MEASURING COMPARATIVE ADVANTAGES OF MANAWTHUKHA AND PAWSAN RICE VARIETIES IN TWO SELECTED TOWNSHIPS OF AYEYARWADDY DIVISION

AYE MOE SAN

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A THESIS SUBMITTED TO THE POST-GRADUATE COMMITTEE OF THE YEZIN AGRICULTURAL UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF AGRICULTURAL SCIENCE (AGRICULTURAL ECONOMICS)

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The thesis attached hereto, entitled "**MEASURING COMPARATIVE ADVANTAGES OF MANAWTHUKHA AND PAWSAN RICE VARIETIES IN TWO SELECTED TOWNSHIPS OF AYEYARWADDY DIVISION"** was prepared and submitted by Aye Moe San under the direction of the chairperson of the candidate supervisory committee and has been approved by all members of that committee and board of examiners as a partial fulfillment of the requirements for the degree **OF MASTER OF AGRICULTURAL SCIENCE (AGRICULTURAL ECONOMICS).**

Dr.Theingi Myint
Chairperson
Supervisory Committee
Lecturer
Department of Agricultural Economics
Yezin Agricultural University, Yezin

U Boon Thein
External Examiner
Director
Planning Division
Department of Agricultural Planning
Naypyitaw

Dr. Khin Oo
Member
Supervisory Committee
Associate Professor
Department of Agronomy
Yezin Agricultural University, Yezin

Daw Yu Yu Tun
Member
Supervisory Committee
Assistant Lecturer
Department of Agricultural Economics
Yezin Agricultural University, Yezin

Dr.Thanda Kyi
Lecturer
Head of the Department of Agricultural Economics
Yezin Agricultural University
Yezin

This thesis was submitted to the Rector of the Yezin Agricultural University and was accepted as partial fulfillment of the requirements for the degree of **MASTER OF AGRICULTURAL SCIENCE (AGRICULTURAL ECONOMICS).**

Dr. Myint Thaung
Rector
Yezin Agricultural University
Yezin

Date -------------------------------

DECLARATION OF ORIGINALITY

This thesis represents the original work of the author, except where otherwise stated. It has not been submitted previously for a degree or any other University.

Aye Moe San

Date -------------------------------

DEDICATED TO MY BELOVED PARENTS,

U AUNG TIN AND DAW KHIN NU

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ABSTRACT

Comparative advantage of rice is important for country's economy because Myanmar is one of the rice exporting countries. Therefore, comparative advantages of currently exporting rice varieties (Manawthukha and Pawsan) were analyzed to ascertain whether Myanmar is an efficient producer of Manawthukha and Pawsan varieties. This study was based on primary and secondary sources of data and carried out during January, 2008. Stratified random sampling method was employed to obtain the required primary data. Total sampling unit was 118 farmers in Pathein and Phyapone Townships. Domestic Resource Cost (DRC) analysis and Policy Analysis Matrix (PAM) were used to measure comparative advantages and effects of existing interventions on Manawthukha and Pawsan rice production.

The results showed that both private and social benefit-cost ratios were greater than one in Manawthukha and Pawsan production of both study areas. The DRC ratios were 0.31 for Phyapone-Pawsan in Phyapone Township and 0.37 each for Ayeyarwaddy-Pawsan and Manawthukha in Pathein Township. The DRC ratio of Manawthukha rice variety was 0.38 in Phyapone Township. All of the DRC ratios indicated that the study areas had comparative advantages for these two rice production and export marketing under current production practices, export prices and exchange rate. Output policy divergences were negative values, it means that farmers were implicitly taxed on the products of Manawthukha and Pawsan in terms of export taxes and quota. Positive input policy divergences indicated that the farmers in study areas had to pay high prices of tradable inputs. Divergences of domestic factor costs were positive values caused by labor market imperfection. Effective Protection Coefficients were less than one which pointed out that farmers have been taxed by output and input policies and these policies were disincentive for farmers. According to the results of sensitivity analyses on DRC ratios, selected two rice production can obtain more favorable comparative advantages, if FOB prices[a] are higher than current prices[b] with the increased exchange rate[c] at different yield levels[d].

Manawthukha and Pawsan production had favorable comparative advantages in both study areas. Moreover, there were still financially and economically viable under existing technologies and government interventions. Among these productions, Phyapone-Pawsan had the highest comparative advantage for export marketing.

Therefore, Manawthukha and Pawsan production have potential to increase the income of farmers as well as foreign exchange earning for the country's economy.

Notes;

[a] = US$ 400/MT for Manawthukha,

US$ 680/MT for Pawsan

[b] = US$ 300/MT for Manawthukha,

US$ 570/MT for Pawsan

[c] = exchange rate higher than 1275 kyat/US$

[d] = (3.10, 3.62, 4.13, 4.65, 5.16) MT/ha for Manawthukha

(1.55, 1.81, 2.07, 2.32, 2.58) MT/ha for Pawsan

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LIST OF ABBREVIATIONS

Ac	acre
ADB	Asian Development Bank
Bsk	Basket
CIF	Cost, Insurance and Freight
CSO	Central Statistical Organization
FAO	Food and Agriculture Organization
FOB	Free on Board
Ha	Hectare
Kg	Kilogram
Ks	Kyat
MAS	Myanmar Agriculture Service
MIS	Market Information Service
MOAI	Ministry of Agriculture and Irrigation
MT	Metric Ton

LIST OF CONVERSION FACTORS

1 Basket of Paddy	= 20.86 kilogram
1 Basket of Rice	= 34.01 kilogram
1 Hectare	= 2.47 acres
1 kilogram	= 2.20 pounds
1 viss	= 1.63 kilogram
1 long ton	= 2240.3 lb = 1.016 metric ton

CHAPTER-I
INTRODUCTION

1.1 Background

Myanmar is endowed with large amount of natural resources such as cultivable land and favorable climates for different agro-ecological zones to grow various varieties of crop. Agriculture sector plays key role in country's economy and it contributes 37% of GDP; 13.3% of total export earnings; and employs 61.2% of the labor force in 2006-2007 (MOAI, 2008). The importance of rice in agriculture plays a principle role in country's economy in terms of share in the gross domestic product, employment and foreign exchange earning.

In Myanmar, rice (*Oryza sativa.* L) is not only known as main staple food but also marked as important national crop. Rice is heartily consumed as rice based value added processing foods like vermicelli, rice noodle, various traditional snacks of food and beverages, etc. Rice is a main source of carbohydrates and vitamin B. Due to wide spread utilization of rice, people in Myanmar consume relatively more rice in comparison with other countries. The average annual per capita rice consumption was 211 kg in Myanmar and which was the highest rate in the world in 1999. It accounts for two thirds of calorie intake and 68% of daily protein consumption (FAO, 2001).

To provide sufficient rice for domestic consumption in line with food security for increasing population and enhancing income by exporting of rice surplus, the successive Myanmar governments generally have attempted to develop the country's rice economy. To obtain sustainable growth in paddy production is a key to domestic food security and economic growth. Therefore, in Myanmar, not only monsoon paddy but also summer paddy is grown in various parts of the country. Monsoon paddy is widely grown as first crop from May to September and the summer paddy is sown from November to April as second crop depending on the availability of irrigation water sources. It is essential to improve paddy production through appropriate production technologies including quality seed, minimization of cost and utilization of agricultural inputs.

Market economy was practiced since 1989 and the Ministry of Agriculture and Irrigation (MOAI) encourages the farmers to produce more rice. Therefore, the sown areas of paddy were increased from 4.78 million hectares in 1988-1989 to 8.13 million hectares (37% of total crop sown area, 21.96 million hectares) in 2006-2007

(Figure 1.1). Yield per hectare of production was also increased from 2.84 MT/ha in 1988-1989 to 3.84 MT/ha in 2006-2007. The paddy production was also increased from 12.96 million tons in 1988-1989 to 30.98 million tons in 2006-2007 (Table 1.1).

1.1.1 Trading Policies and Export Trends of Myanmar Rice Sector

Myanmar has adopted a series of policy reforms to liberalize its economy since the late 1980s. As the country changed from a centrally planned economy to a market- oriented economy, a remarkable growth has been achieved in agricultural sector and also in economy of the country. Although there was increasing in sown area, average yield and total production of rice, rice export was clearly declined from year to year.

Before World War II, Myanmar stands as a top rice exporting country in the world. In the early 1940s, the country produced about 8 million tons of paddies and stood first among the rice exporting countries in the world. However, because of stagnation of production since the early 1960s, Thailand took the place of Myanmar in the export market, as exports declined from 1.7 million tons in 1962 to 0.3 million tons in 1975. The significant yield increased from the mid 1970s to early 1980s was certainly due to implementation of the special high-yielding rice programme with the adoption of modern rice varieties and agronomic practices.

Myanmar exported about 1 million metric tons of rice in 1994-1995, and it was 5.81 % of total production. However, subsequent year up to 2000-2001, rice export of Myanmar drastically declined. Then, in 2001-2002, rice export had raised again to nearly 1 million metric tons, but the percentage of export on total production was accounted for 4.35 % and after that, it was gradually decreasing.

The government of Myanmar adopted new rice trading policy on 24 April 2003 and announced a new rice trading policy, which stipulated: "All nationals have a right to trade rice. The price will be according to the prevailing rates, and monopolizing the rice trade will not be allowed for anyone or any organization". Therefore, all citizens are now free to participate in the domestic rice trade.

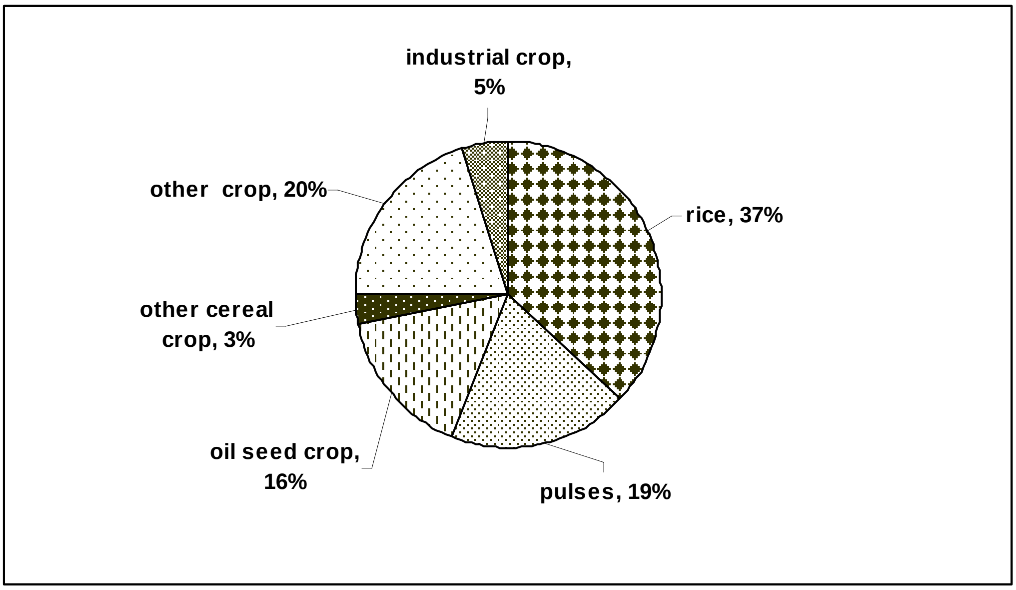

Figure 1.1 Percentage Shares of Total Sown Areas for the Major Crops in Myanmar (2006-2007)

Source: MOAI (2008)

Table 1.1 Rice Sown Areas, Yield, Production and Export of Myanmar

Year	Sown Areas (million ha)	Yield (MT/ha)	Production ('000 MT)	Export ('000 MT)	Export (% of Production)
1988-1989	4.78	2.84	12960	48	0.37
1989-1990	4.88	2.91	13590	169	1.24
1990-1991	4.95	2.93	13750	134	0.97
1991-1992	4.83	2.88	12990	183	1.41
1992-1993	5.14	2.93	14600	199	1.36
1993-1994	5.68	3.05	16500	261	1.58
1994-1995	5.93	3.17	17910	1041	5.81
1995-1996	6.14	2.97	17670	354	2.00
1996-1997	5.88	3.06	17400	93	0.53
1997-1998	5.79	3.08	16390	28	0.17
1998-1999	5.76	3.13	16810	120	0.71
1999-2000	6.29	3.24	19810	55	0.28
2000-2001	6.36	3.38	20970	251	1.20
2001-2002	6.46	3.42	21570	939	4.35
2002-2003	6.49	3.42	21460	793	3.70
2003-2004	6.55	3.54	22770	168	0.74
2004-2005	6.86	3.63	24330	182	0.75
2005-2006	7.58	3.74	28370	180	0.63
2006-2007	8.13	3.84	30980	14.5	0.05

Source: CSO and DAP (2005), MOAI (2008)

As far as rice exports are concerned, however, citizens will have to follow the following three guidelines set by the newly formed Myanmar Rice Trading Leading Committee (MRTLC): rice will only be exported when it is in surplus, exporters must pay a ten percent export tax, and the net export earnings after taxes will be shared between the government and rice exporters on a 50-50 basis. The government will stand for the investment regarding 50% of its share (Min Htet Myat, 2003).

According to the new rice export policy, export tax is not transparent for private rice exporters. However, percentage of rice export on total production was only 3.70 % although total rice production increased in 2003-2004. During 2005-2006, Myanmar's rice was mainly exported to Malaysia (31,000 MT), Indonesia (1000 MT), and Singapore (17,000 MT) in the South East Asia and India (17,000 MT), and Bangladesh (12,000 MT) of the rest of Asia and other countries. The total rice export in 2005-06 was less 2,000 metric tons than total rice export of 182,000 metric tons in 2004-2005 (Table 1.2). Total export volume of rice in 2006 was shown in comparing with world and other Asian rice producing countries in Table 1.3.

Myanmar rice has failed to generate stable export demand and share in percentage of national export and agricultural export value because of its export regime which depended greatly on the government's marketing policies. The export earning of rice decreased from year to year. Table 1.4 showed that the share of rice in total export earning of the agricultural products and national export were 68% and 29% respectively in 1985-86. As against the year 2004-2005, the share of rice in total export earning of the agricultural products was only 12 % and share of national export was only 1%.

1.1.2 Situations of Rice Production in Ayeyarwaddy Division

In Myanmar, rice stands as a crop with a comparative advantage and can be grown in various parts of the country. Regarding the rice production, Ayeyarwaddy, Bago Divisions and Mon State are major rice producing and surplus areas at the lower part of Myanmar. Magway, and Mandalay Divisions and Chin State are the rice deficit areas and Sagaing Division is the surplus area in central Myanmar. Paddy surplus and deficit situation of States and Divisions were shown in Figure 1.2.

Table 1.2 Destinations of Myanmar Rice Export ('000 MT)

Country of Destination	1985-1986	1990-1991	1995-1996	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
South East Asia	182	15	261	20	46	367	321	78	28	49
Rest of Asia	149	66	44	23	174	55	35	53	48	31
Middle East	-	3	-	-	*	367	350	33	66	90
America	20	10	26	-	-	8	31	*	-	-
Europe	43	-	-	12	6	57	14	4	31	1
Africa	210	40	23	-	25	-	-	-	-	9
Oceania	-	-	-	-	-	85	42	-	9	-
Total	604	134	354	55	251	939	793	168	182	180

* = Negligible amount

Source: CSO (2005)

Table 1.3 Rice Productions and Export of Myanmar and Neighboring Countries (2006-2007)

Country	Sown Areas (million ha)	Yield (MT/ha)	Total Production (million ton)	Export ('000MT)
World	**152.53**	**4.15**	**632.46**	**28796.5**
Asia	**137.35**	**4.18**	**574.28**	**18395.9**
Myanmar (2006-07)	8.13	3.84	30.98	14.5
Thailand	10.08	2.91	29.32	7012
Vietnam	7.32	4.90	35.89	2270.5
Indonesia	11.41	4.78	54.49	216.9
Malaysia	0.65	3.34	2.16	144.4
Phillipine	4.17	2.14	15.35	12.3
Laos	0.73	3.62	2.66	-
Cambodia	2.51	2.49	6.27	6.5
China	29.10	6.27	182.34	1088.9
Bangladesh	11.21	3.91	43.80	9.2
India	43.71	3.13	136.74	3891

Source: MOAI (2008)

Table 1.4 Rice Share in National Export and Agricultural Products Export Values (1985-1986 to 2004-2005)

(Unit = kyat in million)

Year	National Export Value	Agricultural Products Export Value	Rice Export Value	Share Percentage	
				Col. (4)/2	Col.(4)/3
(1)	(2)	(3)	(4)	(5)	(6)
1985-1986	2653.90	1126	763	29 %	68 %
1990-1991	2961.91	942	251	8 %	27 %
1995-1996	5043.78	2321	126	2 %	5 %
1997-1998	6446.78	1952	167	3 %	9 %
1998-1999	6755.84	1890	65	1 %	3 %
1999-2000	8947.30	1602	208	2 %	13 %
2000-2001	12736.05	2312	754	6 %	33 %
2001-2002	17130.73	3021	633	4 %	21 %
2002-2003	19955.06	2808	131	1 %	5 %
2003-2004	14119.16	2343	180	1 %	8 %
2004-2005	16697.31	1823	214	1 %	12 %

Source: CSO (2005)

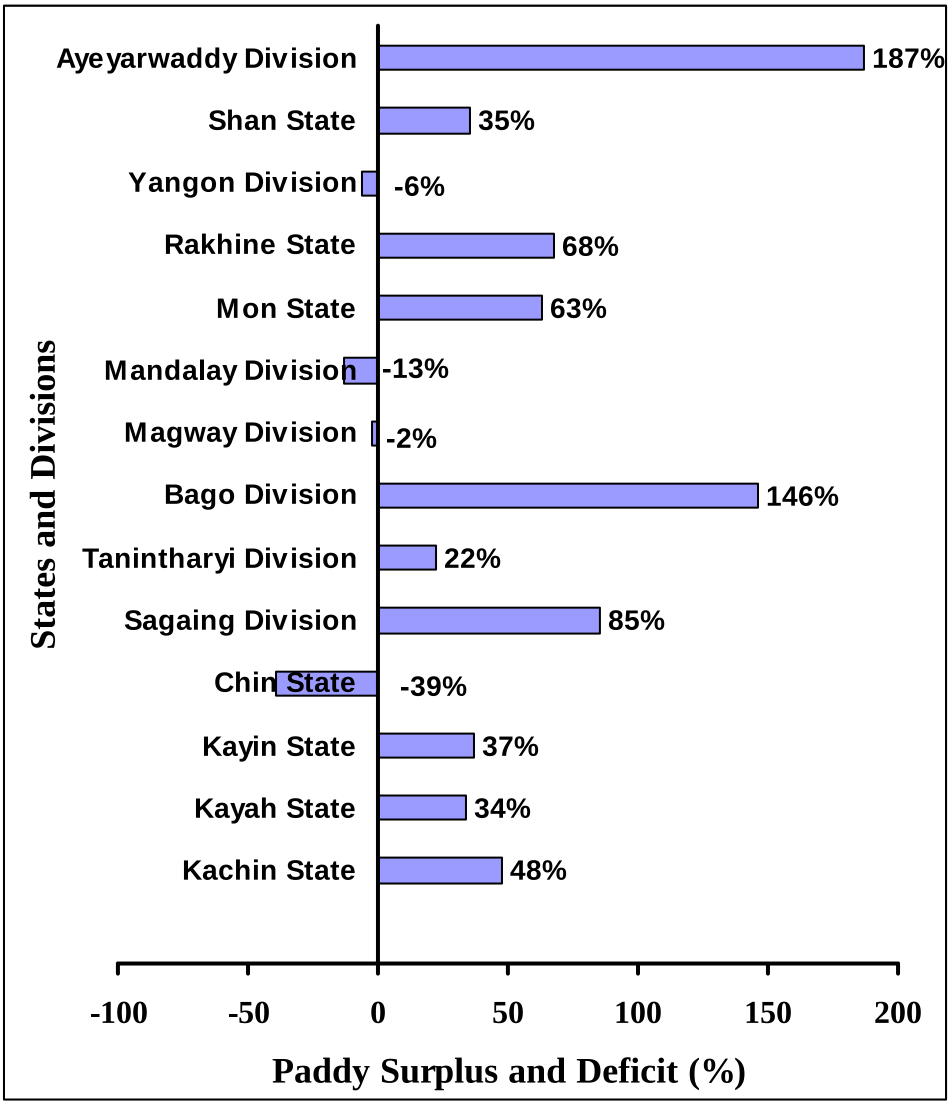

Figure 1.2 Marketed Surplus Percentages across the Administrated Regions, 2006-2007

Source: Own Estimation Based on Appendix 1

According to the report (http://www.chinaview.cn, 2008), 22 private companies had been allowed to export only 400,000 tons of surplus rice as the plan to stabilize the domestic rice market in 2008. The surplus rice, granted to private export, had been produced from three main surplus areas of Myanmar which are Ayeyarwaddy, Bago, and Sagaing Divisions.

Ayeyarwaddy Division is one of the main-surplus rice producing areas where ecological environment is favorable for rice production and mainly supplies not only to the domestic but also to the international markets. The majority of rice production of Ayeyarwaddy Division contributed about 24.42% of the total rice sown areas in 2006-2007. In this division, total rice sown areas were increased from 0.52 million hectares in 1989-1990 to 1.98 million hectares in 2006-2007 that comprise of 1.48 million hectares of monsoon paddy and 0.5 million hectares of summer paddy respectively. Yield per hectare was also increased from 3.25 tons/ha in 1989-1990 to 4.10 tons/ha in 2006-2007. Therefore, paddy production was increased from 1705.09 thousand tons in 1989-1990 to 8161.92 thousand tons in 2006-2007 (MOAI, 2008).

Ayeyarwaddy Division is growing not only the indigenous rice varieties but also the improved high yielding varieties in order to fulfill the demand for domestic and international markets. The varieties sown in Ayeyarwaddy Division consist of Ayeyarwaddy Pawsan, Phyapone Pawsan, Pawsanyin, Sinthwelatt, Theehtatyin, Shwethweyin, Shwewarhtun, Yatana-aung, Medone, Meekauk, Manawthukha, and many other rice varieties. Among these varieties, Pawsan variety is known as quality rice variety and it receives the highest price while Ngasein is the cheapest variety in the markets. Therefore, during a few past years under the market oriented economy, some farmers endeavored to grow the high quality rice to get a good price in Ayeyarwaddy Division.

