-0.34	12.02	-0.44
1989-1991	101.22	0.61	21.25	1.28
1992-1994	301.88	0.52	120.97	0.91
1995-1997	481.52	0.09	242.09	0.13
1998-2000	340.39	0.02	269.84	0.26
2001-2003	598.69	0.17	962.95	0.46
2004-2006	721.96	0.22	1487.88	0.43

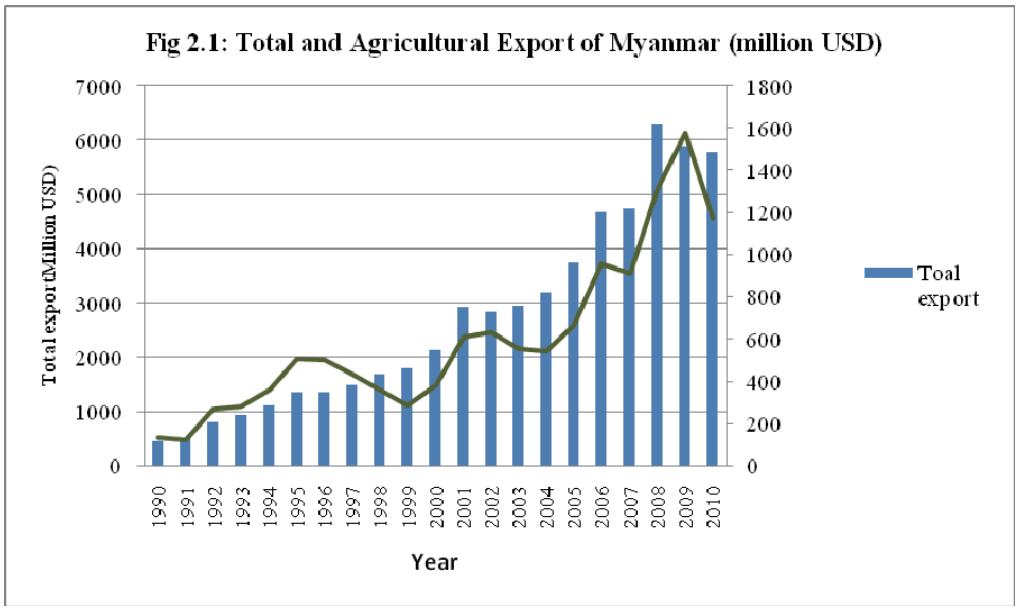
Source: UN COMTRADE

Note: [a]: growth rate from the previous period; Compound annual growth rate can be calculated by using following formula:

$$CAGR = \left\{ (EndingValue / BeginingValue)^{\frac{1}{Years}} \right\} - 1$$

Data for the first period to third period in which the then Myanmar Socialist Government control on export and marketing provides clear signal in declining growth rate of export. During

these sub-periods economic and political situations were seriously deteriorating. Starting from 1990, the military government practiced strong enforcement in production of agricultural products and expansion of cultivated lands. But marketing and export of some commodities were still under the control of state marketing agency. Later the military government liberalized the production of some crops except some pillar crops namely rice, sugarcane, cotton and jute. The growth rate of 1992-1994 sub-periods was 1.28 and exports were reached to 120.97 million US dollars in 2000 price. This growth rate was continued to 1995-1997 sub-periods before the Asian financial crisis took place in 1997. Because of decreasing demand from abroad the growth rate of agricultural products were declined in this period.

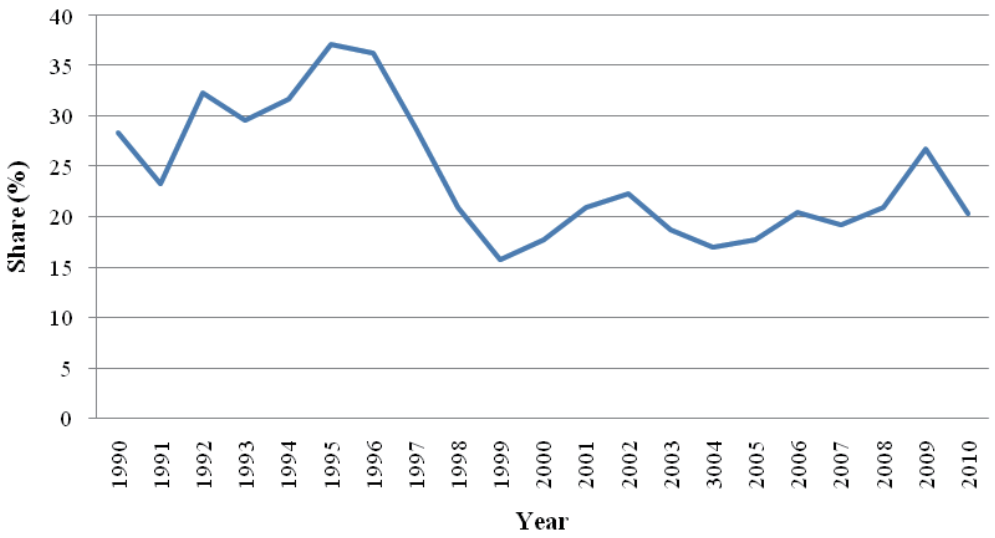


Source: FAO, FAOSTAT database

But from 1998 onward, Myanmar expanded its agricultural export in real terms (Figure 2.1). Figure 2.2 shows the changes in the share of agricultural exports in total commodity exports starting from 1980. The share values were up and down in all periods. The higher the share value means the higher in agricultural contribution in the country's economy. In the 1980s the share of agriculture in total exports was between 30 to 50 percent. During first half of 1990s, agriculture's

share was high again and stand between 30 and 40 percent of exports. But starting from 1995 its share was sharply declined because exporting of off shore natural gas exploration in Myanmar's sea to neighboring countries.

Fig 2.2. Share of Agricultural Export in Total Export



Source; FAO, FAOSTAT database

Though the share of agriculture was declined, its nominal and real values were increased because of rapid expanding demand of vegetable products especially beans from India and Pakistan. But the share and value of rice were clearly down since government's policy was not favor for its producers. Government's policy failure in production, domestic marketing and export of rice made the country to loss its market in the world. If we compare figure 2.1 and 2.2, the agriculture share of Myanmar had fluctuated until 1995 and after that it gained again growth rate indicating that agricultural exports was much lower than that of non-agricultural commodities. It does not mean Myanmar is moving to industrialization. The experience of Myanmar in fact suggests that the shift in export of traditional products to some extent of other variety of crops as well as other natural resources. Though its growth rates of agricultural exports are increased continuously, if we compared the actual value of agricultural exports to other neighboring countries, the values are far lower than that of those countries (Honma 2003).

2.3.3 Export Performance by Commodity

Table 2.4 describes the export performance in terms of export quantity and value of major 11 commodities in Myanmar. Commodities are selected if its export value was accounted for more than 1 million US dollars in 1980-82 sub-periods. The export values of these major commodities also account for more than 75 percent of the total value of agricultural exports. The export value of traditional commodity, rice, decreased consecutively. In 1980-1982 sub-periods, its value was about 185 million US dollars.

But in 2000-2002 periods, its value was sharply down over two fold from starting level in this analysis. Instead of this loss of traditional promising commodity, export of dried beans took place in its position. The value of the export of beans was only about 31 million US dollars in 1980-1982 periods. But in 2000-2002 sub-periods, its export value reached to 220 million US dollars. Its value increased about seven folds of its initial study level. As like dried beans, the values of other variety of exports were increased except cotton, jute and natural rubber. The export values of these exceptional commodities were up and down during the study periods. These figures clearly indicate that domestic policy orientation for these crops is unstable because of government intervention in marketing and export of those commodities. But on the other hand, the export values of other commodities were increased consecutively because government do not control and intervene in production and marketing of those crops. Combination of Table 2.3 and 2.4 shows success of diversification of the variety of export commodities to some extent in one hand and on the other hand decreasing trend of the value of traditional export clearly express that the failure of government policies.

2.3.4 Agricultural Exports by Markets

As Myanmar is agriculture-based country, demand for the production of its agricultural commodities is important for the country's economy. This section, therefore, highlights the importance of markets for Myanmar's products through analysis of its destinations over time.

Table 2.5 set out the compositions of food and live animal (SITC code 0) exports by destinations. The United Nations Commodity Trade Statistics provides such kind of data.

Table 2.4. Quantity and Value of Major Agricultural Export Commodities

Three year average of:	1980-1982	1983-1985	1986-1989	1990-1992	1993-1995	1996-1999	2000-2002
Milled rice							
Value (1000 US$)	184988.00	125599.00	39797.33	43768.00	109885.33	17745.00	83655.67
Quantity (1000 Mt)	676.10	687.23	316.0	193.79	516.70	803.00	696.83
Maize							
Value (1000 US$)	2456.00	2958.33	977.00	3784.67	6995.33	14507.67	11575.33
Quantity (1000 Mt)	19.57	27.40	12.38	35.18	57.60	108.93	120.63
Dried beans							
Value (1000 US$)	30558.67	26705.67	15631.00	98990.33	195510.00	197111.67	219661.67
Quantity (1000 Mt)	82.93	73.43	58.59	255.64	523.47	661.73	988.97
Groundnut cakes							
Value (1000 US$)	596.67	506.67	343.33	960.00	1843.33	286.67	533.33
Quantity (1000 Mt)	3.716	4.17	2.20	8.03	13.77	1.97	2.80
Sesame cakes							
Value (1000 US$)	1100.00	1266.67	1100.00	740.67	2042.00	536.67	1066.67
Quantity (1000 Mt)	6.28	9.70	8.50	5.33	11.60	3.50	5.63
Dried onions							
Value (1000 US$)	0	0	0	197.00	500.00	5333.33	10300.00
Quantity (1000 Mt)	0	0	0	0.244	1.67	17.80	52.27
Pimento							
Value (1000 US$)	0	0	1166.67	5931.00	6383.67	590.00	1497.67
Quantity (1000 Mt)	0	0	1.27	6.79	10.43	61.33	2.77
Spices							
Value (1000 US$)	0	0	0	867.33	1300.00	2383.33	1066.67
Quantity (1000 Mt)	0	0	0	1.75	3.00	5.48	2.79
Cotton lint							
Value (1000 US$)	1913.33	1850.00	973.33	1055.68	1231.33	2679.00	351.33
Quantity (1000 Mt)	1.79	1.70	0.54	1.10	1.20	2.27	0.40
Jute							
Value (1000 US$)	6434.33	200.00	0	0	649.67	302.33	2368.00
Quantity (1000 Mt)	30.23	0.67	0	0	2.60	0.67	10.45
Natural rubber							
Value (1000 US$)	10658.00	7117.33	4437.00	5234.00	20622.00	21961.33	10629.66
Quantity (1000 Mt)	10.90	9.70	5.87	8.19	21.37	25.83	22.57

Source: FAO, FAOSTAT

The most important export partner of food exports of Myanmar for all sub-periods was India though values of export to that country were not stable in some periods. India is a biggest buyer

of Myanmar's peas and beans. Japan plays second important export partner for Myanmar's food export throughout the study periods. The most promising export product to Japan is a variety of fish exports. Food export share of Myanmar to Japan for the last study period is about 10 percent of Myanmar's total agricultural export by destinations in 2006-2007. Singapore was once biggest importer of Myanmar's commodities in early 1990s. But export share to Singapore sharply went down after 1997-1999 sub-periods. Malaysia followed Japan. Food export to Malaysia is about 8 percent in 2006-2007 periods. Export share of food to China from Myanmar is relatively lower than those of India, Japan, Malaysia and Thailand.

Table 2.5. Composition of Food and Live Animal Exports by Destination (%)

	1988-1990	1991-1993	1994-1996	1997-1999	2000-2002	2003-2005	2006-2007
Australia	1.02	1.97	1.26	1.67	1.31	1.56	1.33
Bangladesh	0.01	0.27	2.22	6.12	5.08	0.00	0.00
China	0.00	7.07	2.47	1.38	3.49	2.48	3.86
EU15	9.18	5.97	6.00	6.74	4.30	3.81	2.55
India	23.64	24.81	22.87	23.27	30.62	37.57	52.27
Indonesia	0.56	8.46	11.53	3.54	3.12	1.90	1.48
Japan	15.88	7.76	9.54	16.65	11.05	12.00	9.41
Malaysia	3.56	4.92	4.15	7.22	7.27	8.46	7.68
Singapore	28.06	20.39	15.88	13.85	7.14	4.74	1.45
Thailand	10.62	5.58	4.54	5.31	5.01	11.00	3.66
USA	7.47	2.90	1.62	5.08	5.49	0.00	0.00
ROW	0.00	9.89	17.94	9.18	16.12	16.48	16.33
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: UN COMTRADE

3. RICE POLICY AND REFORMS

3.1 Rice Production and Agricultural Policy Changes

Rice production has increased substantially throughout the years according to government published data (Table 3.1). Annual production increase was contributed by land area expansion and yield increase. Area expansion took place around the country where fallow lands exist. Starting from 1992, government introduced summer paddy production program. It increased crop production intensification for farmers. Farmers who relied on rainy season can now grow second rice with irrigation within a year.

Department of Agricultural Research (DAR), which maintains contact with international research institutes, is producing new improved high yielding varieties. Those improved varieties are transferred to the seed division which is one of the sub-divisions of Myanmar Agriculture Service (MAS). Seed farms under the seed division are reproducing mass scale. There are thirty two seed farms around the country (Figure 3.1). Although considerable efforts have been put into increasing yields in the country, adverse weather conditions in some years due to climate change, and low input use still keep average yields lower than other neighboring countries.

As rice is main staple food in Myanmar, the successive governments practiced consistently regulated prices by intervening in both input and output markets until 2003. After 2003 government announced they will liberalize both for domestic and export rice markets. Unfortunately, government revoked export liberalization after six months to be stable in domestic food market. This liberalization was named as second liberalization by Okamoto (2006). The rice sector was experienced a relatively free domestic trade regime starting from the mid of 2003. Rice export was again permitted to a few companies in 2007. Because of permission for rice export licenses are granted to few numbers of traders, price incentive for producers was unstable. Although regional market price shows increasing trend starting from 2001, the farm gate price for producers are still low due to low quality of paddy caused by inadequate, insufficient, and inefficient storage facilities. Those prices are determined by local traders or millers. There are many local traders and millers associations in every township. But

there is no farmer association at all. Therefore, farmers have a little bargaining power to complain about the price paid by millers or local traders. The recent appreciation of Myanmar Kyats, on the other hand, happen less profit and uncompetitive in the international market for the rice exporters.

Myanmar Agriculture Development Bank (MADB) have borrowed increasing amount of loans to farmers year by year. The amount of loan borrowed by agricultural producers from MADB was about nearly seventy thousand million Kyats in 2009. Among the total amount of loan borrowed to farmers, nearly 84% was borrowed by paddy farmers. It was about sixty thousand million Kyats in amount (Figure 3.2). We can see that how government put rice production sector intensively. Each farmer can borrow twenty thousand Kyats per acre with two percent interest rate per month. In 2011, the amount of loan was increased to Ks 40000 per acre with the same interest rate. Total area of rice sown acre was 20 million acres in 2009. Therefore, nearly 15% of total paddy land only are getting loan from MADB. The rest, 85%, are still inaccessible to the MADB loan. But there are many informal lenders in every place with higher interest rate. This informal financial market makes farmers increased cost to the production. Many farmers cannot escape from debt because of the lack of money which is needed during crop season. They have no other way to choose to get loan even if they do not want to borrow loan with higher interest rate.

Government is also trying to establish small and large local entrepreneurs or cooperative groups who can borrow money to agricultural producers. Because of this effort, many small cooperative groups and rice specialization companies have been emerged to borrow loan and other various inputs for farmers. Though a considerable number of local groups are formed in the light of present policies, the question on whether it is an ad hoc basis or not is remains to answer.

According to MAS and CSO data, government subsidized inputs such as fertilizer and pesticides are becoming fewer by year. The previous government, however, imposed a fertilizer law in 2002 to encourage private sector involvement in large potential domestic market. The imposition of the law made many business tycoons to be appearing in the country' fertilizer market. They expanded their markets in every township and every village. Though the fertilizers produced domestically are experimentally tested by plant protection division of MAS, it is heard

that there are still many inefficient and unregistered fertilizers are in the market. This may affect to the yield and production of farmers. On the other hand, because of the emergence of such fertilizer producing and importing companies, farmers have many choices to use in their production.

