COMPARATIVE ADVANTAGES OF RICE AND BLACK GRAM PRODUCTIONS IN MAUBIN AND DAIK U TOWNSHIPS IN LOWER MYANMAR

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COMPARATIVE ADVANTAGES OF RICE AND BLACK GRAM PRODUCTIONS IN MAUBIN AND DAIK U TOWNSHIPS IN LOWER MYANMAR

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A thesis submitted to the post – graduated 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 "**Comparative Advantages of Rice and Black Gram Productions in Maubin and Daik U Townships in Lower Myanmar**" was prepared and submitted by Kay Thi Khin 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).**

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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.

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DEDICATED TO MY BELOVED PARENTS,

U KHIN OHN AND DAW MYA LAY

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ABSTRACT

This study was carried out to examine whether the rice farmers in the study area are efficient producers in term of comparative advantage by using policy analysis matrix (PAM). This study was based on primary and secondary sources of data. The primary data for the study was obtained by using purposive random sampling method from 120 sampled farmers, in Maubin and Daik U Townships during September to October, 2015. Domestic Resource Cost (DRC) analysis and PAM were used to measure the comparative advantage on rice in monsoon and summer and black gram production.

The results showed that DRC ratios were 0.64 and 0.61 for monsoon rice, 0.45 and 0.44 for summer rice and 0.31 and 0.34 for black gram in Maubin and Daik U Townships. All DRC ratios showed that there was comparative advantage in all selected crops under the current production system, export price and exchange rate in both townships. Output policy divergences were positive values in monsoon rice production and which meant monsoon rice farmers received higher price in domestic market than international market because large shares of monsoon rice were produced for domestic consumption. But output policy divergences were negative in summer rice and black gram productions. This indicated that summer rice and black gram producers received a price lower than what could have earned at international market. Summer rice is clearly commercial one in these areas. Most farmers sold rice in form of wet paddy and largely to trader who came to villages in the study areas. Some are related to poor quality. In input policy, all selected crops showed also positive divergences that indicated farmers in the study areas had to pay higher prices of tradable inputs. Positive divergences in domestic factor costs were caused by labor market imperfection. The results of Effective Protection Coefficients (EPC), the current output and input polices were disincentive for farmer for all selected production because they have been directly or indirectly taxed because of output and input policies. Moreover, they grew high use of tradable inputs and domestic factors, paid high price of inputs and they got low yield low price of outputs. Among these productions, black gram had the most comparative advantage for export market and then followed by summer rice and monsoon rice production. According to the sensitivity analyses, all selected crop productions can obtain more comparative advantages if increasing FOB prices with higher exchange rates at different yield levels. Labor productivity of summer rice production was found to be the most labor use efficient and labor productivity of black gram production was the most labor use efficient in Daik U Township. In both townships, most indicators showed that labor use efficiency of Daik U

Township was greater than that of Maubin Township. All these crops had potential to high farm income and foreign exchange earnings for the country.

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LIST OF ABBREVIATIONS

ASEAN	Association of South East Asia Nation
ACIAR	Australia Centre of International Agricultural Research
CIF	Cost, Insurance and Freight
DRC	Domestic Resources Cost
DoA	Department of Agriculture
DoP	Department of Planning
EPC	Effective Protection Coefficient
FOB	Free on Board
IRRI	International Rice Research Institute
MMK	Myanmar Money Kyat
MOAL	Ministry of Agriculture and Irrigation
MOC	Ministry of Commence
NPCI	Nominal Protection Coefficient for Tradable Input
NPCO	Nominal Protection Coefficient for Output
PAM	Policy Analysis Matrix
PCR	Private Cost Ratio
SPSS	Statistical Packages for Social Science
SRP	Subsidy Ratio to Producers

LIST OF CONVERSION FACTORS

1 Basket of Paddy	= 20.86 Kilogram
1 Basket of Black Gram	= 32.7 Kilogram
1 Metric Ton	= 1000 Kilogram
1 Hectare	= 2.47 Acres
1 Basket of Paddy	= 0.66 Basket of Rice

CHAPTER I

INTRODUCTION

Specialized in specific agricultural products and explore the comparative advantages in the market place are the key for economic growth in developing countries, which allows these countries to concentrate resources and increase productivity on specialized products. In Myanmar, agriculture is the main contributor of the Gross Development Product (GDP) by providing employment, food, raw materials for industries, and foreign exchange earnings. It contributed 22.1% of gross domestic product in 2015 (MOAI 2015). Moreover, agricultural products are Myanmar's main export commodities. To increase the production and productivity of a country is very important in securing the nations' food security, reducing rural poverty and also promoting the national economy.

Myanmar has the potential to produce food not only to feed its people but also to be one of the principal food producers of the region. That is because nature has blessed it with vast areas of fertile land and abundant success of water, which are the principal ingredients of Agro-based economy. Besides, it provides the raw materials for the local industries and also significantly contributes in the export. Since the development in agriculture sector enhances the socio-economic development of the country, the Government has designated agriculture as the main pillar of the economy and is dedicating tremendous efforts to achieve greater progress in this sector.

Myanmar's population is increasing steadily with an annual growth rate of 2% and estimated total for 2014 - 2015 was approximately 51.18 million. Out of this total about 71% was living in rural area where farming is the main occupation. Total labor force was estimated to be 30 million (MOAI 2015) out of which 61.2% were engaged in agriculture sector. Growth in the agriculture sector was necessary for the livelihood of about 61.2% of the people living on agriculture-related activities (MOAI 2015).

Agriculture is the primary engine of economic growth for LDCs; for emerging economies, the agricultural sector requires government efforts to sustain productivity gains; for industrialized countries, it is important to promote agriculture's multifunctional roles such as rural amenities and ecosystem services (Pingali 2007). Efficiency increases productivity, which can be achieved by avoiding misallocation of scarce resources. The low productivity arising from misallocation of resources robs farmers from making meaningful livelihoods. Agricultural productivity and efficient use of scarce natural resources such as agricultural land and variable inputs remain an important focus of government policies in Myanmar.

Comparative advantage relates to how much productive or cost efficient one country is than that of another. When a person or a nation has a lower opportunity cost in the production of a good, they have a comparative advantage in the production of that good (David Ricardo 1817). The choice of crop is typically dictated by the profit orientation of the farm family, where higher returns related to the cost invested are the major factors for driving this choice. The drive is for the farmers to allocate their resources to those productive ventures that earn higher returns for each unit of resource spent. There might be re-allocation of available resources if they expect to benefit more from such economic actions. It is, therefore, necessary to assess the comparative advantage of production of different crops in Myanmar.

Myanmar has four key competitive advantages for agriculture: abundant land, water, and labor resources; and potential to major future food markets. Two general level of trade, domestic and international, through price signals, determine simultaneously the financial and economic viability of the different production alternatives. Actual domestic (market) prices determine the financial feasibility of a commodity enterprise at the farmers' level. On the other hand, export- import prices provided by international trade determine the economic viability of agricultural production activities at the national level. In order to increase the foreign exchange earnings from agricultural sector which basically supports the national economy, concerted efforts are being made for increased production of four major crops, namely _ paddy, pulses, cotton and sugarcane, recognizing as main pillars (Soe 2000).

1.2 Crop Performance

Agricultural production took place on only about 11.98 million hectares (ha), or 17.7% of Myanmar's total land area of about 68 million ha (MOAI 2015 (a)). More than 60 different crops are grown on different agro-ecological zones in Myanmar. The crops are grouped into: cereal crops, oilseeds crops, pulses, industrial crops, culinary crops, vegetables, fruits and other crops. Table 1.1 shows the yield of various selected crops from 1995 to 2015, according to Myanmar's official statistics.