1.2 Rationale of the Study

Achievement of self sufficiency and production of an exportable surplus in rice to boost Myanmar's foreign exchange earnings has been the government's policy goals because of the economic and political importance of rice in Myanmar. Generally speaking there is no substitute food for rice and the domestic use is also increased gradually.

The contribution of rice production to economic development in Myanmar depends to a considerable extent on their economic efficiency in terms of comparative advantage of domestic production and export marketing. Rice is the crop in which Myanmar has comparative advantage, and price stabilization for food sufficiency can be achieved by various inward policies (Fujita and Okamoto, 2006). National income can be increased through policies encouraging farmers to produce commodities that can exploit existing patterns of comparative advantage. This study analyzed the comparative advantages of the exported rice varieties (Pawsan and Manawthukha) in order to ascertain whether Myanmar is an efficient producer of these exported rice varieties or not by using Domestic Resource Cost (DRC) analysis.

Rice production and processing activities can provide the main source of income and employment opportunities for million of rural households in Myanmar. The majority of Myanmar rice farmers are still being lived at subsistence level because not only the farmers' actual yield is still lower than potential yield but also they have not enough money to invest in rice production and marketing activities when compared with other rice producing countries.

Cost and return of rice productions are the important factors to select the suitable varieties for farmers. The production costs and product prices are not equal between varieties, qualities and also among regions. There are many differences between productions of Pawsan and Manawthukha rice varieties regarding with capital investment, use of labor, use of fertilizer, water and weed management, insect and pest control, etc. Regarding with domestic rice marketing, Manawthukha has strong and high domestic and international demand at reasonable price while Pawsan has favorable demand at high price in both domestic and international markets. However, as the traditional rice variety, yield of Pawsan is relatively lower than of the high yielding variety, Manawthukha.

Although Pawsan is denoted as quality rice and high price received rice, its production and export are fewer than of Emata variety. Myanmar is chiefly exporting the Emata variety including Manawthukha and Zeya, and the traditional quality rice variety, Pawsan is also exporting with little amount to international markets such as Malaysia and Singapore.

Wholesale prices of Pawsan and Manawthukha rice in Yangon Bayintnaung Wholesale market, and Pathein and Phyapone markets during 2007 were shown in Fig.1.3, 1.4, and 1.5.

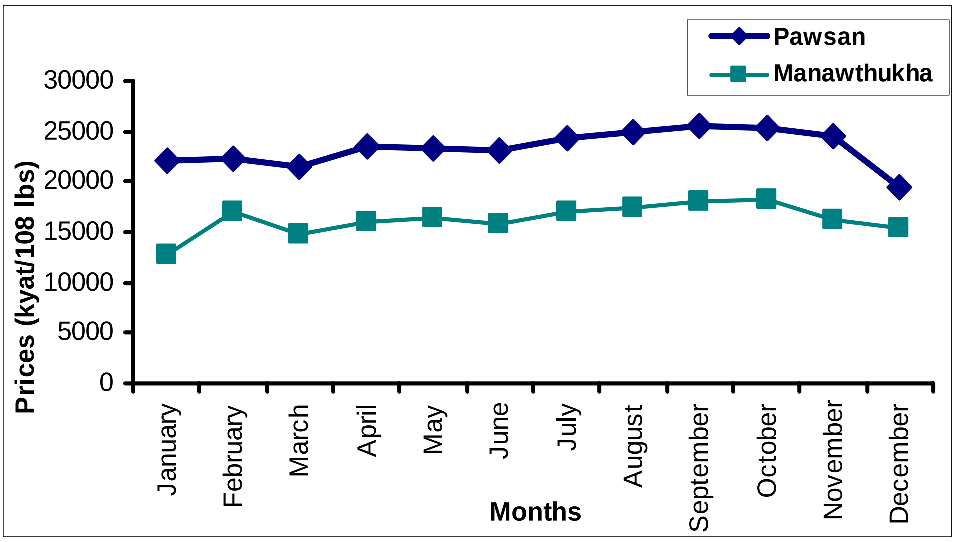

Figure 1.3 Prices of Pawsan and Manawthukha in Bayintnaung Market, 2007

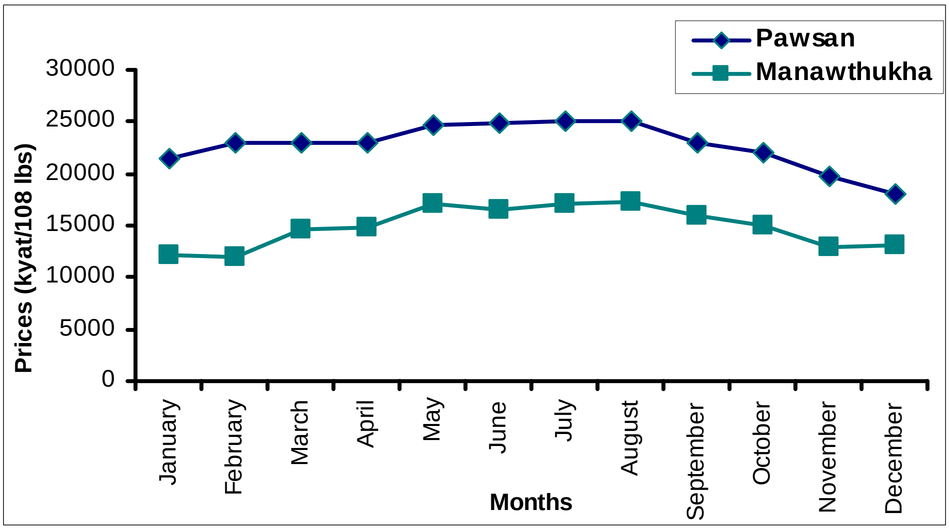

Figure 1.4 Prices of Pawsan and Manawthukha in Pathein Market, 2007

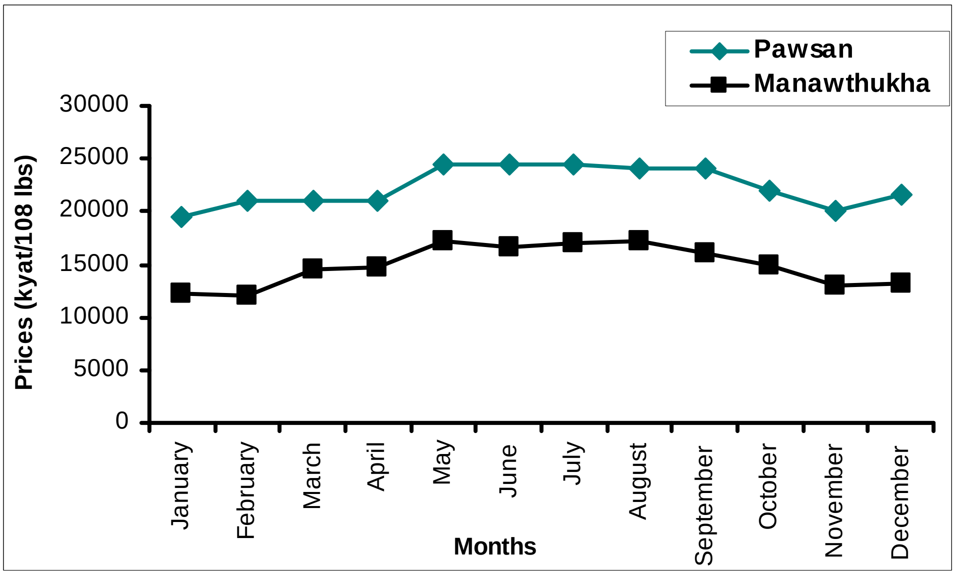

Figure 1.5 Prices of Pawsan and Manawthukha in Phyapone Market, 2007

Source: MIS (2007)

In January 2008, wholesale prices of Manawthukha were 15387.5 kyats in Yangon, 12600 kyats in Pathein and Phyapone markets respectively. Wholesale prices of Pawsan in this month were 21500 kyats in Yangon, 19937.5 kyats in Pathein and 20000 kyats in Phyapone markets. These wholesale prices were values for one bag of rice which contained 108 lbs weight. According to the rice variety and quality, there is price variation in the domestic markets.

Due to the nature of the state marketing sector to place importance for quantity supplied rather than the quality, Myanmar was unable to meet demands for wide range of quality to expand the export. The volume of rice export is constrained by poor grain quality, inadequate processing and marketing infrastructures, limited investment in irrigation and expansion of rice areas, little provision of chemical fertilizers to farmers and underdeveloped trading system, as well as marketing policies. If these factors would be overcome, Myanmar rice production has much more potential relative to the other rice producing countries and it is likely to increase their export substantially in the future. Rice export will bring the incentives to the farmers through the international market price signal.

The current international rice trade is highly competitive and only high quality rice will be able to offer a price premium both the domestic and the export markets. Therefore, Myanmar rice sector should be examined either exported quality rice variety (Pawsan) or high yielding rice variety (Manawthukha) occupies more comparative advantage by comparing the domestic resource cost ratio. The analysis of the comparative advantage can provide in deriving meaningful policy conclusions on how to reorient the farming system towards more efficient crop activities.

1.3 Objectives of the Study

The overall objective of this study is to ascertain whether Myanmar is an efficient producer of the exporting rice varieties (Pawsan and Manawthukha) in terms of internationally comparative advantage.

The specific objectives are as follows: ---

(1) To compare the current comparative advantages of selected rice production by using Domestic Resource Cost (DRC) ratio;

(2) To determine the effects of government intervention policies on the private and social profitability of rice production; and

(3) To study the effects of changes in the key variable factors such as different yield levels, world prices, and exchange rates of selected rice varieties on DRC ratio.

1.4 Hypotheses of the Study

Based on the objectives of this study, the concerning hypotheses are outlined as follows: ---

(1) If the opportunity costs of domestic factors are less than border prices, the country will have comparative advantage in the production of that crop;

(2) There are no significant differences between the production and exporting activities of the selected rice varieties; and

(3) If there is no restriction in rice marketing and exporting, rice productivity and welfare of the rice producers will be improved.

CHAPTER-II
LITERATURE REVIEW

2.1 Theory of Comparative Advantage

Knowledge of comparative advantage is important for developing countries, because potential welfare gains from specialization and trade can be used to foster economic growth (Morris, 1990). The principle of comparative advantage has been central to trade theory, demonstrating the gains from trade. A country has a comparative advantage over another if a commodity was produced at a lower opportunity cost in terms of the foregone alternative commodities that could be produced (Todaro, 1989).

Comparative advantage indicates whether it is economically advantageous for a country to expand production and trade of a specific commodity (Warr, 1994). The principle of comparative advantage according to Samuelson (1975) is perhaps the only proposition in all of the social sciences which is both true and non-trivial 1. It provides an explanation of specialization and gains from trade and, viewed as a positive theory, yields predictions about the direction and the terms of trade.

Applied comparative advantage analysis essentially seeks to answer the following question: for a given country or a region, which is relatively most efficient among a set of alternative production activities in terms of contribution to national income, ignoring the effects of distortions in the economy resulting from government policies and market failures? Relative efficiency in production and hence comparative advantage – depends on three factors; (1) technology, (2) the resource endowment, and (3) international prices (Morris, 1990).

Measures of comparative advantage are the most useful guides to optimal resource allocation in an open economy where international trade is vitally important. Economists have been applying the principle of specialization and comparative advantage to explain the theory of international trade for which the concepts of relative cost and price differences are basic. The doctrine of comparative advantage has been one of the most powerful influences upon economic policy making. Economic planning of a country always involves identification of the sources of comparative advantage with respect to world market. Because comparative advantage measures could indicate the economic efficiency of resource allocation in the production of traded commodities at the national level (Yang, 1965).

The theory of comparative advantage was generally attributed to Ricardo (1817), who first extended the optimization principle defining efficient choice of output by firms into the arena of international trade. In the theory of comparative costs, David Ricardo suggested that countries will specialize and trade in goods and services in which they have comparative advantage. It is easy to see that if countries have an absolute advantage there are advantages to trade. If a country is able to produce more of a good or service with the same amount of resources or the same amount of a good or service with fewer resources, it has an absolute advantage over its trading partners.

Ricardo invoked factor endowments to explain why Portugal exported wine and Britain cloth. Subsequently, the principle of comparative advantage had come to be accepted as an almost universal law of economics.

While Ricardo placed emphasis on physical and natural influences over competitiveness, technological and human factors were given weight by later economists. A reading of the literature on comparative advantage, reveals the continuity of the theoretical development from Ricardo (1817) via and Marshall (1919) to Heckscher (1965), Ohlin (1953) and Samuelson (1975).

The modern treatment, and a foundation for much empirical work, began with the Heckscher-Ohlin model. This model explained the international division of labor in terms of different endowments of different countries with two factors of production-labor and capital. The two fundamental hypotheses of the standard Heckscher-Ohlin model were that factors of production are immobile between countries and these factors are used in different combinations to produce different goods. A country will then possess a comparative advantage in good X if the country is relatively well endowed with factors that are used intensively in the production of X.

The Heckscher-Ohlin two-factor model lends itself to easy presentation and the analytical-geometrical extensions devised by Samuelson (1948) and Meade (1953) had become a standard feature of modern textbooks. Samuelson and Lerner (1952) model showed that commodity price equalizations must lead to full equalizations of the prices of the completely immobile factors that each country is endowed with, if technology is identical, both countries produce both goods and "factor intensity reversals" are ruled out.

The Lerner-Samuelson model was used by Robinson (1956) and Johnson (1968) to rigorously deduce the conditions under which a country with a relatively abundant endowment of a factor would export the commodity in which this factor is used relatively more intensively. In the Lerner-Samuelson model, both factors are regarded as freely transferable between sectors within a country. Alternatively, it is possible to identify a specific input in each sector, such as wheat-land and cotton-land, and another factor such as labor which is freely transferable between both sectors.

Empirical support for modified versions of the theory of comparative advantage was also evident in the work of Haley and Abbot (1986). Their model had identified that relative agricultural prices, income and saving behaviors together with resource availability and allocations (including the level of capital accumulation) help account for flows of trade. Changes in the trade mix over time are attributed to changes in production and consumption behaviors, although differing initial conditions are important, and are used to explain differing production responses. Regressions conducted by Haley and Abbot yield a number of interesting results regarding trends in agricultural production and trade. They showed that natural resource or raw land potential did not explain inter-country differences in agricultural production and that only improved land contributes to agricultural comparative advantage. Land development costs had a significant effect on the productivity of agricultural capital and underline the importance of past investments.

Comparative advantage refers to economic efficiency of different kinds of production within the domestic economy, which are compared in terms of earning or saving a unit of foreign exchange. The costs of producing a commodity are compared to the costs incurred in an alternate domestic activity. The opportunity cost of foreign exchange is a good measure of the next best alternative activity since it indicates what the country as a whole would have to give up in terms of domestic currency to obtain an additional unit of foreign exchange (Tsakok, 1990).

Kannapiran e*t. al*. (1999) estimated the comparative advantage and competitiveness of rubber production in Papua New Guinea (PNG). Their findings suggested that the advantages gained at the farm level are lost during processing and marketing. They also found a wide gap between the two measures. This gap was due to high level of distortions and inefficiency in the domestic economy, mainly due to the inefficient non-traded service sector.

Dearorff (1984) identified that comparative advantage needs not to be based on low cheap domestic resources alone; it can also be achieved because market innovations and higher productivity of factors.

Jabra and Thomson (1980) studied the comparative advantage in the agricultural sector in Senegal under international prices uncertainty. They showed that the pattern of comparative advantage was less clear cut when the price and yield have uncertainties. They also indicated that comparative advantage was influenced by relative weight that planners attached to risk from different sources. Comparative advantage is a static concept but its measure is variable. It changes according to changes in market signals and the adoption of new technologies among other things. This is evident not only a problem with a concept but also with the input data and method used to test the sensitivity of measure. However, it suggested the need for careful processing of input data and adoption of methods to ensure conceptually appropriate results.

A key problem is that the notion of comparative advantage is essentially static and refers to the optimization of resource allocation at a given time. It aims to identify the configuration of products that a country can produce existing factor endowments and technologies and assuming free trade. The emphasis on national resource allocation may mean that a country can lose its competitiveness in some product relative to another country, and yet the production of that product may still be in accordance with the country's comparative advantage (Goldin, 1990).

2.2 Review of Selected Empirical Studies of Policy Analysis Matrix (PAM)

The Policy Analysis Matrix (PAM) is a simple computational framework, developed by Monke and Pearson (1989) and augmented by Masters and Winter-Nelson (1995), for measuring input use efficiency in production, comparative advantage, and the degree of government interventions (Mohanty *et. al*, 2002). PAM is suitable for agricultural price policy and efficiency. The economic analysis of profitability of the technology was analyzed using marginal analysis and Policy Analysis Matrix (PAM).

The PAM framework involves the derivation of several important indicators of protection and comparative advantage. The first one defines profit as the difference between revenues and costs, measured in either private or social terms. The second identity measures the effects of distortions (distorting policies and/or market failures) as the difference between observed values and social values as indicated by the divergences raw in the PAM. These divergences are approximations because social values are evaluated at the initial distorted levels of outputs and inputs. Hence, the PAM provides guidance for incremental changes rather than wholesale ones.

The first row of PAM matrix provides a measure of private profitability, defined as the differences between observed revenues and costs valued at actual market prices. The measures reflect transfers and taxes. They show the competitiveness of the agricultural system, given current technologies, output values, input costs, and policy transfers. The second row of the matrix calculates social profitability measured at “social” prices that reflect social opportunity costs. Efficient outcomes are achieved when an economy aligns its private price signals to social prices. Social profits measure efficiency and provide a measure of comparative advantage. At the margin, a positive social profit indicates that the system uses scarce resources efficiently and the commodity has a static comparative advantage. When social profits are negative, a sector cannot sustain its current output without assistance from the government, with a resulting waste. The cost of domestic production exceeds the cost of importing at the margin.

PAM is not useful for analyzing products that are not traded internationally since, by definition, there is no export price. In addition, it should not be applied to countries that make up a large share of world trade, since the world price would not be exogenous (and therefore not an efficiency price). However, for the majority of product-country combinations, these conditions are not relevant (Tsakok, 1990).

Fang and Beghin (1999) assessed the comparative advantage and protection of China’s major agricultural crops, early indica rice, late indica rice, japonica rice, south wheat, north wheat, south corn, north corn, sorghum, soybeans, rapeseed, cotton, tobacco, sugarcane, and a subset of fruits and vegetables using a modified Policy Analysis Matrix (PAM). The results strongly suggested that China had a comparative advantage in labor-intensive crops, and a disadvantage in land-intensive crops. Specifically, land-intensive oilseed crops (soybeans and rapeseed) and grains (wheat, corn, and sorghum) were less socially profitable than were labor-intensive fruits and vegetables, tobacco, cotton, and japonica rice. Within the grain sector, high quality rice and high quality north wheat had more comparative advantages than early indica rice and south wheat, respectively.

Yao (1997) analyzed the effects of government policies on diversification of products by using Policy Analysis Matrix (PAM). He concluded that the government input subsidies and relative high prices had caused farmers to substitute other product for rice.

Huang *et. al*., (2002) viewed the economic competitiveness of sweet potato in China by using the PAM. Their results showed that the policy distortions have penalized sweet potato relative to maize. The extent to which sweet potato can substitute for maize in pig feed will depend on the direction of future policies, the pace of structural change in pig production, and on technology developments affecting the two crops. If productivity growth in sweet potato continues to lag behind that of maize and other feed crops, we can expect to see the use of sweet potato for pig feed gradually decline, even in household ' back Yard' pig production. Increased investment in sweet potato research and extension and removal of the current policy distortions are steps for realizing sweet potato's potential in China's agricultural economy.

Mohanty *et. al*., (2002) studied an application of Policy Analysis Matrix (PAM) approach to assess the efficiency of cotton production in five major producing states in India. The results indicated that cotton is not efficiently produced in the Maharashtra, second largest cotton producing state in the country. Without government interventions in this state, it is likely that acreage will move away from cotton to more profitable crops such as sugarcane and groundnut, they have significant comparative advantages in that state over cotton. In addition, they concluded that cotton is not the most efficiently produced crop in the other four states, however, there is at least one crop in each state that is less efficiently produces than cotton. These findings suggested that Indian policies directed at maintaining the availability of cheap cotton for the handloom and textile sectors have induced major inefficiencies in the cotton sector.

Hussain *et. al.*, (2005) measured the comparative advantage and the competitiveness and allocative efficiency of small farmers in Faisalabad Division, the central Punjab. This study focused on the production of major crops namely, rice, wheat, sugarcane, and cotton in the central Punjab to provide empirical support to the policy makers. The PAM analysis showed that rice and cotton have comparative advantage both at import and export parity prices. Both crops are highly competitive and are not protected through subsidy. Both crops have private profitability. Wheat and sugarcane had no comparative advantage at export parity prices but showed comparative at import parity prices. However, both crops showed negative private profitability.

Najafi (2005) studied the effect of government policies on wheat production in Iran with the application of Policy Analysis Matrix (PAM). He used the time series data from 1990 to 2001 period extracted from national survey. The result revealed that the Iranian government policies have had negative impact on wheat producer's income. This result caused decreasing the cultivated area and increasing import sharply toward the end of period under study. Finding of this study also indicated that wheat producers could earn higher profit in the absence of government intervention. The result of sensitivity analysis indicated that among income factors, changes in yield per hectare as well as foreign exchange value had greatest effect on comparative advantage of wheat.

San Thein and Oppen (2002) assessed comparative advantages of Myanmar Sugarcane Production relation to other major crops, rice, maize, and green gram, world sugar prices, and macro policies. They formulated recommendation for policies adjustments in sugar sub sector of Myanmar by using Policy Analysis Matrix (PAM) approach. They suggested that sugarcane offered the least comparative advantage and green gram the highest, and rice and maize in between the two crops. The sugar recovery of the private sector was two-fold lower than of the state- owned factories. The authors suggested that Myanmar sugar industry required a great deal of policy adjustment to enhance competitiveness. The state sugar sector would need improvement in economic efficiency, provision of incentives to cane growers and adoption of market prices in both purchasing cane and selling sugar. And the private sugar sector would need improvement in technical efficiency which could be made possible only when the long term investment could be guaranteed and encouraged the private entrepreneurs. They finally recommended that a sound sugar policy should be formulated to serve the interests of primary producers, entrepreneurs, consumers and the whole state.