If we look at the private investment in agriculture, according to SLRD, it was increased nearly 22 percent agricultural implements such as ploughs, harrows and spades. Investment in water pump was increased from 46000 to 198000 in number in 1990 and 2009, respectively. It was increased nearly 4 times during 10 years period. But the most essential machine such as tractor were remain in almost same number during this period indicating that the country is still relying on bullock for plowing, harrowing, and for other uses like transportation of products from farm to house or farm to market. The whole agricultural investment picture indicates that the country is still need to strengthen the mechanization power in the fields.

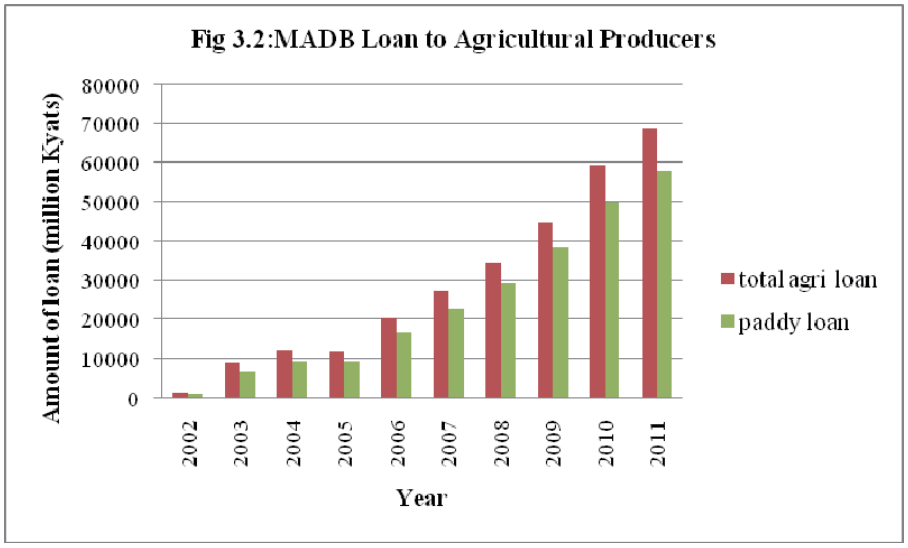
Table 3.1. Paddy Production

Year	Sown Area (mil ha)	Harvested Area (mil ha)	Yield (ton/ha)	Production (mil ton)
1989-1990	4.88	4.73	2.92	13.83
1990-1991	4.95	4.76	2.94	14.00
1991-1992	4.83	4.58	2.89	13.23
1992-1993	5.14	5.06	2.94	14.87
1993-1994	5.68	5.49	3.06	16.79
1994-1995	5.93	5.75	3.17	18.23
1995-1996	6.14	6.04	2.98	17.99
1996-1997	5.88	5.77	3.07	17.71
1997-1998	5.79	5.41	3.08	16.69
1998-1999	5.76	5.46	3.13	17.11
1999-2000	6.29	6.21	3.25	20.17
2000-2001	6.36	6.31	3.39	21.37
2001-2002	6.45	6.42	3.42	21.96
2002-2003	6.49	6.38	3.43	21.85
2003-2004	6.55	6.53	3.55	23.18
2004-2005	6.86	6.81	3.64	24.80
2005-2006	7.39	7.39	3.76	27.74
2006-2007	8.13	8.08	3.84	30.99
2007-2008				

Source: MAS, MOAI

Fig3.1. Location Map of Seed Farms

Source: MAS

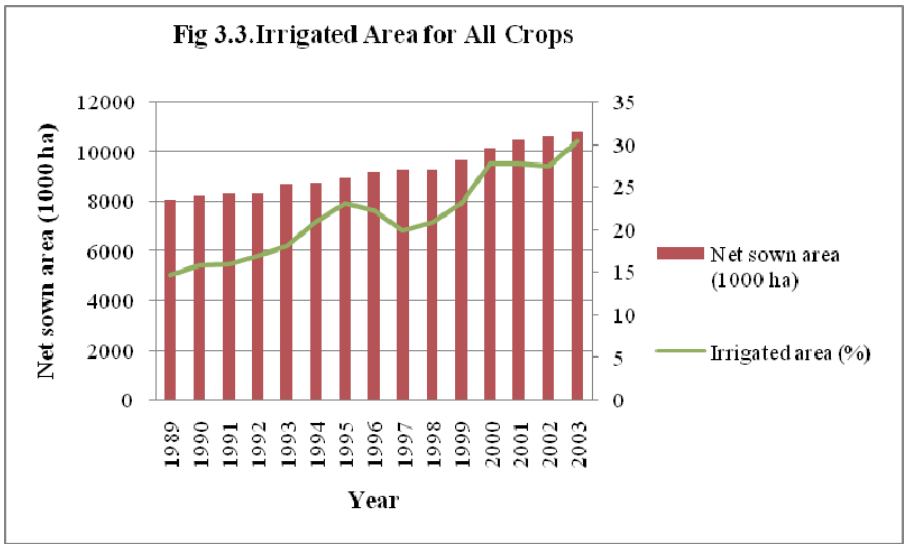


Source: CSO, MAS, MADB

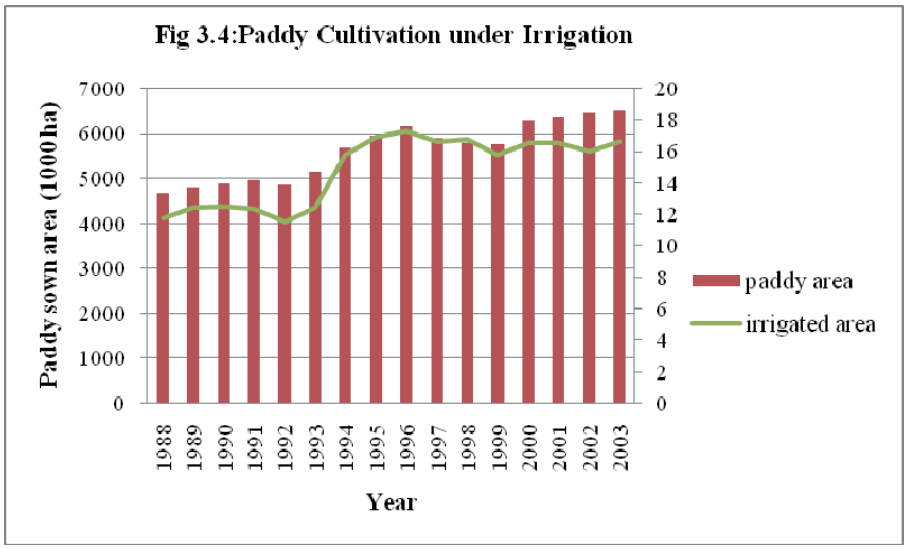
3.2 The Role of Irrigation

In many countries of the region, irrigation is viewed as an important input to the agricultural production systems. In most countries of the region irrigation has a long history which is closely linked to the history of rice cultivation. Asia represents the bulk of irrigation in the world. The region itself accounts for about 50 percent of the world's irrigation. High population density combined with the tradition of irrigated rice cultivation in all the tropical part of the region is the main factors explaining the importance of irrigation in Asia (FAO). While irrigation development in Myanmar dates back several decades, particularly the previous two decades has seen a rapid increase in what could be called modern irrigation development and the country have achieved surplus in several crops, mostly rice.

The total area of Myanmar is about 167.2 million acres, with the arable land standing at 45.8 million acres, or 27.4 percent of the country's total land area. The total net sown area in 1994-95 was 22.23 million acres, with the area receiving irrigation facilities at only 4.07 million acres, or 18.31 percent. During 1994-95, the irrigated area of 4.07 million acres, plus the double cropping irrigated area of 0.97 million acres totaled 5.04 million acres, requiring about only 30 million acre-feet of water, and amounting to about only 4 percent of available water resources.



Source: MOAI, ID, MAS



Source: MOAI, ID, MAS

There are about 26 million acres in Myanmar that are feasible for irrigation, and even if their full requirements of water for cropping are met, the demand would come up to only 200 million acre-feet of water, representing about only 25 percent of current potential availability (Irrigation Department, MOAI). As against the 67.65 million hectares of Myanmar's total land area, some 17.25 million hectares remain suitable for cultivation. However, land currently under crops total to only 10.12 million hectares. The potential for further expansion consequently remains enormous. Accordingly, the country remains engaged in the development of more virgin and fallow land. It has also been giving encouragement and rights for participation of the private sector. The country is also taking all possible measures for exploiting as much water resources as possible in it to grow crops all year round in its bid to address possible issues of irrigation water shortage due to climate change. According to the MOAI data, 233 dams and sluice gates and 327 river water pumping stations, and over 8000 tube-wells were constructed during last two decades. Total irrigation covers 1.39 million hectares of farmland in total.

Figure 3.3 shows the cultivated areas of all crops under irrigation. It covers about 30 percent of total net sown area in the country. It was increased nearly doubled if compared with irrigated area in 1989-90. Figure 3.4 shows the ratio of irrigated rice fields in Myanmar. It is evident that

the irrigation of rice fields has expanded only to a small extent, roughly about 6 percent, starting from 1990 to mid-2000s. But, on the other hand, summer paddy area is around 1.2 million hectare. At present, over 80% of the total summer paddy crop area is under irrigation (Irrigation Department, MOAI) though rain-fed paddy area has been on the rise and has led an overall increase in the cultivation of paddy annually. The scope of irrigable area made available by the Irrigation Department's weir and tanks has gradually enlarged and stands at nearly 1.2 million hectare currently.

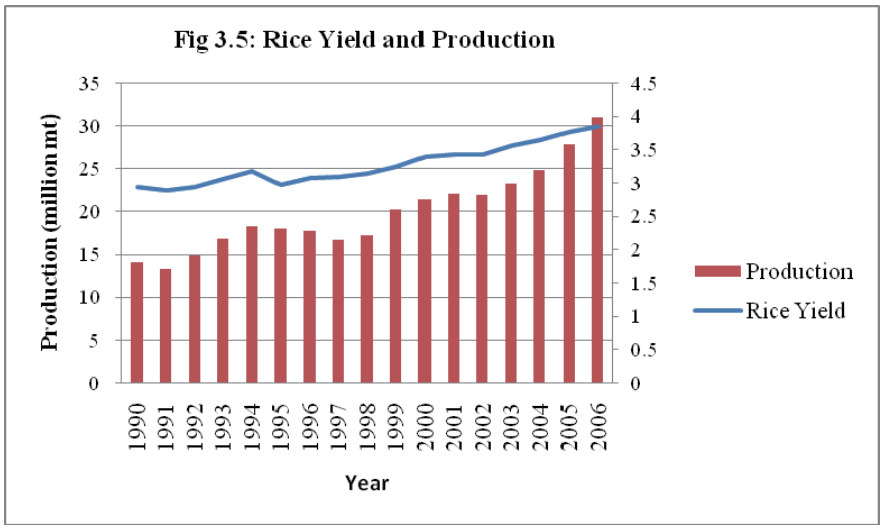
3.3 Yield, Harvested Area and Production

The characterization of the overall rice sector in the country might be complex due to the variable status such as the great diversity of ecosystems within which the crop is grown such as upland, rain-fed lowland, irrigated lowland and upland, mangrove swamp, deep water, etc, the different rice cultivation technologies used, and widely differing governmental policies. Moreover, under the given market conditions, increasing inter-linkages among global agricultural economies and the net importer of Myanmar rice, will also have strong bearing on the rice sector of the country. Anyway, the country's rice production trend is presented based on the available data in hand.

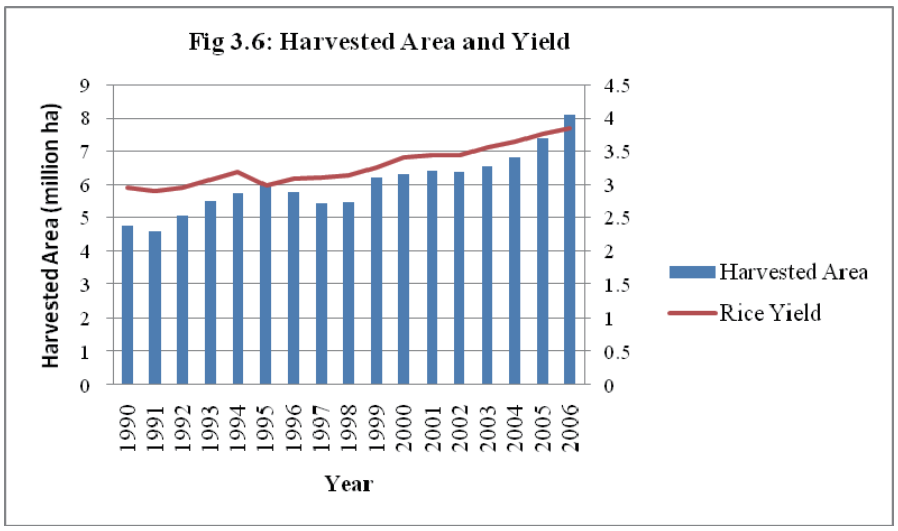
Figure 3.5 and 3.6 shows the trend of harvested area, yield and production of rice in the country. The trend in rice production during last two decades presents increased trend in total production though some regions in the country is not still sufficient. In 1990, paddy production in Myanmar was about 14 million metric tons (Figure 3.5). Rice production in the country increased in successive years with an average growth rate of nearly 1 percent per year which was lower than the yearly population growth rate of 1.6 percent during the same period.

The country harvested an average of 4.5 million hectares of rice in 1990. The area expansion was significantly increased starting from 1992 due to the introduction of summer paddy program. But it was again slightly decreased from 1995 to 1999, and then increased from 6 million hectares in 2000 to over 8 million hectares in 2007. The expansion in total area harvested explains much of the increase in rice production. The growth rate of harvested area has been

faster than the rate of yield increase- this is consistent with the historical pattern of rice sector dynamics in the country where increase in total output was driven mainly by horizontal expansion, i.e. bringing more land into cultivation. The limited growth of the aggregate productivity of rice in Myanmar, if we compared with Vietnam's rice production growth rate of 3.97 percent (Nguyen and Singh, 2006), is due to the yield increase which is hindered by low yield varieties, insufficient and inefficient land preparation, limited use of inputs, and etc.



Source: MOAI, ID, MAS



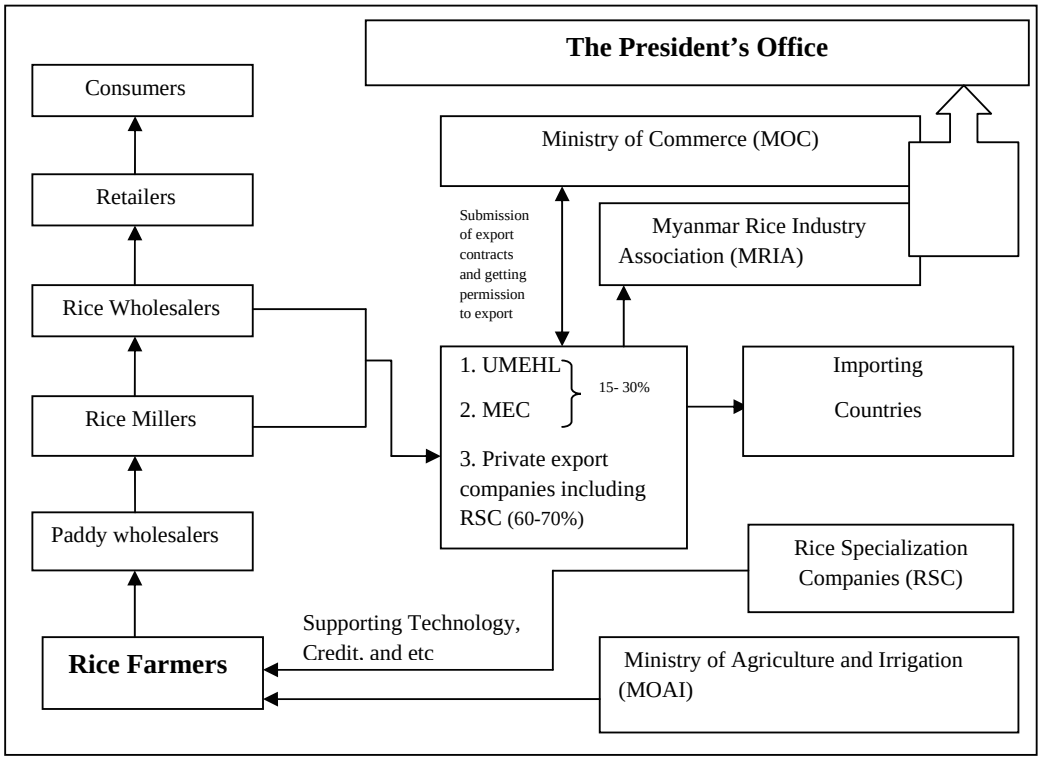
Source: MOAI, MAS

The low national average yield figures do, however, suggest a strong and mostly untapped potential for boosting the productivity of rice in Myanmar, should the country apply the appropriate technologies and adopt an enabling rice policy environment. The current changes in the economic policy of the country and surge in the rice prices in the international market due to heavy flooding among rice mainly growing areas in Asia should give new impetus for enhancing investment in the rice sector in order to expand rice production and economic profit for the farmers.