1.2.1 Rice

Among agricultural products rice is one of the important commodities due to its role as staple food of Myanmar. The seasonal Monsoons from the South-West brings rain to Myanmar for about five months every year, filling the rivers and creeks and watering

Table 1.1 Yield of Major Crops in Myanmar, 1995–2014 (Metric Tons Per Hectare)

Crops	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014
Paddy	3.08	3.38	3.75	4.03	4.06	4.07	3.83	3.84	3.90	3.94
Maize	1.70	1.73	2.87	3.39	3.43	3.54	3.61	3.64	3.70	3.75
Black gram	0.78	0.87	1.25	1.46	1.48	1.52	1.26	1.40	1.43	1.44
Green gram	0.74	0.74	1.00	1.19	1.24	1.26	1.22	1.28	1.29	1.31
Pigeon pea	0.60	0.90	1.14	1.27	1.25	1.32	1.32	1.31	1.33	1.36
Groundnut	1.15	1.25	1.42	1.55	1.57	1.59	1.58	1.59	1.60	1.61
Sesame	0.34	0.33	0.40	0.54	0.53	0.54	0.57	0.56	0.57	0.56
Sunflower	0.76	0.54	0.81	0.88	0.89	0.92	0.93	0.94	0.96	0.98
Cotton	0.51	0.51	0.71	1.23	1.46	1.57	1.64	1.68	1.70	1.75
Sugarcane	51.17	44.38	55.72	61.20	61.61	62.64	63.22	62.26	61.83	63.41
Rubber	0.53	0.58	0.59	0.65	0.67	0.69	0.75	0.77	0.76	0.77

Source: Department of Planning, Ministry of Agriculture and Irrigation, 2015 the land for cultivation of rice, the principal crop of Myanmar. Rice production has increased considerably since the introduction of high-yielding varieties in the late 1970s and Ministry of Agriculture and Irrigation (MOAI) encourages the farmers to grow more rice. Nowadays, the sown area of rice was increased from 6.14 million hectares in 1995 - 1996 to 7.17 million hectares in 2014-2015. Production of the rice was also raised from 17.67 MT/ha in 1995-1996 to 28.19 MT/ha in 2014 – 2015 (Table 1.2).

Nowadays, rice is also being grown in summer in areas, where irrigation is accessible from the various dams, or from the rivers and creeks. After the mid-1990s, the policy also stressed self-sufficiency of rice in each locality, including rice deficit areas, such as the mountains and the dry zone. This policy conflicts with the promotion of production based on the principle of comparative advantage. Rice double cropping, or the summer rice program, was introduced in 1992, supported generously with irrigation and other services. For promoting summer rice production, investment in irrigation was indispensable not only in the dry zone in upper Myanmar but also in lower Myanmar. Sown area, yield and production of monsoon and summer rice are described in Table 1.3 and 1.4.

Myanmar was stood as major exporter of rice with amount of about 3 million tons between 1921 and 1941, in colonial period. In the period of 2000 – 2006, Myanmar rice export sharply declined to 0.05 metric tons, after that it had gradually increased again to nearly 1 million metric tons.

1.2.2 Pulses

The production of pulses in Myanmar underwent a remarkable development in both output and exports after the liberalization of agricultural marketing in 1989. Indeed the government showed relatively little interest and the expansion in the production of pulses was led exclusively by the private sector. The government appreciated the sector's success in later years and attempted to obtain part of the benefit of expansion by introducing a procurement system at the end of 1990s.

In Lower Myanmar, pulses were introduced everywhere as a second crop after monsoon rice, which was a new development because there was virtually no second crop produced before 1988. In the dry season, idle land suddenly came to be utilized for the production of pulses. In order to cultivate rice in the dry season, as was noted earlier, irrigation is indispensable. Because irrigation is not necessary for pulses, the introduction of pulses was relatively undemanding for irrigation infrastructure investment.

Table 1.2 Rice Sown Areas, Yield, Production and Export of Rice in Myanmar

Year	Sown Areas (million ha)	Yield (MT/ha)	Production ('000 MT)	Export ('000 MT)	Export (% of production)
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	145	0.05
2007 – 2008	8.09	3.81	31450	359	1.14
2008 – 2009	8.10	3.91	32573	666	2.04
2009 – 2010	8.07	3.93	32681	818	2.50
2010 – 2011	8.04	4.07	32579	536	1.65
2011 – 2012	7.60	3.72	29,010	707	2.44
2012 – 2013	7.24	3.84	27704	1396	5.03
2013 – 2014	7.28	3.90	28322	1192	4.21
2014 – 2015	7.17	3.94	28193	1823	6.47

Source: Department of Planning, Ministry of Agriculture and Irrigation, 1995- 2015.

Table 1.3 Sown Areas, Yield and Production of Monsoon Rice in Myanmar

Year	Sown Areas (million ha)	Yield (MT/ha)	Production ('000 MT)
2005 – 2006	6.24	3.51	22557
2006 – 2007	6.90	3.59	25320
2007 – 2008	6.82	3.69	25789
2008 – 2009	6.82	3.79	26582
2009 – 2010	6.78	3.82	26698
2010 – 2011	6.80	3.84	26762
2011 – 2012	6.53	3.60	24105
2012 – 2013	6.30	3.61	23287
2013 – 2014	6.23	3.65	23326
2014 – 2015	6.23	3.70	23717

Source: Department of Agriculture, Ministry of Agriculture and Irrigation, 2005 - 2015

Table 1.4 Sown Areas, Yield and Production of Summer Rice in Myanmar

Year	Sown Areas (million ha)	Yield (MT/ha)	Production ('000 MT)
2005 – 2006	1.15	4.31	5119
2006 – 2007	1.23	4.42	5596
2007 – 2008	1.27	4.47	5653
2008 – 2009	1.28	4.54	5982
2009 – 2010	1.29	4.51	5975
2010 – 2011	1.25	4.5	5809
2011 – 2012	1.06	4.47	4897
2012 – 2013	0.95	4.51	4410
2013 – 2014	1.06	4.57	4989
2014 – 2015	0.94	4.62	4469

Source: Department of Agriculture, Ministry of Agriculture and Irrigation, 2005 - 2015

Cultivation of pulses is relatively less expensive in cost of cultivation and increased demand for domestic consumption and export. Sown area of pulses has increased substantially from 0.73 million hectares in 1988 – 89 to 5.91 million hectares in 2014 -2015. Export of pulses rose from 17,000 metric tons in 1988 – 1989 to around 1.46 million metric tons in recent years. Consequently, both production and exports increased significantly and pulses are now the top foreign exchange earner among agriculture commodities. The export tax on these products has also been reduced, from 10% during 1988 – 2010 to 2% in 2011; this is levied as income tax paid by exporters on their export income. According to the new policy, export tax is not transparent for private exporters (Aye Moe San 2008).

Among the 17 varieties of pulses produced in Myanmar, the three varieties such as black gram, green gram and pigeon pea are particularly more important because they are major exportable varieties of pulses. Sown area of black gram accounted for 1.10 million hectors and total production was in recent year 1.58 million metric tons in 2014 - 2015 (Table 1.5). The sown area of green gram and pigeon pea were 1.17 million hectors and 0.62 million ha in 2014 - 2015. The productions were 1.53 million metric tons in green gram and 0.84 million metric tons in pigeon pea. These three pulses account for between 80 and 90% of total exports by value.

Myanmar is recently standing as a leading country in pulses production among ASEAN countries. The emergence of the large Indian market was a key factor underlying the development of pulse cultivation in Myanmar. By 2014 - 2015, 1.1 million tons of beans and pulses were exported annually to India, of which 600,000 MT were black gram, 300,000 MT of green gram, 200,000 MT of pigeon pea, and another 200,000 MT of other (MOAI 2015).

1.3 Rationale of the study

In most developing countries including Myanmar, social or economic profitability deviates from private profitability because of distortions in factor and output markets, externalities and government policy interventions that tend to distort relative prices. The choice of crop would depend not only on the comparative advantage of producing the crop, but also on the importance of the crop to the people in the specific zone as well as market availability. Comparative advantage advocates resources to be allocated to the most efficient enterprises.