2.3 Selected Empirical Studies of Comparative Advantage by Using Domestic Resource Cost (DRC) Analysis

Relative comparative advantage across countries is measured by ranking each country's ratio of the domestic resource costs (DRC) per unit of foreign exchange earned or saved to the shadow price of foreign exchange. A country has a comparative advantage in the production of a specific commodity if the social opportunity costs of producing an incremental unit of that commodity are less than its border price. DRC was calculated by rearranging the discounted results of the financial and economic analyses. The DRC compared the opportunity costs of domestic factors to the value added at border prices. The domestic factors are land, labor, and capital and the value added is equal to the revenues minus the costs of tradable input.

The Domestic Resource Cost (DRC) framework generates quantitative indicators of the efficiency of using domestic resources to produce a given commodity, as measured against the possibilities of trade. These quantitative indicators provide an empirical measure of comparative advantage. At the same time, the analytical framework also allows measurement or the distortion effects of government policies.

The DRC method is based on the principle of exchange rate through a particular commodity. In an open economy with frequent external balance problems, the rate at which the domestic resource costs are converted into foreign exchange for a given level of official exchange rate (OER) or shadow exchange rate (SER) is crucial. This link between primary commodity exports and the exchange rate relates to the important role of the traded goods sectors in achieving macroeconomic growth and stability.

Within countries, the DRC approach allows a comparison of the relative efficiencies of regions of productions or of alternative technologies. International comparisons of efficiency are derived from the ranking of the regions or techniques with the lowest DRC coefficients in each country. Although the DRC does not capture the effects of technical change, technological change influences the patterns of comparative advantage (and DRC coefficients) in the future.

Leung and Cai (2005) studied the appraisal of two approaches commonly used in the economic literature for comparative advantage assessment. One is the "domestic resource cost" (DRC) approach and the other is the "revealed comparative advantage" (RCA) approach. They attempted to review the concept of comparative advantage and discussed two approaches of comparative advantage assessment in the context of aquaculture development.

Scandizzo and Bruce (1980) viewed that the main determinants of the DRC ratio and benefit-cost (B/C) ratio were relative yields and relative border prices where land and labor requirements for different crops within specific areas do not vary substantially. In such cases, the analysis of comparative advantage or competitiveness can be simplified by comparing the border prices multiplied by the yields for each crop. However, benefit -cost ratio was as much as easy to calculate and it was not necessary to clear which were domestic resources and which were foreign resources.

Baulita-Inncencio and David (1995) studied comparative and competitive advantage of rice production in Phillipine. Their analysis suggested that if price distortions that bias incentives against rice production are removed, the country may be able to maintain rice self-sufficiency, at least in the medium term. Over the long-term, however, public investments for raising productivity are essential for maintaining the country's comparative advantage particularly for rice research and extension.

Morris (1988) determined whether or not Zinbabwe had a comparative advantage in wheat production using DRC framework of analysis. Comparison of private and social profitability revealed that agricultural policies in Zinbabwe provided disincentive for commercial farmers, since private profitability was less than social profitability for all major commercial crops. In other words, government policies were taxing away a portion of the social profits. However, this tax occurred across all commodities with similar incidence, so the relative ranking among crops in terms of private profitability was not greatly altered from the ranking in terms of social profitability.

Probably the most common use of DRC analysis is to determine comparative advantage between alternative enterprises, whether cropping activities or other types of agricultural production activities. A good example of this use of DRC analysis appeared in Byerlee's (1985) study of wheat in Ecuador. This study was motivated by the Ecuadoran government's concern over the sharp decline in wheat production which occurred during the late 1970s and early 1980s, at a time when wheat consumption was increasing rapidly. Policy makers interested in determining whether or not wheat production represented an efficient use of the nation's resources. Wheat in Ecuador competed with three alternative enterprises: barley, potatoes, and dairying. According to 1983 data, potato production represented the most efficient use of Ecuador's domestic resources, followed by wheat production, dairying, and finally barley production. In this study, government policies including a vastly overvalued exchange rate and differential import tariffs across commodities were found to discriminate strongly against wheat, which was the least profitable of all crops from the farmer's point of view.

Byerlee and Longmire (1986) focused on wheat in Mexico to estimate the influences of government policies on producer incentives and to determine Mexico's pattern of comparative advantage in wheat production by using Domestic Resource Cost (DRC) analysis. Wheat was produced in two widely separated regions of Mexico: the northen irrigated Yaqui Valley (located far from major consumption points), and the central rainfed high plateau or *altiplano* (located adjacent to major consumption points). The resource cost ratio for wheat in Sonora (Yaqui Valley) was close to 1, indicated that the value of domestic resources invested in wheat production was approximately equal to the net value added to tradable.

In contrast, the resource cost ratio for wheat in Tlaxcala (*altiplano*) was well below 1, indicated that the value of domestic resources invested in wheat production was less than the net value added to tradable. Their final findings suggested that wheat production in the *altiplano* region was slightly more efficient than in the Yaqui Valley. In addition, the results appeared to justify a government initiative to revitalize wheat production in an area where production had been declining.

Longmire and Lugogo (1989) determined the comparative advantage between alternative productions technologies used in wheat production of Kenya by using DRC analysis. Wheat was produced in Kenya on large-scale commercial farms using high levels of purchased inputs and machinery. The Kenya government was interested in expanding wheat production into the smallholder sector, which would necessitate a shift to less capital- intensive production technologies characterized by greater use of animal power and/ or human labor. DRC analysis was undertaken in an attempt to assess the relative efficiency of these proposed smallholder production technologies under a range of farm size. The results suggested that labor-intensive production technologies were socially profitable in Kenya for smallholder wheat producers with restricted access to land (0.5 ha and 1 ha). However, in the absence of constraints on farm size, wheat production was remained most efficient on larger land holdings (>4 ha) where levels of mechanization were feasible.

Mbiha *et. al*., (1998) analyzed the comparative agricultural economic advantage and the extent of policy distortion in alternative agricultural production activities in various agro climatic zones and farming system in Tanzania. The results of DRC suggested that Tanzania possesses comparative advantage in the production of Southern highlands Coffee, Western zone Cotton and Morogoro Rice. The authors also found that the country has comparative disadvantage in production of Northern highlands Coffee and Morogoro Maize.

Reddy *et. al.,* (2005) studied the global competitiveness of the two median-quality Indian rice by using PAM and the same results were obtained in their trade competitiveness. After the calculation of Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), and Domestic Resource Cost (DRC), this study showed that liberalization will benefit the rice sector in terms of giving farmers a better deal. Consumers may have to pay a higher price because of the limited domestic supply and increase in prices. The positive impact on the farming community may lead to more efficient rice production and in the process increase the export prospects of rice.

Gonzales *et. al.,* (1984) measured the comparative advantage in the production of food crops in the Philippines by comparing border prices with the social or economic opportunity costs of production, processing, transportation, handling and marketing on incremental unit of the food commodity. If the opportunity costs were less than the border price, that country had a comparative advantage in the production of that commodity. They used three indicators of comparative advantage: net social worth, the DRC ratio and the resource cost ratio.

Talat (1999) investigated that the production opportunities, marketing efficiency, and options of trade for fruits and vegetable in Palestine. Talat discussed the comparative advantage of producing fruits and vegetables in the West Bank using DRC method described by Monke and Pearson (1989) through the policy analysis matrix (PAM) methodology.

Chung-Gil and Weiguang (2004) analyzed the comparative advantage of Japonica rice between China and Korea by comparing domestic production cost to estimate production and trade of future correctly. After comparing the cost and its structure, it was found that the production of Japonica in China had more comparative advantage obviously. Japonica production cost of Korea is about 5-6 times than that of China. They forecasted that the gap between two countries would become smaller in the long term, while the inferior advantage of Korea could not be changed during short-mid term. The authors suggested that some measure should be adopted to develop the competitiveness of japonica in Korea, such as adjusting agricultural structure, enlarging the land scale, and making quality differentiation.

Shahabuddin and Dorosh (2002) examined the relative efficiency of production of crops in Bangladesh and their comparative advantage in international trade as measured by net economic profitability (the profitability using economic, rather than financial costs and prices), and the domestic resource cost (DRC) ratio (the amount of value of non-tradable domestic resources used in production divided by the value of tradable products). The economic profitability analysis demonstrated that Bangladesh had a comparative advantage in domestic production of rice for import substitution. However, at the export parity price, economic profitability of rice was generally less than economic profitability of many non-rice crops, implying that Bangladesh had more profitable options other than production for rice export.

Oppen *et. al*. (1995) examined the economic potential of soybean production for the domestic markets by applying DRC analysis in West Africa, based on data from Nigeria, Ghana and Cote d'Ivoire. The results of the study showed that there was a comparative advantage for soybean production under existing production practices in Nigeria and Ghana if average yields of at least 1MT/ha could be harvested. The production of soybeans through the project approach in Cote d'Ivoire did not have a comparative advantage at the yield of 2.2MT/ha. In addition, the project in Cote d'Ivoire was using more foreign exchange than the value of the crop contributes to the economy, thus leaving questionable the continuity of production once the project phases out in this country. Research to come up with high yielding adapted varieties and labor saving production practices could further improve the comparative advantage in Nigeria and Ghana.

In Myanmar, DRC analysis and PAM were applied for estimating the effects of government interventions on sugarcane production, and for determining the comparative advantage of sugarcane production and export marketing in the selected state-owned sugar mills (No.2 and No.3) areas in Pyinmana township (Dolly Kyaw, 2000). The results showed that there was a comparative advantage for sugarcane production at present production practices and world reference prices of US$ 262.5

and 315. Sugarcane production in Myanmar has a potential to increase the income of sugarcane producer as well as to contribute to foreign exchange earnings. However, expansion of sugarcane production especially in the state-owned sugar mill areas cannot provide the full benefit to the state due to the output price distortion together with overvalued exchange rate which against the welfare of sugarcane producers in Myanmar. The sugarcane enterprise faced with the challenge for maintaining comparative advantage in producing sugarcane and it deserved continue government supports of not only tradable inputs but also domestic factors.

Aye Aye Mon (2002) studied the long-run comparative advantage of black gram (Vigna mungo) and green gram (Vigna radiate) in four study areas, Pyinmana, Hinthada, Thonegwa, and Magway in Myanmar. The purpose of this study was to determine whether Myanmar was an efficient producer of these pulses in terms of internationally comparative advantage. The results indicated that the green gram and black gram in four study areas were financially and economically viable under current conditions. The results of PAM revealed the need for economic reform to liberalize the economy further and to remove distortions caused by direct and indirect effects of government intervention on agriculture incentives. This study also showed that the resources for green gram and black gram production were efficiently allocated to the national welfare.

Swe Mon Aung (2006) studied the economic potential and its comparative advantage of kenaf growing in Taungoo, Hinthada, and Maubin Zones of Myanmar. DRC and PAM were used to measure the comparative advantage of kenaf with other alternative crops. According to the result of DRC and PAM, all selected crops have comparative advantages. Other alternatives had both private and social profits. Producers were implicitly taxed on their output and tradable inputs used. However, they obtained subsidies on their domestic factor costs. Kenaf and jute production were not profitable to growers because of high labor cost, lack of improved variety, lack of high technologies for fiber extraction and low procurement prices as a result of market failure and policy distortion. But kenaf and jute were profitable at the social price. Other crops such as pulses, maize and paddy were profitable at both private and social prices. Kenaf, jute, all pulses, paddy and maize had comparative advantage to compare with other trading partners. It means that the domestic resources for the production were efficient to national welfare.

CHAPTER-III
RESEARCH METHODOLOGY

3.1 Data Sources and Data Collection

This study was based on both primary and secondary sources of data. The survey was carried out during January 2008. Stratified random sampling method was employed to organize the data for the farm survey and farmer was considered as sampling unit. Pathein and Phyapone Townships were purposively selected due to their large sown areas of Manawthukha and Pawsan rice varieties in Ayeyarwaddy Division. All sorts of technical and socio-economic data such as age, education, family size, farm size, area planted, crop yield, cropping pattern, input- output prices, resources used, marketing costs of selected rice productions were collected by interviewing 60 farmers from 3 villages in Pathein Township and 58 farmers from 3 villages in Phyapone Township.

The import parity prices and export parity prices were estimated by using secondary data such as the FOB (Free on Board) product prices, CIF (Cost, Insurance, and Freight) factor prices, and market exchange rates and wage rates. The secondary data were taken from published and official records of Ministry of Agriculture and Irrigation (MOAI), Myanma Agriculture Service (MAS), Central Statistical Organization (CSO), Food and Agriculture Organization (FAO), Myanmar Rice Trader Association in Yangon and other related documents.

To obtain the data regarding input prices, marketing costs, processing costs, transportation costs, farm gate and wholesale prices of products, 3 retailers, 2 millers, 3 local wholesalers from each township and 4 central wholesalers from Yangon Bayintnaung wholesale market and 3 exporters from Myanmar Rice Trader Association were also interviewed.

3.2 General Description of Study Areas

Ayeyarwaddy Division has the largest rice production areas and is named as "**rice bowl**" of Myanmar. **Pathein** is the city of Ayeyarwaddy Division and **Pathein Township** is one of the largest rice surplus areas in this division at lower part of Myanmar. Surplus rice was marketed to both Yangon and the rice deficit areas, the central part of Myanmar and it was transported to other markets by means of waterway and road. Ayeyarwaddy Pawsan, Pawkywe, Manawthukha, Meekauk, Sinthwelatt, Ayeyarmin, Theethatyin, and other rice varieties were sown in this township. Among them, Ayeyarwaddy Pawsan variety was the most famous variety for its quality and exporting with preferable demand for domestic consumption and oversea trade. The exported Pawsan variety was also known as "**Myanma Pearl Rice**". Common cropping patterns in the survey areas were monsoon paddy- summer paddy and monsoon paddy- pulses. Vegetables and sunflower are also grown in this area.

Phyapone Township is also one of the largest rice surplus areas in Ayeyarwaddy Division. Both traditional and improved high yielding varieties were growing in Phyapone Township. Among these varieties, **Phyapone Pawsan** variety was the main product of this township. It was one of the most famous aromatic rice variety and widely grown in the whole township. Being one of a delta region, monsoon paddy was mainly sown and common cropping patterns were monsoon paddy only, monsoon paddy-summer paddy and monsoon paddy-pulses respectively. Pulses were sown as winter crop and a second important crop of this township.

Sown areas of Manawthukha and Pawsan rice varieties in both townships for 2006-2007 were shown in Table 3.1. Maps of the study areas were depicted in Appendix 2 and 3.

3.3 Methods of Analysis

After collecting the primary and secondary data, they were analyzed with Microsoft Excel program. The Statistical Packages for Social Science (SPSS) software was employed for descriptive analysis of actual farm data. Means and standard deviation of social characters, amount of resources used, production costs, and other required data were calculated.

In this study, comparative advantages in productions of Pawsan and Manawthukha rice varieties were measured by using Domestic Resource Cost (DRC) ratio derived from Policy Analysis Matrix (PAM) approach. DRC method was developed simultaneously by Bruno (1967) and Krueger (1969).

Table 3.1 Sown Areas of Selected Rice Varieties in the Study Areas (2006-2007)

Townships	Sown Areas (ha)		Total Monsoon Rice Areas (ha)	Township's Contribution in Total Monsoon Rice Areas (%)	
	Manawthukha	Pawsan		Manawthukha	Pawsan
Pathein	**10047.35**	**5201.94**	**40316.88**	**24.90**	**12.90**
Phyapone	**532.33**	**24569.00**	**85558.07**	**6.20**	**28.70**

Source: MAS (2008)

Estimation of DRC can be a convenient method of generally assessing the comparative advantage of a single dominant crop by indicating the economic profitability of keeping resources in its production instead of allocating them elsewhere. There are many approaches for calculating DRC. Among them, the estimation of DRC that had been described by Monke and Pearson (1989) derived from Policy Analysis Matrix (PAM) was applied for this study.

The effects of government interventions on the private and social profitability of domestic producers were determined by using Policy Analysis Matrix (PAM) for exported Pawsan and Manawthukha rice productions in Ayeyarwaddy Division. The effects of changes in different yield levels, FOB prices of crops and exchange rates on DRC ratios were examined by conducting sensitivity analyses.

3.4 Steps in Calculating DRC for Pawsan and Manawthukha Rice Varieties in Study Areas

There were six steps in calculating the DRC.

Step 1: Developing Enterprise Budgets

DRC analysis in the selected townships began with the development of an enterprise budget for each production alternative being compared. Budgets were used to compare economic profitability of different production activities or enterprises within or among farms, to indicate whether a proposed change will be profitable under a given set of circumstances, and to explore conditions under which certain farm practices become profitable or unprofitable, in such a way to help for decision making.

Enterprise budgets were prepared to estimate costs, returns and profit per unit area of each of selected rice productions under study areas. Benefit-Cost ratio was calculated by establishing the enterprise budget. One important use of the enterprise budget was to permit opportunity costing of primary factors of production (e.g.; land, labor, and capital). The input and output data and unit price (market prices) were required for calculating the enterprise budgets of Pawsan and Manawthukha rice varieties.

Step 2: Classifying Inputs and Outputs

After enterprise budgets in market prices have been constructed and verified, all inputs and outputs were classified as primary factors (non-tradable) or tradable. This distinction was necessary because DRCs were calculated as the ratio of the total opportunity cost of primary factors and the value added to tradable.

The primary factors were classified as goods that were not normally traded internationally such as land, family and hired labors, manure, cattle, and transportation cost. Non-tradable goods were valued at their returns in alternative opportunities.

Tradable goods were defined as goods that are traded internationally or potentially could be traded. In this study, milled rice, and fertilizers were taken as traded factors and they were valued at their world price equivalent adjusted for transport costs and current market exchange rates.

Step 3: Determining Market Prices and Social Prices

After the tradable and non-tradable inputs were classified, the market prices of inputs were transformed into economic or social prices. Market price is a price at which a good or service is actually exchanged for another good or service as money. Social price is the true economic value of goods and services in the absence of taxes, subsidies, import tariff, quotas, price controls, and other government policies. Accurate estimation of social prices is critically important in DRC analysis, because these prices represent the opportunity costs to the economy of inputs and outputs.

Market prices were used to calculate the private values by means of financial analysis. Social prices of non-tradable and tradable inputs were determined to conduct the economic analysis for the overall economy. All world market prices were converted into national currency to the domestic price level by using a shadow exchange rate factor (SERF). Standard conversion factors were used to measure the economic prices of traded and non-traded components at world market prices.

Social prices were calculated by adjusting the private prices after eliminating the taxes and subsidies and other transfer charges. Social prices were determined differently for primary factors (non-tradable) and tradable inputs. Social prices of traded goods were calculated through border prices. The border price was defined as the price in the international market converted into domestic currency equivalent using an appropriate foreign exchange rate and adjusted it for internal transportation and marketing margins (Tsakok, 1990). For non-tradable inputs such as family and hired labor, manure, seed, capital costs, and transportation costs, social prices were equal to their opportunity costs. The opportunity costs of labor and cattle were estimated by calculating their weighted average values in each township.

For the imported farm items, the border prices were obtained by computing the import parity prices, which were the world market prices in domestic currency obtained after adjusting the transport costs and other market distortions to the domestic markets. In this case, custom duties, port charges, handling costs, and transport costs from port to wholesale markets were added to the based import CIF prices to obtain the wholesale prices of imported items in domestic markets. Transportation costs from wholesale markets to farm gates including intermediary margins were subtracted from the wholesale prices of import and to arrive at the social prices equivalent to the import parity prices.

For the exported farm products, the export parity prices were computed by correcting the world market prices for marketing and transport costs from the farm gates to the international reference markets. In this case, port charges, processing costs and transportation costs from farm gates to port were subtracted from the FOB export prices to arrive at the social prices equivalent to the export parity prices.

Comparative advantage in the production of a given crop for a particular country or region was measured by comparing with its border price and the social or economic opportunity costs of producing, processing, transportation, handling, port charges and marketing an incremental unit of the commodity (Fang and Beghin, 1999). The border price equivalent value adjustments for exported output/input and imported outputs/ imports are shown in Table 3.2.

Step 4: Calculations of Policy Effects

A Policy Analysis Matrix (PAM) was used to measure the impact of government policy on the private and social profitability of economic activity. Policy Analysis Matrix (PAM) was a computational framework, developed by Monke and Pearson (1989) and augmented by Masters and Winter-Nelson (1995), for measuring input use efficiency in production, comparative advantage, and the degree of government interventions (Mohanty *et. al*, 2002).

Table 3.2 Border Price Equivalent Value Adjustments

Outputs Exported Imported	 FOB price CIF price	 less PTDH from farm gate plus TDH to market less TDH market to farm gate
Inputs Imported Export substitute	 CIF price FOB price	 plus TDH to wholesale market less TDH wholesale market to farm gate less PTDH production to port plus PTDH production to farm gate

FOB- Free on Board, CIF- Cost, Insurance and Freight

PTDH- Processing, transport, distribution, handling in economic prices

TDH- Transport, distribution, handling in economic prices

(Source: ADB, 2005)

PAM is suitable for testing agricultural price policy and efficiency. PAM results show the individual and collective effects of prices and factor policies. The PAM analysis also provides essential baseline information for benefit-cost analysis of agricultural investment projects. The data requirements for construction of PAM include yields, input requirements, and the market prices for inputs and outputs. Additional data such as transportation costs, port charges, storage costs, production subsidies,import/ export tariffs, and exchange rates are also required to calculate social prices (Table 3.2).

In Table 3.3, the data for private revenues (A) and costs (B, C) typically were taken directly from enterprise budgets. The entries for social revenues (E) and social tradable input costs (F) were not directly obtained from the enterprise budgets and other related documents. The entries for social valuation of domestic factor costs (G) could also not be observed directly in the field.

The standard conversion factors (SCF) were used to get the social values of outputs, tradable and domestic factors. Conversion factors for tradable inputs and outputs were calculated by dividing the border prices to domestic price at the farm gates. After that, social prices of tradable outputs and inputs were obtained by multiplying the private prices with conversion factors.

The concept of profit was used as a main point of PAM analysis. Cost and return structures were presented in the form of a matrix, which allowed for easy presentation and interpretation results. Policy Analysis Matrix (PAM) was described in Table 3.3 and the interpretation of PAM on policy effects was found in Table 3.4.