3.4 Rice Export Policy and Institutional Arrangements

The then State Peace and Development Council (SPDC) maintained strict control over rice export since 1990 though the so-called first liberalization was already began in 1987 under socialist government from absolute state control over rice marketing. The liberalization was done in response to the economic and political turmoil of the country. Okamoto (2005) stated that major reason for the collapse of comprehensive state control over the rice marketing system of the socialist period (1962-1988) was because of deteriorating productivity and fiscal stress that made it difficult to sustain the low-rice-price rationing system targeting the whole population.

Figure 3.7.Institutional arrangement of Myanmar rice industry



Source: Author's survey

The aim of SPDC government was to stabilize and maintain the rice price at an affordable level for the most of the people. Therefore, government continued to practice the same rice marketing policy as in the previous socialist government, and purchased the rice for civil servants and military personnel. It controlled the export of rice to keep the domestic prices far lower than international prices so that general consumers who were not included in the rice ration system can attempt. When SPDC government thought that the rice prices were largely stabilized, rice marketing was again liberalized in 2003 both for domestic and international market. But unfortunately it was revoked for export market after six months it was imposed with the aim of keeping rice prices at low level. The government banned on rice exports in 2004 designed to

maintain rice supply at low price. The ban, however, has been relaxed incrementally each year since 2006 although it was temporarily suspended by the order of Myanmar Trade Policy Council (MTPC) which was chaired by first secretary of SPDC again for five months after cyclone Nargis was hit in the delta region where rice is mainly grown in 2008. The exports were mainly controlled by the then Ministry of Trade under the direct management of MTPC. Starting from 2010 after forming Myanmar Rice Industry Association (MRIA), the authority for right for exporting of rice was handed over to the newly established association.

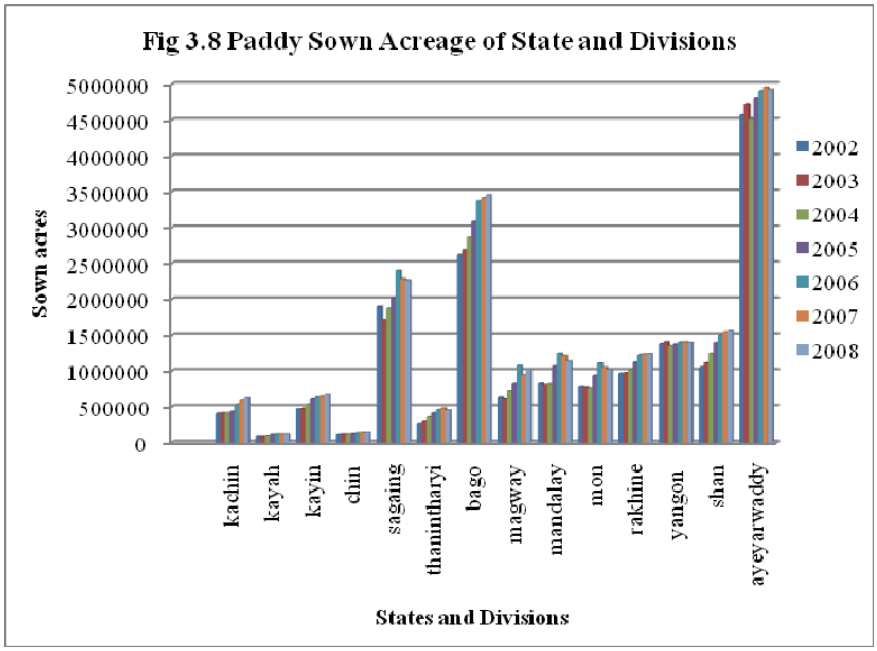
MRIA was created as a national body with the aim to develop the country's rice industry by uniting three separate associations_ the Myanmar Rice and Paddy Traders' Association, the Myanmar Rice Millers' Association, and the Myanmar Paddy Producers' Association_ which became effective on January 12, 2010. The newly formed association declared that export licenses will not be monopolized, and it is only responsible for recommending which companies are eligible to export by deciding whether their supply chains are in accord with the legal framework or not. But one year later it was formed, rice exporters have to apply to get export licenses to the Ministry of Commerce (MOC) of the newly elected civilian government which was effective starting from April 2011. It is heard that there are some hearsay of internal conflicts among senior MRIA officials. If the association wants to get similar achievement of its neighboring country' association like Thai Rice Exporter Association (TREA), it should laid down robust regulations, and should obey the regulations as it had imposed.

As depicted in Figure 3.7, four major institutions are mainly playing in the country's rice industry. The Ministry of Agriculture and Irrigation (MOAI) is providing farmers recommended technology, credit and gathering information and estimating rice production each year. The MOC is doing for export policy formulation and monitors the progress of rice exports under the direct management of the President's office. The rice export policy in recent years seems to be no restrictions and no quota limitations. But the government of the Republic of the Union of Myanmar will try to suspend if they see increasing trend of domestic rice prices caused by greater amount of rice export. This policy is expected to promote the expansion of rice export and will create competition among exporting companies. There is, however, an uncertainty about

when total export will be halted by the government. Similar uncertainty was also likely happened in Vietnam (Tsukada, 2011).

MRIA is private association dealing for recommending which companies are eligible to export. The association itself is not entitle to issue trade licenses. All the export licenses will be issued by the MOC. The export companies do not need to be a member of MRIA to get permission to export. The expected role of MRIA is to increase the productivity and to reestablish the country as a major rice exporter in the world market while considering the strategic plans and addressing the challenges and risks of the industry. Rice Specialization Companies (RSC) were recently formed in main rice growing areas consisting of exporter, traders, millers and some farmers who have comprehensive knowledge about the industry. The intention of RSC formation was to upgrade the small scale farms into more commercialized ones and finally aims to transform as public companies. The RSC is giving seasonal loans, credit in kind such as seeds and other necessary inputs, extension services, farm mechanization services and providing recommended agronomic practices. It also aims to purchase paddy at just price in the harvesting time. But it says it will buy the paddy which has moisture content of 14% with a guaranteed price when price trend is going down less than 3000 Kyats per basket (46 lbs). According to Ye (2011), present secretary general of MRIA, RSC network operation now only covers 5 to 8% of the sown area in some townships and hoping that it will be broadened in future. Twety five percent of rice growing areas are located in Ayeyarwaddy division followed by Bago and Sagaing in the second and third places, respectively (Figure 3.8). Thus, the degree of commercialization may differ across the regions. Generally, supply chain of the country could be categorized into six main groups as presented in the left hand side of Figure 3.7. Double cropping pattern is practiced where irrigation is availbable around the country. Ususally, farmers use to grow rice-rice and rice-pulses pattern in rainy season which is rain-fed and in summer which is irrigated. In those rice commercialized regions, hired labor system is widely prevails while only a few regions such as Kachin, Kayah, Kayin and Chin regions depend on the family-labor intensive system. Recently due to the low wage cost for a hired labor, it is heard that labors are migrating to other regions or another sectors or moving to abroad where wage rates are higher than their places. Thus, marketing system may slightly differ among the regions depends on the labor availability.

Theingi Myint (2007) said that more complex rice marketing channel was found in rice deficit markets.



Source: MOAI, MAS

Paddy is generally collected by wholesalers. Wholesalers ask collectors and brokers who typically collect paddy directly from farmers in a small scale. But in some regions farmers directly go to the wholesalers or to the millers and sell their paddy. Wholesalers pay commission fee to the hired collectors. Some wholesalers themselves are millers, and some resell the purchased paddy to the millers. In Myanmar, hullers or small-sized millers are in every villages around the country. Only a few commercial mills are located in the twonships nearby villages. Data on how many hullers and how many commercial mills are not officially published in the country. There are five main process in milling rice. Some mills engage only removing husks. Some deals polishing rice. Only a few large mills process all necessary stages. Thus, most of the rice quality that comes to both domestic and international market is very low. Those milled rice are delivered to retailers for the domestic consumption and exporters for international market.

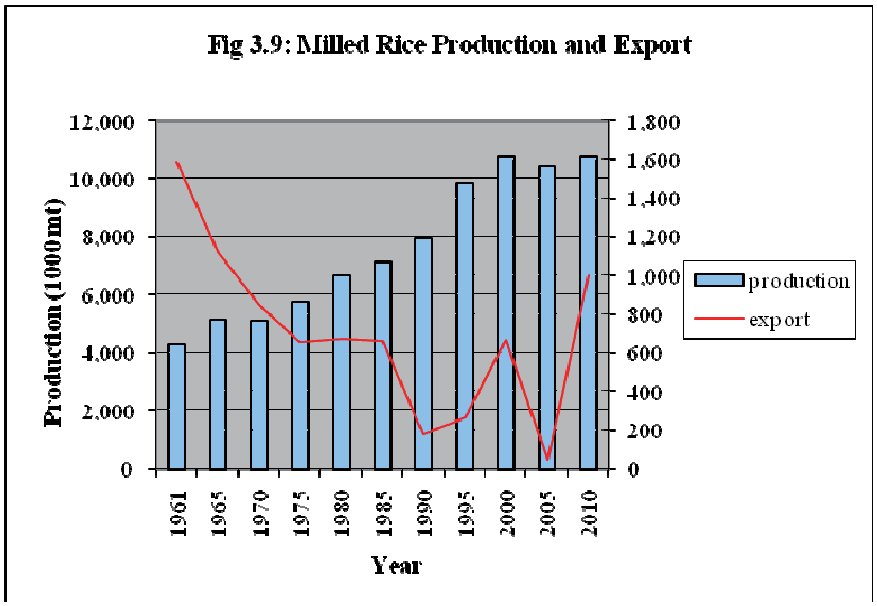
Some wholesalers purchase rice from main growing regions and sell to retialers. Some exporting companies themselves are millers and wholesalers, and member of MRIA. They also purchase milled rice according to the grades and then export. It is important to remark that the domestic rice market is largely organized by private traders. This is one remarkable achievement for rice export market that is exporting about 1 million metric tons in recent years. The involvement of private sector in milling, trading, and processing also solves the problem of existing multi-layered and complicated distribution system that cause inefficiency in the marketing system. According to Nay (2011), farmers are selling their harvest directly to millers without or reducing the use of brokers and local traders in Waw township. This make increasing return for farmers.

All the private and public institutions involved in the rice industry are more or less providing credit, extension services, necessary inputs, and etc. Myanmar Agricultural Development Bank (MADB) under MOAI is supporting large amount of credit to farmers on a large scale. But such a provision may require robust institutional capacity. It has widespread network around the country. However, credit expansion with proper management will require well-trained staff of institutional capacity. Removing unnecessary procedures when providing loans are essential. Farmers will borrow more loans if it is easier to obtain it. Moreover, expansion of loan should be extended not only to farmers but also to the stakeholders of the whole supply chain. And private banks participation in providing loan to the traders, fertilizer dealers, and processors are also need to consider for longer term financial development.

3.5 Export Destinations and Export Companies

Myanmar expended its rice market to Russia, Ukraine, Australia and South Korea in 2009-2010. According to MOC, Myanmar's rice export in 2009-2010 reached over 1.3 million tons during the first nine months of that fiscal year. Figure 3.9 shows the rice export trend of the country. Although its trend of rice export shows increasing trend, it is far less than the Vietnam and Thailand which exported 5 million and 9 million tons in 2009, respectively (Shigetomi and Tsukuda, 2011). The country is also extending its quality rice export to Middle-East countries, African countries and European countries. Nearly 40 companies are undertaking the export of rice to South Africa, Singapore, Sri Lanka, The United Arab Emirate, South Korea and Egypt. Based on the information from Union of Myanmar Federation of Chambers of Commerce and

Industry (UMFCCI), it is heard that more private companies have come and invested in the rice production sector. The Union of Myanmar Economic Holding Limited (UMEHL) and Myanmar Economic Corporation (MEC) are also exporting rice.



Source: FAO, MOAI, MAS

Before the establishment of MRIA, rice exports were mainly controlled by MOC, and since 2000, it was become under control of private organizations. Private companies' exports share is about 60 percent of total rice exports and the remaining 20-40 percent are under the control of the Union of Myanmar Economics Holdings Limited. Emergence of private companies and rising trend of production in the country could compete with its giant neighboring exporters in which they have higher production costs than Myanmar, and recent flooding in Thailand. The cost of producing 1 ton of rice in the country is about half of what it costs to produce in Thailand (Nay, 2011). Thanks to the recent hard-efforts by the country's private sector and MOAI for boosting the quantity and quality of rice production and export, Myanmar will be able to benefit from it and expecting to export millions of tons in coming year if climate is not changed very much while worldwide demand is growing 1.5 percent a year (FAO). But, on the other hand, the

country's rice industry may face a problem of declining crop yield without fulfilling the credit needs of farmers. Another important point to increase the country's rice production would be more intense cultivation of higher yield plants and to increase rice planting from double to triple cropping per year. But it would also need to consider construction more dams, and maintaining of the efficiency of those constructed dams and weirs around the country.

3.6 Trend of Rice Prices

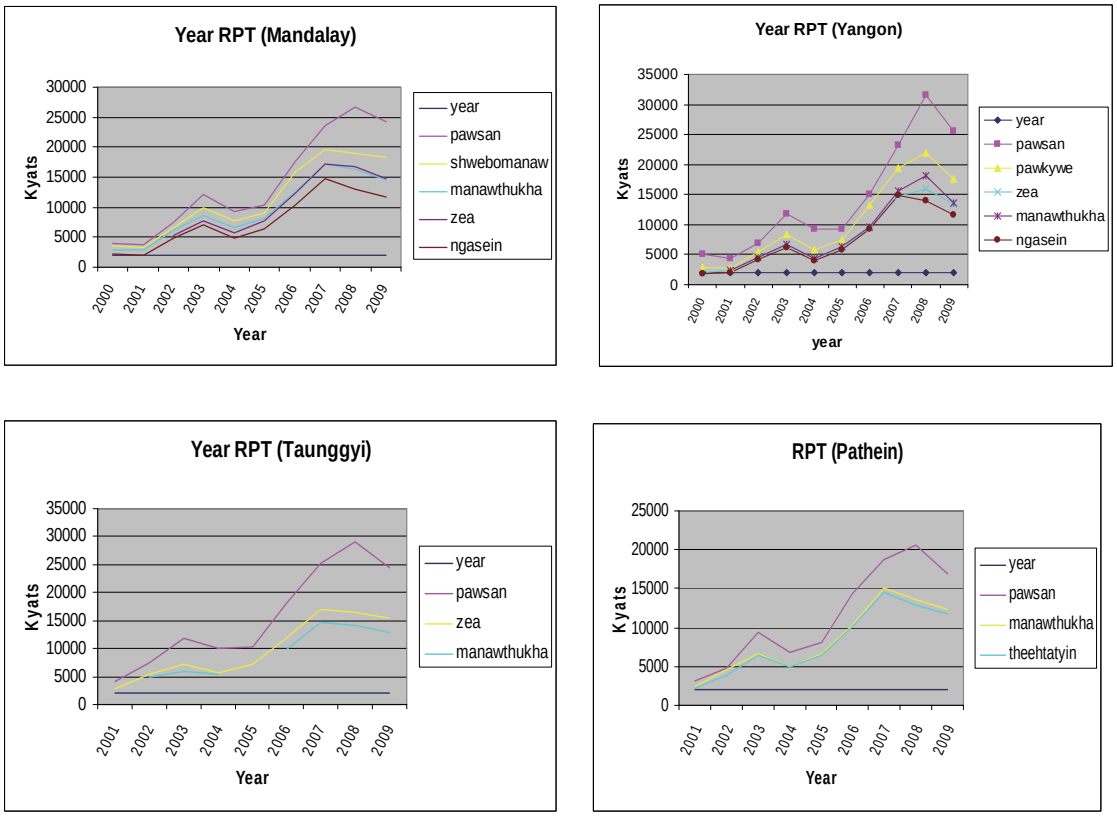
Rice export were temporarily suspended in the early months of 2011 to keep the domestic prices stable and low by the then Myanmar Trade Policy Council of SPDC. But it was again lifted the suspension starting from summer harvest when it was secured an abundant supply of rice was in the domestic market, and only the surplus were allowed to export. The suspension was come after the price of high quality rice_ pawsan_ was increased from about Ks 27000 in February to Ks 33000 in March. The price of Zeeya variety which is lower quality of rice variety was also rose up from Ks 16000 to Ks 17000 (Bayintnaung Rice Market, 2011).