Table 1.5 Sown Areas, Yield, Production and Export of Black Gram in Myanmar

Year	Sown Areas (million ha)	Yield (MT/ha)	Production ('000 MT)	Export ('000 MT)	Export (% of production)
2000 – 2001	6.20	0.87	532	275	0.52
2001 – 2002	7.22	0.88	636	320	0.50
2003 – 2004	7.82	1.01	740	458	0.62
2004 – 2005	7.82	1.17	914	407	0.45
2005 – 2006	8.15	1.25	1021	380	0.37
2006 – 2007	8.98	1.34	1201	487	0.41
2007 – 2008	9.80	1.41	1381	494	0.36
2008 – 2009	10.39	1.19	1240	530	0.43
2009 – 2010	10.23	1.43	1509	616	0.41
2010 – 2011	10.55	1.52	1604	457	0.28
2011 – 2012	10.90	1.26	1375	598	0.43
2012 – 2013	11.08	1.40	1548	658	0.43
2013 – 2014	11.02	1.43	1574	644	0.41
2014 – 2015	10.98	1.44	1580	626	0.40

Source: Department of Agriculture, Ministry of Agriculture and Irrigation, 2005 - 2015

The rural farm households are faced by two main aspects in their productions. The first one is the natural aspect, which means the unexpected changes and fluctuations of the environmental conditions leading to low production of the food and cash crops. The second one is economic aspect, which is the formulation of the prices and price policies disfavoring the main food and export commodities.

Most of agricultural land was cultivated by small scale farmers and total cultivated average size of holding was 2.21 hectares (Kyu 2015). Production costs are kept rising and farmers are facing declining profits. Farmer's actual yields are much lower than target yields in both rice and pulses. Exports of agricultural products, particularly rice and pulses, were controlled by export licenses.

Cost and return of corps productions are important factors to select suitable crops for farmer. There are many differences between the rice and pulses productions and also among regions according to the seasons, capital investment, use of labor, fertilizer, water and pest management, etc. How the current level of annual production and products price could be increased like other agricultural based countries using less land, less water, less manpower and fewer agro-chemicals is a big question.

It is therefore necessary to assess the comparative advantage of the production of major crops. It is also needed to analyze why farmer's actual yield is much lower than target yield. Analysis of the comparative advantage can help in deriving meaningful policy conclusions on how to transform the farming system toward more efficient crop activities. This study examined the comparative advantage of rice and pulses, Myanmar major export crops, in order to find out whether Myanmar is an efficient producer of these crops or not. From this study, the valuable information can be provided not only to farmers but also to the policy makers for making decisions to choose the crops.

Objectives of the Research

General objective to ascertain whether the rice and pulses producers in the study area are efficient producers in term of comparative advantage

The specific objectives of this study are:

(1) To find out and compare the comparative advantages of monsoon rice, summer rice and black gram productions in Maubin and Daik U Townships

(2) To point out the effects of changes in the key variable factors such as different yield levels, world prices, and exchange rates of selected rice and black gram productions on DRC ratio in the study areas

(3) To compare labor use efficiency of rice and black gram productions in the study areas

CHAPTER II
LITERATURE REVIEW

2.1 Theory of Comparative Advantage

David Ricardo (1817) considered what goods and services countries should produce, and suggested that they should specialize by allocating their scarce resources to produce goods and services for which they have a comparative cost advantage. There are two types of cost advantage – absolute, and comparative. Absolute advantage means being more productive or cost-efficient than another country whereas comparative advantage relates to how much productive or cost efficient one country is than another.

The concept of comparative advantage is not only intellectually important, it also has significant implications for policy: in the absence of strong evidence to the contrary, free trade policies or reforms which move in that direction are likely to be superior to interventionist trade policies. Comparative advantage is a determinant of economic performance, it may be expected that it is revealed in economic growth and the share of agriculture in this growth.

Adam Smith (1776) alluded that if the country can produce some set of goods at a lower cost than a foreign country and if the other foreign country can produce some other set of goods at a lower cost than it can produce them, then clearly it would be best for it to trade the relatively cheaper goods for their relatively more expensive goods. In this way, both countries may gain from trade. Comparative advantage not only affects the production decisions of trading nations, but it also affects the prices of the goods involved.

Warr (1994) reviewed the relevance of the concepts of comparative and competitive advantage for the developing countries of the Asian-Pacific region. Comparative advantage deals with the efficient allocation of resources in an open economy. Comparative advantage indicated that whether it is economically advantageous for a country to expand production and trade of a specific commodity. Competitiveness indicated that whether a firm or a set to firms could successfully compete in the trade of the commodity in the international markets given existing policies and economic structure.

The concept of comparative advantages was first developed by the classical economist David Ricardo (1817) building on Adam Smith's (1776) principle of absolute advantages. According to this theory, if a country has comparative advantage in the production of a good over another country it means that its opportunity costs of production are relatively lower than that of in the other country. Absolute advantage refers to a country having higher (absolute) productivity or lower cost in producing a commodity compared to another country. David Ricardo’s principle of comparative advantage does not require a higher absolute productivity but only a higher relative productivity in producing a commodity.

Revealed comparative advantage (RCA) indices offer a useful way of analyzing a country’s comparative advantage, based on demonstrated (i.e. actual) export performance. The original RCA measure was proposed by Balassa (1965) who defined the export performance of a specific product/industry from a country – as measured by revealed comparative advantage index – as the relative share of the country’s export of the product in the world export of the same product, divided by the overall share of the country in world exports (Riaz and Jansen 2012).

Comparative advantage from observed data is named “revealed” comparative advantage (RCA). In practice, this is a commonly accepted method for analyzing trade data. The Balassa index tries to identify whether a country has a “revealed” comparative advantage rather than to determine the underlying sources of comparative advantage. Balassa’s index identified a group of products, which has relatively stable comparative advantage during the whole period. Lafay index, used in the analysis by regions, showed that Russia has comparative advantages in relation to CIS countries and Asian countries due to its geographical location and good trade relations (Ishchukova and Smutka 2013).

Riaz and Jansen (2012) studied spatial patterns of revealed comparative advantage of Pakistan’s agricultural exports. This analysis showed several product and region combinations are identified where Pakistan has demonstrated comparative advantage despite not enjoying such advantage at the world level. The approach was identified top export markets for Pakistan’s main exports, and shed light on the types of agricultural products from Pakistan that have the potential for penetrating the markets in developed countries.

Revealed Comparative Advantage (RCA) is a measure of international trade specialization (Balassa 1965). It identifies the comparative advantage or disadvantage a country has for a commodity with respect to another country or group of countries. It provides a ranking of commodities by degree of comparative advantage and identifies a binary type demarcation of commodities based on the comparative advantage (Balance et al. 1987).

A country's comparative advantage in a product can change over time due to changes in any of the determinants of comparative advantage including resource endowments, technology, demand patterns, specialization, business practices, and government policies. As propounded by Heccksher and Ohlin, a country has a comparative advantage in the production of that commodity which uses the relatively abundant resource in that country more intensively (Gupta 2009).

The Heckscher-Ohlin model is used to evaluate international trade, specifically trade equilibriums between countries that may have different features. The model emphasizes how countries with comparative advantages should export goods that require factors of production that they have in abundance, while importing goods that it cannot produce as efficiently. The Heckscher-Ohlin model seeks to mathematically explain how countries should operate when resources are not distributed equally around the world. The resource and endowments differences are explained by Heckscher-Ohlin model.

Differences between Ricardian and H-O model are: Ricardian model explains that comparative advantage arises from productivity or technological differences and the H-O model indicates that comparative advantage arises from differences in factor endowments. Since the original Ricardian model uses one factor and it moves freely across the industry, free trade does not hurt the factor. But in H-O model free trade benefits the abundant factor and hurts the scarce factor. Ricardian model assumes constant cost industry. The H-O model assumes increasing cost industry.

Kanaka and Chinadurai (2012) ascertained the changes in comparative advantage status of India's major agricultural exports during the post reforms period (1994-95 to 2008-09). India has been losing out its comparative advantage in export of some agricultural commodities to world after economic reform period.

Sarker and Ratnasena (2014) studied that the competitiveness literature by measuring the international competitiveness of wheat, beef, and pork sectors in Canada using data from 1961 to 2011. The results demonstrated that Canada enjoys competitiveness in the wheat sector but not in the beef or pork sectors. The findings of the emperical results also suggested that the competitiveness of the Canadian wheat sector can be improved if the cost of seed in Canada relative to that in the United States is lower. Similarly, if the relative labor cost of meat processing is lower, the competitiveness of both beef and pork sectors in Canada will be enriched.