Step 5: Calculations of Efficiency Coefficients

In this step, Domestic Resource Cost (DRC) ratio, nominal protection coefficient on outputs and inputs (NPC, NPCI), and effective protection coefficient (EPC) were computed from PAM.

Comparative advantage expressed the efficiency of using resources to produce the products by using a given production technology when measured against the possibilities of international trade. Therefore, Domestic Resource Cost (DRC) was the most important policy indicator to estimate the comparative advantage.

Table 3.3 Policy Analysis Matrix

Value (per ton of commodity)	Revenue	Tradable input	Domestic Factor Cost	Profit
Private prices	A	B	C	D
Social prices	E	F	G	H
Policy effect or divergences	I	J	K	L

Private profit	D = A-(B+C)
Social profit	H = E- (F+G)
Output policy	I = A-E
Input policy	J = B- F
Factor cost	K = C- G
Net policy divergence	L = D-H = I- (J+K)
Domestic Resource Cost ratio (DRC)	= G/ (E-F)
Nominal Protection Coefficient for Revenue (NPC)	= A/ E
Nominal Protection Coefficient for Tradable Inputs (NPCI)	= B/ F
Effective Protection Coefficient (EPC)	= (A-B)/ (E-F)

Source: Monke and Pearson (1989)

Table 3.4 Interpretation of PAM on Policy Effect

Policy effect	Definition	Interpretation
Net policy divergence (L)	D-H	Positive = domestic consumer prices are greater than world market prices or the product is more profitable privately than socially and domestic production is subsidized Negative = domestic prices are less than export parity prices or the product is more profitable socially than privately
Output policy (I)	A-E	Positive = the producers are supposed to receive a subsidy Negative = domestic producers are taxed
Input policy (J)	B- F	Effect of policy distortion from the divergence between domestic and border price of tradable inputs Positive = the private costs of tradable inputs are greater than the social costs. This indicates that the government is probably taxing the price of inputs used by farmers Negative = the private costs of tradable inputs are lower than the social costs. This means that the government is actually subsidizing the costs of inputs.
Factor cost (K)	C- G	Difference between market and economic values of domestic factor costs Positive = the government taxed on domestic factors, which is rarely in developing countries. Negative = the private costs of a domestic factor will be less than the social costs and production is subsidized.

Source: Monke and Pearson (1989)

DRC was the ratio of domestic factor cost required to produce a certain amount of output valued at social prices to the value added created by the same resources at social prices. It was an indication of the total cost of production when prices are adjusted for taxes, subsidies, and market imperfection and resources valued at their opportunity costs.

In other word, DRC showed the price that a country pays in terms of domestic resources in order to save one unit of foreign exchange by not importing the product (or by exporting the product). In calculating DRC, factors of productions and outputs were differentiated each into tradable and non-tradable.

The formula of DRC ratio is

$$\text{DRC} = \frac{\text{(Value of non- traded inputs, DRCs)}}{\text{(Output value) - (Value of traded inputs, FRCs)}}$$

(or)

$$\text{DRC} = G/\ (E\text{-}F)$$

Where, FRC = Foreign resource costs

Traded inputs = Fertilizers

Non-traded inputs = Labor and cattle

The protection rates were common indicators used to measure the effects of government policies on agricultural prices.

Nominal Protection Coefficient (NPC) was a simple indicator of policy effects. It was defined as the ratio of its domestic price to its border price of a product. Nominal Protection Coefficient on tradable inputs (NPCI) was defined as the ratio between the private values of all tradable input components to their social values. It showed the degree of tradable input transfer. The nominal protection rates reflected the impacts of commodity-specific price interventions such as domestic procurement and distribution system, import tariff, export taxes, and quantitative restrictions on domestic trade.

Effective Protection Coefficient (EPC) measured the difference between domestic and border prices converted at the market exchange rate. While NPC and NPCI measured the policy distortions in the product and tradable input markets individually, EPC measured the combined policy effects in both markets. This coefficient indicated the degree of policy transfer from output and tradable input distortions (Huang *et. al*., 2002).

Step 6: Conducting Sensitivity Analysis

One convenient feature of the DRC framework was to make a sensitivity analysis. The analyses were conducted to determine whether the results would be substantially altered by changes in the underlying assumptions (Yao, 1997).

Policy Analysis Matrix (PAM) was a static model and it might generate results which were not realistic in a dynamic sense and potentially biased against government policies. To overcome this limitation, sensitivity analyses on DRC were done by changing in world reference prices for outputs, different exchange rates and different yield levels.

To conduct the sensitivity analyses for Manawthukha variety, the lowest, current, and the highest world prices (250, 300, 400 US$/MT) and the average yield levels (3.10, 3.62, 4.13, 4.65, 5.16 MT/ha) were employed. Similarly for Pawsan varieties, the highest, current, and lowest world prices (680, 570, 400 US$/MT) and various average yield levels (1.55, 1.81, 2.07, 2.32, 2.58 MT/ha) were also used. For all calculations of the sensitivity analyses, minimum, current and maximum exchange rates (1000, 1275, 1400 kyats/US$) obtained from January 2007 to June 2008 were used.

Sensitivity analysis was important because technical coefficients used in constructing enterprise budgets (e.g.; yields, uses of inputs) were often mean values calculated from a range of observed values, and because prices used in calculating social profitability (including the shadow exchange rate) were often estimated prices or projected prices.

3.5 Interpretation of Policy Coefficients

Table 3.5 represented the interpretation of policy coefficients. The appropriate value of DRC is between one and zero. If DRC>1, the value of domestic resources used to produce the commodity exceeds its value added at social prices. In other words, the opportunity cost of domestic resources used to produce the commodity is greater than the amount of foreign exchange generated from these resources. Therefore, production of the commodity does not represent an efficient use of the country's domestic resources or the country does not have comparative advantage in producing the product.

Table 3.5 Interpretation of Policy Coefficients

Efficient/ policy coefficient	Definition	Interpretation
Domestic Resource Cost (DRC)	DRC = G/E-F	0 < DRC< 1 = CA (efficiency) DRC> 1 = No CA (inefficiency) DRC< 0 = No CA (inefficiency)
Nominal Protection Coefficient on Output (NPC)	NPC = A/E	NPC>1 = domestic price higher than world market prices NPC<1 = distinctive to domestic producers
Nominal Protection Coefficient on Tradable Input (NPCI)	NPCI = B/F	NPCI>1 = domestic producers are taxed by purchasing inputs NPCI<1 = producers are subsidized in their input use
Effective Protection Coefficient (EPC)	EPC = (A-B)/(E-F)	EPC>1 = incentive to production EPC<1 = disincentive to production

In contrast, if DRC < 1, the value of domestic resources used to produce the commodity is lower than its value added at social prices.Therefore, the country has a comparative advantage in producing the commodity or it is desirable to produce and expand the production of the commodity from the social point of view. If DRC = 1, the country is neutral in terms of comparative advantage of the product.

A lower value of DRC of a product indicates a lower relative cost of domestic resources which again exhibits a higher comparative for a country and vice versa. DRC may be biases against activities that rely heavily on domestic non-traded factors, i.e. land and labor.

The NPC can assume a range of numerical values showing the overall policy distortion. If NPC > 1, the market price of output exceeds the social price, implying that the domestic producers receive higher price. This is called positive protection for producers who receive the output subsidy. For consumers it denotes negative protection.

If NPC is less than 1, the negative protection occurs for producers. The consumer is being favored while the producer is being discriminated against. It implies that the producer implicitly pays a tax on the product. If NPC = 1, the protection is neutral. There may be no policy intervention on producers and consumers; therefore they are facing market prices that are equal to the social prices of outputs.

If NPCI < 1, the private prices of inputs are lower than their social prices showing that policies are reducing input costs. In other words, the producers are subsidized in their input use. If NPCI > 1, they are taxed by purchasing the tradable inputs. If NPCI = 1, it indicates that there is either no policy distortion or neutral situation.

If EPC >1, domestic producers are receiving a greater return on their resources given interventions than without interventions. They are enjoying positive protection. A positive EPC, however, denotes a potential incentive, not an actual one. If EPC < 1, it implies that the producers have a net disincentive or an equivalent tax from the policies in both product and tradable input markets as a whole. They are receiving negative protection. Again, a negative EPC denotes a potential disincentive, not an actual one. The EPC is indicator of relative incentives in production. A ranking of EPCs for different crops is indicative of the relative efficiency of these production activities.

CHAPTER-IV
RESULTS AND DISCUSSION

4.1 Description of Sample Rice Farmers

4.1.1 Socio-economic Characteristics of Sample Farmers

Socio-economic characteristics of sample farmers producing Manawthukha and Pawsan rice in study areas were shown in Table.4.1.

In the study areas, average age of the sample farmers was 51.35 years in Pathein Township and 52.16 years in Phyapone Township. There were not so much differences between average age of sample farmers in both townships. Experience in farming was around 30 years on average in both townships. The average farming experience was 29.85 years in Pathein and 28.64 years in Phyapone respectively.

The average schooling years of the sample household heads were 7.62 years in Pathein and 9.14 years in Phyapone. In this study, education level of the sample farmers was categorized into five groups. "Monastery education" referred informal schooling although they could read and write. "Primary level" referred formal schooling up to 5 years; "Secondary level" intended formal schooling up to 9 years and "High school level" referred the formal schooling up to 11 years. The last "Graduate level" referred to those who had an education of degree from college or university. The education level of farmers was assumed to determine decision making of their farming system.

Under the study areas, 5.00 % of farmers in Pathein and 1.70 % of farmers in Phyapone had only monastery education level. About 38.30 % of farmers in Pathein had attained the primary education level. It was the highest percentage among the education levels. For Phyapone, the farmers who had primary educational level were 27.60 % of the total sample numbers.

In Pathein, 25.00 %, 26.70 %, and 5.00 % of sample farmers attained secondary, high school, and graduate level of education respectively. About 29.30% of sample farmers in Phyapone had the secondary education level. The remaining 15.50 % and 25.9% of farmers obtained the high school and graduate level of education respectively in Phyapone.

Table 4.1 Socio-economic Characteristics of Sample Farmers in Study Areas in 2007

No.	Item	Unit	Mean Value	
			Pathein (N=60)	Phyapone (N=58)
1.	Age	Year	51.35	52.16
2.	Experience in farming	Year	29.85	28.64
3.	Schooling year of household head	Year	7.62	9.14
4.	Education level of household head			
	Monastery education	Percent	5.00	1.70
	Primary level	Percent	38.30	27.60
	Secondary level	Percent	25.00	29.30
	High school level	Percent	26.70	15.50
	Graduate level	Percent	5.00	25.90
5.	Family size	No.	4.20	4.72
6.	Family labor	No.	2.07	2.00
7.	Permanent hired labor	No.	0.77	1.66

N = Number of the Sample Farmers

The average family members were 4.20 in Pathein and 4.72 in Phyapone Townships. The average numbers of family labors in rice productions were 2.07 in Pathein and 2.0 in Phyapone. The average numbers of permanent hired labor for rice farming were 0.77 in Pathein and 1.66 in Phyapone.

4.1.2 Land Holdings and Farm Assets of Sample Farmers

The average possessions of farm like farm size, plough, harrow, cattle, cart, tractor, power tiller, sprayer, water pump, pumped pipe, thresher and set tone per respondent farmers were shown in Table 4.2.

The average land holdings for a sample household were 6.73 hectares in Pathein and 15.48 hectares in Phyapone Townships. Land holdings of sample farmers were classified into four groups according to their farm size. In Pathein, the majority of farmers possessed 1-5 ha of land and it was 45.6% of total sample farmers. Moreover, 33.3% of farmers possessed 6-10 ha of land, 19.3% of farmers had 11-20 ha and 1.8% of farmers had more than 20 ha of land.

In Phyapone, the majority of farmers (31% of the sample farmers) possessed 1-5 ha of land. The other 25.9% of farmers owned 6-10 ha of land, 19% of farmers had 11-20 ha, and 24.1% of farmers had more than 20 ha of land respectively.

4.2 Cropping Patterns of Sample Farmers

Cropping patterns of the sample farmers were shown in Table.4.3. Four cropping patterns of sample farmers were generally observed in the survey areas. They were monsoon paddy solely, monsoon paddy-summer paddy, monsoon paddy-pulses, and monsoon paddy followed by both summer paddy and pulses.

According to Myanmar government's land use right policy, monsoon paddy must be grown in all farm lands and then summer paddy must also be grown as the second crop if irrigation water is available.

Under the study areas, some of the sample farmers cultivated only pulses especially green gram after monsoon paddy while some farmers cultivated simultaneously both pulses and summer paddy in parts of their farms. Some vegetables like onion, chili, carrot, coriander, etc were also cultivated little amount for home consumption.

Table 4.2 Land Holdings and Farm Assets of Sample Farmers in Study Areas in 2007

No.	Item	Unit	Mean Value	
			Pathein (N=60)	Phyapone (N=58)
1.	Farm size	Hectare	6.73	15.48
	1-5 ha	Percent	45.6	31.00
	6-10 ha	Percent	33.3	25.9
	11-20 ha	Percent	19.3	19.00
	> 20 ha	Percent	1.80	24.10
2.	Plough	No.	1.35	1.70
3.	Harrow	No.	1.30	1.78
4.	Cattle	No.	2.67	4.60
5.	Cart	No.	1.10	1.36
6.	Tractor	No.	0.10	0.10
7.	Power tiller	No.	0.52	0.67
8.	Sprayer	No.	1.13	1.53
9.	Water pump	No.	0.62	0.86
10.	Pumped pipe	No.	0.62	0.86
11.	Thresher	No.	0.10	0.04
12.	Set tone	No.	1.47	1.69

N = Number of the Sample Farmers

Table 4.3 Cropping Patterns of Sample Farmers in Study Areas in 2007

No.	Cropping Pattern	Pathein		Phyapone	
		Frequency	Percent	Frequency	Percent
1.	Monsoon Paddy	13	21.70	36	62.60
2.	Monsoon Paddy- Summer Paddy	25	41.70	7	11.90
3.	Monsoon Paddy- Pulses	9	15.00	9	15.00
4.	Monsoon Paddy- Pulses & Summer Paddy	13	21.70	6	10.50
	Total	60	100.00	58	100.00

In Pathein, 41.70 % of the respondents carried out pattern of the monsoon paddy-summer paddy. Only monsoon paddy was grown by 21.70 % of the farmers, and same percentage of sample farmers also grew the pattern of monsoon paddy followed by pulses and summer paddy. The remaining 15.00 % of farmers practiced double cropping pattern under monsoon paddy followed by only pulses. Farmers can quickly get cash incomes from pulses during a short time. Therefore, they actually wanted to grow pulses than summer paddy. However, there were some constraints to grow pulses due to land conditions, government's policy, etc. According to their cropping patterns, double rice cropping pattern was mostly grown in Pathein.

In Phyapone, the majority of the respondents, about (62.60 %) practiced solely monsoon paddy because of their flooded land condition. In this Township, majority of land were faced with salt water intrusion in summer period. About 11.90 % of the farmers did monsoon paddy-summer paddy pattern and 15.00 % of farmers planted monsoon paddy-pulses pattern. The remaining 10.50 % of farmers used their land under monsoon paddy followed simultaneously by pulses and summer paddy. Calendar of cropping patterns for major crops in selected townships were shown in Table 4.4.

4.3 Resource Uses and Yield of Rice Varieties in Study Areas

In order to understand the economic conditions of the sample farmers in relation to their performances of rice cultivations, the summarized basis statistics data such as average yield levels achieved by the respondents, sown areas of rice, amounts and costs of seed, home consumption, chemical fertilizers (Urea, T-super, Compound fertilizer), FYM (Farm Yard Manure), fuel, and costs of human and animal labor used for rice cultivations were shown in Table 4.5 to Table 4.8.

4.3.1 Resource Uses and Yield of Manawthukha Rice Productions in Study Areas

Resource uses and yields of Manawthukha rice productions for the sample farmers were summarized in Table.4.5 and Table.4.6 respectively.

The average Manawthukha sown area of farmers was 2.82 hectare ranging from 0.51 ha to 11.33 ha in Pathein, and that in Phyapone was 3.04 ha ranging from 0.40 ha to 16.19 ha respectively.

Table 4.4 Calendar for Cropping Patterns of Major Crops in Pathein and Phyapone Townships

Townships	Cropping Pattern	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Pathein	Monsoon Paddy						Monsoon Paddy						
	Monsoon Paddy-Summer Paddy	Summer Paddy					Monsoon Paddy						Sum-Paddy
	Monsoon Paddy-Pulses	Pulses					Monsoon Paddy					Pulses	
	Monsoon Paddy-Pulses- Summer Paddy	Pulses & Summer Paddy					Monsoon Paddy					Pulses & Su-Paddy	
Phyapone	Monsoon Paddy						Monsoon Paddy						
	Monsoon Paddy-Summer Paddy	Summer Paddy					Monsoon Paddy						Sum-Paddy
	Monsoon Paddy-Pulses	Pulses					Monsoon Paddy					Pulses	
	Monsoon Paddy-Pulses- Summer Paddy	Pulses & Summer Paddy					Monsoon Paddy					Pulses & Su-Paddy	

Table 4.5 Summary Statistics for Manawthukha Rice Production of the Sample Farmers in Pathein

Variables	Unit	Sample No.	Sample Mean	Standard Deviation	Minimum	Maximum
Yield	MT/ha	42	3.79	0.15	3.10	4.03
Sown area	ha	42	2.82	2.44	0.51	11.33
Seed rate	kg/ha	42	111.28	14.53	77.47	154.93
Home consumption	kg/ha	26	576.18	281.05	184.44	1291.10
Seed cost	Ks/ha	42	23959.76	3127.77	16679.17	33358.34
Value of home consumption	Ks/ha	26	104761.37	51099.60	33535.34	234747.35
Uses of Chemical Fertilizer, FYM, and Diesel						
- Urea	kg/ha	42	170.62	55.94	123.55	370.65
- T super	kg/ha	42	100.61	40.43	61.78	247.10
- Compound fertilizer	kg/ha	2	61.78	0.00	61.78	61.78
- FYM	cartloads/ha	42	2.62	0.95	1.24	4.94
- Diesel	gallons/ha	17	6.83	0.99	4.94	7.41
Costs of Chemical Fertilizer, FYM, and Diesel						
- Urea	Ks/ha	42	88691.25	29181.87	59304.00	196444.50
- T super	Ks/ha	42	50420.17	22259.48	22239.00	138376.00
- Compound fertilizer	Ks/ha	2	37065.00	0.00	37065.00	37065.00
- FYM	Ks/ha	42	6545.21	2383.02	3088.75	12355.00
- Diesel	Ks/ha	17	34157.94	4940.86	24710.00	37065.00
Costs of family labor from land preparation to threshing	Ks/ha	39	52423.22	25661.14	9884.00	129974.60
Costs of hired labor from land preparation to threshing	Ks/ha	42	114853.09	31438.75	71659.00	207124.84
Costs of animal labor from land preparation to threshing	Ks/ha	40	18069.19	8890.35	6177.50	55597.50

Table 4.6 Summary Statistics for Manawthukha Rice Production of the Sample Farmers in Phyapone

Variables	Unit	Sample No.	Sample Mean	Standard Deviation	Minimum	Maximum
Yield	MT/ha	48	3.67	0.19	3.10	4.13
Sown area	ha	48	3.04	3.15	0.40	16.19
Seed rate	kg/ha	48	107.05	11.90	103.29	154.93
Home consumption	kg/ha	21	785.56	764.94	96.83	3098.63
Seed cost	Ks/ha	48	21513.47	2391.10	20756.72	31135.07
Value of home consumption	Ks/ha	21	142829.60	139080.59	17605.87	563388.00
Uses of chemical fertilizer, FYM, and Diesel						
- Urea	kg/ha	48	216.21	78.55	123.55	494.20
- T super	kg/ha	40	97.30	39.29	61.78	247.10
- Compound fertilizer	kg/ha	9	68.64	20.59	61.78	123.55
- FYM	cartloads/ha	48	3.55	1.24	1.24	6.18
- Diesel	gallons/ha	27	6.27	1.08	4.94	7.41
Costs of chemical fertilizer, FYM, and Diesel						
- Urea	Ks/ha	48	107630.07	39255.13	60539.50	247100.00
- T super	Ks/ha	40	47659.41	19532.74	29652.00	118608.00
- Compound fertilizer	Ks/ha	9	52646.03	19293.63	33976.25	74130.00
- FYM	Ks/ha	48	10656.19	3716.34	3706.50	18532.50
- Diesel	Ks/ha	27	31345.09	5397.92	24710.00	37065.00
Costs of family labor from land preparation to threshing	Ks/ha	47	55581.73	25240.11	11860.80	11564.80
Costs of hired labor from land preparation to threshing	Ks/ha	48	63180.55	22502.10	17297.00	130508.07
Costs of animal labor from land preparation to threshing	Ks/ha	31	28934.61	13446.62	7413.00	51891.00

Average seed rate of Manawthukha variety was 111.28 kg/ha in Pathein and 107.05 kg/ha in Phyapone. The average seed price was 215.31 kyats/kg in Pathein and 200.96 kyats/kg in Phyapone. Therefore, average seed cost was 23959.76 kyats/ha in Pathein and 21513.47 kyats/ha in Phyapone. The average seed rate and price were higher in Pathein than Phyapone Township. Therefore, average seed cost in Pathein was higher than that in Phyapone area.

Regarding the sensitivity analysis of government's policy, the target yield of Manawthukha variety was 5.16 MT/ha (100 baskets/ac). However, the actual average yield of sample farmers was 3.79 MT/ha (73.42 baskets/ac) ranging from 3.10 MT/ha to 4.03 MT/ha in Pathein and 3.67 MT/ha (71.06 baskets/ac) with the range of 3.10 MT/ha to 4.13 MT/ha in Phyapone. Yields of Manawthukha variety in both townships had little differences according to land and seed qualities, management practices, topography, natural conditions of the regions, pest and disease controls, and many other factors.

The average amount of Manawthukha variety for home consumption was 576.18 kg/ha in Pathein and 785.56 kg/ha in Phyapone. The consumption rate of Phyapone was higher than that of Pathein because Phyapone farmers consumed Manawthukha variety not only for their family but also for permanent hired labor. In both townships, the average market price of Manawthukha variety was the same value, 181.82 kyats/kg. Therefore, the mean value of home consumption cost was 104761.37 kyats/ha in Pathein and 142829.60 kyats/ha in Phyapone respectively.