There are three main driven forces to push up the prices of rice and all other commodities. These are (1) standardization of maximum truck loads were down as ASEAN standard from its previous high level of loads; (2) low quality of rice due to unusual rain during the harvest of late 2010 subsequently leaded to higher moisture content that resulted to larger amount of broken rice in milling; (3) due to higher fuel prices especially diesel prices rose 20 percent up made the prices of various varieties to be increased. Rising of the prices of rice were stopped when export was temporarily halted by MTPC. But the prices were not returned to its previous level.

The following figure 3.10 present the price trend of a variety of rice including Manawthukha, Zeeya, and Ngasein which are low quality rice varieties, and Pawsan and Shwebo Pawsan which are high quality rice varieties. It is noted that all of the rice prices were increased starting from 2005 in all markets. In 2004, the price of Pawsan variety was Ks 10000, and it became nearly Ks 30000 in 2009. The prices of other varieties were less than Ks 10000 in 2004, and then increased doubly to Ks 20000 in 2008 while world price of rice were abruptly and drastically surged to unprecedented levels. Among the markets, Yangon central market is relatively strong if

compared with other markets. Hnin Yu Lwin (2005) stated that none of the markets will be fully integrated in the short run in developing countries. Many scholars discussed about this price surge that might cause food crisis to a number of countries. Some of those were (Abbott 2009; Timmer 2008; World Bank 2008c; Warr 2008). Among those papers, Shigetomi, Kubo and Tsukuda, (2011) focused on food crisis and strategies of Major Asian rice exporters.

Fig 3.10. Year Rice Price Trend (RPT) in Different Locations



Source: MOAI, DAP

However, the country's rice export and increasing trend of rice prices were not the effect of consequences of world rice price surge. It was caused by its owned export policy practiced by the successive governments. It could be seen the prices of rice were increased continuously before the abrupt price surge in the world. The country's rice export is also directly linked with

its domestic consumer market. The rice export was frequently disrupted for keeping rice prices to be stable, and subsequently farmers were not able to enjoy the reasonable prices pushed up by world rice prices. Thus there was a lack of market co-integration between domestic and international. Therefore, to get such a reasonable price for farmers who are nearly 70 percent of the total population, careful calculation of the amount of export should be considered for every year.

3.7 Conclusion

It is widely admitted that low income countries are characterized by small size of market. The small size of market fails to absorb sufficient volume of output that leads to low inducement to invest. But international trade can expand the size of the market because it increases the investments; promote the growth of income for all people who involve in all channels and saving through more efficient allocation of resources. It also helps to transform the subsistence sector into a monetized sector by providing market for their farm produce and raise the income level and the standard of living of the people. Given the domestic production and international market conditions, the country have certainly has a potential to become again a major rice exporter in the world. Kubo and Okamoto (2011) stated some points to be considered: (1) to improve the export quality of rice (2) to create transactions friendly environments.

The country is still suffering from low grade quality being exported. The quality should be improved by fulfilling the international consumers' specifications. The low grade quality rice mainly comes from poor storage and milling facilities. Thus this can be accomplished by purchasing high quality rice with good relative humidity about 14 and 15 percent. And mills which are milled for export purposes should be inspected regularly as an international standard. Kubo and Okamoto (2011) also suggested that some foreign buyers find it difficult to do transaction due to the lack of viability of export licenses. The export licenses should be guaranteed once they are issued. It is very important to maintain the policy environment to enhance the stable transactions both for suppliers and buyers.

4. PRODUCTION AND ECONOMIC EFFICIENCY OF RICE FARMERS

4.1 Introduction

Myanmar government is recently trying to increase agricultural productivity and employment to achieve economic development for farmers and to alleviate poverty through various schemes such as micro-credit program, increased agricultural loan, establishing small cooperative groups, encouraging to use prescribed package technology, and etc. However, agricultural growth should be linked to farm profits. A considerable research for agricultural efficiency in the country is still very weak. Agricultural efficiency is gaining attention in the light of agricultural market liberalization and Myanmar currency appreciation. The experience of agricultural market reforms since the early years of 1990s shows how particularly important farm household efficiency is to the country's rural economy. The fundamental role of such reforms was to enable private markets to perform better by replacing the dominant public sector, encouraging the development of private sector, and letting price role in the allocation of factors of production, goods, and services. One of the key explanations for previous intensification of rice production in the country is to get price stability and achieve food security in some rural and urban areas. But such policy might lead to failure in socioeconomic situations of farmers. Given the market reforms, the reduction or removal of subsidies on agricultural inputs such as fertilizer, or various other inputs tends to increase the cost of those inputs to farmers (Table 4.1 and 4.2). And new technology package brings additional cost of production for farmers. The agricultural output and productivity can be increased by encouraging using those recommended technology. The profit, however, for farmers are not considered. Policy makers think the profit will be increased if there will be an increased physical production. And little attention was paid on the relationships among market indicators, household characteristics, and production efficiency particularly during this unfolding process of agricultural and market reform. Those decision makers can better implement reform measures contributing to enhancing agricultural efficiency if we can try to convince them how production efficiency is affected by market indicators and household characteristics. If agricultural households are integrated with output and input markets under the market reform process, then profit maximization becomes an economic goal.

Table 4.1. Cost of Production Using Recommended Technology (one acre)

Particular	Unit	Unit Cost (Kyats)	Cost (Kyats)
Land Preparation			
Nursery plot preparation	2	4000	8000
Leveling	1	4000	4000
Plowing	1	50000	50000
Band cleaning	2	2000	4000
Weeding	7	1500	10500
Seed			
Seedling	1	500	500
Broadcasting	10	1500	15000
Organic application	1	500	500
Transplanting			
Taking off seedling	1	10000	10000
Transplanting	1	13000	13000
Replanting	1	1500	1500
Inter-weeding	8	1500	12000
Fertilizer application	3	2000	6000
Irrigation	5	2000	10000
Spraying	4	2000	8000
Harvesting			
Harvesting with machine	1	50000	50000
Input			
Urea fertilizer	1	22000	22000
Compound fertilizer	1	19000	19000
Chicken dung	20	500	10000
Potash fertilizer	0.25	32000	8000
Pesticide	1	3500	3500
Herbicide	1	8500	8500
Hybrid seed	6	50000	50000
		Total	**338500**

Source: Author's Survey

Table 4.2. Cost of Production Using Traditional Method (one acre)

Particular	Unit	Unit Cost (Kyats)	Cost (Kyats)
Land Preparation			
Nursery plot preparation	2	4000	8000
Leveling	1	4000	4000
Plowing	1	20000	20000
Harrowing	2	4000	8000
Leveling	1	4000	4000
Making nursery plot	1	4000	4000
Band cleaning	2	2000	4000
Weeding	3	1500	4500
Seed			
Seedling	1	500	500
Broadcasting	1	1000	1000
Transplanting			
Taking off seedling	1	10000	10000
Transplanting	1	13000	13000
Replanting	1	1500	1500
Inter-weeding	8	1500	12000
Fertilizer application	3	2000	6000
Irrigation	5	2000	10000
Spraying	4	2000	8000
Harvesting			
Harvesting	12	1500	18000
Transportation	5	2000	1000
Threshing	80	200	16000
Input			
Urea fertilizer	1	22000	22000
Compound fertilizer	0.5	19000	9500
Chicken dung	10	500	5000
Pesticide	1	3500	3500

Herbicide	1	8500	8500
Seed	1.5	6000	9000
		Total	**218000**

Source: Author's Survey

Accordingly, this section try to analyze unique data set for rice producing agricultural households in some selected areas of Bago and Yangon to examine the households' profit efficiency and the relationship between farm and household attributes and profit inefficiency. Three assumptions are made in the analysis: (a) farmers' production is consistent with profit maximization; (b) profit efficiency differs across households through different aspects; and (c) profit efficiency is related to farmers' education, access to credit, experience, and etc. The objective of this section is to improve policy formulation for rice farmers in Myanmar agriculture. While the government aims at alleviating poverty by increasing agricultural productivity, this section will show an evident how achieving productivity can fail without considering market behavior, household characteristics and production efficiency. This specific objective will be achieved by fulfilling particular objectives: (1) evaluating rice farmers' marketing behavior and determinants that are related to it; (2) explaining the key factors in rice production; (3) quantifying the factors related to household productivity.

4.2 Efficiency Model

Farrell (1957) said that there are three components in the concept of efficiency: technical, allocative, and economic. As components of economic efficiency, technical and allocative efficiency can be derived from production function. Production efficiency represents the efficient resource input mix for any given output that minimizes the cost of producing that level of output or, equivalently, as the ability to produce a given level of output at lowest cost. Technical efficiency means the ability of a firm to maximize output for a given set of resource inputs, while allocative efficiency deals with the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost.

In fact, technology is not absolutely changing, but decision making is changing. Thus, changes in decision making come from a function of other factors such as knowledge, experience, education, socioeconomic characteristics, and etc. Though technical and allocative efficiency are required for economic efficiency, farms may show that technical and allocative efficiency without having economic efficiency. Production frontier functions can be used to measure agricultural production efficiency. However, it fails to capture inefficiencies associated with different factor endowments and different input and output prices across farms.

In literature, there are many alternative ways to measuring productive efficiency. Lau and Yotopoulos (1971) used a profit function in which specific farm prices and levels of fixed factors are incorporated in the analysis of economic efficiency. Their model explained input use and output supplied while input and output prices are exogenous to farm household decision making. In general, the resulting parameter estimates shows statistically consistent. Aigner, Knox Lovel, and Schmidt (1977) said that the profit function do not provide the numerical measure of efficiency. Ali and Flinn (1992) said that profit or economic inefficiency in this framework is defined as profit loss from not operating on the profit frontier, taking into consideration farm-specific prices and fixed factors. Kumbhakar, Ghosh and McGuckin (1991) used two-stage approach in which specification and estimation of the stochastic production function and subsequent prediction of the technical inefficiency coefficients. Battese and Coelli (1995) also applied same approach. Second stage explains the predicted technical inefficiency effects contradict the assumption of identically distributed inefficiency effects in the stochastic frontier function.

4.3 Stochastic Profit Function

The stochastic frontier approach unlike the other profit functions proposed by Aigner, Knox Lovel and Schmidt (1977) decomposes the error term into two-sided random error that captures the random effects outside the management of the farm, and the one-sided efficiency component. The normalized profit function can be expressed as follows:

$$profit = y_i(a^*, b) - \sum_i p_i a^*, \qquad a^* = f(p, b), \qquad (1)$$

where y_i is the production function; a^* denotes vector of optimized variable inputs; b is the vector of fixed factors; $p_i = w/p$ is the normalized price of input i; and p and w are the output and input prices, respectively. Then stochastic profit function spf_j can be expressed as

$$spf_j = f(p_{ij}, b_{kj}).\exp e_j, \qquad (2)$$

where spf_j is normalized profit of j^{th} farm, and it can be calculated as gross revenue less variable cost divided with farm specific output price P; p_{ij} is the normalized price of input i for the j^{th} farm, and can be computed as input price divided by farm specific output price P; b_{kj} is the level of the k^{th} fixed factor for the j^{th} farm; and e_j is an error term. $e_j = v_j - u_j$, consists of two error terms; v_j is the symmetric error term or two-sided error term, and u_j is the one-sided error term. The components of the composed error term are governed by different assumptions about their distribution. The random (symmetric) component v_j is assumed to be identically and independently distributed as $N(0, \sigma_v^2)$ and is also independent of u_j. The random error reflects random variations in the economic atmosphere facing the production units such as weather, machine breakdown, variable input quality, and etc. The error term u_j is used to represent inefficiency. It reflects profit shortfall from its maximum possible value given by the spf_j. Thus, if $u_j = 0$, the farm is getting potential maximum profit given the market indicators and the level of fixed factors. However, if $u_j \succ 0$, the farm is inefficient economically, and the profit is less than the potential maximum. Then, an estimated value of profit efficiency for each observation can be calculated as $\exp(-u_j)$.

According to Jondrow et al., the unobservable value of one-sided error term u_j could be obtained from its conditional expectation given the observable value of $v_j - u_j$. The farm-specific inefficiency index ii is given as

$$ii = \left(1 - \exp(u_j)\right) \quad (3)$$

Then, profit loss can be calculated by multiplying farm-specific inefficiency index (ii) with potential maximum profit spf_j given farm-specific prices and fixed factors.

Farm and household attributes can then be specified as $ii = f(x) + z$, where x is a vector of farm household attributes, and z is the unexplained component of inefficiency such as weather, prices, and etc. that are peculiar to a particular farm.

4.4 Empirical Model

A Cobb-Douglas stochastic production frontier approach is used to estimate the production function and the determinants of technical efficiency among the rice farmers in the selected areas of Myanmar. One stage procedure is adopted by following Battese and Coelli (1995) given the potential estimation biases of the two-step procedure for estimating technical efficiency scores and analyzing their determinants. It remains one of the popular production functions in production frontier studies though this approach has its own limitations.

$$\ln\pi = \beta_0 + \sum_{i=1}^{m}\beta_1 \ln SA + \sum_{i=1}^{m}\beta_2 \ln L + \sum_{i=1}^{m}\beta_3 \ln K + \sum_{i=1}^{m}\beta_4 \ln F + v_j - u_j \quad (4)$$

where π is normalized profit computed as gross revenue less variable costs; SA is the land input measured as hectares of rice grown per farm; L is the total labor cost applied in rice cultivation; K is the capital input computed as the sum of costs of animal and mechanical power; and v and u are the error terms. The estimate of u_j could be obtained by replacing e_j by its sample residual and the unknown parameters given in equation (4).

Inefficiency index (ii) then can be calculated by inserting the sample residual for u_j in the inefficiency index equation $ii = \left(1 - \exp(u_j)\right)$. The inefficiency index can be redefined as $\ln\left(ii/(1-ii)\right)$ to fit the relationship between profit inefficiency and household attributes. Then the

empirical equation for the relationship between inefficiency and household attributes can be specified as:

$$\ln\left(ii/(1-ii)\right) = \alpha_0 + \alpha_4 A + \alpha_2 Ex + \alpha_1 Ed + \alpha_3 OF + \alpha_4 SC + \varepsilon_j \qquad (5)$$

where A represents age of the household head, Ex denotes experiences, Ed reflects level of education of household head, OF stands for off-farm employment, SC designates for income of second crop, respectively, and ε_j serves as an error term.

4.5 Data and Definitions of the Variables

The data used in this empirical application is two random sample surveys conducted in May 2011 and June 2011 in two townships of Bago and Yangon. The first survey took place in Waw township of Bago district in Bago Division. The second survey was in Hmawbi township in northern district of Yangon division. A total of 110 households were collected. Information from these farm households were gathered using a structured questionnaire. Additional survey data were obtained from the local office of Myanmar Agriculture Service (MAS) of the Ministry of Agriculture and Irrigation. The data covers information about rice producing and marketing activities as well as household demographic characteristics. Information on rice farming activities include cost of nursing, land preparation, planting, fertilizer application, weeding, harvesting, and so on. Wages and capital assets were also collected.

Farmers in both regions are mainly cultivating paddy. The major second crop is a variety of pulses. Some farmers grow paddy in dry season where irrigation is available. Table 4.3 and 4.4 describes the selected characteristics of sample farms. Output is measured in metric ton of paddy rice per hectare. The mean rice yield over the sampled farms in Waw was 2.54 ton/ha with a range of about 1.55 tons per hectare to 4.13 tons per hectare. The yield gap between the average and the lowest farm yield was 0.99 ton per hectare, and that between the average and the highest was 1.59 tons per hectare suggesting that there is potential for improving average rice yields in the area. The mean rice yield over the sampled farms in Hmawbi was 3.38 ton/ha with a range of about 2.59 tons per hectare to 3.63 tons per hectare. The yield gap between the average and the

lowest farm yield was 0.79 ton per hectare, and that between the average and the highest was 0.25 tons per hectare suggesting that there is less potential for improving average rice yields if we compare with Waw township.

The input of land is measured in terms of paddy grown area per farm in the cropping season when survey is done. Total land area is the number of total crops under cultivation in the same cropping season. The total labor expenditure per farm includes the calculated costs of family labor used in production at the wage rate paid to permanent hired labor. The money wage rate is computed by dividing the total labor expenditure for rice production per farm by the quantity of labor including both family and hired labor. Capital input can be obtained as the sum of costs of animal and mechanical power used in rice production. Fertilizer price is measured as total expenditure on fertilizer kilogram including transportation and application cost. Recent government policy has no subsidy schemes of price and input to farmers. So that production and distribution of inputs and outputs come from the forces of demand and supply. The farm level specific prices differ a little across the farms due to their product quality. Input prices are not different since most of the companies come and distribute fertilizer directly to farms in the survey area.