Eng (2004) measured productivity and comparative advantage in rice agriculture in South-East Asia. The results showed that it quantifies labor productivity in rice production and argues that simple, low-cost and labor-extensive, but low-yielding production technology allowed farmers in mainland South-East Asia to achieve significantly higher levels of labor productivity than in the more heavily populated rice-producing areas in South-East Asia and Japan. High levels of labor productivity were a major source of comparative advantage in rice production for Myanmar, Thailand and Southern Vietnam.

Matsuyama (1991) analyzed agricultural productivity, comparative advantage, and economic growth. This study addressed in a two-sector model of endogenous growth in which (a) preferences are no homothetic and the income elasticity of demand for the agricultural good is less than unitary, and (b) the engine of growth is learning-by-doing in the manufacturing sector. And this suggests that the openness of an economy should be an important factor when planning development strategy and predicting growth performance.

Australia’s comparative advantage and competitiveness in textile and clothing (TAC) industries were analyzed by using Balassa’s revealed comparative advantage index and Vollrath’s measures of competitiveness. Grubel-Loyd index of intra-industry trade was calculated for seven categories of textiles and two categories of clothing. The results showed that a rising trend in intra-industry trade in some of these categories of TAC products, implying that Australia increasingly exports and imports differentiated TAC products (Havrila and Gunawardana 2003).

Ishchukova and Smutka (2013) analyzed of the Russian foreign trade in agricultural products and foodstuffs from the two points of view: international competitiveness and country’s trade balance. The analysis was based on the combination of two indices i.e. Revealed Symmetric Comparative Advantage, and Trade Balance Index that were used to represent an analytical tool named “products mapping”. The results showed that items in this group (A) have a comparative advantage and positive trade balance and items in the group (D) also have comparative disadvantage but negative trade balance. There was a reduction in the value of products in group D, while the value of products in group A has been steadily growing. These trends could be considered as a strengthening of the comparative advantages of Russian agricultural export.

Goldin (1990) examined the theory and the measurement of comparative advantage with a view to understanding trends in agricultural production and trade in developing and OECD countries. From this was found that developing countries were increasingly unable to afford distortions and appear most likely to engage in structural adjustments. And efficiency and cost could be expected to become more important. An awareness of the importance of comparative advantage was thus likely to become more important to both actual and potential developing country participants in agricultural trade.

Havrila and Gunawardana (2003) analysised Australia's comparative advantage and competitiveness in textile and clothing (TAC) industries using Balassa's revealed comparative advantage index and Vollrath's measures of competitiveness. The results showed a rising trend in intra-industry trade in some of these categories of TAC products, implying that Australia increasingly exports and imports differentiated TAC products.

Estudillo et al. (1999) investigated that new rice technology and comparative advantage in rice production in the Philippines. The results found that the country gained sharp improvement in comparative advantage in rice production in 1979, when yield rose remarkably due to the diffusion of pest- and disease-resistant modern rice.

Ansah et al. (2014) studied a comparative analysis of profit efficiency measurement as a proxy in maize and cowpea production in the Ejura Sekyedumase district of the Ashanti region, Ghana. The study showed that education, farm size and on-farm labour participation were major significant factors which influences profit efficiency in the study area.

Nwaru and Iheke (2012) observed comparative analysis of resource use efficiency in rice production systems in Abia state of Nigeria. This study was designed to examine resource use efficiency in rice production systems. Results indicated that the upland rice farmers are technically more efficient than the swamp and inland rice farmers and that there was no difference in technical efficiency between the swamp and inland rice farmers. There was no significant difference in the mean output of rice from the production systems; upland, inland valley and swamp while each operated in region one on the production surface indicating that overall, resource levels could be increased to achieve higher levels of productivity in each system.

Abdullahi (2012) studied on the comparative economic analysis of adopters and non-adopters of improved rice varieties among farmers in Paikoro local area of Niger state. It was found that farm size and fertilizer were significant at 1% and improved seed was significant at 5% level for the adopters, while only farm size and quantity of agro-chemicals were significant at 1% and 10% respectively for the non-addopters. Some of the problems encountered by both categories of farmers in the study area include; pests and diseases, high cost of seed, fertilizer and labour.

Peterson and Valluru (2000) analysised agricultural comparative advantage and government policy interventions. This study explored the relation between factor endowments and agricultural trade patterns and examined the impact of agricultural and environmental policies on trade flows. The results found that Government intervention do not contribute to the explanation of trade patterns while national factor endowments do account for much of the variation in trade patterns of grains, oilseeds, cotton, and, to a lesser extent, meat products and an aggregate of all agricultural goods. Commodities such as sugar, tropical products and fruits and vegetables did not appear to be well explained by factor endowments.

Makosholo and Jooste (2006) evaluated the comparative economic advantage (CEA) of irrigated longterm crops (cherries, peaches, apples and asparagus) in the four agro-ecological zones of Lesotho based on analyses of profitability coefficients and domestic resource costs. All examined crops in the Lowlands, Foothills, the Senqu River Valley and the Mountains of Lesotho were shown higher private returns relative to economic returns. In the Lowlands zone all products had a resource cost ratio (RCR) of lower than one indicating a comparative advantage. In the Foothills only apples and peaches show a comparative advantage of equal strength. In the Senqu River Valley, apples show a comparative advantage, whilst peaches show a comparative disadvantage. In the Mountain zone only apples has a comparative advantage.

Huang et.al. (2003) studied the changing pattern of China's sweetpotato production and utilization, examined the incentives governing sweetpotato production, and analyzed the efficiency of substituting sweetpotato for maize as feed in pig production. The results from this study showed that both sweetpotato and maize producers are facing great challenges. Policy distortions have penalized sweetpotato and protected maize production. The social profitability of sweetpotato is at least as high as maize in both Sichuan and Shandong.

Ferto and Hubbard (2002) investigated the competitiveness of Hungarian agriculture in relation to that of the EU employing four indices of revealed comparative advantage, for the period 1992 to 1998. The results suggested that despite of significant changes in Hungarian agriculture during the 1990s, the pattern of revealed comparative advantage has remained fairly stable. RCA indices, despite their limitations, provided a useful guide to underlying comparative advantage and offered a further insight into the competitiveness of Hungarian agri-food sectors and the implications for trade when membership of the EU becomed a reality.

2.2 Issues and Purpose of Policy Analysis Matrix

The Policy Analysis Matrix (PAM) ia a computational framework developed by Monke and Pearson (1989) and augmented by Idris, Babiker (1993). for measuring input use efficiency in production, comparative advntage, and the degree of government interventions The PAM approach to agricultural policy analysis can provide decision-makers and analysts with both a helpful conceptual construct for understanding the effects of policy and a useful technique for measuring the magnitudes of policy transfers. Because the accounting matrix is simultaneously a teaching tool and a way of undertaking and reporting empirical analysis, PAM results can be communicated easily to policy-makers, who might not be specialists in economics.

PAM results expressed the individual and collective effects of price and factor policies. The PAM also provides essential baseline information for benefit-cost analysis of agricultural investment projects. The Policy Analysis Matrix methodology provides information to help policy makers address three central issues of agricultural policy analysis. The first one is whether agricultural systems are competitive under existing technologies and prices – that is, whether farmers, traders, and processors earn profits facing actual market prices. Prospective price policies would change the value of output or the costs of inputs and thus the private profitability of the system. A comparison of private profitability before and after the policy change measures the impact of the policy change on competitiveness (Monke and Pearson 1989).

The second is the impact of new public investment in infrastructure on the efficiency of agricultural systems. Efficiency is measured by social profitability, the valuation of profits in efficiency prices and successful public investment (in irrigation or transportation) would raise the value of output or lower the costs of inputs. A comparison of social profits before and after the new public investment measures the increase in social profits (Monke and Pearson 1989).