All of the sample farmers in Pathein and Phyapone applied urea fertilizer in Manawthukha cultivation. The average amount of urea application was 170.62 kg/ha in Pathein and 216.21 kg/ha in Phyapone. The average cost of urea was 88691.25 kyats/ha in Pathein and 107630.07 kyats/ha in Phyapone.

T-super fertilizer was utilized by all respondents in Pathein, however, 83.3% of the respondents utilized that type of fertilizer in Phyapone. The average amount of T-super used was 100.61 kg/ha and their cost was 50420.17 kyats/ha in Pathein. In Phyapone, the 97.30 kg of T-super were applied and 47659.41 kyats was incurred for one hectare.

All of the sample farmers used compound fertilizer especially "Armo." In Pathein, only 4.76 % of the sample farmers used 61.78 kg/ha of compound fertilizer and their average cost was 37065.00 kyats/ha. In Phyapone while about 18.75 % of sample farmers applied 68.64 kg/ha and 52646.03 kyats/ha was paid for compound fertilizer.

All of the sample respondents in both townships used FYM (Farm Yard Manure) as a basal manure during land preparation for Manawthukha cultivation. The average rate was 2.62 cartloads/ ha in Pathein and 3.55 cartloads/ha in Phyapone. The average cost for FYM was 6545.21 kyats/ha in Pathein and 10656.19 kyats/ha in Phyapone respectively.

Some of sample farmers in both townships used machinery for land preparation and threshing. In Pathein, the only 40.48% of sample farmers used diesel with the average rate of 6.83 gallons/ha and their average cost was 34157.94 kyats/ha. In Phyapone, the average rate of 6.27 gallons/ha was used by 56.25% of sample farmers and 31345.09 kyats/ha was paid for that.

The average opportunity cost of family labors employed in Manawthukha cultivation was 52423.22 kyats/ha and of animal labors was 18069.19 kyats/ha in Pathein. In Phyapone, 55581.73 kyats/ha was paid for family labors and 28934.61 kyats/ha was also paid for animal labors. The average cost of permanent hired labors was 114853.09 kyats/ha and 63180.55 kyats/ha in Pathein and Phyapone respectively.

4.3.2 Resource Uses and Yield of Pawsan Rice Productions in Study Areas

Resource uses and yield of Ayeyarwaddy Pawsan and Phyapone Pawsan rice varieties by sample farmers in study areas were summarized in Table 4.7 and Table 4.8.

According to the survey records, Ayeyarwaddy Pawsan variety was grown in Pathein and Phyapone Pawsan variety was grown in Phyapone Township. The average sown area of Ayeyarwaddy Pawsan variety was 4.71 ha with the range of 0.61 ha to 16.19 ha and of Phyapone Pawsan variety was 10.12 ha ranging from 1.80 ha to 72.85 ha under the study.

The average seed rate of Ayeyarwaddy Pawsan variety was 104.81 kg/ha and of Phyapone Pawsan variety was 111.30 kg/ha. Average seed price of Ayeyarwaddy Pawsan variety was 311.00 kyats/kg and that of Phyapone Pawsan variety was 287.08 kyats/kg. The average seed cost of Ayeyarwaddy Pawsan variety was 32595.42 kyats/ha and that of Phyapone Pawsan variety was 31952.44 kyats/ha respectively due to differences in seed rate and market prices.

Table 4.7 Summary Statistics for Ayeyarwaddy Pawsan Rice Production of Sample Farmers in Pathein

Variables	Unit	Sample No.	Sample Mean	Standard Deviation	Minimum	Maximum
Yield	MT/ha	34	2.13	0.22	1.76	2.58
Sown area	ha	34	4.71	3.48	0.61	16.19
Seed rate	kg/ha	34	104.81	20.04	51.64	154.93
Home consumption	kg/ha	29	545.67	499.03	120.50	2151.83
Seed cost	Ks/ha	34	32595.42	6233.52	16061.51	48184.53
Value of home consumption	Ks/ha	29	156651.29	143260.23	34593.84	617747.12
Uses of chemical fertilizer, FYM, and Diesel						
- Urea	kg/ha	34	196.23	67.11	61.78	370.65
- T super	kg/ha	33	127.29	30.65	61.78	247.10
- Compound fertilizer	kg/ha	7	79.43	30.14	61.78	123.55
- FYM	cartloads/ ha	33	2.36	1.04	1.24	4.94
- Diesel	gallons/ha	24	6.85	1.03	3.71	7.41
Costs of chemical fertilizer, FYM, and Diesel						
- Urea	Ks/ha	34	102764.53	35905.87	37065.00	196444.50
- T super	Ks/ha	33	64283.44	22732.20	24710.00	148260.00
- Compound fertilizer	Ks/ha	7	42713.00	17572.17	24710.00	74130.00
- FYM	Ks/ha	33	5896.70	2603.04	3088.75	12355.00
- Diesel	Ks/ha	24	34110.10	5091.48	18532.50	37065.00
Costs of family labor from land preparation to threshing	Ks/ha	32	38848.75	17162.31	6177.50	66717.00
Costs of hired labor from land preparation to threshing	Ks/ha	34	135042.06	24626.67	83519.80	208799.50
Costs of animal labor from land preparation to threshing	Ks/ha	31	15543.39	7110.12	6177.50	37065.00

Table 4.8 Summary Statistics for Phyapone Pawsan Rice Production of the Sample Farmers in Phyapone

Variables	Unit	Sample No.	Sample Mean	Standard Deviation	Minimum	Maximum
Yield	MT/ha	58	2.01	0.21	1.55	2.58
Sown area	ha	58	10.12	12.12	1.80	72.85
Seed rate	kg/ha	58	111.30	16.90	77.47	154.93
Home consumption	kg/ha	42	252.96	166.83	21.52	688.59
Seed cost	Ks/ha	58	31952.44	4851.46	22238.90	44477.79
Value of home consumption	Ks/ha	42	70199.32	46296.11	5971.54	191089.32
Uses of chemical fertilizer, FYM, and Diesel						
- Urea	kg/ha	58	223.67	52.81	123.55	370.65
- T super	kg/ha	55	115.69	23.94	61.78	185.33
- Compound fertilizer	kg/ha	33	88.17	33.20	43.24	123.55
- FYM	cartloads/ ha	58	3.51	1.40	1.24	7.41
- Diesel	gallons/ha	34	6.40	1.07	4.94	7.41
Costs of chemical fertilizer, FYM, and Diesel						
- Urea	Ks/ha	58	111354.76	26449.10	60539.50	185325.00
- T super	Ks/ha	55	55844.60	11922.79	29652.00	88956.00
- Compound fertilizer	Ks/ha	33	52040.76	19239.11	25945.50	74130.00
- FYM	Ks/ha	58	10544.35	4211.88	3706.50	22239.00
- Diesel	Ks/ha	34	31977.65	5370.49	24710.00	37065.00
Costs of family labor from land preparation to threshing	Ks/ha	57	54869.21	24268.76	11860.80	115642.80
Costs of hired labor from land preparation to threshing	Ks/ha	58	62103.53	21041.79	17297.00	130508.07
Costs of animal labor from land preparation to threshing	Ks/ha	39	28891.69	13260.22	7413.00	51891.00

The average yield of Ayeyarwaddy Pawsan variety for sample farmers was 2.13 MT/ha (41.24 basket/ac) ranging from 1.76 MT/ha to 2.58 MT/ha. The average yield of Phyapone Pawsan variety was 2.01 MT/ha (38.92 basket/ac) with the range of 1.55 MT/ha to 2.58 MT/ha.

The average amount of home consumption was 545.67 kg/household in Pathein and 252.96 kg/ha in Phyapone. The average market price of Ayeyarwaddy Pawsan variety and Phyapone Pawsan variety was 287.08 kyats/kg and 277.51 kyats/kg respectively. The mean values of home consumption cost were 156651.29 kyats/ha in Pathein and 70199.32 kyats/ha in Phyapone.

All of the sample farmers in Pathein and Phyapone applied urea fertilizer in Pawsan rice cultivations. The average amount of urea applications was 196.23 kg/ha in Pathein and 222.67 kg/ha in Phyapone. Their average cost was 102764.53 kyats/ha in Pathein and 111354.76 kyats/ha in Phyapone.

T-super fertilizer was utilized by 97.06% of the respondents in Pathein and 94.83% of the respondents in Phyapone. In Pathein, the average amount of T-super application was 127.29 kg/ha and their average cost was 64283.44 kyats/ha. In Phyapone, 115.69 kg/ha of T-super was applied and 55844.60 kyats/ha was incurred for that.

In Pathein, only 20.59 % of the sample farmers used compound fertilizer (NPK) with an average rate of 79.43 kg/ha and their average cost was 42713.00 kyats/ha. The 56.90 % of sample farmers in Phyapone applied 88.17 kg/ha and their average cost was 52040.76 kyats/ha for compound fertilizer.

All of the sample respondents in both townships used FYM in rice cultivations as a basal fertilizer during land preparation. In Pathein, the average rate of FYM was 2.36 cartloads/ ha and 5896.70 kyats was paid for one hectare. In Phyapone, 3.51 cartloads of FYM were used and their average cost was 10544.35 kyats for one hectare.

About 70.59% of sample farmers used machine during land preparation and threshing with the average rate of 6.85 gallons/ha and their average cost was 34110.10 kyats/ha in Pathein. Similarly, 58.62 % of Phyapone farmers used fuel with the average rate of 6.40 gallons/ha and average cost was 31977.65 kyats/ha.

The average opportunity cost of family labors employed in Pawsan rice cultivation was 38848.75 kyats/ha and that of animal labor was 15543.39 kyats/ha in Pathein. In Phyapone, 54869.21 kyats/ha was paid for family labors and 28891.69

kyats/ha was incurred for animal labor respectively. The average cost of permanent hired labors was 13042.06 kyats/ha in Pathein and 62103.53 kyats/ha in Phyapone.

4.4 Calculations of Economic Export and Import Parity Prices

Calculations of export and import parity prices at the farm gates were needed to estimate the economic values of traded commodities. These estimated prices at the farm gate levels were obtained by adjusting all relevant charges from FOB (Free on Board) product prices and CIF (Cost, Insurance, and Freight) factor prices at the points of all international markets to the farm gates.

4.4.1 Economic Export Parity Prices for Manawthukha and Pawsan Rice Varieties in Study Areas

The calculation of export parity prices for Manawthukha and Ayeyarwaddy Pawsan rice varieties in Pathein were shown in Appendix 4. The average FOB price of Manawthukha variety was 300 US$/MT and of Ayeyarwaddy Pawsan variety was 570 US$/MT. These FOB prices were obtained from Myanmar Rice Trader Association in Yangon at the time of survey. These FOB prices in foreign currencies were converted into domestic currencies by using current average shadow exchange rate (1275 kyats/US$).

Export parity prices, 218.29 US$/MT (278325 kyats/MT) for Manawthukha variety and 463.70 US$/MT (591223 kyats/MT) for Ayeyarwaddy Pawsan variety were obtained from their respective FOB prices by subtracting of the export tax (10%), fees for grading standard, port charges, stevedoring and loading, packaging, handling and processing costs, marketing costs and transportation costs from farm gates to Yangon export point.

Conversion factor for Manawthukha variety was 1.19, which was calculated by dividing the border price (278325 kyats/MT) to the domestic farm gate price (234747 kyats/MT). Conversion factor for Ayeyarwaddy Pawsan variety (1.61) was obtained by dividing the border price (591223 kyats/MT) to the domestic farm gate price (367430 kyats/MT).

Calculations of export parity prices for Manawthukha and Phyapone Pawsan varieties in Phyapone were mentioned in Appendix 5. All of the calculation steps were similar to the calculation steps of Manawthukha and Ayeyarwaddy Pawsan varieties in Pathein. In this study, FOB prices of Ayeyarwaddy Pawsan and Phyapone Pawsan were same.

In Phyapone, the export parity price of Manawthukha variety was 277125 kyats/MT and conversion factor (1.13) was obtained by dividing border price to the domestic farm gate price (244953 kyats/MT). After adjusting the relevant charges from the FOB price, the export parity price of Phyapone Pawsan variety was 590022 kyats/MT. Its conversion factor was 1.61 which was obtained by dividing that export parity price to the domestic farm gate price (367430 kyats/MT).

The export parity prices of Manawthukha and Pawsan varieties were different between two townships due to differences in some of the relevant charges such as packaging, handling and processing and transportation costs from farm gates to the export point.

4.4.2 Economic Import Parity Prices for Urea, T-super, Compound Fertilizer in Study Areas

The calculations of import parity prices for chemical fertilizer (Urea, T-super, and Compound fertilizer) were calculated in Appendix 6 and 7. The calculation steps were based on the C.I.F import prices which were available from the private fertilizer importing company (Soe San Company) in Yangon at the time of survey.

To obtain wholesale prices of Urea, T-super, and Compound Fertilizer, custom duties, port charges, handling costs, and transport costs to the relevant local wholesale markets were added to the based C.I.F prices. Based import C.I.F prices of Urea, T-super, and Compound Fertilizer were 410, 360, and 380 US$/MT respectively. These foreign currencies of chemical fertilizers were also converted into domestic currencies by using average shadow exchange rate, 1275 kyats/US$.

After adjusting the relevant charges, the wholesale prices in the inland markets of Urea, T-super, and Compound Fertilizer were 534250, 470500, and 496000 kyats/MT respectively. Economic farm gate prices of chemical fertilizers were calculated by deducting local transportation costs including intermediary margins from the wholesale markets to farm gate.

Therefore, the import parity prices of Urea were 515750 kyats/MT in Pathein and 519250 kyats/MT in Phyapone. The import parity prices of T-super and

Compound Fertilizer were 452000 kyats/MT and 477500 kyats/MT respectively in Pathein and 455500 kyats/MT and 481000 kyats/MT respectively in Phyapone. If there were absence of import tariffs, subsidies, and import ban, import parity prices were the maximum market prices which farmers have to pay for that tradable inputs.

The conversion factors of the imported fertilizers were calculated by dividing the border prices to their respective domestic prices. Conversion factors for Urea, T-super, and Compound Fertilizer were 0.99, 0.90, and 0.84 respectively in Pathein and 0.94, 0.94, and 0.81 respectively in Phyapone.

4.5 Private Prices and Social Prices

Table.4.9 mentioned the average values of major inputs and outputs in terms of private (market) prices and social (economic) prices associated with Manawthukha and Pawsan rice productions in study areas.

Market price was a price at which a good or service was actually exchanged for another good or service as money. Social price was the true economic value of goods and services in the absence of taxes, subsidies, import tariff, quotas, price controls, and other government interventions.

Social prices of the traded goods were valued through their border prices and for non-tradable inputs such as seed, manure, labor, and machine, social prices were equal to their opportunity cost. The opportunity costs of labor and cattle were estimated by calculating their weighted average values in each township (Appendix 8 and 9). To obtain the social prices of inputs and outputs, their respective private prices were multiplied with their respective conversion factors (Appendix 10 to 13).

For traded items, the border prices were available from calculations of the export parity prices by correcting the world market price for marketing and transport costs from the farm gates to the international reference markets.

For imported chemical fertilizers, the border prices were obtained by computing the import parity prices which were the world market prices in domestic currency obtained after adjusting the transport costs and other market distortions to the domestic markets.

Table 4.9 Average Private and Social Values of Major Inputs and Outputs Associated with Manawthukha and Pawsan Rice Productions in Study Areas

Items	Unit	Manawthukha		Pawsan	
		Pathein (N=42)	Phyapone (N=48)	Pathein (N=34)	Phyapone (N=58)
Private (Market) Prices					
Rice selling price	Ks/kg	181.82	181.82	287.08	277.51
Seed price	Ks/kg	215.31	200.96	311.005	287.08
Urea	Ks/50kg	26011.90	24885.42	26191.18	24887.93
T-super	Ks/50kg	25202.38	24500.00	25000.00	24163.64
Compound fertilizer	Ks/50kg	30000.00	30000.00	26857.14	29621.21
FYM	Ks/cartload	2500.00	3000.00	2500.00	3000.00
Machine	Ks/plough	5000.00	5000.00	4983.33	5000.00
Hired labor	Ks/day	1250.00	1250.00	1250.00	1250.00
Hired cattle	Ks/day	1250.00	1250.00	1250.00	1250.00
Social (Economic) Prices					
Rice selling price	Ks/kg	216.37	205.46	462.20	446.79
Seed price	Ks/kg	215.31	200.96	311.005	287.08
Urea	Ks/50kg	25751.78	23392.29	25929.27	23394.65
T-super	Ks/50kg	22682.14	23030.00	22500.00	22713.82
Compound fertilizer	Ks/50kg	25200.00	24300.00	22559.99	23993.18
FYM	Ks/cartload	2500.00	3000.00	2500.00	3000.00
Machine	Ks/plough	5000.00	5000.00	4983.33	5000.00
Hired labor	Ks/day	1375.00	1375.00	1375.00	1375.00
Hired cattle	Ks/day	1250.00	1250.00	1250.00	1250.00

4.6 Divergences between Private and Social Prices

Table 4.10 compared the divergences between the private and social revenues, costs of tradable inputs and domestic factors, and profits for Manawthukha and Pawsan in the study areas.

Divergences appeared from market failures or distorting policies, reveal constraints and possibilities for rice cultivations. A market failure occurred if a market fails to provide a competitive outcome and an efficient price. A distortion policy was a government intervention forcing a market price to diverge from its efficient values. It could occur due to trade restrictions, price regulation, taxes and subsidies.

Divergences between private and social revenues (I) were negative values for Manawthukha and Pawsan varieties in both study areas. These negative values occurred due to the direct and indirect interventions.

The divergences in revenues of Manawthukha variety were -107525.18 kyats/ha in Pathein and -65648.06 kyats/ha in Phyapone, and of Pawsan varieties were -257340.58 kyats/ha in Pathein and -278592.67 kyats/ha in Phyapone. Percentages of relative divergences in revenues of Manawthukha variety were -13.40 % in Pathein and -8.93 % in Phyapone. Divergences of Ayeyarwaddy Pawsan variety were -29.63 % and of Phyapone Pawsan variety were -33.27 %. Divergences of Phyapone Pawsan were the highest values among the selected rice varieties.

The negative values indicated that the producers obtained 29.63% and 33.27% decrease in revenues of social prices for Pawsan varieties in Pathein and Phyapone respectively because of implicit tax charged by government. In other words, the producers sold the output with prices lower than those prevailing in international markets or those that equate private and social valuations. The interpretation is similar for farmers who grew Manawthukha variety in both townships.

The obtained prices of farmers were lower than the world prices. Therefore, it can be interpreted that the farmers in Pathein and Phyapone were implicitly taxed on the production of Pawsan and Manawthukha varieties. The implicit tax was a transfer from farmers to the government's treasury. If there were positive divergence values in revenues, the producers would be supposed to receive a subsidy.

There were the similar interpretations of tradable input transfer (J) as of tradable output transfer (I). Tradable input transfer (J) measured the extent of divergence between the private and social costs of tradable inputs as a whole.

Table 4.10 Revenues, Foreign Resource Costs (FRC), Domestic Resource Costs (DRC), and Profits of Manawthukha and Pawsan Farmers with respect to Private and Social Prices in Study Areas

(Unit = kyats/ha)

Items	**Manawthukha**		**Pawsan**	
	Pathein	**Phyapone**	**Pathein**	**Phyapone**
Revenues				
Private prices (A)	694643.15	669328.12	611117.24	558861.06
Social prices (E)	802168.33	734976.18	868457.82	837453.73
Output policy (I)	-107525.18	-65648.06	-257340.58	-278592.67
Relative divergences (A-E)/E in %	-13.40	-8.93	-29.63	-33.27
Cost of Tradable Inputs of FRC				
Private prices (B)	176176.42	207935.51	209760.97	219240.12
Social prices (F)	164317.09	188615.40	195470.90	199320.41
Input policy (J)	11859.33	19320.11	14290.07	19919.71
Relative divergences (B-F)/F in %	7.22	10.24	7.31	9.99
Cost of Domestic Factors				
Private prices (C)	250008.41	211211.64	262036.42	220338.87
Social prices (G)	234786.27	199756.59	246212.35	210342.03
Factor cost (K)	15222.14	9996.84	15824.06	11455.05
Relative divergences (C-G)/G in %	6.48	4.75	6.43	5.73
Profits				
Private prices (D)	268458.32	241053.74	139319.85	128409.3
Social prices (H)	403064.98	336018.75	426774.56	438376.72
Net policy (L)	-134606.66	-94965.01	-287454.71	-309967.42
Relative divergences (D-H)/H in %	-33.40	-28.26	-67.36	-70.71

All of the divergences in costs of tradable inputs were positive values in study areas. The highest divergences were found in Phyapone rice productions.

The divergence of tradable input costs for Phyapone Pawsan cultivation was 19919.71 kyats/ha followed by 19320.11 kyats/ha for Manawthukha cultivation. Small positive divergences were found rice production in Pathein. Divergences for Manawthukha variety was 11859.33 kyats/ha and for Ayeyarwaddy Pawsan variety was 14290.07 kyats/ha respectively.

The positive divergences in tradable inputs indicated that the private costs of tradable inputs were higher than the social costs and the government was probably taxing the prices of inputs used by farmers. The farmers were paying private costs 7.22 % and 10.24 % more than social costs for Manawthukha cultivation in Pathein and Phyapone. Moreover, 7.31 % and 9.99 % more than social costs were paid for Pawsan production in both study areas. This was occurred because tradable inputs were available from under restrictions of imports such as import quota, licenses and tariffs. Therefore, the prices paid by farmers for tradable inputs were high because the government did not subsidize any fertilizers to farmers. Moreover, the farmers were taxed indirectly by purchasing tradable inputs. The net effect of input policies was the domestic prices of tradable inputs paid by farmers were greater than the social prices.

In this study, divergence on domestic factor costs (K) was influenced by the prices of domestic factors especially wage. The divergences on costs of domestic factors were positive values for Manawthukha and Pawsan production under study areas. In other words, the private costs of domestic factors were higher than the social costs. These could appear due to market imperfection (Stiglitz, 1988; Singh, 1989). The policy caused that the government taxed implicitly on domestic factors.