Farm and household characteristics variables that are used in the estimation of profit inefficiency index include the age, experience and educational level of household head, off-farm income, and income of secondary crop. Income of secondary crop is obtained as the proportion of a farm' land area used in second crop production multiplied with average yield and then subtracted to total variable cost used in the production of that crop. It is assumed that farmers who devote more of their time and resource allocation in second crop production have lower efficiency than would other producers who pay much effort and time on rice production.

Off-farm employment effect on economic efficiency is having two definitions; (1) taking part in the non-farm labor market may restrict specialization in production and decision making activities, thereby increasing inefficiency; (2) participating in off-farm work increase financial liquidity, and thus enable them to purchase necessary input for rice cultivation especially for resource poor farmers. The ability to or right to access formal credit makes farmers to prevail

over financial constraints for the purchase of different inputs such as fertilizer or high yielding varieties that are accompanied with new technology package.

Table 4.3. Selected Characteristics of A Sample Farm in Waw Township

Farm and Household Characteristics	Minimum	Maximum	Mean
Age	33	72	53
Experience	2	60	28.11
Education	0	4	1.52
Off-farm work	0	1	0.24
Number of family	1	9	5.57
Plough	0	4	1.61
Harrow	0	4	1.59
Bullock	0	12	4.48
Cart	0	2	0.81
Tractor	0	1	0.04
Trailer	0	1	0.11
Power tiller	0	2	0.30
Inter-cultivator	0	2	0.04
Seeder	0	0	0.00
Sprayer	0	4	1.00
Water pump	0	1	0.15
Harvesting machine	0	1	0.02
Threshing machine	0	1	0.04
Ware house	0	1	0.46
Sown acreage	5	80	13.69
Yield (ton/ha)	1.55	4.13	2.54
Wage rate	1200	3000	1661.11

Source: Author's survey

Therefore, formal credit, in a proper use in production, increases the net revenue that is obtained from fixed inputs, market conditions, and household characteristics. Informal credit, however, with higher interest rate reduce net revenue for farmers. Credit constraints, on the other hand, might decrease the economic efficiency of farmers especially during the time for planting and harvesting. These effects will be affected only for the farmers who are in need for credit.

For representing the characteristics of farm manager, age and education of household head are included in the analysis of the determinants of profit inefficiency. The simplifying assumption is that the farm manger who is also household head of that farm is a key decision

maker for that farm whether he or she is. Another determinant factor for household characteristic is education of household head, and it is hypothesized to have positive effect on efficiency.

Table 4.4. Selected Characteristics of A Sample Farm in Hmawbi Township

Farm and Household Characteristics	Minimum	Maximum	Mean
Age	30	70	52.89
Experience	5	47	25.71
Education	1	4	1.88
Off-farm work	0	1	0.59
Family number	1	9	4.95
Plough	0	4	1.63
Harrow	0	4	1.64
Bullock	0	5	1.21
Cart	0	2	0.82
Tractor	0	1	0.05
Trailer	0	1	0.88
Power tiller	0	2	0.80
Inter-cultivator	0	1	0.84
Seeder	0	1	0.52
Sprayer	0	4	1.02
Water pump	0	1	0.29
Harvesting machine	0	1	0.05
Threshing machine	0	1	0.07
Ware house	0	1	0.48
Sown acreage	5	20	10.5
Yield (ton/ha)	2.59	3.63	3.38
Wage rate	1400	1600	1496.43

Source: Author's survey

Education as a role of human capital mainly referred to as allocative ability stems from the fact that reallocation of resources in response to changes in economic environment requires (a) to recognize the changes are occurring (b) to gathering, retrieving, and examining critically on useful information on those changes, and (c) to bring effective decision from the information in hand, and (d) proceeding without hesitation. Allocative skill, therefore, as human capital in that sense, that it is acquired at a cost and tend to yield a valuable stream of services over future periods. That skill is gained in schooling, by getting information, and in experience from reallocating resources.

Age of the household head or farm manager is included to represent general decision-making ability. Schultz (1975) argued that education is likely to be more effective than the better location of farm exists. Farmers who have poor access to markets have less incentive in profit maximizing activities compared to those farmers who have better access to markets and their farms locate near cities. All of above-mentioned variables affect the efficiency of farm production.

4.6 Results

Maximum likelihood estimates for the parameters of the Cobb-Douglas production frontier function is given in Table 4.5. The ratio of the standard errors of u and v, λ is 2.0015 implying that the one-sided error term u dominates the symmetric error v. This is indicating that variation in actual profit from maximum (frontier profit) possible profit between farms attributed mainly by the differences in farmers' practices rather than random variability. The average inefficiency indexes are 10.4286 and 22.1111 in Hmawbi and Waw townships, respectively. Inefficiency index suggests that, on average, about 10 percent of potential maximum profit is lost in Hmawbi, and about 22 percent is lost in Waw for the production of rice. This corresponds to a mean profit loss of 42573 Kyats per hectare in Hmawbi, and 79246 Kyats in Waw. This discrepancy between observed profit and the frontier profit is due to both technical and allocative inefficiency.

The frequency distribution of the farm specific profit inefficiency for both townships is reported in Table 4.6. The distribution shows that sample farm profit inefficiency varies widely. Although the minimum observed profit inefficiency is 0.03, and the maximum is 0.73, the most inefficient indexes lies between 6 to 20 % group of farmers in Waw township. The lowest inefficiency index in Hmawbi is 0.06, and the highest index is 0.19.

The frequency distribution reveals that the mean technical inefficiency is 0.1627 with a minimum of 3 percent and maximum of 73 percent which indicates that, on average, about 16 % of potential maximum output is lost owing to technical inefficiency in both townships. While 85% of the sample farms exhibit profit inefficiency of 20% or less, about 40% of the sample

farms is found to exhibit technical inefficiency of 20% or less, indicating that among the sample farms technical inefficiency is much lower than profit inefficiency.

The estimated efficiency and inefficiency indexes of sample farms for different studies and different countries may vary based on database collection, referred period of survey time, farm structure, and etc. Thus, comparison between those estimates obtained in different analysis must be interpreted cautiously. A. Abdulai and W. Huffman (2000) used translog profit frontier function and obtained inefficiency index about 0.27 for northern Ghana; and Ali, Parikh, and Shah (1994) obtained a mean profit inefficiency index about 0.28 for China. But J. Wang, E.J. Wailes, and G.L. Cramer obtained a mean profit efficiency measure of 0.61, implying that inefficiency accounts for an average 38.9% loss of profits in China. E.W. Chirwa (2007) used a Cobb-Douglas frontier production function and obtained technical efficiency index of 46.23% implying that inefficiency among farms is about nearly 55% in southern Malawi for the study of maize. It is interesting to note that the mean inefficiency index obtained in this study is about 16 percent indicating that the value is much lower than those studies.

Table 4.5. Maximum Likelihood Estimates of the Production Frontier Model

Variables		OLS		Frontier	
Stochastic production function	parameter	coefficient	SE	coefficient	SE
Constant		8.5897	3.3376	8.7737	3.1045
Land	β_1	0.0288	0.0396	0.0304	0.0346
Capital	β_2	0.3282**	0.2221	0.2765**	0.2074
Labor	β_3	0.2617**	0.1585	0.2252**	0.1494
Fertilizer	β_4	-0.2155**	0.0814	-0.1271**	0.0863
Lambda	λ			2.0015	0.0665
Sigma	σ			0.0772	0.0183
	σ_u^2			0.2485	0.0453
	σ_v^2			0.1242	0.0255
Log likelihood				25.9078	
Inefficiency model					
Constant		-0.6236	0.4297		
Age	α_1	0.0034	0.0936		
Experience	α_2	0.0083	0.0357		
Education	α_3	-0.1982***	0.0311		
off-farm	α_4	0.0067	0.0292		
secondary crop	α_5	0.0278***	0.0027		

Note: ***, **, * shows that statistically significant at 1%, 5% and 10% level, respectively

There are several reasons why profit inefficiency indexes are differed among sample farms in this study. Although prices among the sample farms are not so different in both townships since both are near to the cities, other factors such as soil condition, weather, extension service access, and so on affects the efficiency of those sampled farms. Those variables are not included in the study. Other non-physical input like market information service could not be also included since to get such kind of data is very difficult in those areas. Instead of those variables, age, experiences and schooling year of household head, off-farm employment, and income of the secondary crop which influence on the specialization in the production of rice are used in this analysis.

Table 4.6. Frequency Distribution of Farm-specific Profit inefficiency in Stochastic Frontier Function

Inefficiency index (%)	Hmawbi		Waw	
	Number of farmers	Percentage	Number of farmers	Percentage
1—5	0	0.00	6	11.11
6—10	31	55.36	9	16.67
11—15	14	25.00	12	22.22
16—20	11	19.64	5	9.26
21—25	0	0.00	3	5.56
26—30	0	0.00	3	5.56
31—35	0	0.00	5	9.26
36—40	0	0.00	3	5.56
41—45	0	0.00	2	3.70
46—50	0	0.00	3	5.56
51—55	0	0.00	1	1.85
56—60	0	0.00	0	0.00
61—65	0	0.00	0	0.00
66—70	0	0.00	1	1.85
71—75	0	0.00	1	1.85

Source: Author's calculation
Notes: minimum=0.03, and maximum=0.73

The parameter estimates of the relationship between profit inefficiency obtained from the stochastic frontier model and farm and household characteristics using an ordinary least square estimator are also shown in the Table 4.5. The technical inefficiency model shows that two of the five variables are statistically significant at the 1% level. The coefficient of the education as a kind of human capital is negative suggesting that the schooling year of the household head tends to have a highly significant impact on profit inefficiency. This finding is consistent with the

estimate of Lockheed, Jamison, and Lau (1980). The negative sign indicates that more schooling year of household head reduces the inefficiency. The estimates of other findings such as Kumbhakar and Bhattarcharya (1992), and Abdulai and Huffman (2000) are also in line with this finding.

The coefficient for the income of the secondary crop shows positive and significant at 1% level indicating that farmers who specialize in the production of second crop tend to exhibit higher level of inefficiency in rice production. This is the real case happening in most parts of the country. Farmers in Myanmar are very much interested in the cultivation of various kinds of pluses since the price of pulses is quite higher than the price of rice. Even they suffer the cost in rice production due to government compulsory rice production program; they think that they might compensate for the loss with the income getting from second crop. Therefore, most of the farmers emphasize the second crop production especially pulses following a season after rice production.

Age and experiences of the household head shows no significant coefficient implying that those variables are not contributed to technical inefficient for the farmers in the studied areas. The dummy variable for off-farm employment also express positive and not significant statistically since most of the farmers in the areas are engaging only in agriculture. There are a few farmers who have higher schooling year and who have income from non-farm activities. Those farmers who have off-farm employment do not specialize in the production of rice.

The relatively high level of technical efficiency or low level of technical inefficiency in compared with other studies in other countries point that the need to pursue the recent technology with small scale intensive rice farming in the country. If the government tries to introduce new technology accompanied with additional cost of production, it will cause farmers decreasing their income.

4.7 Conclusions and Policy Implications

A Cobb-Douglas production frontier function is used in this study to examine the economic efficiency of rice production. The estimates of the function show mean level of profit efficiency is relatively high, but there is a significant variation between efficiency and inefficiency indexes

among farms. The average inefficiency for both areas is about 16%; about 10% in Hmawbi and about 22% in Waw townships. Farmers who have higher income from secondary crop tend to lower profit efficiency. The higher educational level of farmers reduces the profit inefficiency. Farmers who have higher schooling year have more allocative ability in relation to perceiving and responding to the changes in the market prices and market behavior. Furthermore, the marginal value of an additional year of the household head' education in rice production is 23450 Kyats per farm in one rice production season. Mellor (1976) argued that investment education in rural areas should be considered as a central ingredient in a strategy designed to improve agricultural productivity when technology is dynamic. The finding in the study agrees with Mellor's argument.

Despite the long history of the country investment in the irrigation sector for improving the water ability for agriculture, and extension services and bringing new technology to the farmers' fields, smallholder farming of rice remains uneconomic and technically inefficient. Two main policy issues emerge from the results of this study. First, there should be an improved and quality education investment in the rural areas. Though the government is saying they are trying in their utmost effort for education, public investment in rural areas should be considered carefully. Second, farmers prefer to produce a variety of pulses as a second crop after rice in a year indicates that the various policies such as production, marketing, and export policies for pulses are more favorable than the policies-related for rice.

Although this study does not include the relationship between inefficiency and access to credit, improving the efficiency of resources will require streamlining the acquisition of credit among small farmers. The government has recently decided to increase the amount of loan borrowed to farmers from 20000 Kyats to 40000 Kyats per acre. This is good news for the farmers themselves and to the persons-related in agriculture and rural development. But the number of loan available to the rice producers is limited and about 15% percent of the total rice cultivable land. Overall, the rice producers in the studied area are highly responsive to market prices, labor prices and fertilizer prices since its results show statistically significant implying that market reform affects to the rice farming of those areas. There are, however, limitations in the study.

The results of this analysis may not necessarily be representative of the entire rice industry with its various land holding sizes, soil conditions, weather conditions, and so on.

5. COST AND BENEFIT ANALYSIS OF RICE MILLS

5.1 Introduction

The annual production of paddy in the world, estimated by FAO, in 2007 was about 650 million tones, mostly in developing countries and the amount is rising at an average rate of 1.5 percent per annum. Myanmar is the sixth biggest rice producing country in the world (Figure 5.1). It contributes about 32.7 million metric tons in the world output of paddy. Rice as a major cereal crop of Myanmar covers an area of nearly 40 percent of total agricultural land or about 20 million acres, the largest under any single crop. According to the Myanmar Agriculture Service (MAS), the production of paddy in 2007 was nearly 31 million tons. It was increased up to 32 million tons in 2009. Rice is grown in almost all the states and divisions of the country but nearly 30 percent of the total production accounts from the Irrawaddy division which is located in the delta area. Rice production, processing and marketing activities contribute a big industry in the country.

Myanmar rice-milling industry has already a two-decade long history and is a largest agro-based industry. The problems facing by rice mills have been discussed in detail by Okamoto (2005). The overall supply of rice in the country could be increased getting additional yield with high quality through upgrading the existing rice processing techniques. There are recently many small mills and hullers in most of the villages around the country. No farmers need to go to the far-distance rice mills. They bring their paddy to the village mill if they want to process for home consumption. Most of the small mills or hullers are owned by farmers who have enough capital to invest. But rice milled in those hullers is low grade because of poor milling quality. About 34 percent of small rice hullers are operating lower than performance index of 0.45, considered as a very poor standard (Myo Oo, 2004).

Rice milling sector needs stable policy environment without anti-export bias to ensure the upgrading of its performance to help internationally competitive. Myanmar milling sector has not yet been blessed with favorable environment for high milling standard and performance (San Thein, 2006). If farmers want cash for their paddy, they bring their crops to the medium-sized mills which are mostly located in the nearby townships. The quality of rice come out from those

medium-sized mills is better than those from small hullers. But, the investment of those mills needs a higher capital. Therefore, there are only a few numbers of those medium-sized mills around the country.

The rice milling industry has much expanded after 1990s. The changes took place in response to changes especially in domestic rice market. The number of private rice mills increased throughout the 1990s, mainly due to a sharp rise in the number of small mills or hullers in the villages. Rice milling in the country is carried out in three categories: large-sized, medium-sized and small-sized rice mills though the milling capacity varies among the categories. According to Tin Htut Oo and Kudo (2003), rice mills in Myanmar could be classified as rice mills owned by MAPT, private rice mills registered with MAPT to mill the contracted paddy on commission basis, and small rice mills or hullers. Huller mills as explained in above have the advantage of being cheap and simple to operate but are very inefficient in converting paddy into rice. The rice recovery from huller is less than 50 percent while it is more than 60 percent in medium-sized and large-sized mills with high quality of rice. It could be noticed that the modern medium and large-sized mills return higher yield of rice output with least broken and better quality of by-products. The establishment of small rice mills was first permitted officially from circa FY 1992 (Okamoto, 2009). The numbers of small scale rice mills are presented in Table 5.1. They are mostly located in Ayeyarwaddy which is about 25%, east and west Bago has 19%, in Sagaing 17%, and Mandalay has 10% while relatively fewer were located in Yangon about 4%.