The last issue is the impact of new public investment in agricultural research or technology on the efficiency of agricultural systems. Successful public investment in new seeds, farming techniques, or processing technologies would enhance farming or processing yields and thus rise revenues or decline costs. A comparison of social profits before and after the investment in research measures the gain in social profitability (Monke and Pearson 1989).

The three principal purposes of the Policy Analysis Matrix (PAM) methodology are to provide information and analysis to support policy makers in these three central areas of agricultural policy. 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. The third purpose of PAM analysis is to measure the transfer effects of policies. The PAM method determines the effects of policies influencing both products and factors of production (land, labor, and capital). The transfer effects of policies are measured in the third (bottom) row of the PAM matrix (Monke and Pearson 1989).

The policy analysis matrix is a product of two accounting identities, one defining profitability as the difference between revenues and costs and the other calculating the effects of divergences (distorting policies and market failures) as the difference between observed parameters and parameters that would occur if the divergences were removed (Monke and Pearson 1989).

Two cost columns (one for tradable inputs and the other for domestic factors are contained in each PAM. Intermediate inputs-including fertilizer, pesticides, purchased seeds, compound feeds, electricity, transportation, and fuel are separated into their tradable-input and domestic factor components. This process of disaggregation of intermediate goods or services divides intermediate costs into four categories-tradable inputs, domestic factors, transfers (taxes or subsidies that are set aside in social evaluations), and nontradable inputs which themselves have to be further disaggregated so that ultimately all component costs are classified as tradable inputs, domestic factors, or transfers) (Monke and Pearson 1989).

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

Rehman et al. (2011) determined that the competitiveness of wheat production in D.I.Khan with special reference to the policy analysis to know whether the policy incentives have favored or discriminated against wheat enterprise. The results of the PAM analysis suggested that wheat could be nationally produced as import substitution strategy for self sufficiency and increase in farm income. So, wheat production should be discouraged for export purpose.

The study combined policy analysis matrix (PAM) and data envelopment analysis (DEA) techniques to evaluate the profitability and competitiveness of maize, rice, and soybean production in Ghana. PAMs were computed under observed average and profit-efficient farming conditions. The results were distinctively different under observed average and profit maximizing conditions. One may argued that average maize, rice, and soybean farmers are not viable in the long term because they are making losses at social prices. Policies based on dissemination of best practices could improve overall efficiency of these cropping systems. Rice production does not seem profitable in social prices even for efficient farmers. Excluding family labor from domestic cost factor provided different perspectives that point to the ability of maize, rice, and soybean production to create value for farmers and also to added welfare gains to the society (Akramov and Malek 2012).

Ugochukwu and Ezedinma (2011) measured intensification of rice production systems in southeastern Nigeria. The result indicated that upland; lowland and double rice cropping systems in southeastern Nigeria are profitable based on the policy analysis matrix (PAM) model, and rice production under various systems and technologies is socially profitable and financially competitive. There exist comparative advantage in the various production systems, with lowland and double cropping being highest, substantial tax was imposed on rice imports in Nigeria and government investment in intensifying rice production had a positive impact on the output of local rice production.

Mohanty et al. (2002) assessed the efficiency of cotton production in five major producing states in India by using policy analysis matrix (PAM) approach. The results indicated that cotton is not efficiently produced in the second largest cotton producing state in the country. The study 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 produced than cotton. These findings was 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.

Fang and Beghin (1999) assessed the comparative advantage and protection of China’s major agricultural crops using a modified Policy Analysis Matrix (PAM) and 1996 to 1998 data. In this study, early *indica* rice, late *indica* rice, *japonica* rice, south wheat, north wheat, south corn, north corn, sorghum, soybean, rapeseed, cotton, tobacco, sugarcane, and a subset of fruits and vegetables were considered. The results strongly suggested that China has a comparative advantage in labor-intensive crops, and a disadvantage in land-intensive crops. The findings indicated that China's current grain self-sufficiency policy incurs efficiency losses. If China keeps its food security policy, greater input productivity in grain production to improve its competitiveness was needed.

Reig-Martínez et al. (2008) evaluated that profitability in rice cultivation in Albufera by using the policy analysis matrix with profit-efficient data. While conventional analysis points to a lack of profitability, farmers was shown to make positive profits at private and social prices when data reflecting efficiency adjustments were used in the analysis. This study mainly concluded that the usefulness of the policy analysis matrix might be substantially enhanced by simulating profitability after efficiency-improving managerial decisions have been adopted.

Mahlanza et al. (2003) analysised the comparative advantage of wheat under conventional practices, and later contrasts conventional with organic practices in Agrekon of South Africa. A Policy Analysis Matrix (PAM) was used to determine whether wheat production would have a comparative advantage if produced under organic practices. The results of the analyses mainly indicated a comparative advantage for wheat grown under organic practices especially when the social cost benefit ratio (SCB) is incorporated into the analyses. The finding of the results also showed the existence of distortions in the market even if wheat were to be produced under organic practises, although these are shown to be less than for wheat produced under conventional practices.

Yao (1997) measured that comparative advantages and crop diversification for Thai agriculture by using a policy analysis matrix. Three competitive crops (rice, soybeans and mungbeans) were selected in two provinces to study their comparative advantages in terms of a policy analysis matrix. The results suggested that rice is more profitable than soybeans and mungbeans, implying that government intervention may incur efficiency losses. The authors also suggested that potential price changes, increasing water scarcity, and the effects of crop production on the environment are important concerns which may justify government intervention.

Ugochukwu and Ezedinma (2011) stated that intensification of rice production systems in southeastern Nigeria using Policy Analysis Matrix (PAM). The result showed that upland; lowland and double rice cropping systems in southeastern Nigeria are profitable based on the policy analysis matrix (PAM) model, and rice production under various systems and technologies is socially profitable and financially competitive.

Dunmola et al. (2015) assessed that the competitiveness, comparative and social advantages and effect of government policies on cocoa production in Ondo State, Nigeria.

The results of PAM indicated that cocoa production is privately and socially profitable and policies are decreasing the market price below international price. This also found that policies also increase tradable input costs which producers were highly taxed on tradable inputs purchased and farmer were also taxed on value added at world refrerence price.

Elzaki et al. (2011) evaluated comparative advantage of the crops production in the agricultural farming systems in Sudan. The liner programming associated with Policy Analysis Matrix was applied to determine competitiveness and policy effects of crops production in the farming systems. The PAM results indicated that the farmers grow the food crop only to maintain self-sufficiency level as it will be cheaper in domestic market than to invest on import of food crop. This study explained that it has comparative advantage for the three representative farms, both under the current policies and in the absence of government intervention.

Tavassoli et al. (2013) investigated that the comparative advantage of rapeseed in Sistan by using DRC index and policy analysis matrix (PAM) during 2010-2011. According to calculation based on a policy analysis matrix, results showed that the rapeseed in Zabol city has a social benefit. The idea supported that increase in yield, decrease in production cost and improve in cropping pattern are approaches for usefulness of rapeseed production in Sistan Region.

Akter (2003) assessed competitiveness and efficiency of local, crossbred and exotic breeds of poultry and pig production in north and south using Policy Analysis Matrix in 1999. According to the resuts of PAM, poultry meat and egg production is generally competitive except meat and egg production with local breeds, and egg production with crossbreds in the North, and egg production with local breeds in the South, due to low productivity and high per unit cost.

Hai and Heidhues (2004) examined the fluctuations in the comparative advantage of Vietnamese rice production based on different situations of trade liberalization and economic reform in Vietnam. The empirical results showed that the comparative advantage in rice was relatively high and that the use of domestic resources – i.e., land, labor and water – was efficient in economic terms during 1998 (the baseline scenario).

Haji-Rahimi (2014) investigated the coincidences of self-sufficiency and comparative advantage and the real impact of self-sufficiency on net social benefit as a measure of food security by developing a Policy Analysis Matrix (PAM). The study was conducted that the self-sufficiency policy through price supports, inputs and credit subsidies and research and extension programs, has increased the physical productivity of wheat farms as well as increased the area under cultivation. However, the net social profit of wheat production was negative during the period of study, indicating a negative effect of self-sufficiency policy on the food security.