The private prices were greater than the social prices of human labor in the study areas. Because social values of human labors (kyats/man day) were calculated from their weighted average marginal values and these were lower than the average private values. Economic values of animal labors were calculated as human labors; however, there were no divergences in private and social values.

Therefore, the positive divergences occurred in domestic factor costs due to higher prices paid to labor especially at the harvesting time. The highest percentage of relative divergences in domestic factor costs (6.48 %) was found in Manawthukha rice cultivation in Pathein when compared with Phyapone Township. It pointed out that labor wage was (6.48 %) more than social prices for Manawthukha rice production in Pathein Township.

Divergences in private and social profits or net transfer (L) measured the total of net distortions in both input and output markets. In this study, the net transfers (L) were negative values for selected rice varieties. The negative values in divergences pointed out that the domestic prices were lower than export parity prices or the productions were more profitable socially than privately. The negative divergence between private and social profits implied that the net effect of interventions was to reduce the private profitability of rice production. Low level of private profit was resulted due to high private costs of inputs and low private revenues in rice production.

If there were positive divergence values occurred between private and social profits, the domestic consumer prices would be greater than world market prices or the products are more profitable privately than socially and then domestic production was subsidized.

The negative values of relative divergence percentages for Manawthukha rice production were -33.40 % in Pathein and -28.26 % in Phyapone. Divergences for Pawsan rice production were -67.36 % in Pathein and -70.71 % in Phyapone. The private profits received by sample farmers were much lower than their respective social profits. Among the relative divergence percentages of rice production, Phyapone Pawsan rice production was the highest divergence value (-70.71 %) and it means that farmers who grown this variety would obtain the additional profits of 70.71 % of social values without any taxes and subsidies.

Taxes and subsidies were commodity-specific policies. They directly affected the prices of products or inputs. Government might use indirect policies such as the manipulation of the exchange rate of the country's currency to affect commodity prices. The exchange rate was required to convert international prices in their domestic currency equivalents for PAM calculation. The effects of exchange rate manipulation depended upon whether the policy results in over or under valuation.

4.7 Profitability of Manawthukha and Pawsan Rice Productions and Policy Effects

The Policy Analysis Matrix (PAM) is a simple and effective conceptual framework for organizing information at the micro-economic level to show the effects of policy on financial profitability and comparative advantage of agricultural systems. According to Monke and Pearson (1989), PAM was suitable for agriculture price policy analysis and for evaluating public investment policy and efficiency, and this analysis provided an insight into the adverse impacts of policies pursued.

Table 4.11 illustrated the summary results of Policy Analysis Matrix (PAM) indicators namely Domestic Resource Cost (DRC) ratios, Nominal Protection Coefficients for Revenues (NPCs), Nominal Protection Coefficients for Tradable Inputs (NPCIs), and Effective Protection Coefficients (EPCs) for Manawthukha and Pawsan rice production under the study areas. All of these indicators were calculated based on the results of Table.4.10.

In measuring the comparative advantages of Manawthukha and Pawsan rice productions, Domestic Resource Cost (DRC) ratio was the most important indicator from the PAM for this study. It was the ratio of domestic factor cost required to produce a certain amount of output valued to the value added created by the same resources at social prices.

DRC ratios for Manawthukha and Pawsan rice varieties were less than one in study areas. It can be generally interpreted that the values of domestic resources used to produce Manawthukha and Pawsan varieties were lower than its value added at social prices. Therefore, it could be seen that the study areas had comparative advantages in these two rice production or it was desirable to produce and expand the production of these varieties from the social point of view. Moreover, the private and social benefit- cost ratios were greater than one for these two rice production.

According to the results, Phyapone Pawsan rice production had the highest comparative advantage with respect to the world markets, current technologies and input prices because its lowest DRC ratio was 0.31. This DRC value showed that 0.31 unit of domestic resources was utilized in order to earn one unit of foreign exchange by exporting Phyapone Pawsan variety.

Table 4.11 Summary of Policy Analysis Matrix (PAM) Indicators in Study Areas

Policy Analysis Matrix (PAM) Indicator	Manawthukha		Pawsan	
	Pathein	**Phyapone**	**Pathein**	**Phyapone**
Domestic Resource Cost Ratio (DRC)	0.37	0.38	0.37	0.31
Nominal Protection Coefficient for Revenue (NPC)	0.87	0.91	0.70	0.67
Nominal Protection Coefficient for Tradable Inputs (NPCI)	1.07	1.10	1.07	1.10
Effective Protection Coefficient (EPC)	0.81	0.84	0.60	0.53

Moreover, farmers who grown Phyapone Pawsan rice variety obtained the relatively higher profit than the farmers who grown the other selected rice varieties. The social benefit-cost ratio of Phyapone Pawsan rice production was 2.04 (Appendix 13).

There were favorable comparative advantages by expressing the DRC values of 0.37 each for productions of Manawthukha and Ayeyarwaddy Pawsan varieties in Pathein. Manawthukha rice production of Phyapone Township had the relatively lowest comparative advantage. Its DRC ratio was 0.38 and it was the relatively largest DRC ratio under the study.

Social benefit-cost ratio of Manawthukha variety was 2.01 in Pathein (Appendix 10) and 1.89 in Phyapone (Appendix 12). Therefore, Pathein farmers could obtain more comparative advantage and more profits than Phyapone farmers according to their DRC and social benefit-cost ratios for Manawthukha rice productions. Ayeyarwaddy Pawsan rice production had 1.97 of social benefit-cost ratio (Appendix 11) and Pathein farmers received reasonable profit for Pawsan variety.

Comparisons of DRC ratios, and private and social benefit-cost ratios of Manawthukha and Pawsan rice production were shown in Figure 4.1. Lower DRC ratio of Phyapone Pawsan variety demonstrated less uses of domestic resources when compared with other rice varieties. A lower value of DRC indicated a lower relative cost of domestic resources which again exhibited a higher comparative advantage for a country and vice versa.

Nominal Protection Coefficients for Revenues (NPCs) were also calculated in this study. These coefficients from PAM were defined as the ratios between the revenues of the products in private prices to their counter part in social prices. All of the NPC values on selected rice production were less than one in all study areas. Therefore, the domestic prices were lower than the world market prices and negative protections occurred for farmers. The NPC values implied that the producers implicitly paid taxes on the crop.

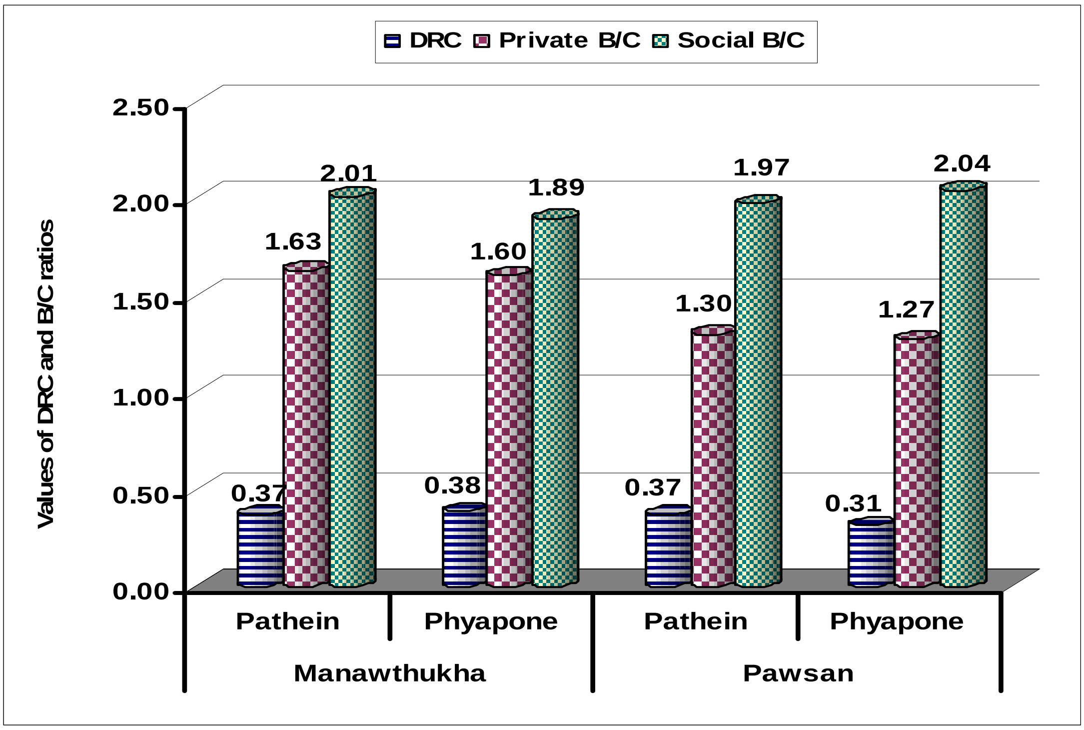

Figure 4.1 DRC and BC ratios of Manawthukha and Pawsan Rice Varieties in Study Areas

Source: Based on Table 4.11, Appendix 10, 11, 12, and 13

NPC values for Manawthukha variety were 0.87 in Pathein and 0.91 in Phyapone and for Pawsan varieties were 0.70 in Pathein and 0.67 in Phyapone. These NPC values could be explained that the trade margin could contribute a large difference in farm gate prices received by farmers and export prices received by traders.The market information services in Myanmar had inadequate conditions and there was an information gap between primary producers and terminal markets. Hence these divergences could be caused by market imperfection.

Nominal Protection Coefficients for Tradable Inputs (NPCI) were greater than one for Manawthukha and Pawsan varieties in study areas. The values for two rice varieties were 1.07 each in Pathein and 1.10 each in Phyapone. NPCI was defined as the ratio between the private values of all tradable input components to their social values.Therefore, these large NPCI values indicated that the private values of tradable inputs were greater than the social values. In study areas, the extents and cost of fertilizers used by farmers were high for rice production. This was because farmers paid high prices for tradable inputs. The large values of NPCI demonstrated that the farmers were implicitly taxed on the prices of tradable inputs by purchasing.

The last indicator from PAM, Effective Protection Coefficients (EPC) was calculated to measure the combined effects of policy transfers affecting both tradable product and tradable inputs markets. The EPC compared value added in private prices with value added in social prices. The values of EPC for Manawthukha varieties were 0.81 in Pathein and 0.85 in Phyapone, and for Pawsan varieties were 0.60 in Pathein and 0.53 in Phyapone. The values of EPC were less than one for Manawthukha and Pawsan rice production. These can be interpreted that the farmers had taxes from both output and input policies and these policies were disincentive to farmers. The farmers were not protected through government interventions.

4.8. Sensitivity Analyses on DRC Ratios

Comparative advantage rankings tend to be highly sensitive to world reference prices of outputs, to the level of yields and to the shadow exchange rates. Sensitivity analyses on DRC ratios for different yield levels, world reference prices, and exchange rates of Manawthukha and Pawsan rice varieties were illustrated in Figure 4.2 to 4.5.

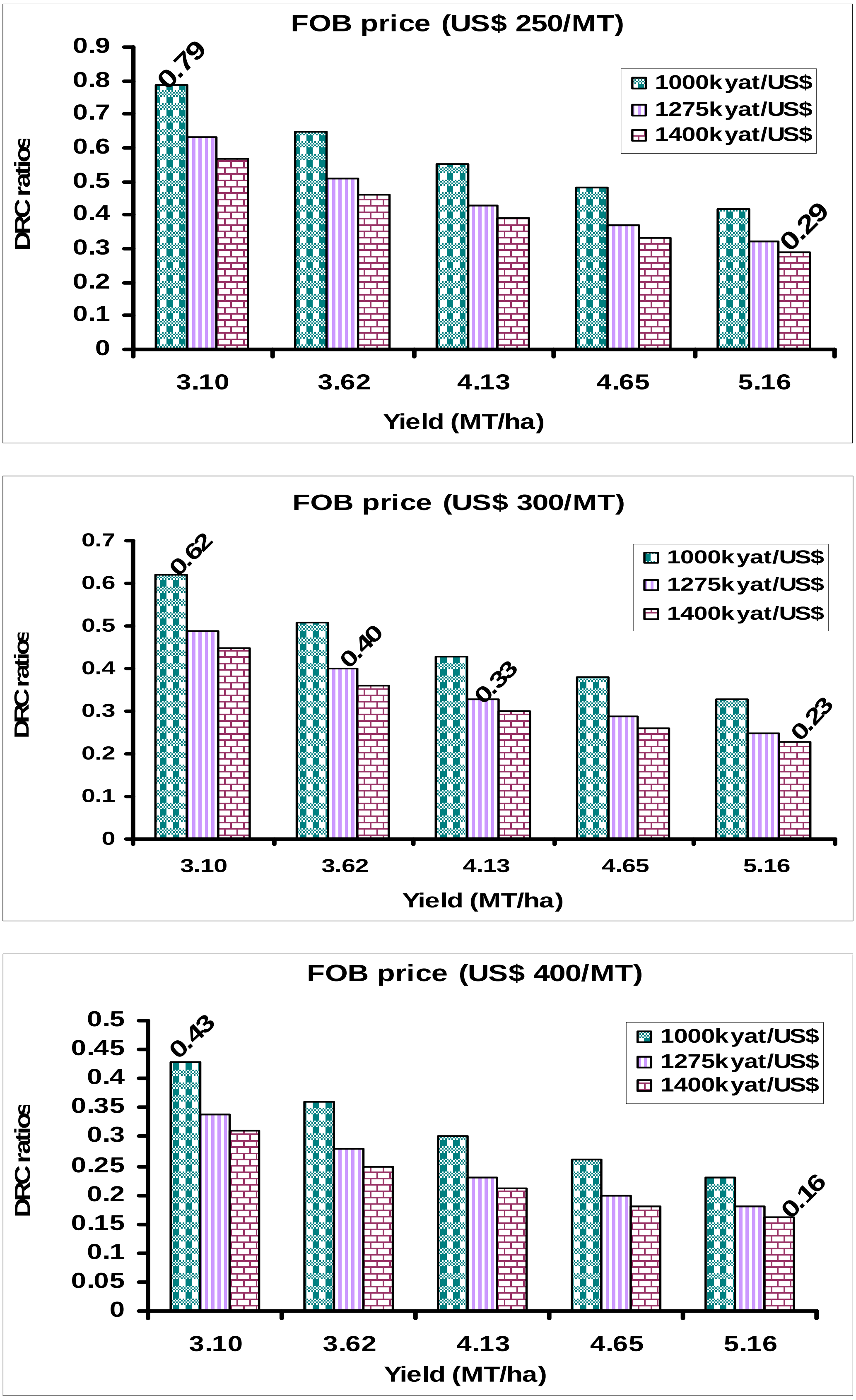

Figure 4.2 Sensitivity Analyses on DRC Ratios at Different Yield Levels, World Prices and Exchange Rates for Manawthukha Rice Variety in Pathein

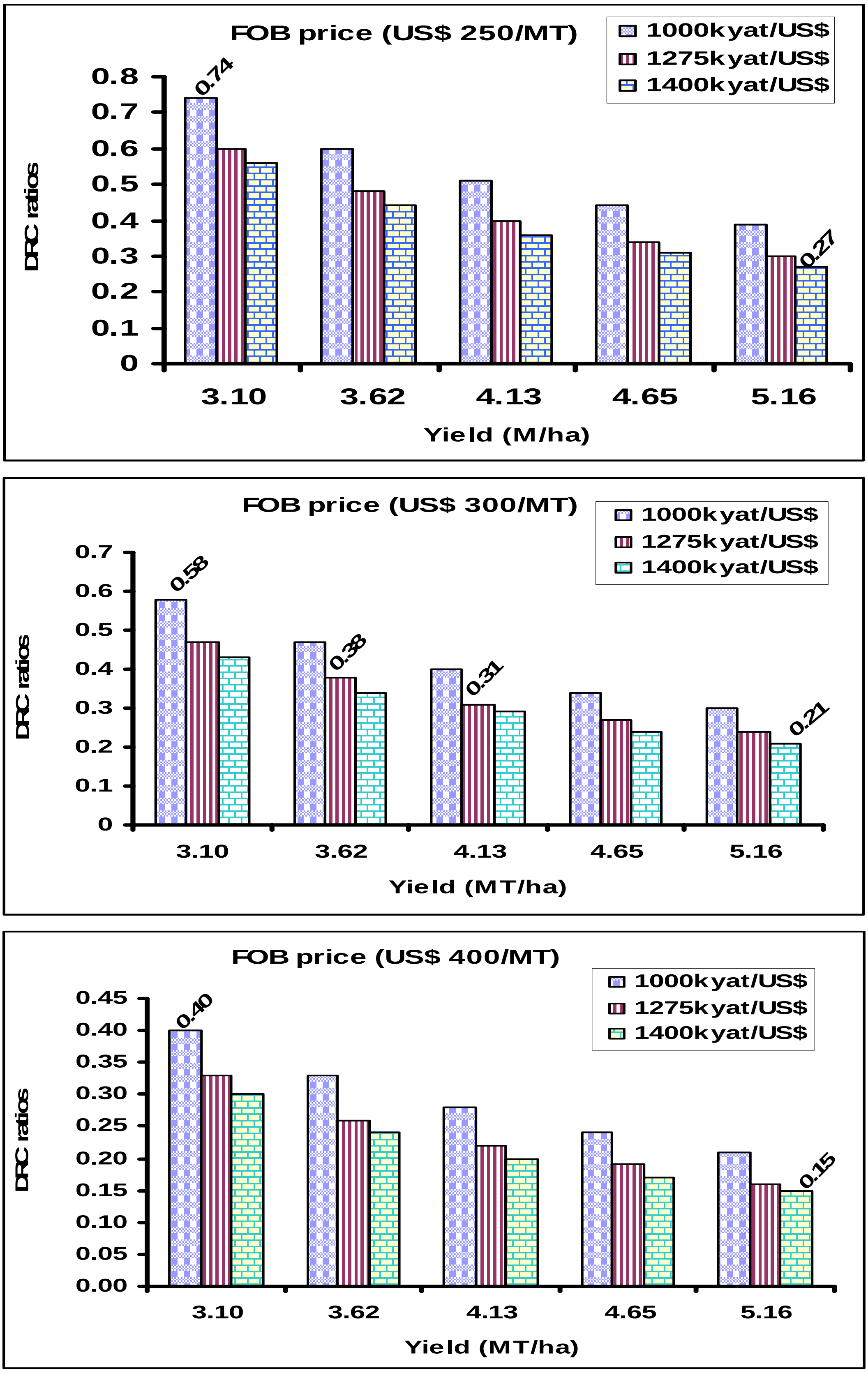

Figure 4.3 Sensitivity Analyses on DRC Ratios at Different Yield Levels, World Prices and Exchange Rates for Manawthukha Rice Variety in Phyapone

To conduct the sensitivity analyses, the required data were obtained from own survey data and other related records. The domestic resource costs, tradable input costs, labor and cattle costs and the prices of the products were assumed as a constant.

For Manawthukha rice production in study areas, the calculations were based on different average yield levels (3.10, 3.62, 4.13, 4.65, 5.16 MT/ha), the lowest, current and highest FOB prices (250, 300, 400 US$/MT) and the minimum, current and maximum exchange rates (1000, 1275, 1400 kyats/US$) during January 2007 to June 2008 (Figure 4.2 and 4.3).

All of the DRC values were between zero and one based on the above scenarios. The values demonstrated that there would be comparative advantages in Manawthukha production in study areas.At the current average yield level of Manawthukha variety between 3.62 MT/ha (70 baskets/ac) and 4.13 MT/ha (80 baskets/ac), the current average FOB price (300 US$/MT) and the current average exchange rate (1275 kyats/US$), the moderately favorable comparative advantage could be obtained by producing Manawthukha variety for study areas due to their DRC ratios based on the scenarios were between 0.40 and 0.33 in Pathein and between 0.38 and 0.31 in Phyapone.

If the farmers obtained the average yield of Manawthukha variety 5.16 MT/ha (100 bsk/ac) and sold at highest FOB prices and maximum exchange rate, the highest comparative advantage would be achieved. It was due to their lowest DRC values, 0.16 in Pathein and 0.15 in Phyapone. Therefore, it could be concluded that the appropriate strategy for increased productivity would be the most efficient for Manawthukha cultivation. Even if the farmers obtained the lowest average yield level, 3.10 MT/ha (60 bsk/ac), rational comparative advantage could be obtained at the lowest FOB prices and minimum exchange rate. The DRC values at this point were 0.79 in Pathein and 0.74 in Phyapone.

For Pawsan varieties, sensitivity analyses were similarly calculated like Manawthukha varieties which were shown in Figure 4.4 and 4.5. The lowest, current, and highest FOB prices (400, 570, and 680 US$/MT) during Jan., 2007 to June, 2008 were used as different world prices. Furthermore, different average yield levels of farmers (1.55, 1.81, 2.07, 2.32, 2.58 MT/ha) and similar exchange rates employed in Manawthukha variety were utilized for the scenarios. Calculations of DRC ratios based on the scenarios were described in Appendix 16 and 17.