The quality of mills affect on the price of rice. Twenty five percent Myanmar rice in the international market has much competition with Vietnamese rice. To get a higher level of price, therefore, there is a need to modernize of rice mills in Myanmar to achieve higher quality of rice. It is still recognized that the rice milling industry has not been successfully implemented in most parts of the country. Given the higher priority getting from the government to the rice industry, the industry should try to improve the quality of mills. On the other hand, cost and benefit getting from investing in those hullers and medium-sized mills should be carefully examined. Therefore, this section attempts to analyze the cost and benefit of those hullers and medium-sized mills located in the Waw township in Bago division which is the second largest rice producing region of the country.

5.2 The Rice Milling

The rice milling industry in the country is facing heterogeneity in the composition especially in type, capacity, location, services rendered as well as in ownership of different processing units.

Table5.1. Small Scale Mills Recorded in FY2002

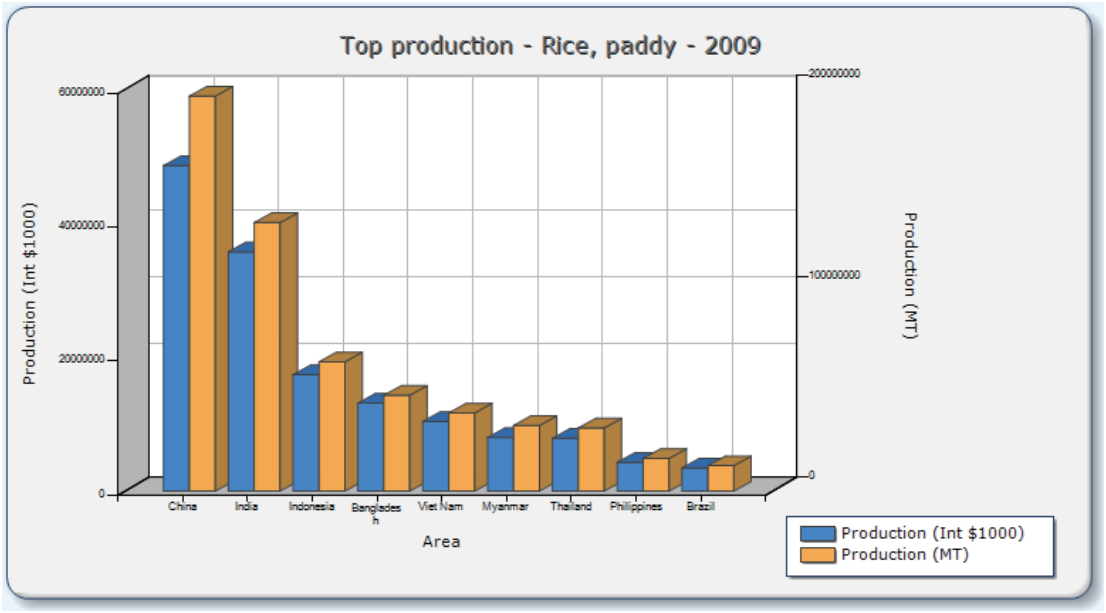
State/Division	Number of mills	Share (%)
Shan	688	6.6
Mandalay	1000	9.6
Rakhine	359	3.4
Kachin	292	2.8
Mon	313	3.0
Tanintharyi	477	4.6
Sagaing	1783	17.0
Magwe	470	4.5
Kayin	36	0.3
Yangon	424	4.1
Bago (east)	916	8.7
Bago (west)	1103	10.5
Ayeyarwaddy	2578	24.6
Kayah	30	0.3
Total	10469	100.0

Source: Myanmar Rice Millers' Association (MRMA)

The industry in the country is regarded as not fully utilized or underutilized because of the seasonal concentration and spatial production of paddy associated with a different kind of processing units. Small hullers usually do not purchase and store paddy on their own. Their operations, therefore, are limited in the paddy harvesting season only, and their storage capacity is remained as inadequate facility. The estimated amount of the lost of paddy after harvesting is about 10-15 percent of the total production. It is around 3.2 million metric ton of paddy for the

whole country. The lost is attributed by inefficient harvesting method and transportation, poor processing, and inadequate storage facilities.

Figure 5.1: Rice production of Top Countries



Source: FAO

Harvested paddy consists of the rice grain, germ, and bran, covered with a shell or hull. Moisture content of the harvested paddy ranges from 18-25 percent depending upon the weather condition. Paddy must be dried to get 14-15 percent of moisture to be secured longer storage and to improve milling efficiency. There are five steps in rice milling: drying, cleaning, removing the hull and the bran layers, polishing, and sizing. Farmers in Myanmar usually used to dry the paddy under the sun. The next step is to remove the stones, dirt and other foreign material. This can be done by using shakers that separate the size and density too. After removing those unnecessary things, rice hull is removed by shelling machine. These machines use steel rollers or rubber rollers to separate the hull and part of the germ. The next step is milling. The degree of milling varies according to the desire and need of rice. Less milled rice has more bran making it more nutritious with darker color and takes more time to cook, and has a shorter shelf-life. The

conversion ratio between paddy and rice ranges from 50 to 70 percent if it is accounted also broken rice. Polishing is done depending on the desire of consumers who are willing to get white rice. Sizing grains can be accomplished using shakers with different holes. Finer size can be get with thousands of small indentations to pick up individual kernels. In fact, not all rice mills carry out all of these processing activities. Rice hullers usually do shelling and milling. Some medium-sized mills can clean, shell and mill. Large-sized mills perform all of those steps.

Several factors affect on rice quality. The most important factor is how many percentage of broken rice are outturned when paddy is milled. Rice between 5 to 10 percent of broken rice is considered as a good quality while above 10 percent is regarded as poor quality. In addition, the length of the grain is also another criterion. Most of the consumers like long-grained rice. The aroma and color are also important judgment such as highly aromatic variety paw-san-hmwe that is a local variety of delta region commanding a premium in the country. The percentage of broken rice included in the rice output is not the only factor that affects on quality. There is very little number of large-sized mills in Myanmar which have color sorters that would allow exporters to ensure that off-color rice grains are exported. Though size grading is not common in the country's mills, it would be necessary to emphasize in research related to grading system and producing long-grain varieties that is compatible with local conditions to become a good competitor of long-grain rice varieties in the international market.

Medium and large-sized mills located in small and medium towns decreased in number in the 1990s and the early 21st century, losing in competition with small scale hullers located in wards and villages just close to local consumers. Small scale rice mills were made of locally available materials, used local technology, and was adapted to circumstances of the local environment, such as shortage or lack of electricity (Kudo, 2011).

Generally, two types of milling operations are involved in the production of rice in Myanmar; custom mills (hullers) and commercial mills (Table 5.2). Custom mills are small operations that mill primarily for farmers' home consumption and market very small amount of rice in the local market. Usually, the custom mills or village mills operate 200 Ks to 300 Ks per basket of paddy depending on the paddy quality to be milled. Some village mills take 100 Ks per basket if farmers want milled-rice with all by-products. Only if the farmers ask bran for their livestock

feeding or poultry farming, village mills ask cash for milling. The by-products of mill such as husk are sold to local users who use for fuel.

Table 5.2. The Characteristics of Hullers and Medium-sized Mills in the Studied Area

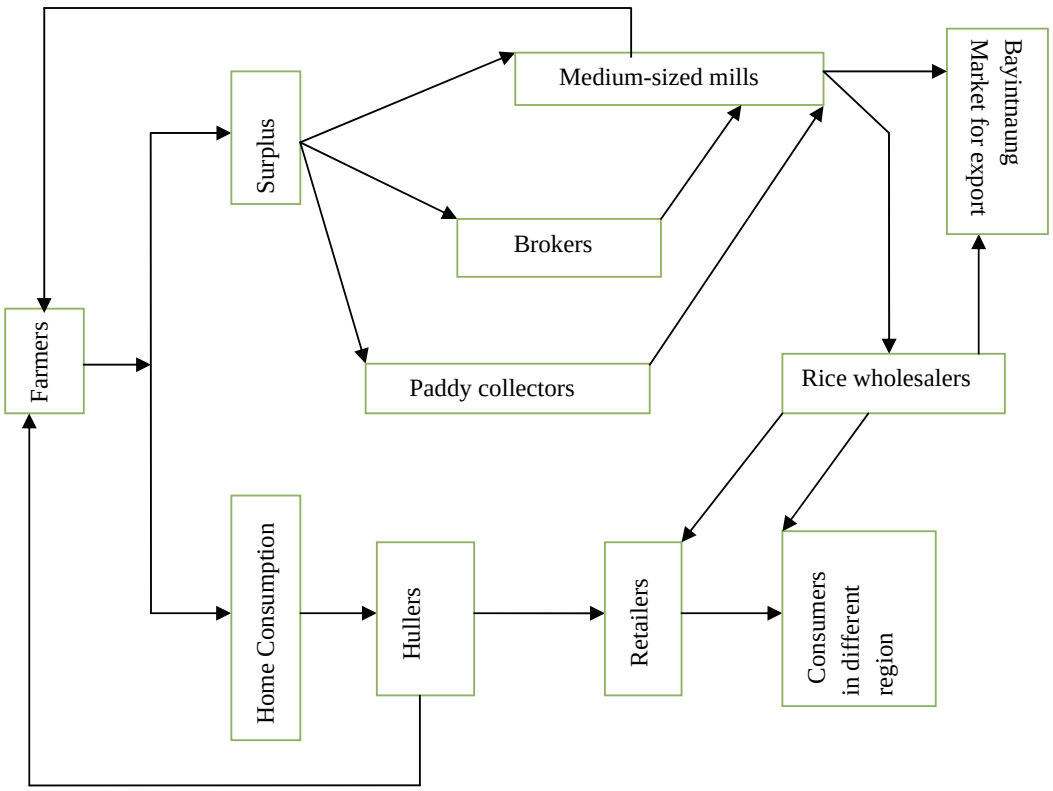
Hullers	Medium-sized mills
Home business owned by individual	Commercially operated business
Constructed in the house compound	Constructed in a separate area from house
Registration is not compulsory	Registration is needed to the concerned-ministry
Usually not a member in millers' association	Member in country' millers' association
No formal enterprise structure	Some have formal enterprise structure/some not
Operated with family labor	Operated with permanent and daily workers
Low quality milling system, usually <300 Kg per hour/ Fueled by diesel/ Mostly milled for home consumption purposes/ Limited or no paddy warehouse	Standard milling system depending on the capacity/ Have a capacity of >700Kg per hour/ Power is generated by husk-used-generator/ Milled for market purposes as well as home consumption/ Paddy and rice storage of >500 tons warehouse/
No long-term business plan/ Have no purpose to expand milling business/ Some are major business activity and some are only for additional business	Some have business plan, and some have not with weak book keeping system/ Have purpose of expansion their business/ Major business activity
License fee/ Industrial fees per year/ Commercial taxes are paid to local government	License fee/ Industrial fee/ Income and commercial taxes are paid to local government

Source: Author's survey

Custom mills have a capacity from one ton to 4 tons per day with most mills operating for only a few hours per day or 7 to 8 hours per day in average. Thus the average capacity for a huller is 125- 500 kg per hour in the studied area. The capital need for a huller is small valued at between USD 1000 to USD 3000 depending on the quality and capacity of the huller. The village mills are mostly done by local manufacturers. But, the combination of low levels of operating custom technology with mixed varieties of paddy result in high level of broken rice ranging from 30 to 50 percent. This study survey 10 hullers in 10 villages in Waw. But most of the hullers are same type and have same cost structure. The average quality of milled rice is generally low, and the potential yield of rice, bran and husk is 65, 15 and 20 percent respectively. The huller owners

usually do not borrow money from lenders for their operations as well as no credit is given to farmers who want to mill their paddy. But they, sometimes, give credit to some farmers who are relatives of them or who are believed to repay their milling cost. The hullers generally do not hire outside labor. Most are run by family labors.

Figure 5.2. Paddy-Rice Marketing Channel of the Studied Area



Source: Author's Survey

Commercial or medium-sized mills refer to those mills that produce for domestic and international markets. Commercial mills can be differentiated into small, medium, and large mills on the basis of their milling capacity. All of the commercial mills in the studied area are medium-sized which have a capacity of 700Kg to 1 ton per hour or 15- 25 tons per day. Some farmers who want higher quality of rice for their consumption, and the surplus is sold in local markets usually use medium-sized mills. Those mills directly buy paddy from farmers and sell

directly to local traders. No collectors or brokers are usually used between farmers and mills except in some cases in which commercial mills need to buy paddy urgently for local demand. Figure 5.2 shows paddy-rice marketing channel of the studied area. Most purchase of paddy is made on a cash basis although a few mills buy in credit from farmers. Commercial mills, generally, return back of fine bran, coarse bran, and broken rice to farmers, and they ask money for milled rice. The cost is set on rice output in commercial mills. The cost for one and half basket of milled-rice is 1000 Ks. Some commercial mills often work directly with farmers to obtain paddy for their operations, and such arrangement need in advanced payment of cash or in kind such as seeds, fertilizers, and etc. Commercial mills in the studied area sell their milled rice to wholesalers and traders in Mawlamyaing and Pa-an in Mon state, and to Bago in Bago division, Taunggyi in Shan state, and Yangon in Yangon division. However, most of the milled-rice from Waw goes to Mon state.

Millers, in the studied area, usually set rice price depends on the daily market price of rice in Yangon market. Based on Yangon market price, they sell their milled-rice to the wholesalers or traders in credit. Wholesalers just contact with phone from their places. If wholesalers agree the price set by millers, millers send the requested amount of rice by truck to the wholesalers. And all of the charges including transportation cost and labor charges are given by wholesalers. Millers just define the daily spot price of milled-rice according to the rice varieties. After milled-rice is received by local wholesalers, money is transferred to the millers by bank transfer or by men. Field interviews with 9 commercial mills reveal that the majority of sales are made on credit which contributes to the shortage of working capital of mills in sometimes as most purchase of paddy are made on a cash basis. Therefore, millers need some capital money in hand every time to buy paddy while waiting money from rice wholesalers. Wholesalers or traders transfer money after their requested rice is sold to local consumers. Usually it takes one to two weeks with no interest fee. With the lack of legally enforceable contracts, millers and traders form secured-relationships over long period of time. Recovery rate for milled rice is generally higher for commercial mills in the studied area. The average extraction rate for both seasons (rainy and summer) is about 70 percent. Commercial mills or medium sized mills have a capacity of about one ton per hour. There are 9 commercial mills in Waw at the time of survey.

5.3 The Problem Statement

Rice is staple food in Myanmar and second most important crop in the world. It is the main food crop for the world's most populated areas especially in Africa, Asia, and Latin America. Rice processing is the oldest and longest history in the country. Rice industry comprises not only paddy production but also the milling sector, trade and distribution, and other food related processing sectors. Rice milling sector is the major manufacturing sub-sector in Myanmar. The food and beverage sub-sector occupied 64 percent of the total number of private industrial establishment in the country in FY 2007. In the food and beverage sub-sector, rice mills accounted for more than 60 percent (Kudo, 2011).

Figure 5.3. Map of the Studied Area

Source: Township administrative office (Waw)

Rice industry, at present, has labor turnover of more than 17 million. The country processes about 32 million metric ton of paddy per year and provides staple food grain and other value added products for the consumers. Most of the paddy is processed by hullers, and marketable rice is processed by modern medium and large-sized mills located in the towns and cities. The

study was done in Waw Township located in Bago division. There are 60 wards and villages in the town. All villages grow both rain-fed and summer paddy. Rain-fed paddy area in 2010-2011 was 178661 acres. And summer paddy area was 21407 acres in the same year. Figure 5.3 shows the paddy growing acres of Waw for 2009-2010 rainy seasons. There are 374 hullers in the wards and villages indicating that, in average, about 6 hullers in a village. And there are 9 medium-sized China-made medium-sized rice mills are located in the town. These investments in rice mills showing how rice industry is large in this studied area. The private investment in post harvest technology has come a long way since the previous government liberalized rice market in 1992. The sustained growth of rice milling industry depends on the viability which is largely determined by the cost of production and management efficiency in processing.

The profit of a mill is affected by the structure of cost of production. Thus cost of production is an important factor which is also an indicator of management efficiency. The medium-sized mills which can operate 15-25 tons of white rice per day could not be run by diesel generators due to their mechanical limitations. But imported rice mills from China have solved the problem. Rice mill itself can generate electricity, and thus these medium-sized mills do not need any fuel-generators. The modern rice mills are operated by adopting new technology and the recovery percent of head rice is more comparable with conventional rice hullers. But the key point is continued operation of modern units could be higher costs, and on the other hand, lower net returns associated with conventional rice mills or hullers.