Torres and Lenin (2011) studied the comparative advantage in regional guava production. The main finding of the study pointed out the existence of comparative advantage in the production of Michoacán's guava. The given resources were well used in the production of guava because it gave wealth to the growers. Guava production is a productive alternative, although there was some degree of vulnerability.

Salam and Abbas (2004) studied that the profitability and competitiveness of rice farming in Polmas District, South Sulawesi, Indonesia by using Policy Analysis Matrix (PAM) approach. The PAM analysis presented that if tradable inputs and outputs were valued at international prices and domestic resources (land, labor, and capital) were at opportunity costs. The author pointed out the country has a comparative advantage in producing the commodities, which have positive social profits, and can compete to international rice market.

Longwe-Ngwira et al. (2012) assessed the competitiveness of groundnut production in Malawi for 2006-2007 growing season. The analysis of Malawian groundnut production using the Policy Analysis Matrix methodology suggested that both traditional and improved technology productions are both privately and socially profitable. This concluded that protectionist policies that would raise domestic groundnut prices above the import parity prices determined in world markets were unnecessary.

Legese et al. (2007) assessed the comparative advantage of Ehiopia in malt barley production. Result of the study pointed out that Ethipia has a comparative advantage in production of malt barley grain. So, This study indicated that malt barley producers are taxed and the policy evironment is disfavoring them.

Kanaka and Chinnadurai (2013) observed that the policy analysis matrix of rice cultivation in india during periods of 1994-95 and 2008-09. According the findings, it conclued that the usefulness of the policy analysis matrix might be substantially improved by simulating profitability after efficiency-improving managerial decisions have been adopted.

Adeoye and Oni (2013) analyzed competitiveness and effect of government policies on plantain flour and chips processing in Southwestern Nigeria. In PAM analysis, result indicated that plantain chips and flour processing had positive private and social profit indicating that processing of the commodities was economically profitable under existing government policies. Result of the protection coefficients showed that the prevailing incentive structure affected processors negatively. Sensitivity analysis result indicated that policy indicators were sensitive to changes in exchange rate and world price of the products. This study has applied Policy Analysis Matrix (PAM) as the main research framework to analyze the profitability and the effects of intervention policies on the profitability of *Acacia* production in order to provide information. Results showed that *Acacia* production offers both private and social efficiency. Comparative advantage had in *Acacia* production. This study suggested that policy-makers and other forestry development programs should support farmers in cultivating the intensive model and lowering the interest rate for planting and expanding *Acacia* forest (Ha and Thuong 2011).

Hassanpour et al. (2013) investigated that the policies effects and comparative advantage of rainbow trout farming in KB province in Iran during 2012. In this regard, it is suggested that the custodians of agricultural production section reduce production costs and increase the comparative advantages through promoting new technologies, methods of reducing waste, increasing mechanization, etc.

The study determined the policy incentive in terms of protection and efficiency of production through comparative advantages in the rice sector by using policy analysis matrix (PAM) for the period of 2003 to 2005. The findings showed that Bangladesh has comparative advantage in rice production under import parity price not under export parity price. In sensitivity analysis in efficiency, it indicated that productivity or yield increase or decreases have lot of influence in efficiency (Islam and Kirschke 2005).

Khan et al. (2006) determined the competitiveness of sugarcane production in North West Frontier Province (NWFP) of Pakistan in 2003 - 2004. The Policy Analysis Matrix (PAM) described that sugarcane production is more nationally profitable for import substitution than sugarcane production as export promotion objective. This study further recommended that Pakistan's top management and policy makers should make serious efforts to make both sectoral and macroeconomic policies consistent with national goals of agricultural development, trade and food security.

Khai and Yabe (2013) analyzed the comparative advantage of Soybean Production in Vietnam in 2004. By applying the approach of policy analysis matrix (PAM), the result showed that soybean production had a comparative advantage because of DRC was less than 1.

Nkurunziza (2015) determined Rwanda's comparative advantage in rice and identifying constraints limiting efficiency. The key findings of the analysis demonstrated that this province has a comparative advantage in rice. But within the sample, 68 % of rice farmers' cooperatives, cultivating rice on 25% of the total area under study, didn't have no comparative advantage.

Aye Aye Mon (2002) studied that comparative advnatage of black gram and green gram in Myanmar by using policy analysis matrix (PAM) with Domestic Resource Cost (DRC). The results indicated that resources for green gram and black gram production were efficiently advantage in national. In four study areas (Pyinmana, Hinthada, Thonegwa, and Magway), the black gram and green gram were financially and economically viable under current condition. This highlighted that long-term comparative advantage depends on superior productivity through technical change and increased technical efficiency and need economic reform to liberalize the economic further and to remove distortions caused by direct and indirect effects of government intervension on agriculture incentives.

Swe Mon Aung (2006) studied that the economic potential and its comparative advantage of kenaf growing in selected zones of Myanmar by using the method of DRC and PAM. Among the crops grown by farmers in Taungoo and Maubin zones, black gram, green gram and sultapya had more comparative advntages than kenaf and jute. In Hinthada zone, black gram had the highest comparative advantage and kenaf had the lowest. In all selected zones, it was found that farmers were implicitly taxed on their prices of output and tradable inputs for the production of all crops they have grown because divergence was negative and high.

Aye Moe San (2008) measured the comparative advantages of two rice export varieties of Manawthukha and Pawsan in selected areas of Mynmar. This study used Domestic Resource Cost (DRC) and Policy Analysis Matrix (PAM) methods. The results showed that both of Manawthukha and Pawsan have privatelly and socially profited in the study areas of Phyapone and Pathein Townships. By calculating the DRC ratios, it indicated that the study areas have comparative advantages for production of two selected rice varieties production and export marketing under current production practices, export prices and exchange rate.

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

Domestic Resource Cost (DRC) ratio is defined as the opportunity costs of domestic resources spent for a unit of foreign exchange earned from exporting commodities produced domestically or saved by substituting for imports. It measures the relative efficiency of domestic production by comparing the opportunity costs of domestic production with the value added it generates (Tsakok 1990).

Cho Cho Win (2013) compared the comparative advantage of selected rice production (Shwebo Pawsan and Ayeyarmin) by using Domestic Resource Cost (DRC) analysis. From the results of sensitivity analysis, higher comparative advantage was found at the high world price, high yield level, and high exchange rate for both rice productions. According to the research findings, Shwebo Pawsan should be enhanced to exploit the international market by reducing implicit tax because DRC ratio and NPC was low. This study indicated that government should reduce the explicit and implicit tax or the market failure on tradable inputs for increasing the economic efficiency of rice production.

Domestic Resource Cost (DRC) is an indicator of the efficiency with which a country's domestic resources, such as labor and capital, are converted into useful output. The domestic resource cost (DRC) approach was developed by Michael Bruno in the 1960s. It compares the domestic social costs of export production to foreign exchange earned. DRC analysis measures the economic resource costs of production based on “social prices” that is, prices of goods that reflect the true economic value devoid of price distortions from taxes, subsidies, price controls, import tariffs, or other government policies.

Domestic Resource Cost (DRC) is a technique used to measure the degree of comparative advantage of productive activities. The theory of comparative advantage states that the optimum pattern of production and trade for a country should be determined by comparing the opportunity cost of producing a given commodity with the price at which the commodity can be imported or exported.

The degree of comparative advantage depends on the value of domestic resources used in producing a commodity. The relative comparative advantage of a country, region, or industry vis-a-vis another country, region, or industry is obtained by calculating their Domestic Resource Cost (DRC) ratios. If the DRC ratio for the first country is less than that for the second country, then the former has a comparative advantage in producing the commodity.

The DRC approach allows a comparison of the relative efficiencies of region of production or of alternative technologies within countries. 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. The DRC approach to the measurement of revealed comparative advantage is conducted with reference to border or traded prices which in themselves may not reflect international competitive equilibrium prices.

Pakravan and Kalas (2011) determined the comparative advantage in crops of Sari Township during 2009 - 2010. The results showed that barley has disadvantage in this region and compared to foreign import. DRC index of wheat indicated one in the minimum amount of national currency exchange rate value. This directed the fact that only wheat, compared to rice, soybean, canola and barley in this region, can compete with global markets and had a social profitable production system.