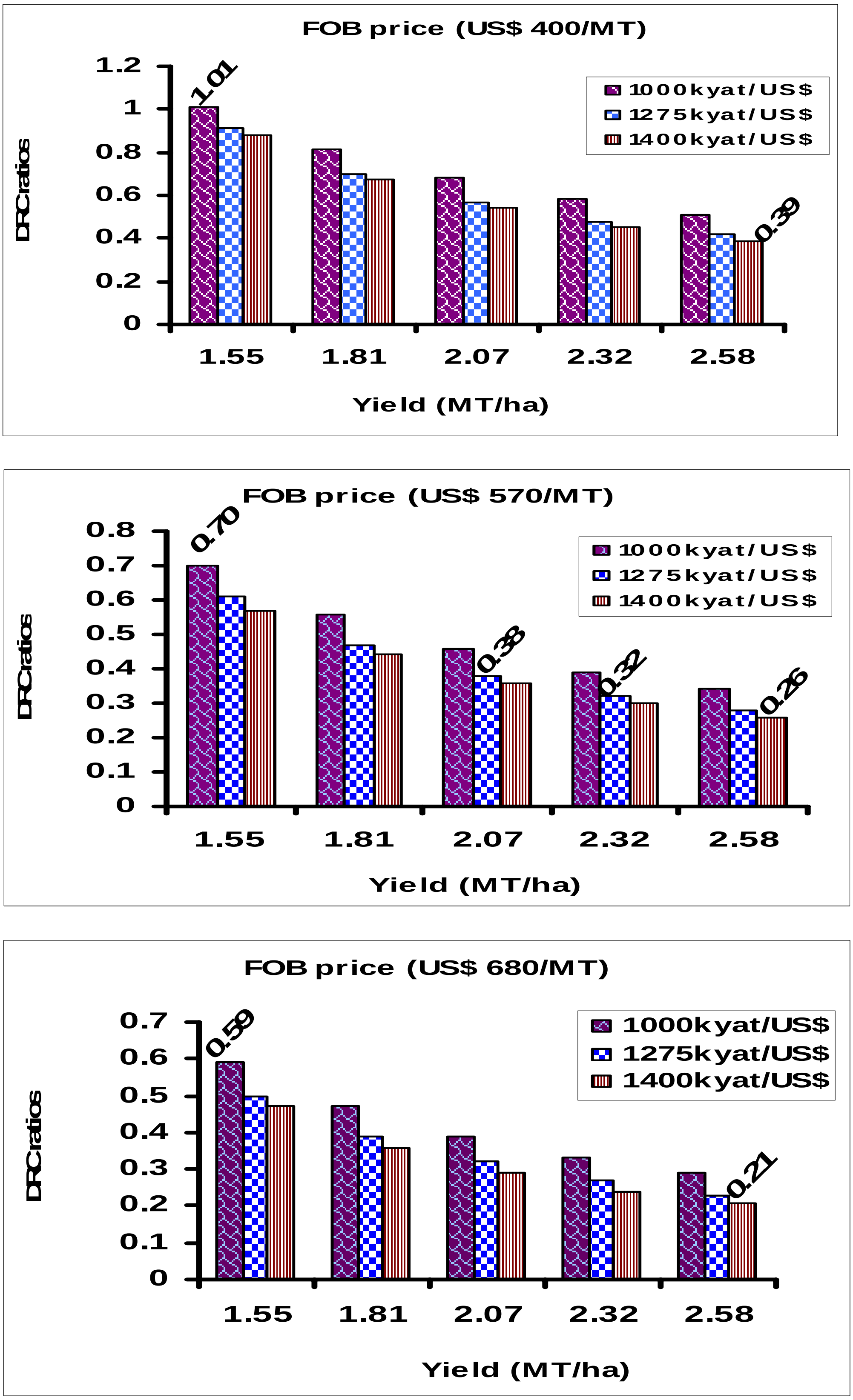

Figure 4.4 Sensitivity Analyses on DRC Ratios at Different Yield Levels, World Prices and Exchange Rates for Ayeyarwaddy Pawsan Rice Variety in Pathein

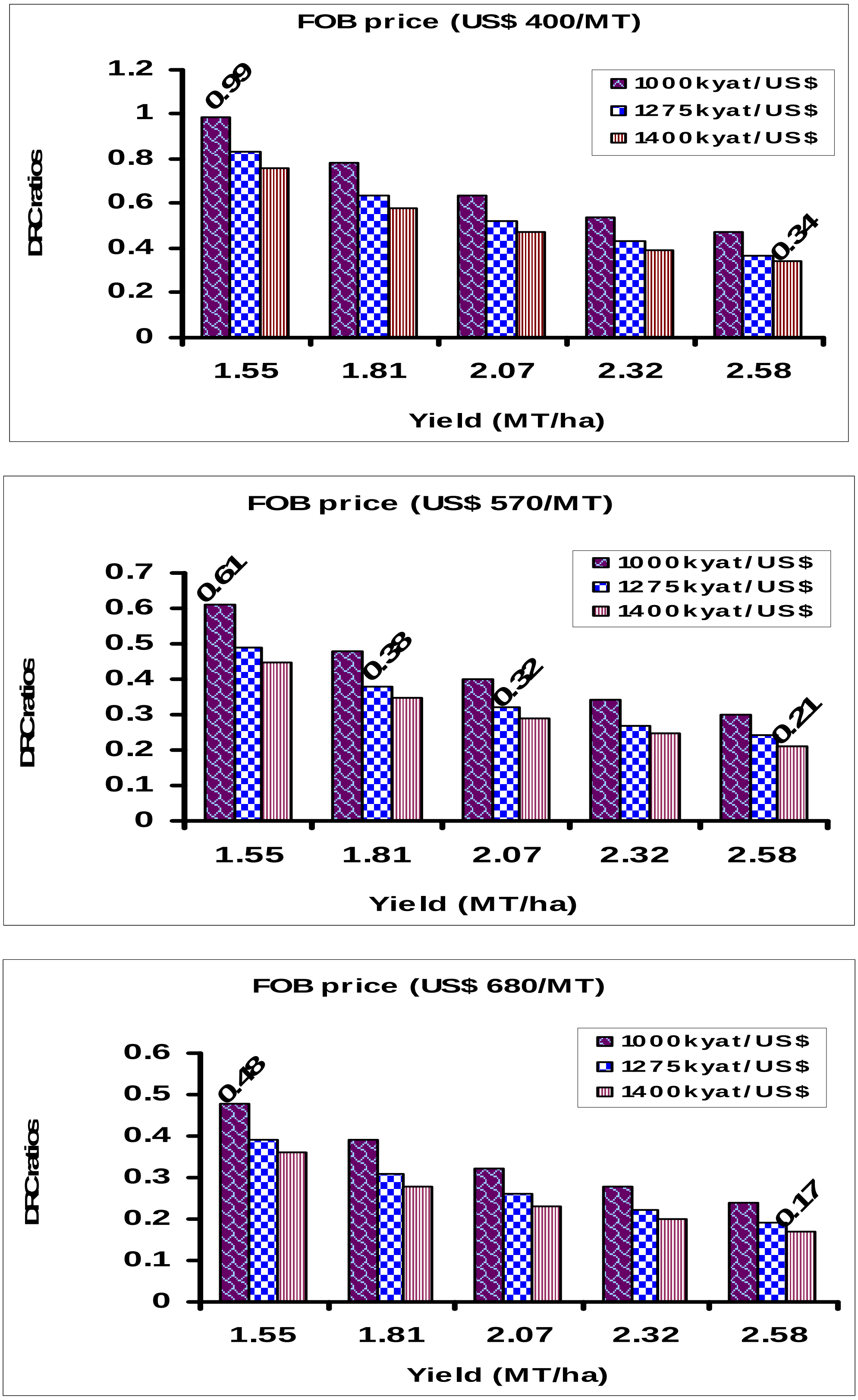

Figure 4.5 Sensitivity Analyses on DRC Ratios at Different Yield Levels, World Prices and Exchange Rates for Phyapone Pawsan Rice Variety in Phyapone

If the highest yield level of Pawsan varieties 2.58 MT/ha (50 bsk/ac) was obtained by sample farmers at the highest world price and maximum exchange rate, the highest comparative advantage because the DRC ratios of 0.21 in Pathein and 0.17 in Phyapone were observed.

If the farmers obtained the lowest yield level, 1.55 MT/ha (30 bsk/ac) at lowest FOB price and minimum exchange rate, Pathein farmers could not obtain comparative advantage due to its DRC value was 1.01. However, in this case, Phyapone farmers could receive lower comparative advantage because DRC value was equal to 0.99. The result of DRC value greater than one indicated that more than one unit of domestic resources was used in order to save one unit of foreign exchange by exporting Ayeyarwaddy Pawsan variety. Based on the results of the scenarios, farmers could get various comparative advantage levels at the current FOB price and present exchange rate under the analyzed different yield levels of Pawsan varieties.

According to the overall results of sensitivity analyses on DRC ratios, DRC ratios became smaller and smaller if yield and exchange rate increased. Therefore, it could be concluded that Manawthukha and Pawsan rice production would obtain more favorable comparative advantages if FOB prices are higher than current prices at the increased exchange rate and different levels of yield. At the lower world price and lower exchange rate, costs of tradable inputs would play a vital role in rice production.

CHAPTER - V
SUMMARY AND CONCLUSION

To examine the comparative advantage of rice is important for country's economy because Myanmar is one of the rice exporting countries in Asia Pacific region. The contribution of rice production to economic development in Myanmar depends to a considerable extent on their economic efficiency in terms of comparative advantage of domestic production and export marketing. This study analyzed the comparative advantages of the currently exported rice varieties (Manawthukha and Pawsan). The overall objective was to ascertain whether Myanmar is an efficient producer of Manawthukha and Pawsan rice varieties.

This study was based on the primary and secondary data. Ayeyarwaddy Division, one of the major rice surplus regions of Myanmar, was firstly selected for this study. Moreover, Ayeyarwaddy delta is well known as rice bowl of Myanmar and Pawsan variety is unique rice variety in this area due to its aromatic quality. In this Division, Pathein and Phyapone Townships were purposively selected according to their large sown areas and high production on Manawthukha and Pawsan rice varieties. After choosing the study areas, the survey was carried out during January, 2008. After that, 60 farmers from Pathein Township and 58 farmers from Phyapone Township were randomly selected and interviewed with structurized questionnaires.

Domestic Resource Cost (DRC) analysis was used to measure comparative advantages and Policy Analysis Matrix (PAM) were used to determine the effects of existing interventions on Manawthukha and Pawsan rice varieties. Moreover, the effects of changes in different yield levels, world prices of that commodity and different levels of exchange rates on DRC ratios were examined by conducting sensitivity analyses.

The results showed that both private and social benefit-cost ratios were greater than one for Manawthukha and Pawsan rice production in study areas. Therefore, it can be concluded that the activities of selected rice production were financially and economically feasible in study areas. Social B/C ratio of Phyapone Pawsan production was the relatively higher and it was 2.04. It was followed by social B/C ratio of Manawthukha rice cultivation in Pathein which was 2.01. Social B/C ratio of Ayeyarwaddy Pawsan rice production was 1.97 and that of Manawthukha rice production in Phyapone was 1.89.

DRC ratios for Manawthukha and Pawsan rice production in study areas indicated between one and zero. Among the study areas, the highest comparative advantage was obtained by Phyapone Pawsan rice production (DRC = 0.31) followed by Manawthukha and Pawsan rice productions (DRC = 0.37) each in Pathein Township. Manawthukha production in Phyapone Township had the lowest comparative advantage due to its relatively highest DRC ratio (DRC = 0.38). The results pointed out that there were comparative advantages for Manawthukha and Pawsan rice production and export marketing regarding with current world prices, current practicing technologies and current input prices. Phyapone Pawsan production had more comparative advantage than other rice productions.

The overall average DRC ratio (0.36) indicated that there were clear comparative advantages for Manawthukha and Pawsan rice productions in study areas. Therefore, these two rice production were needed to expand in both areas for more foreign exchange earnings and sufficient for domestic consumptions.

Output policy divergences between private and social revenues were negative values. Therefore, the private prices received by farmers were lower than the export prices. The divergences were very strong in Manawthukha and Pawsan production due to direct and indirect interventions especially overvalued exchange rate policy by government. The government taxed 10 % on the rice exporters and there were implicitly taxes on the producers of selected rice production. Effects of overvalued exchange rate were more serious in Pawsan rice production than that in Manawthukha productions.

There were positively divergences in tradable inputs because the government did not subsidize any tradable inputs for study areas. Positive input policy divergences indicated that the private costs of tradable inputs were higher than the social costs. These inputs were available from under restrictions of import such as import quota, licenses, and tariff. The effect of input policies was that the farmers had purchased tradable inputs at high prices. Therefore, it might be seem that the government was probably taxing the prices of inputs used by farmers because there were differences between domestic and international market prices of inputs.

Positive divergences in domestic factor costs were found for production of Manawthukha and Pawsan varieties because of distortions in prices of non-tradable inputs due to market imperfection. The private prices of labor were greater than the social prices in this study. Policy effects on domestic factors were relatively high because there were higher prices paid to labor especially at harvesting time.

The negative divergences between private and social profits implied that the net effect of policy interventions was to reduce the profitability of farmers in rice production. The products were more profitable socially than privately because of domestic consumer prices were lower than export parity prices. Low private profit level of rice production in study areas were due to the intensive uses of tradable inputs, high uses of domestic factors, and low levels of rice yield.

Nominal Protection Coefficients (NPC) for revenues were less than one for Manawthukha and Pawsan rice farmers in study areas. These indicated that several constraints were being imposed on the production of rice. Nominal Protection Coefficients for Tradable Inputs (NPCI) were greater than one and Effective Protection Coefficients (EPCs) were less than one in this study. The large values of NPCI indicated that the producers were probably taxed via the prices of tradable chemical fertilizers by input policy. The EPC values indicated that the producers had taxes from the policies in both tradable output and tradable input markets as a whole. It meant government interventions was disincentive to farmers.

The results of PAM showed that the economy needs to liberalize and existing interventions should be flexible on input and output markets for rice sector in agriculture.

According to the sensitivity analyses on DRC ratios using different yield levels, different world reference prices and different exchange rates, DRC ratios for Manawthukha variety were between zero and one. Therefore, Manawthukha rice productions had respective comparative advantages at different yield levels [3.10 MT/ha (60 bsk/ac) to 5.16 MT/ha (100 bsk/ac)], different FOB prices (250, 300, 400 US$/MT) and different exchange rates (1000, 1275, 1400 kyats/US$).

At the current average yield between 3.62 MT/ha (70 bsk/ac) and 4.13 MT/ha (80bsk/ac), the current FOB price (300 US$/MT) and the current exchange rate (1275 kyats/US$), domestic resources used in Manawthukha productions were efficient. Therefore, it can be concluded that there were comparative advantages for productions in study areas under existing production system.

Even the lowest yield level of 3.10 MT/ha (60 bsk/ac) can give a comparative advantage at the minimum world prices, US$ 250/MT with the lowest exchange rate (1000 Ks/US$) because of the DRC values of 0.79 in Pathein and 0.74 in Phyapone for Manawthukha production. At the highest world price (400 US$/MT), the DRC ratios provided that production of Manawthukha were more efficient at various yield levels and various exchange rates.

For Pawsan rice production in study areas, farmers can get various comparative advantage level at the current FOB price (570 US$/MT), current exchange rate (1275 kyats/US$) and five scenario yield levels. At the highest yield level of sample farmers, 2.58 MT/ha (50 bsk/ac) with the highest world price (680 US$/MT) and highest exchange rate (1400 kyats/US$), the results of DRC ratios were concluded that the producers can get the highest comparative advantage and the most efficient in domestic resources used.

At the lowest yield level, 1.55 MT/ha (30 bsk/ac) with lowest FOB price (400 US$/MT) and lowest exchange rate of 1000 kyats/US$, Pathein farmers had no comparative advantage due to its greater than one (1.01) DRC value. However, lower comparative advantage was available for Phyapone Pawsan production because its DRC value was 0.99. The DRC value (1.01) indicated that more than one unit of domestic resources were used in order to save one unit of foreign exchange by exporting Ayeyarwaddy Pawsan variety.

The smaller the DRC ratio, the greater the comparative advantages if yield and exchange rate increased. Therefore, at the lower world price and lower exchange rate, cost of tradable inputs played a vital role in rice production. At the higher world price and increased exchange rate, rice productions at all yield levels were more efficient than at the lower world price and lower exchange rate.

The overall results of the study showed that there were comparative advantages for Manawthukha and Pawsan rice production at present production practices and world prices in Pathein and Phyapone townships. This indicated that domestic resources for Manawthukha and Pawsan production were efficient for the national welfare. Moreover, there were still financially and economically viable under existing technologies and government interventions on export of rice. Financial returns to domestic producers were also attractive even though there were distortions in market prices and other constraints. Among these two rice production, Phyapone Pawsan production had the greatest comparative advantage for export marketing. Manawthukha and Pawsan productions in Myanmar have a potential to increase the income of producers as well as to contribute to foreign exchange earnings for the country.

As all we known, Myanmar rice export market is facing with lower export price than world price. To fill this gap, policy makers would consider not only to boost the higher rice production but also to meet the export market demand by quality rice. Due to this study, policy makers would find out Myanmar rice market which should have comparative potential and they can reap the profits for the country.

To obtain higher comparative advantages in productions of Manawthukha and Pawsan rice varieties in the long- term, productivities of these two rice varieties should be enhanced by applying improved production technologies through technical changes and increased technical efficiency. As the DRC ratios will become smaller and the more comparative advantage can be obtained if yield increased.

If an area expansion of land is available for rice production, high yielding varieties such as Manawthukha variety should be cultivated for food sufficiency of increasing population. Pawsan rice production tends to be considerably more socially profitable than Manawthukha rice production mainly due to higher prices of output in international market. In addition, Pawsan rice production needs to utilize lesser domestic resources when compare with Manawthukha rice production in order to earn one unit of foreign exchange by export. To obtain the strong international market demand and more comparative advantage, high quality rice like Pawsan variety should be desirable to produce than other varieties. Moreover, further researches should be done for quality rice variety like Pawsan to meet the demand of international and domestic market.

Reforms of trade and macroeconomic policy regimes, which have penalized rice production and export marketing, will provide a significant stimulus to the rice sector of Myanmar. The existing interventions on rice sector would perform wedges between world and domestic prices. Therefore, these interventions should be flexible and transparent for output and input prices to be more competitive market condition for rice farmers and the market oriented economy.

Finally, further analyses which may not be easily justified through DRC analysis derived from Policy Analysis Matrix (PAM) should be done beyond DRC analysis to achieve the long-term comparative advantages in Manawthukha and Pawsan productions for Myanmar.

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APPENDICES

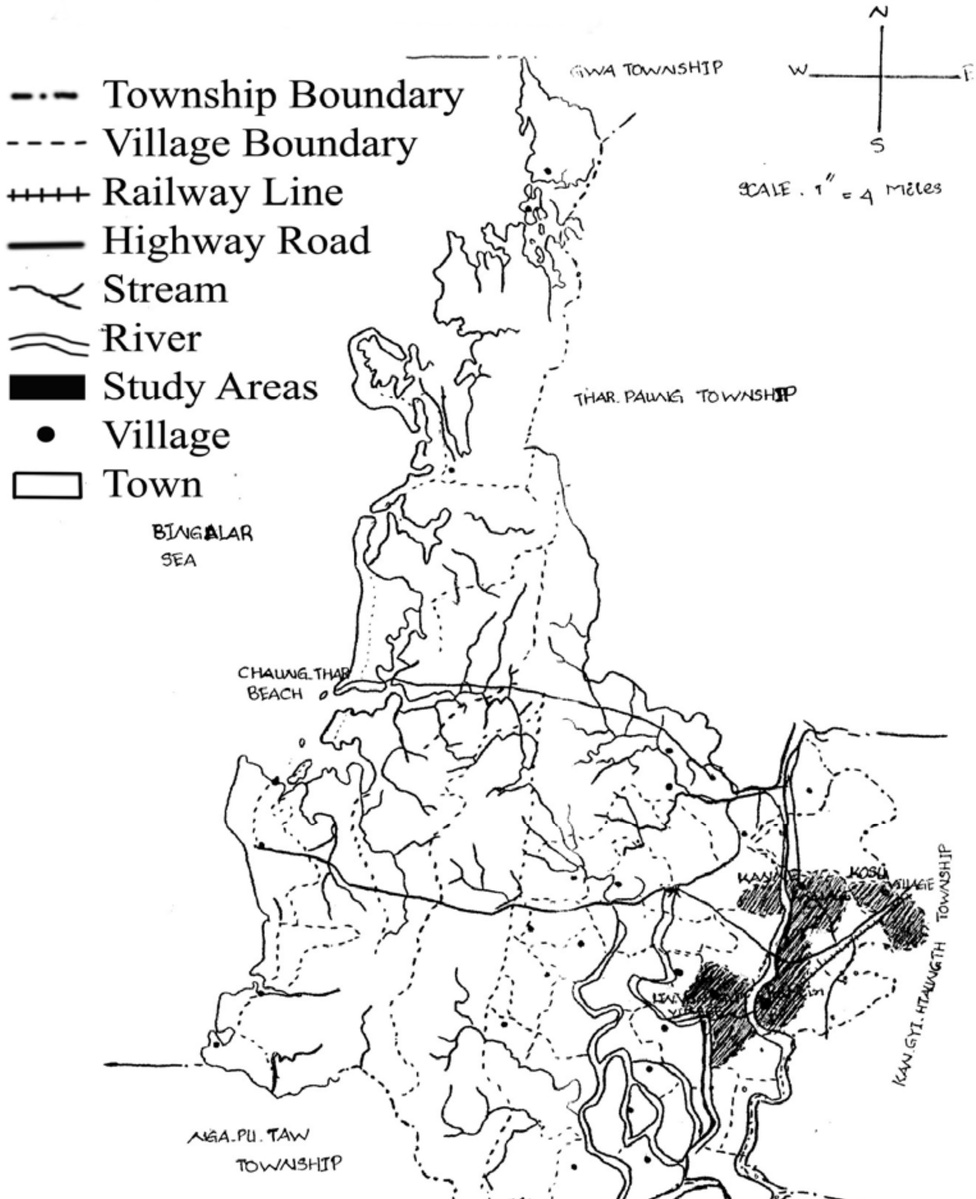
Appendix 1 Paddy Sown Areas, Total Production, Population, Utilization, and Self Sufficiency in Different Regions (2006-2007)

No.	State and Division	Sown area (ha)	Harvested area (ha)	Yield (ton/ha)	Production (MT)	Population (1000)	Utilization (MT)				Balance	Sufficiency (%)
							Seed used	Waste	Consumption	Total		
1	Kachin State	215159	215144	3.44	740257	1482	22161	33349.589	444726	500237	240020	148
2	Kayah State	44590	44567	3.27	145606	325	4593	6911.4569	97541	109046	36561	134
3	Kayin State	256145	256042	3.10	793302	1708	26383	39702.456	512525	578611	214692	137
4	Chin State	52364	52364	2.02	105818	529	5393	8116.3921	158583	172093	-66275	61
5	Sagaing Division	969884	964809	4.00	3879863	6150	99898	150332.06	1845108	2095338	1784526	185
6	Tanintharyi Division	185509	185358	3.44	639014	1593	19107	28753.911	477963	525824	113189	122
7	Bago Division	1363576	1339887	3.73	5089282	5723	140448	211354.32	1716853	2068656	3020626	246
8	Magway Division	434735	434066	3.82	1659382	5292	44778	67383.851	1587544	1699706	-40324	98
9	Mandalay Division	503779	490474	4.33	2181015	7895	51889	78085.751	2368511	2498486	-317472	87
10	Mon State	447483	447483	3.63	1623923	2926	46091	69359.834	877782	993232	630690	163
11	Rakhine State	496550	495438	3.61	1793781	3140	51145	76965.184	941965	1070074	723706	168
12	Yangon Division	563464	563236	3.53	1988076	6590	58037	87336.886	1977046	2122420	-134344	94
13	Shan State	606577	605496	3.96	2404377	5413	62477	94019.512	1623958	1780455	623922	135
14	Ayeyarwaddy Division	1984731	1979991	4.11	8150741	7748	204427	307633.35	2324499	2836560	5314182	287
	UNION	8124546	8074354	3.84	31166641	56515	836828	1259304.6	16954605	19050737	12115904	164