The constraints for hullers and medium-sized mills are different. The main constraint for hullers is insufficient amount of financial availability to get consistent flow of paddy to be milled. Thus, hullers have lengthy period of no milling time during a year. They only have one month peak time period of milling just after harvesting. On the other time they remain idle and consequently reducing revenue of huller owners from the milling of paddy. Because of insufficient amount of revenue for the whole year, it is difficult for hullers to be modernize their mills to acquire higher quality of milled-rice, and becoming unable to compete with medium-sized mills. In a longer term, the number of hullers might decline due to un-competitiveness in compared with those medium-sized mills. Hullers also face quality and technological constraints because of their limited financial capability to purchase higher quality paddy. Therefore, they are

just milling the paddy when farmers ask to mill theirs for home consumption. In order to purchase paddy at harvest time, they require enough capital.

In the case of hullers, the conventional technology has resulted in higher percentage of broken rice, which yields less return. Therefore, this chapter seeks to investigate into the issues of economics of paddy processing into rice for hullers and medium-sized mills. Waw is a leading township with respect to paddy growing and processing. Thus, this study is undertaken with objectives of analyzing the costs and returns structure of both hullers and medium-sized mills, and addresses the related issues.

5.4 Cost and Margins

This study enquires into the processing costs and returns of paddy milling units in ten Ywar (villages) in Waw township, Bago division. One huller in a Ywar were randomly selected. Nine medium-sized mills which are located in the town are interviewed for their operation. The primary data such as paddy procurement cost, processing costs, power, fuel, marketing, transportation, packing, returns from main product and fees for milling, salaries and wages, administrative, depreciation on machinery and buildings, interest on working capital and fixed capital, and other related costs in the industry were collected to evaluate the objective of the study.

The capacity utilization of hullers and medium-sized mills is depicted in Table 5.3. The averaged annual installed capacity for hullers is 1146.1 tons per year while it is 4580.75 tons per year as in the case of medium-sized mills. However, the capacity utilization for hullers is only 16.44 percent and 49.32 percent for hullers and medium-sized mills, respectively. Capacity utilization depends on the financial status of the respective mill owners. If they have adequate amount of money to purchase paddy for milling in the whole year, the capital utilization will be increased. Usually, huller owners have inadequate capital. The actual quantity processed per year for hullers is 188.4 tons, and 2259 tons for medium-sized mills. The hullers operate 8 hours per day continuously as in a one shift while medium-sized mills run two shifts with 12 continuous working hours.

The costs incurred on various components in processing of paddy into rice for one year is presented in Table 5.4. The cost structure differs between hullers and medium-sized mills. The major cost for hullers is diesel. Field interview with huller owners suggest that diesel is usually required 3 gallons or 11.4 liters for 100 baskets or 2.3 tons of paddy. Hullers have different capacity. It ranges from 1 ton to 4 tons per day. Thus, in average, hullers operate 2.5 tons per day. And hullers operate 7 to 8 hours per day. Hullers, therefore, typically need three gallon of diesel for one day in average. The price for one gallon of diesel is 4000 Ks or US$ 5 per day. Most labor on hullers is household labor, and the survey reveals that the hired wage rate for a labor to operate huller is 3000 Ks per day including provision for lunch. Annual interest rate is 15% per year and it is calculated based on the interest rate of Myanmar Commercial Bank though the most of the hullers were bought with their own money. Depreciation costs vary widely by the capital outlay of the hullers. The investment cost of hullers ranges from US$1000 to US$ 3000. Supposing a depreciation rate of 10 percent per year with at least 10 years life span implies that the cost for depreciation varies from US$100 to US$300 per year. The maintenance cost of a huller for one month is 30600 Ks or US$38.25 with an exchange rate of 800 Ks per dollar at the time of survey.

Table 5.3. Capacity Utilization in Hullers and Medium-sized Mills

Particulars	Hullers	Medium-sized mills
Average installed capacity per hour (ton)	0.34	1.05
Number of working days per annum	60	180
Number of shifts per day	1	2
Duration of each shift (hours)	8	6
Annual installed capacity (ton)	1146.1	4580.75
Quantity processed per day (ton)	3.14	12.55
Actual quantity processed per year (ton)	188.4	2259.0
Capacity utilization (%)	16.44	49.32

Source: Author's survey

Table 5.4. Cost of Processing Paddy into Rice for One Year

Particulars	Hullers		Medium-sized mills	
	Cost (USD)	% of total	Cost (USD)	% of total
Fuel	900	51.68	49950	10.20
Paddy purchase	0	0	236250	48.25
Salaries and wages	225[a]	12.92	8250	1.69
Administrative cost	0	0	750[c]	0.15
Maintenance cost	54[b]	3.10	146.25	0.03
Interest for working capital	0	0	44280	9.04
Interest for fixed capital	281.25	16.15	75000[d]	15.32
Depreciation for building (5%)	93.75	5.38	25000	5.11
Depreciation for machinery and equipment (10%)	187.5	10.77	50000	10.21

Source: Author's survey

Notes: [a] Daily wage is 3000 Ks if huller hires a worker or if not hire, it will be an opportunity cost.

[b] Maintenance cost for huller mainly derives from lubricant cost and cleaning of the machine

[c] Administrative cost for medium-sized mill is the cost of telephone and fuel for automobiles

[d] Annual interest rate is used the interest rate imposed by Myanmar commercial bank

Hullers are mainly getting their income from milling fees (Table 5.5). Some hullers derive income from bran and husk sales. Sometimes, bran is not sold to the feed market. In such a case the value of bran represents the opportunity cost for hullers. Some huller and most of medium-sized mill owners themselves are farmers and thus they derive income from sales of paddy or rice from their own production. Partial budget for hullers in Waw is provided in Table 5.6. The budget reveals that huller owners have positive net profit from milling operations. However, to sustain such a kind of net profit, they need capital to buy paddy for milling in other months. Required amount of money in hand to get such a sustained net profit would be about 10 to 15 million Ks or USD 18750. Huller owners, generally, do not have enough capital, adequate storage facility, and efficient rice marketing network. They just, in the rest of the year, operate milling of rice for farmers who store their paddy for home consumption and who live in the same village or nearby villages. Thus, the quantity of paddy to be milled is very low in other months.

There are also, in average, 5 to 6 hullers in the villages of Waw. Therefore, there is much competition among hullers in the same villages.

Table 5.5. Estimated Returns from100 Baskets of Paddy Processing into Rice

Particulars	Hullers				Medium-sized mills			
	Qty	(ton)	Price/ton ($)	Value ($)	Qty	(ton)	Price/ton ($)	Value ($)
Rice	1.23		381.94[a]	468.75	1.43		381.94	543.75
Broken rice	0.196		35[b]	6.87	0.05		35	1.75
Point	-		-	-	-		-	-
Coarse bran	0.05		1.16[c]	0.05	-		-	-
Fine bran	0.13		12.96[d]	1.65	0.19		12.96	2.47
Husk	40 bags		2000 Ks	2.5	40 bags		2000 Ks	2.5

Source: Author's survey

Notes: [a] One bag of milled-rice (108lb) equals 15000 Ks at mill-gate price for Manawthukha

[b] One bag of broken-rice (108lb) equals 7000 Ks

[c] One bag of coarse bran (50lb) equals 2000 Ks

[d] One bag of fine bran (70lb) equals 4000 Ks

[e] All values are calculated based on the prices at survey time with exchange rate of 1USD=800Ks

For medium-sized mills in the town, the major cost is the purchasing cost of paddy from farmers (Table 5.4). Medium-sized mill owners are themselves large farmers. They grow rice in many acres. They mill their owned paddy and purchased-paddy. Thus, the major cost, approximately 48% of the total cost, derives from buying paddy followed by interest on working capital which accounts for around 15% of the total cost. An averaged one time purchase of different varieties of paddy is shown in Table 5.7. The largest amount of purchased variety of paddy is Manawthukha which belongs to the Emata group. Many varieties of rice are found in the local market of the studied area. It is known that consumers in the area, however, much like Manawthukha variety according to an interview with an officer from the township administrative office.

Table 5.6. Partial Budget for Hullers in A Peak Milling Month in Waw (One harvesting season)

Quantity of paddy milled (tons)		92 tons per peak milling month				
	Item	Unit	Quantity	Price per unit (Ks)	Price per unit (USD)	Value (USD)
Cost	Diesel	Gallon	120	5000	6.25	750
	Maintenance	Times	3	10200	12.75	38.25
	Labor	Worker	30	3000	3.75	112.5
	Total Cost					900.75
Revenue	Fees	Basket	4000	300	0.375	1500
	Husk	Basket	3200	5	0.00625	20
	Total Revenue					1520
Net profit						**619.25**

Source: Author's calculation; Exchange rate at the survey time was 800Ks per dollar

Partial budget for medium-sized mill in Waw is shown in Table 5.8. The budget exhibits that medium-sized mill owners also have positive net profit from milling operations. However, to keep going such a kind of net profit, they need sufficient capital to buy paddy for milling in other months and adequate storage facility for purchased paddy. Required amount of money in hand for one time purchasing paddy to get such a sustained net profit would be about 40 million Ks or USD 44726. Medium-sized owners generally have enough capital, easy access to government loan, adequate storage facility for one time purchase, and efficient rice marketing network.

They, therefore, can purchase paddy to operate milling process continuously for the whole year. Sometimes they mill paddy from farmers who store their paddy for speculative purposes. Even though they have enough capital to purchase paddy, milling days per year is ranged from 150 days to 180 days due to limited supply of paddy in the township and limited storage facility. Thus, the quantity of paddy to be milled in the rest of year is not very much. There are 9 medium-sized mills in Waw at the time of survey. All of those mills are similar type of mills which are made in China. The capacity of milling is almost the same. Those mills are operating within the range of their financial availability.

Table 5.7. Average One-time Paddy Purchase of Different Paddy Varieties of Medium-sized Mills in Waw

Variety	Quantity (baskets)	Price per basket (Ks)	Labor cost (Ks)	Cost (Ks)	Advanced pay (Ks)	Total (Ks)
Manaw-thukha	5569.50	4000	99890	23203690	102600	23001200
Tun-shwe-war	1508.78	3900	13450	5890590	-	5877140
Sin-thu-kha	1044.11	3900	37220	4121900	971800	3112880
Yadanar-toe	607.65	3700	15600	2301500	-	2285900
Manaw-pyat	412.87	3700	10090	1545090	210000	1325000
Sin-shweli	159.02	3700	4800	604200	-	599400
Sin-new-yin	124.55	3900	3800	487300	-	483500
Ta-po	392.30	3200	4700	1265900	165800	1095400
Pyi-lone	123	3600	3800	442800	-	439000
Unit-thit	77.23	3500	3100	270300	-	267200
Manaw-tun	61.36	3900	1800	242300	48700	191800
Bay-kyar	56.68	5000	1700	283400	-	281700
Thukha-tun	46.66	3800	1800	177300	-	175500
Nyin	14.40	4700	400	67700	-	67300
Kamar	25.20	4500	1000	115800	-	114800
Total	10223.31	-	203150	41019770	1498900	**39317720**

Source: Author's survey

5.5 Conclusion

In the past two decades virtually unnoticed rice milling industry has become importance across the country. As recently as 2011 informed estimates of nearly 90 percent of rice mills are hullers and the rest are commercial mills and both are operating for home consumption and trading. There are no direct statistics from which to judge. It is agreed that significant changes occurred after 1990 the country seemed likely to change its agricultural policy and major increase in rice production had been recorded. Thanks to the indirect evidence getting from FAO representative office from Myanmar, especially the number of small hullers was installed during 20 years. Socio-economic impacts of the booming of rice milling industry are starting to be

affected, and any assessment of these changes in the rural areas is necessarily for the future development of the industry.

Table 5.8. Partial Budget for Medium-sized Mills of Waw Township in A Year

Quantity of paddy milled (tons)		1242 tons per year				
	Item	Unit	Quantity	Price per unit (Ks)	Price per unit (USD)	Value (USD)
Cost	Paddy purchase	Basket	54000	3500	4.375	236250
	Diesel	Gallon	3600	3700	4.625	17112.5
	Maintenance	Time	3	39000	48.75	146.25
	Staff and Labor	Month	12	550000	687.5	8250
	Loss	Basket	2160	3500	4.375	9450
	Packing	Bag	5000	130	0.1625	812.5
	Total Cost					272021.3
Revenue	Rice sale	Bag	13500	18000	22.5	303750
	Fees	Bag	13500	1000	1.25	16875
	Total Revenue					320625
Net profit						**48603.75**

Source: Author's calculation

Note: Exchange rate at the survey time was 800Ks per dollar

Accordingly, this section tried to answer the cost and benefit of the rice milling industry. In order to know the present status of rice milling industry, a case study was done in Waw township of Bago division using a structured questionnaire. There are 374 hullers most are made with local technology ranging a capacity of 1 to 4 tons in the wards and villages, and 9 medium-sized commercial mills with various capacities from 15-25 tons which are Chinese made mills. Most of hullers are running for home consumption purposes, and medium-sized mills are operating for trading rice. Huller mills have the advantage of being cheap and simple to operate but are very inefficient in converting paddy into rice though they have net profit during harvesting month. The rice recovery in huller ranges from 40-60 percent with more than 15 percent of broken rice

whereas 60 to 70 percent recovery with 5-10 percent of broken rice in medium-sized mills. Hullers have constraints in working capital which makes them unable to modernize their mills. To get a sufficient loan from official lending sources is difficult for huller owners. As a result of the lack of working capital, there is a significant gap between paddy production of the area and utilized milling capacity.

Other major constraints for millers in the studied area concern the quality of paddy which is mixed with various varieties and foreign materials. Although the farmers used specific variety of paddy, there is still a problem of poor quality seed that result in higher losses in milling as the rollers used in the milling process are better suited for paddy of a relatively uniform length. Even farmers used recommended varieties by Myanmar Agriculture Service (MAS), collectors and brokers have limited ability to segregate the paddy. Another important point relates with post-harvest technology particularly drying which is not adequate, and results in high level of moisture that leads to high level of broken rice.

According to an official from MAS, it is estimated around 10 percent of paddy is damaged or lost in harvesting, drying, storage, processing and transport with conventional harvesting method. The estimated loss in terms of money due to such kind of losses indicating that post-harvest technology is how important for increasing of farmers' income themselves and income for the other channels of the rice industry. Since paddy is the staple food in the country, there should be some facility in storage which can be protected from various hazards like damage caused by spontaneous heating, damage by birds, rodents, and insects. Sun drying is completely traditional and dependent upon weather and it needs wide space. Some farmers are drying their paddy on beside of roads. Thus, excessive losses will occur due to scattering, birds, rodents, and etc. This can be improved by drying paddy in a mechanical dryer using a by-product of paddy, husk, as a fuel. One point to increase the milling outturn is a process of partial boiling or cooking prior to milling which imparts an extra strength to the rice kernel so that it could withstand the milling stress and results in higher head yield. This kind of kernel hardness is resulted due to gelatinization of the starch during parboiling and the disrupted protein which expanded and occupied all the air spaces in the endosperm. Due to better milling quality, the losses of milling

as broken rice, fine bran, and coarse bran could be reduced, and hence, total rice outturn is increased from 5 to 10 percent. Therefore, parboiling method in milling should be considered.

6. CONCLUSION AND IMPLICATIONS

The government of the Republic of Union of Myanmar recognizes the role of rice industry in poverty eradication and is therefore implementing to attain the maximum potential yield in the farmers level as the key national development agenda. Ministry of Agriculture and Irrigation is the most responsible ministry to achieve that goal. The MOAI is trying to distribute new cultivation method, but most are old cultural practices, in which so-called 14 points good agricultural practices for rice growing are set. The MOAI envisages getting rice yield over 100 baskets per acre. The Myanmar Rice Industry Association (MRIA) is also non-governmental business association which is also reinforcing the government's plan to achieve the most exploitable yield in the ground. The major strategies supporting by the ministries concerned and private business associations are strengthening institutional framework and research, technology dissemination, capacity building, increased production, multiplication and dissemination of certified seeds, improved and maintenance of irrigation and water management, increased utilization of agro-inputs, sustainable soil management, post-harvest handling, processing, and marketing, increased use of mechanization, access to agro-credit, and policy development. These strategies, if efforts are being made in a right way, will result increased rice production in the country.

This research report addresses the challenges and prosperous facing by farmers and millers in selected townships. The issues presented in here will be of partial importance to the rice industry and its prospects for achieving a higher level of growth and bringing the reduction of poverty in the country. Rice is, however, mainly grown today by small scale farmers almost throughout the country though there are few large scale farmers in some locations. Most of the rice farmers has less than one hectare due to fragmentation of land in several reasons. The additional cost accompanied with the new technology made difficult to adopt for small scale farmers who are struggling to survive their lives.