Quddus and Mustafa (2011) determined that comparative advantage of major crops production in punjab.They analysised to determine the relative efficiency of major crops (wheat, rice, sugarcane, and cotton) in Punjab (Pakistan) and their comparative advantage in international trade as measured by economic profitability and the domestic resource cost (DRC) ratio. The economic profitability analysis demonstrated that Punjab has a comparative advantage in the domestic production of wheat for self-sufficiency but not for export purposes.

Anderson and Ahn (1984) measured protection policy and changing comparative advantage in Korean agriculture by using the domestic resource cost methodology. The paper concluded that agricultural protection is unlikely to continue to achieve its objectives of slowing the decline in food self-sufficiency and helping incomes of farmers keep pace with urban incomes unless it is increased continually.

Zhong et al. (2001) explored the regional comparative advantage in grain production in China directly according to production and associated costs. Two groups of indicators, Net Social Profitability (NSP) and Domestic Resource Cost (DRC), were used in the study. The study indicated that China is able to compete in the world market even if it as a whole has comparative disadvantage in producing some crops, as some of its provinces may still have comparative advantage in those crops. This implied that detailed analyses at provincial level are needed in projecting China’s grain trade flow in the future.

Kapaj et al. (2007) applied the methodology of Domestic Resource Cost (DRC) analysis to calculate comparative advantage of the domestic potential of producing five agriculture commodities: olive oil, tomato, peppers, cucumbers and wheat of *Albania*. The study showed that *Albania* has a relative comparative advantage in wheat, tomatoes, cucumber and peppers production and that import price, exchange rate, import prices of fertilizers and domestic factor prices are key factors affecting this comparative advantage. But there was no comaparative advantage in production of olive oil.

This paper analyzed the financial and economic viabilities of irrigating non-rice crops in two regions in the Philippines during the dry season, using the Domestic Resource Cost (DRC) approach. The DRC analysis indicated that garlic, onion and peanut production systems are economically efficient users of irrigation water. Except for mungbean and white open pollinated corn, other irrigated crop production systems examined were economically efficient as import substitutes (rice and peanut) and as exports (garlic and onions). Results from the economic analysis indicated a high potential in using irrigation water for non-rice crops (Gonzales 1989).

Domestic Resource Cost indicator is widely used to measure commparative advantage in developing countries and guide policy reforms. In this paper indiacted that DRC fomula is biased against activities that rely heavily on domestic factors. The simple SCB ratio was generally superior measure of social profitability (Master and Winter-Nelson 1995).

Yercan and Isikli (2009) measured the competitiveness of Turkish horticultural products by calculating the Domestic Resource Cost (DRC) ratios in 2004. The results underlined the Turkish horticultural sector has an international competitive advantage. The most competitive crops were tomatoes followed by melons, watermelons and tangerines.These findings are also reinforced by foreign trade statistics on the basis of quantity and earnings.

Herdt and Lacsina (1976) evaluated that several apparently feasible methods of increasing rice production in the Philippines by using the DRC approach. The author stated that DRC is a measure of the value of domestic resources needed to produce one dollar's worth of rice. In the calculation, the foreign exchange costs are subtracted from the value of production. Hence, the DRC used to measure the efficiency with which foreign exchange can be saved or earned in a particular production process.

Shahabuddin and Dorosh (2002) examined that the relative efficiency of production of crops in Bangladesh and their comparative advantage in international trade by using the data from 1996/97 through 1998/99. After calculating the net economic profitability and the domestic resource cost ratio, The economic profitability analysis demonstrated that Bangladesh has a comparative advantage in domestic production of rice for import substitution. 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.

Rashid et al. (2009) determined financial profitability of selected crops in the different locations in the country and examined the implications of Bangladesh's trade policies and comparative advantages of selected agricultural commodities like rice, wheat, maize, potato and lentil in 2009. It indicated that domestic rice production was taxed and consumers were subsidized. The estimates of DRC showed that Bangladesh had comparative advantage in wheat production. Thus the results of the study implied that production of potato and lentil would be highly efficient for import substitution.

Karbasi et al. (2013) analyzed the temporal effect of Subsidy Reform Plan (SRP) on the comparative advantage of dairy farms in 2009 and 2011. The results indicated that after SRP, the government introduced the new milk price distortion in order to support the consumers, the nominal protection coefficient on tradable inputs (NPCI) has been decreased and farmers pays indirect tax. The comparative advantage had in the production of dairy farms, but the DRC ratio has been increased. This study suggested that it is important for the removal of the output price distortions and for enhancing farmers' access to input markets for improving the dairy farm profitability and the farmer's motivation.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Data Sources and Data Collection

The study was based on primary data for crops such as rice (monsoon rice and summer rice), pulses (black gram) production in the study areas and secondary sources of data. The survey was carried out by using stratified random sampling method during October to November in 2015. Farm level cross-sectional data were generated for the analysis using purposive sampling technique. Firstly, farm level data of these crops were obtained from purposively selected different locations, Maubin and Daik U Townships because of being IRRI and ACIAR joint project areas. As the second stage four villages were chosen purposively from each township because of the project's villages. A simple random selection of 60 farmers was chosen from the villages of each township thus making 120 respondents. All sorts of technical and socio-economic data such as family size, farm size, area planted, crop yield, input-output prices, resources used, marketing costs of selected crops productions were collected by interviewing 120 farmers based on a structured questionnaire.

By using secondary data such as border price, market exchange rates and wage rates, the import parity prices and export parity prices were estimated. These data were taken from published and official records of Ministry of Agriculture and Irrigation (MOAI), Department of Agriculture (DoA), Department of Planning (DoP), Ministry of Commence (MOC), other related documents.

Four retailers, two millers, two local wholesalers from each township, three major wholesalers from Yangon wholesale market were also interviewed to obtain the data regarding input prices, marketing costs, processing costs, transportation costs, farm gate and wholesale prices of products.

3.2 General Description of Study Area

The study was carried out in Maubin and Daik U Townships. It is the townships of rice surplus area in lower Myanmar.

3.2.1 Maubin Township

It is located in Ayeyawady Region, the heart of Myanmar's 'rice bowl' delta region. The common cropping patterns in the study areas are monsoon rice – summer rice and monsoon rice – pulses. The farmers grow not only the improved high yielding varieties but also the high quality rice varieties in order to fulfill the demand for domestic and international markets. The total sown areas of monsoon rice were 57,349 ha and total growing areas of summer rice were 33,447 ha in 2015 (DoA 2015). Total pulses growing areas were 51,558 ha in 2015 (DoA 2015). Other crops in this area were vegetable, sunflower, jute and betel. The study was concentrated in the rice – rice and rice – pulses production areas in the townships. Pann Pan Su, Nga Gyee Ghayat, Tar Patt and Alam village tracts were selected for study area in Maubin Township. The map of Maubin Township is shown in Figure 3.1.

3.2.2 Daik U Township

Bago Region is the second largest rice cultivated area after Ayeyarwaddy Region. Daik U Township is also one of the largest rice surplus areas in this region. The common cropping patterns of this study area were only monsoon rice, monsoon rice-pluses or summer rice and vegetables. Total monsoon rice cultivated areas were 75,704 ha and summer rice was cultivated 9,764 ha in 2014 (DoA 2015). After growing monsoon rice, farmers grew summer rice and some in places pulses were cultivated. Total pulses growing areas was 51,958 ha in 2014. This study was conducted in four village tracts such as Pyin Ma Lwin, Ka Toke Phayar Gyi,Pha Aung Wal, Oke Shit Kone where rice – rice and rice – pulses cropping pattern were observed. The map of Daik U Township is shown in Figure 3.2.

3.3 Method of Analysis

After collecting the primary and secondary data, Microsoft Excel program was used for the compilation and analysis of data. The Statistical Packages for Social Science (SPSS) version 19 was employed for descriptive analysis of actual farm data. Mean of amount of resources used, production costs, and other required data were calculated.