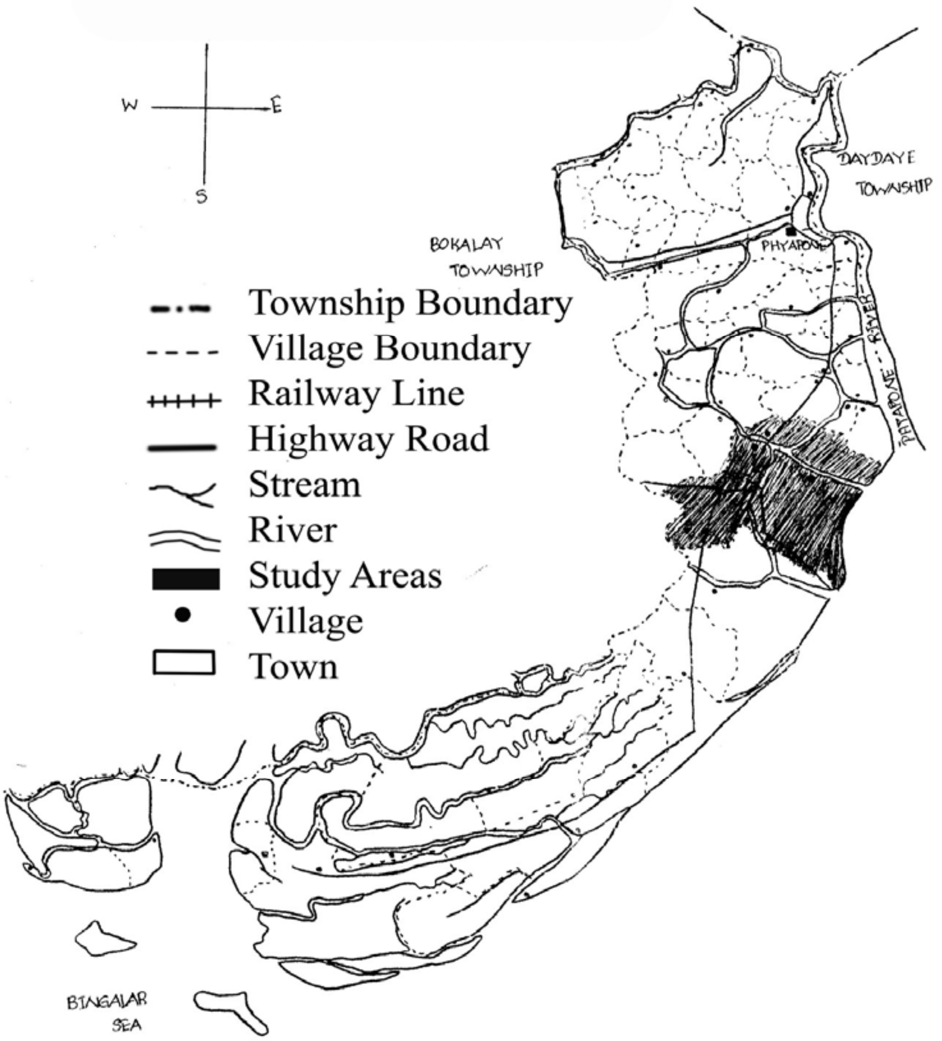
Note: All amounts are paddy equivalent, assumed seeding rate is 103 kg/ha (2 baskets/ac), waste is 155 kg/ha (3 baskets/ac), paddy consumption per capita is 300 kg/year (180 kg rice/cap) (average consumption rate of rural and urban)

Source: CSO (2005) and Own estimation

Appendix 2 Map of Pathein Township



Appendix 3 Map of Phyapone Township



Appendix 4 Calculation of Export Parity Prices of Manawthukha and Ayeyarwaddy Pawsan Rice Varieties for Pathein

No.	Steps in Calculation	Unit	Value per MT Manawthukha	Value per MT Ayeyarwaddy Pawsan
1.	Export price FOB Yangon [a]	US$/MT	300	570
2.	Exchange rate Ks per US$ [b] (average of daily value in January, 2008)	Ks/ US$	1275	1275
3.	Export price in domestic currency	Ks/ MT	382500	726750
4.	(-) Export tax 10%	Ks/ MT	38250	72675
5.	(-) SGS fee	Ks/ MT	3000	3000
6.	(-) Port charges, stevedoring and loading	Ks/ MT	5000	5000
7.	(-) Packaging, handling, and processing cost	Ks/ MT	9000	9000
8.	(-) Transport from Yangon (Wholesale) to Export point	Ks/ MT	6000	6000
9.	(-) Transport from Pathein to Yangon	Ks/ MT	12000	12000
10.	(-) Packaging, handling, and processing Cost in Pathein	Ks/ MT	13175	12150
11.	(-) Transport from farm gate to Pathein	Ks/ MT	17750	15702
12.	Economic farm gate value of Rice	Ks/ MT	278325	591223
13.	Economic farm gate value of Rice	US$/MT	218.29	463.70
14.	Financial farm gate value of Rice [c]	Ks/ MT	234747	367430
	Conversion Factor		1.19	1.61

Source: [a] **= FOB prices in January, 2008, derived from Myanmar Rice Trader Association**

[b] **= Exchange rate (1 US$ = 1275 kyat)**

[c] **= Derived from field survey data**

Appendix 5 Calculation of Export Parity Price of Manawthukha and Phyapone Pawsan Rice Varieties for Phyapone

No.	Steps in Calculation	Unit	Value per MT Manawthukha	Value per MT Phyapone Pawsan
1.	Export price FOB Yangon [a]	US$/MT	300	570
2.	Exchange rate Ks per US$ [b] (average of daily value in January, 2008)	Ks/ US$	1275	1275
3.	Export price in domestic currency	Ks/ MT	382500	726750
4.	(-) Export tax 10%	Ks/ MT	38250	72675
5.	(-) SGS fee	Ks/ MT	3000	3000
6.	(-) Port charges, stevedoring and loading	Ks/ MT	5000	5000
7.	(-) Packaging, handling, and processing cost	Ks/ MT	9000	9000
8.	(-) Transport from Yangon (Wholesale) to Export point	Ks/ MT	6000	6000
9.	(-) Transport from Phyapone to Yangon	Ks/ MT	13200	13200
10.	(-) Packaging, handling, and processing Cost in Phyapone	Ks/ MT	17612.5	16076.5
11.	(-) Transport from farm gate to Phyapone	Ks/ MT	13312.5	11776.5
12.	Economic farm gate value of Rice	Ks/ MT	277125	590022
13.	Economic farm gate value of Rice	US$/MT	217.35	462.76
14.	Financial farm gate value of Rice [c]	Ks/ MT	244953	367430
	Conversion Factor		1.13	1.61

Source: [a] **= FOB prices in January, 2008, derived from Myanmar Rice Trader Association**

[b] **= Exchange rate (1 US$ = 1275 kyat)**

[c] **= Derived from field survey data**

Appendix 6 Calculation of Import Parity Prices of Urea, T super, Compound Fertilizer for Pathein

No.	Steps in Calculation	Unit	Value per MT Urea	T-super	Compound fertilizer
1.	Based import price CIF Yangon [a]	US$/MT	410	360	380
2.	Exchange rate Ks per US$ [b] (average of daily value in January,2008)	Ks/US$	1275	1275	1275
3.	Import price of fertilizer in domestic currency	Ks/MT	522750	459000	484500
4.	(+) Handling, Port charges and custom duty	Ks/MT	5500	5500	5500
5.	Landed cost of fertilizer at Yangon	Ks/MT	528250	464500	490000
6.	(+) Transport from port to ex-warehouse	Ks/MT	6000	6000	6000
7.	Price of fertilizer at ex-warehouse (wholesale price)	Ks/MT	534250	470500	496000
8.	(-) Transport from Yangon to Pathein	Ks/MT	11000	11000	11000
9.	(-) Transport from Pathein to farm gate	Ks/MT	7500	7500	7500
10.	Economic farm gate value of fertilizer	Ks/MT	515750	452000	477500
11.	Economic farm gate value of fertilizer	US$/MT	404.51	354.51	374.51
12.	Financial farm gate value of fertilizer [c]	Ks/MT	520660	502020	568571.4
	Conversion Factor		0.99	0.90	0.84

Source: [a] **= CIF prices in January, 2008, derived from private fertilizer importing company (Soe San) in Yangon**

[b] **= Exchange rate (1 US$ = 1275 kyat)**

[c] **= Derived from field survey data**

Appendix 7 Calculation of Import Parity Prices of Urea, T super, Compound Fertilizer for Phyapone

No.	Steps in Calculation	Unit	Value per MT Urea	T-super	Compound fertilizer
1.	Based import price CIF Yangon [a]	US$/MT	410	360	380
2.	Exchange rate Ks per US$ [b] (average of daily value in January,2008)	Ks/US$	1275	1275	1275
3.	Import price of fertilizer in domestic currency	Ks/MT	522750	459000	484500
4.	(+) Handling, Port charges and custom duty	Ks/MT	5500	5500	5500
5.	Landed cost of fertilizer at Yangon	Ks/MT	528250	464500	490000
6.	(+) Transport from port to ex-warehouse	Ks/MT	6000	6000	6000
7.	Price of fertilizer at ex-warehouse (wholesale price)	Ks/MT	534250	470500	496000
8.	(-) Transport from Yangon to Phyapone	Ks/MT	12000	12000	12000
9.	(-) Transport from Phyapone to farm gate	Ks/MT	3000	3000	3000
10.	Economic farm gate value of fertilizer	Ks/MT	519250	455500	481000
11.	Economic farm gate value of fertilizer	US$/MT	407.25	357.25	377.25
12.	Financial farm gate value of fertilizer [c]	Ks/MT	550000	486640	596200
	Conversion Factor		0.94	0.94	0.81

Source: [a] = **CIF prices in January, 2008, derived from private fertilizer importing company (Soe San) in Yangon**

[b] = **Exchange rate (1 US$ = 1275 kyat)**

[c] = **Derived from field survey data**

Appendix 8 Calculation of Weighted Annual Average Labor Cost (Financial Term)

No.	Particular	K/day	%	Total
1.	Peak labor time	1500	75	1125
2.	Slack labor time	1000	25	250
	Weighted annual average labor cost or shadow wage rate (Kyat/day)			1375

Source: Own Survey Data, 2008

Appendix 9 Calculation of Weighted Annual Average Cattle Cost (Financial Term)

No.	Particular	K/day	%	Total
1.	Peak cattle time (Land Preparation time)	1250	50	625
2.	Slack cattle time (Harvesting time)	1250	50	625
	Weighted annual average cost or shadow price of cattle (Kyat/day)			**1250**

Source: Own Survey Data, 2008

Appendix 10 Enterprise Budget for Producing Manawthukha Rice Variety in Pathein Township

Outputs and Inputs	Classification of inputs and outputs	Private value (Kyats/ha)	Social value (Kyats/ha)	Conversion factor
Average yield (kg/ha)	T	3799.50	3799.50	
Average producer price (kyats/kg)		181.82	216.37	1.19
Gross return		694643.15	802168.33	
Cash return		565922.02	673447.20	
Crop sale	NT	565922.02	673447.20	1.19
Non cash return		128721.13	128721.13	
Home consumption	NT	104761.37	104761.37	
Reserved seed *	NT	23959.76	23959.76	
Total variable cost		426184.83	399103.36	
Total cash cost		325187.45	302876.49	
Toral hired labor cost	NT	149011.03	138559.40	
Land preparation to threshing (labor)	NT	114853.09	104401.46	0.91
Land preparation and threshing (machine)	NT	34157.94	34157.94	
Total material cash cost		176176.42	164317.09	
Urea	T	88691.25	87804.34	0.99
T-super	T	50420.17	45378.15	0.90
Compound fertilizer	T	37065.00	31134.60	0.84
Total non cash cost		100997.38	96226.87	
Total family labor cost		70492.41	65721.90	
Land preparation to threshing (labor)	NT	52423.22	47652.71	0.91
Land preparation and threshing (animal)	NT	18069.19	18069.19	1.00
Total material non cash cost		30504.97	30504.97	
Home grown seed *	NT	23959.76	23959.76	
FYM	NT	6545.21	6545.21	
Return above variable cost		268458.32	403064.98	
Return above cash cost		369455.70	499291.84	
Benefit- Cost ratio		1.63	2.01	
Return per unit of cash cost		2.14	2.65	

(N= 42)

*** = Seed price (215.31 ks/kg)**

Source; Own Survey Data, 2008

Appendix 11 Enterprise Budget for Producing Ayeyarwaddy Pawsan Rice Variety in Pathein Township

Outputs and Inputs	Classification of inputs and outputs	Private value (Kyats/ha)	Social value (Kyats/ha)	Conversion factor
Average yield (kg/ha)	T	2125.00	2125.00	
Average producer price (kyats/kg)		287.08	462.20	1.61
Gross return		611117.24	868457.82	
Cash return		421869.80	679210.38	
Crop sale	NT	421869.80	679210.38	1.61
Non cash return		189247.44	189247.44	
Home consumption	NT	156652.02	156652.02	
Reserved seed *	NT	32595.42	32595.42	
Total variable cost		471797.39	441683.26	
Total cash cost		378913.13	352334.23	
Toral hired labor cost	NT	169152.16	156863.33	
Land preparation to threshing(labor)	NT	135042.06	122753.23	0.91
Land preparation and threshing (machine)	NT	34110.10	34110.10	
Total material cash cost		209760.97	195470.90	
Urea	T	102764.53	101736.88	0.99
T-super	T	64283.44	57855.10	0.90
Compound fertilizer	T	42713.00	35878.92	0.84
Total non cash cost		92884.26	89349.02	
Total family labor cost		54392.14	50856.90	
Land preparation to threshing (labor)	NT	38848.75	35313.51	0.91
Land preparation and threshing (animal)	NT	15543.39	15543.39	1.00
Total material non cash cost		38492.12	38492.12	
Home grown seed *	NT	32595.42	32595.42	
FYM	NT	5896.70	5896.70	
Return above variable cost		139319.85	426774.56	
Return above cash cost		232204.11	516123.58	
Benefit- Cost ratio		1.30	1.97	
Return per unit of cash cost		1.61	2.46	

(N = 34)
*** = Seed price (311.005 ks/kg)**

Source: Own Survey Data, 2008

Appendix 12 Enterprise Budget for Producing Manawthukha Rice Variety in Phyapone Township

Outputs and Inputs	Classification of inputs and outputs	Private value (Kyats/ha)	Social value (Kyats/ha)	Conversion factor
Average yield (kg/ha)	T	3669.95	3669.95	
Average producer price (kyats/kg)		181.82	205.46	1.13
Gross return		669328.12	734976.18	
Cash return		504985.05	570633.11	
Crop sale	NT	504985.05	570633.11	1.13
Non cash return		164343.07	164343.07	
Home consumption	NT	142829.60	142829.60	
Reserved seed *	NT	21513.47	21513.47	
Total variable cost		419147.15	388371.99	
Total cash cost		302461.15	277391.61	
Toral hired labor cost	NT	94525.64	88776.21	
Land preparation to threshing (labor)	NT	63180.55	57431.12	0.91
Land preparation and threshing (machine)	NT	31345.09	31345.09	
Total material cash cost		207935.51	188615.40	
Urea	T	107630.07	101172.27	0.94
T-super	T	47659.41	44799.85	0.94
Compound fertilizer	T	52646.03	42643.28	0.81
Total non cash cost		116686.00	110980.38	
Total family labor cost		84516.34	78810.72	
Land preparation to threshing (labor)	NT	55581.73	49876.11	0.91
Land preparation and threshing (animal)	NT	28934.61	28934.61	1.00
Total material non cash cost		32169.66	32169.66	
Home grown seed *	NT	21513.47	21513.47	
FYM	NT	10656.19	10656.19	
Return above variable cost		250180.97	346604.19	
Return above cash cost		366866.97	457584.57	
Benefit- Cost ratio		1.60	1.89	
Return per unit of cash cost		2.21	2.65	

(N = 48)

*** = Seed price (215.31 ks/kg)**

Source: Own Survey Data, 2008

Appendix 13 Enterprise Budget for Producing Phyapone Pawsan Rice Variety in Phyapone Township

Outputs and Inputs	Classification of inputs and outputs	Private value (Kyats/ha)	Social value (Kyats/ha)	Conversion factor
Average yield (kg/ha)	T	2014.11	2014.11	
Average producer price (kyats/kg)		277.51	446.79	1.61
Gross return		558861.06	837453.73	
Cash return		456709.30	735301.97	
Crop sale	NT	456709.30	735301.97	1.61
Non cash return		102151.76	102151.76	
Home consumption		70199.32	70199.32	
Reserved seed*	NT	31952.44	31952.44	
Total variable cost		439578.99	409662.45	
Total cash cost		313321.30	287750.17	
Toral hired labor cost	NT	94081.18	88429.76	
Land preparation to threshing (labor)	NT	62103.53	56452.11	0.91
Land preparation and threshing (machine)	NT	31977.65	31977.65	
Total material cash cost		219240.12	199320.41	
Urea	T	111354.76	104673.47	0.94
T-super	T	55844.60	52493.92	0.94
Compound fertilizer	T	52040.76	42153.02	0.81
Total non cash cost		126257.69	121912.27	
Total family labor cost		83760.90	79415.48	
Land preparation to threshing (labor)	NT	54869.21	50523.79	0.91
Land preparation and threshing (animal)	NT	28891.69	28891.69	1.00
Total material non cash cost		42496.79	42496.79	
Home grown seed*	NT	31952.44	31952.44	
FYM	NT	10544.35	10544.35	
Return above variable cost		119282.07	427791.28	
Return above cash cost		245539.76	549703.56	
Benefit- Cost ratio		1.27	2.04	
Return per unit of cash cost		1.78	2.91	

(N = 58)
* = Seed Price (287.08 ks/kg)

Source; Own Survey Data

Appendix 14 Sensitivity Analysis of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Manawthukha Rice Production in Pathein

Yield		DRC at Different World Prices (US$/MT) and Exchange Rates (Ks/US$)								
		US$ 250			US$ 300			US$ 400		
MT/ha	bsk/ac	1000*	1275*	1400*	1000*	1275*	1400*	1000*	1275*	1400*
3.10	60	0.79	0.63	0.57	0.62	0.49	0.45	0.43	0.34	0.31
3.62	70	0.65	0.51	0.46	0.51	0.40	0.36	0.36	0.28	0.25
4.13	80	0.55	0.43	0.39	0.43	0.33	0.30	0.30	0.23	0.21
4.65	90	0.48	0.37	0.33	0.38	0.29	0.26	0.26	0.20	0.18
5.16	100	0.42	0.32	0.29	0.33	0.25	0.23	0.23	0.18	0.16

* = exchange rates

Source: Own Survey Data, 2008

Appendix 15 Sensitivity Analysis of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Manawthukha Rice Production in Phyapone

Yield		DRC at Different World Prices (US$/MT) and Exchange Rates (Ks/US$)								
		US$ 250			US$ 300			US$ 400		
MT/ha	**bsk/ac**	**1000***	**1275***	**1400***	**1000***	**1275***	**1400***	**1000***	**1275***	**1400***
3.10	60	0.74	0.60	0.56	0.58	0.47	0.43	0.40	0.33	0.30
3.62	70	0.60	0.48	0.44	0.47	0.38	0.34	0.33	0.26	0.24
4.13	80	0.51	0.40	0.36	0.40	0.31	0.29	0.28	0.22	0.20
4.65	90	0.44	0.34	0.31	0.34	0.27	0.24	0.24	0.19	0.17
5.16	100	0.39	0.30	0.27	0.30	0.24	0.21	0.21	0.16	0.15

* = exchange rates
Source: Own Survey Data, 2008

Appendix 16 Sensitivity Analysis of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Ayeyarwaddy Pawsan Rice Production in Pathein

Yield		DRC at Different World Prices (US$/MT) and Exchange Rates (Ks/US$)								
		US$ 400			US$ 570			US$ 680		
MT/ha	**bsk/ac**	**1000***	**1275***	**1400***	**1000***	**1275***	**1400***	**1000***	**1275***	**1400***
1.55	30	1.01	0.91	0.88	0.70	0.61	0.57	0.59	0.50	0.47
0.81	35	0.81	0.70	0.67	0.56	0.47	0.44	0.47	0.39	0.36
2.07	40	0.68	0.57	0.54	0.46	0.38	0.36	0.39	0.32	0.29
2.32	45	0.58	0.48	0.45	0.39	0.32	0.30	0.33	0.27	0.24
2.58	50	0.51	0.42	0.39	0.34	0.28	0.26	0.29	0.23	0.21

* = exchange rates

Source: Own Survey Data, 2008

Appendix 17 Sensitivity Analysis of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Phyapone Pawsan Rice Production in Phyapone

Yield		DRC at Different World Prices (US$/MT) and Exchange Rates (Ks/US$)								
		US$ 400			US$ 570			US$ 680		
MT/ha	bsk/ac	1000*	1275*	1400*	1000*	1275*	1400*	1000*	1275*	1400*
1.55	30	0.99	0.83	0.76	0.61	0.49	0.45	0.48	0.39	0.36
0.81	35	0.78	0.64	0.58	0.48	0.38	0.35	0.39	0.31	0.28
2.07	40	0.64	0.52	0.47	0.40	0.32	0.29	0.32	0.26	0.23
2.32	45	0.54	0.43	0.39	0.34	0.27	0.25	0.28	0.22	0.20
2.58	50	0.47	0.37	0.34	0.30	0.24	0.21	0.24	0.19	0.17

* = exchange rates
Source: Own Survey Data, 2008