The recommended technology comes with increased cost of production though it can increase the productivity. Trying to get physical target of output alone can not bring the profit for the farmers. There are several factors that affects on decision making whether to adopt a new

technology or not such as market indicators, household characteristics, economic efficiency should be considered particularly during the process of agricultural and market reform. The decision makers should be informed by convincing them how production efficiency is affected by market indicators and household characteristics. This research tries to evaluate farmers' marketing behavior and determinants, key factors in rice production, and the factors related to household productivity.

It was found that there is a significant variation in economic inefficiency indexes among farms in the selected area. The average inefficiency for both studied areas is about 16% means that 16 percent of total sampled farmers are trapped in economic inefficiency due to lack to access to credit, lower schooling year, poor communication with extension workers, poor socio-economic conditions, and so on. Farmers who are getting higher income from secondary crop have lower economic efficiency in rice production. Education as a human resource indicator shows the farmers who have higher schooling year tends to decrease profit inefficiency indicating those farmers have more allocative ability in relation to perceiving and responding to changes in the market prices and market behavior.

The country processes about 32 million metric tons on paddy per year. Thus the rice milling sector is a major manufacturing sub-sector in the country. Most of the paddy is processed by hullers and medium-sized mills. The sustained growth of milling industry depends on the viability which is largely determined by the cost of production and economic and management efficiency in processing. Accordingly, this report also tries to analyze the cost and returns structure of both hullers and medium-sized mills, and discuss the related issues in Waw Township which is located in Bago division. There are 374 hullers and 9 medium-sized China-made rice mills in the township. Most of the hullers are running for home consumption purposes, and medium-sized mills are operating for trading rice.

The partial budget analysis reveals that huller owners have positive net profit from mill operations though they need capital to buy paddy for milling in the whole year. Required amount of money in hand to get such a sustained net profit would be about 15 million Kyats. They are milling just in the main harvesting season. For the rest of year they just operate milling of rice farmers who store their paddy for home consumption. Thus the quantity of paddy to be milled is

very low in the rest of the year. As a result of the lack of working capital, there is a significant gap between paddy production and utilized milling capacity of hullers in the studied area. The constraint in working capital makes hullers difficulty to modernize their mills.

Medium-sized mill owners generally have enough capital, easy access to government loan, adequate storage facility for one time purchase, and efficient rice marketing network. Therefore, they can purchase paddy to operate milling process continuously for the whole year. The major cost for those mills are derived from buying paddy about 48 percent of total cost followed by interest on working capital which accounts for around 15 percent of total cost. Major constraint for medium-sized mills in the studied area is the quality of paddy which is mixed with various varieties and foreign materials.

Thus, it shows that the current post harvest handling practices by farmers are relatively poor. Although the majority of farmers use threshing machine after harvested rice is dried under natural sunlight, a significant amount of farmers thresh by beating the heaped rice on a tarpaulin or plastic sheet or mat. Many other farmers thresh rice by beating it on bare ground. Such practices usually lead to heavy contamination of the paddy with stones and other foreign matter which significantly contribute to low quality of the milled rice and increased rate of wear and tear of mill spare parts. All the millers said that most of the paddy supplied in most cases is wet and contaminated with stones, metals straws and dust. Majority of local paddy in the studied areas is milled by hullers that have inferior technology.

Another problem for low grade of milled-rice quality comes from low quality of seed used in the cultivation. Thus it is important for farmers to get good seed with high yielding variety. The MOAI is doing rice research including rice variety development, trial and dissemination. This is done by Department of Agricultural Research (DAR), Myanmar Rice Research Institute (MRRI) which belongs to the Myanmar Agriculture Service (MAS). The DAR works in close collaboration with international partners such as International Rice Research Institute. The DAR produces foundation seed for multiplication. This foundation seed are multiplied in the MRRI seed farms and private companies. Yezin Agricultural University (YAU) farm is also trying to produce hybrid rice varieties with direct support and management from the MOAI. However, multiplication and dissemination of HYV seeds are inadequate due to high demand, limited

facilities for rice research, and limited financial support to rice research. However, only a small percentage of seed used in the farmers' fields comes from those departments. Most of the seeds are farmers' owned seeds harvested from their farms. Thus, there is a large demand for rice seed with good quality in the country.

One major constraint for farmers is lack of access in enough credit to purchase seeds, fertilizer and to practice the recommended technology that improves yields. There are a number of credit sources in many rural areas with different terms and conditions. The majority of farmers can borrow Ks 40000 per acre directly from Myanmar Agriculture and Development Bank (MADB) with an interest rate of about 2 percent per month though some costs such as cost of visit to bank offices, tea money or some small payment to process loans quickly and other unnecessary and unexpected costs are accompanied with those borrowed loans. And the MADB loans cover 15 percent of the total land areas. Insufficient and inadequate amount of credit and lack of access to credit imposes heavy costs on agriculture in terms of productivity and income (Turnell 2008).

Therefore, farmers are automatically forced to secure to get credit from informal money lenders_ traders, millers, fertilizer distributors, pawn shops, wealthy persons, and etc_ whose interest rates are about 10 to 15 percent per month in their villages or nearby towns. The high interest cost might leave farmers from farm businesses if their crops are failed for several reasons. Many farmers have to sell their paddy at harvest time with low prices. This makes small farmers unable to escape from their debts. Dolly Kyaw (2009) said that the landless and small farm households constitute 74 percent of the total food insecure households but their contribution to the total sampled household is 53 percent in one of her studies. It indicates that most of the farmers around the country are comprised of small scale farmers. To solve these problems the formal private lending sector should be encouraged to establish with predetermined interest rate that will be fair both for farmers and lenders. Nobody will come into financial sector without getting business profit. Therefore, the MOAI or the government of the Republic of Union of Myanmar should formulate some rules and regulations or laws that stimulate informal lending sources to become formal ones.

References

Abbott, Philip. 2009. "Development Dimensions of High Food Prices." *OECD Food, Agriculture and Fisheries Working Papers* No. 18. Paris: OECD Publishing.

Abdulai, A. and W, Huffman. 2000. "Structural Adjustment and Economic Efficiency of Rice Farmers in Northern Ghana," *Economic Development and Cultural Change* 48: 503- 520.

ADB. Asian Development Bank. Country Economic Data (Myanmar). 2010.

Aigner, D. J; C. A, Knox Lovel, and P, Schmidt. 1977. ''Formulation and Estimation of Stochastic Frontier Function Models,'' *Journal of Econometrics* 6 (July): 21–37.

Ali, M. and Byerlee, D. 1991. "Economic Efficiency of Small Farmers in a Changing World: A Survey of Recent Evidence," *Journal of International Development*, Volume 3, Issue 1: 1-27.

Ali, M. and Flinn, J, C. 1989. "Profit Efficiency among Basmati Rice Producers in Pakistan Punjab," *American Journal of Agricultural Economics*, Volume 71, Issue 2: 303-310.

Ali, F; A. Parikh, and M. K. Shah, 1994. ''Measurement of Profit Efficiency Using Behavioral and Stochastic Frontier Approaches,'' *Applied Economics* 26 (February): 181–88.

Ali, F; S. C. Kumbhakar, and A. Bhattacharyya. 1992. ''Price Distortions and Resource-Use Efficiency in Indian Agriculture: A Restricted Profit Function Approach,'' *Review of Economics and Statistics* 74 (February): 231–39.

Battese, G.E. and T. Coelli. 1995. "A model of Technical Inefficiency effects in a Stochastic frontier production Function for Panel Data", *Empirical Economics*, 20: 325- 32.

Chirwa, E. W. 2007. "Sources of Technical Efficiency among Smallholder Maize Farmers in Southern Malawi," *AERC Research Paper*: African Economic Research Consortium, Nairobi.

CSO. Central Statistical Organization, Ministry of National Planning and Development. Monthly Economic Indicatior Various Issues.

Dolly Kyaw. 2009. "Rural Household's Food Security Status and Coping Strategies to Food Insecurity in Myanmar," *IDE VRF Series* No. 444. Institute of Developing Economies, Japan External Trade Organization.

Dutt, S. D. and D. Ghosh. 1996, "The Export Growth-Economic Growth Nexus: A Causality Analysis", *Development Areas*, Vol. 30, 167-182.

FAO, Food and Agriculture Organization. Country Data, Myanmar. 2010.

Farrell, M. J. 1957. ''The Measurement of Productive Efficiency,'' *Journal of the Royal Statistical Society,* ser. A (general) 120: 253–81.

Feder, G. (1983), "On Exports and Economic Growth", *Development Economics*, Vol. 12, 59-74.

Fujita, Koichi. And Okamoto, Ikuko. 2006. "Agricultural Policies and Development of Myanmar's Agricultural Sector: An Overview," Discussion Paper No. 63. Institute of Developing Economies, IDE-JETRO.

Gutierrez de Pineres and others. 1997, "Export Diversification and Structural Dynamics in Growth Process: The Case of Chile", *Development Economics*, Vol. 52, 375-391.

Hnin Yu Lwin. 2005. "A Study of Rice Market Performance in Myanmar," Master Thesis submitted to the Kyusyu University.

Honma, M. (2003), "The Role of Agricultural Exports Reconsidered: A Case of Three Southeast Asian Countries", in Hirohisa Kohama (ed.) *External Factors for Asian Development*, Utopia Press, pp. 169-193.

Hsiao, M. W. (1987), "Test of Causality and Exogeneity between Export Growth and Economic Growth", *Development Economics*, Vol. 12. 143-159.

Johnston, B. F. and J. W. Mellor. (1961), "The Role of Agriculture in Economic Development". *American Economic Review*, Vol. 51, pp. 566-593.

Jondrow, J; C. A, Lovell; I, S, Materov; and P, Schmidt. 1982. ''On the Estimation of the Technical Inefficiency in the Stochastic Frontier Production Function,'' *Journal of Econometrics* 19 (August): 233–38.

Kubo, Koji. and Okamoto, Ikuko. 2011. "Note of Export Policy for Myanmar," The note presented at a seminar held in Myanmar Rice Industry Association Headquarter, Yangon, Myanmar.

Kudo, 2011. "Distribution of Myanmar Rice Mills in the Age of Economic Integration". (with Toshitaka Gokan and Ikuo Kuroiwa) in Ikuo Kuroiwa ed., The location of Industries in newly integrated East Asian economies: a new economic geography perspective, forthcoming, Palgrave Macmillan.

Kumbhakar, S, C. and Bhattacharyya, A. 1992. "Price Distortions and Resource-Use Efficiency in Indian Agriculture: A Restricted Profit Function Approach," *The Review of Economics and Statistics*, Volume 74, Issue 2, 231-239.

Kumbhakar, S, S; Ghosh, S. and McGuckin, J. T. 1991. "A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in U.S. Dairy Farms," *Journal of Business and Economic Statistics*, Volume 9, Issue 3, 279-286.

Lau, L. and P, Yotopoulos. 1971. ''A Test for Relative Efficiency and Application to Indian Agriculture,'' *American Economic Review* 61 (March): 94–109.

Lockheed, M. E; D. T. Jamison; and Lawrence, J. Lau,1980. ''Farmer Education and Farm Efficiency: A Survey,'' *Economic Development and Cultural Change* 29: 37–76.

Mellor, J. 1976. "The New Economics of Growth: A Strategy for India and the Developing World", (Ithaca, N.Y.: Cornell University Press,).

Michaely, M. 1977. "Exports and Growth: An Empirical Investigation", *Development Economics*, Vol. 4, 49-53.

Myo Oo. 2004. "The Role of Rice Hullers and Their Milling Losses," In Myanmar Rice Papers, *Myanmar Academy of Agriculture, Forestry, Livestock and Fishery Sci.* (Agr. Sci.), Yangon, Myanmar.

Nay Myo Aung. 2011. "Agricultural Efficiency of Rice Farmers in Myanmar: A Case Study in Selected Areas," *IDE Discussion Paper* No. 306. Institute of Developing Economies, Japan External Trade Organization.

Nguyen, C. T. and Singh, B. 2006. "Trend in Rice Production and Export in Vietnam," *Omonrice* 14, 111-123.

Okamoto, Ikuko. 2005. "Transformation of the Rice Marketing System and Myanmar's Transition to a Market Economy", *IDE Discussion Paper* 43, Institute of Developing Economies: Japan External Trade Organization.

Okamoto, Ikuko, 2005. *Rice Marketing in the Transition to a Market Economy in Myanmar*, in Fujita Koichi Ed. Myanmar's economy in transition. Chiba. Institute of Developing Economies, JETRO, pp. 231-271.

Okamoto, Ikuko, 2009. "Transformation of the rice marketing system after market liberalization in Myanmar" in Fujita Koichi, Mieno Fumiharu, and Okamoto Ikuko eds, *The economic transition in Myanmar after 1998:*

market economy versus state control, Kyoto CSEAS Series on Asian Studies, Center for Southeast Asian Studies, Kyoto University, NUS Press in association with Kyoto University Press, Singapore, pp. 216-245.

San, Thein. 2006. *Agro-based industries in Myanmar: the long road to industrialization*, VRF Series No.414, Institute of Developing Economies, JETRO. Tin Htut Oo and Kudo, Toshihiro eds. 2003. Agro-based industry in Myanmar: prospects and challenges, ASEDP No.67, Institute of Developing Economies, JETRO.

Schmidt, P. and Knox Lovell, C.A. 1979. "Estimating Technical and Allocative Inefficiency Relative to Stochastic Production and Cost Frontiers," *Journal of Econometrics*, Volume 9, Issue 3, 343-366.

Schultz, T. W. 1975. ''The Value of the Ability to Deal with Disequilibria,'' *Journal of Economic Literature* 13: 827–46.

Shigetomi, Shinichi; Kubo, Kensuke. And Tsukada, Kazunari. 2011. "The World Food Crisis and the Strategies of Asian Rice Exporters," Spot Survey No. 32. Institute of Developing Economies, IDE-JETRO.

Thein, M., (1997) "Country Paper on International Agricultural Marketing", Paper presented at the Seminar on International Agricultural Marketing, 25-29 August.

Theingi Myint. 2007. "Myanmar Rice Market: Market Integration and Price Causality," A PhD Dissertation submitted to the Yezin Agriculture University.

Timmer, P. C. 2008. "Causes of High Food Prices," In *Asian_Development Outlook 2008 Update*, ed. Asian Development Bank, 73-93. Manila: ADB.

Tin, Soe. and Brian Fisher, B. S. (1990), "An Economic Analysis of Burmese Rice Policies", in Mya Than and Joseph L.H. Tan (ed.) *Myanmar Dilemmas and Options*, Institute of Southeast Asian Studies, Singapore. pp.117-166.

Tin Htut Oo. and Kudo, Toshihiro. 2003. "Agro-Based Industry in Myanmar Prospects and Challenges," ASEDP, Institute of Developing Economies, IDE-JETRO.

Turnell, S. 2008. "Burma's Economy 2008: Current Situtation and Prospects for Reform," Burma Economic Watch/Economics Department, Macquarie University, Sydney, Australia.

UNCTAD. United Nations Conference on Trade and Development. UNCTADSTAT. Country Profile for Myanmar. 2010.

Wang, J; E. J. Wailes; and G. L. Cramer. 1996. ''A Shadow-Price Frontier Measurement of Profit Efficiency in Chinese Agriculture,'' *American Journal of Agricultural Economics* 78 (February): 146–56.

Warr, P. 2008. "World Food Prices and Poverty Incidence in a Food Exporting Country: A Multi-household General Equilibrium Analysis for Thailand," *Agricultural Economics* 39, Suppl.: 525-537.

World Bank. 2008c. "Rising Food Prices: Policy Options and World Bank Response." Paper distributed for information as background to the discussion of recent market developments at the Development Committee meeting, World Bank.

Ye Min Aung. 2011. "Challenges, Strength and Potential to Reemerge as Major Rice Exporter," The Paper Presented at Third Development Partnership Forum (June 27-28): Improving Rice Policies for National and Regional Food Security: Challenges and Opportunities, Nay Pyi Taw, Myanmar.

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List of Major Works

1. 2011. Agricultural Efficiency of Rice Farmers in Myanmar: A Case Study in Selected Areas, *IDE Discussion Paper* No. 306, Institute of Developing Economies, Japan External Trade Organization (IDE-JETRO).

2. 2010. The Empirical Analysis of Export-Led Growth Driven by Diversification, Competitiveness and Market" Proceeding of the Myanmar Academy of Agriculture, Forestry, and Fishery and Livestock.

3. 2009. An Empirical Analysis of the Markets for Major Agricultural Export Commodities of Myanmar, Japanese Journal of Rural Economics (Special Edition).

4. 2007. Regional Integration, Bilateral Trade Flow and Myanmar, Japanese Journal of Rural Economics (Special Edition).

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