Comparative advantage or efficiency of producing selected crops was analyzed here using Domestic Resource Cost (DRC) measure derived from Policy Analysis Matrix (PAM) approach. DRC method was developed simultaneously by Bruno (1967) and Krueger (1969). The estimation of DRCs 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 (Anderson and Ahn 1984).

The effects of government intervention on the private and social profitability of domestic producers were determined by using Policy Analysis Matrix (PAM) for the selected crops of two study areas. The effects of changes in different yield levels, border prices of crops and exchange rates on DRC ratios were examined by conducting sensitivity analyses.

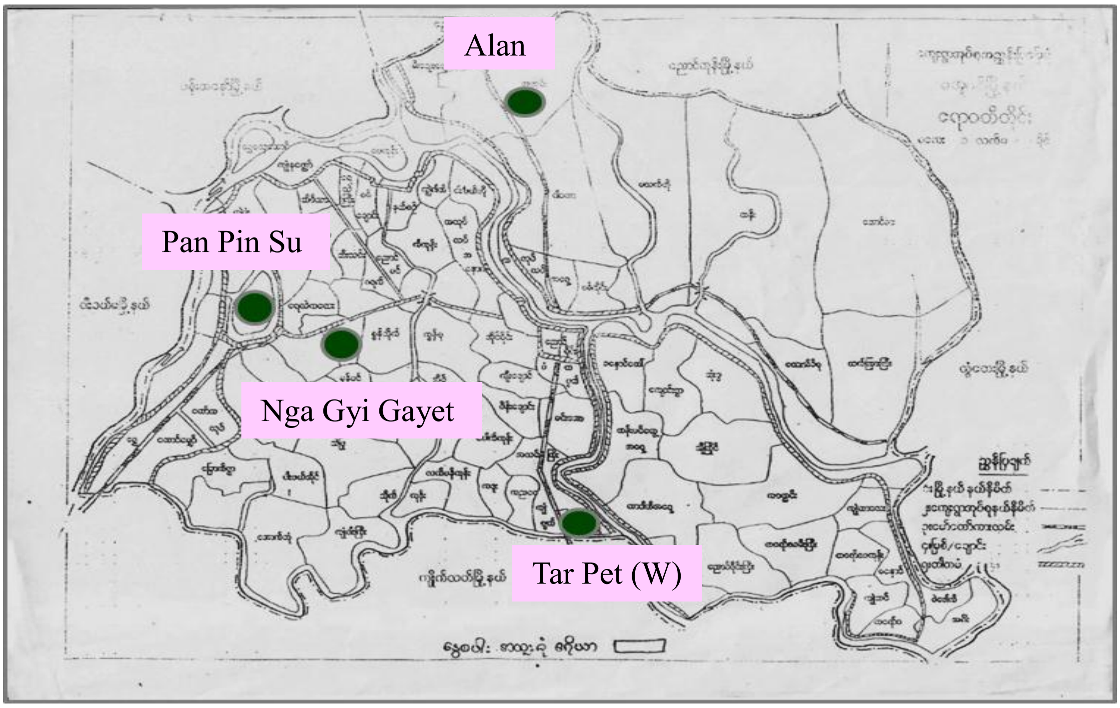

Figure 3.1 Map of Maubin Township Showing the Study Area

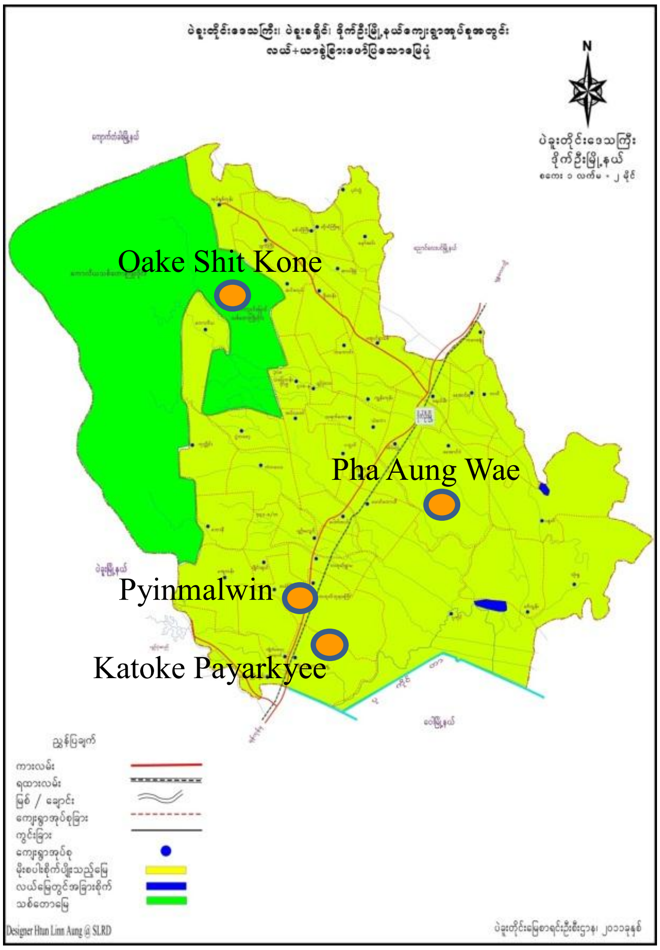

Figure 3.2 Map of Daik U Township Showing the Study Area

3.4 Steps in Calculating DRC for Selected Crops in Study Areas

There were six steps in calculating the DRC.

Step 1: Developing Enterprise Budgets

After selecting selected crops productions activities, the first step in the DRC analysis requires to assemble the production budget. 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 used to estimate costs, returns and profit per unit area of each enterprise. Benefit cost ratio was calculated by establishing the enterprise budget. Total gross return, total variable cost (TVC), total non-cash cost and total cash cost to permit opportunity costing of primary factors of production (e.g. land, labor, and capital) were computed. Calculation of the enterprise budgets for all selected crops: monsoon rice, summer rice and black gram in study areas are shown in Appendix 21 to 26.

Step 2: Classifying Inputs and Outputs

In the next step, all inputs and outputs have been classified into tradable and non-tradable factors. The tradable factors are commodities or services which are imported or exported. Traded good is one whose domestic production cost is either lower than its FOB price or greater than the CIF price. Basically this implies that there exist economic incentives to move the good from one country to another for profitable sale and gains in welfare (Gittinger 1982). Non-traded good is one whose domestic production cost is above its FOB price but below its CIF price (assuming no taxes or subsidies). Essentially, there are no incentives to buy (sell) the product from (to) another country.

In this study rice, fertilizers, insecticide, weedicide, and diesel are tradable inputs and they were valued at their world price equivalent adjusted for tax, transport costs and current market exchange rates. Factors which do not enter the international market, such as labor, land, cattle, FYM and transportation costs are non-tradable or so called domestic factors. Non-tradable goods were valued at their returns in alternative opportunities.

Step 3: Determining Market Prices and Social Price

Such a classification is necessary for social value estimations (also known in literature as shadow, efficiency, accounting, economic, opportunity cost prices or value of marginal physical product (Tsakok 1990). Market price is a price at which a good or service is actually exchanged for another good or service as money. Social prices are intended to reflect the true economic value of outputs and inputs in the absence of taxes, subsidies, tariffs and quotas, price control and other effects of government policies or market failures.

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 convert from the market prices to the economic prices of traded and non-traded components at world market prices.

In this case, social prices are equal to their opportunity cost for non-tradable inputs namely, hired labor, family labor, capital cost and transportation cost. In all economies, domestic market price levels are higher than world market price levels.

Conversion factors can be calculated for efficiency prices or social prices (Tallec 2005). 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 economic farm gate price (parity price) to financial farm gate price (market price). After that, social prices of tradable outputs and inputs were obtained by multiplying the private prices with conversion factors.

Social prices were calculated by adjusting the private prices after eliminating the taxes, 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 of a good or service is the price of this good at the point of entry (for imports) or exit (for exports) from the country. This is the FOB price for exports and the CIF price for imports, whether intermediate inputs or import substitute products (Tallec 2005).

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 selected townships.

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 farm gate were added to the based import CIF prices to obtain the farm gate prices of imported items in domestic markets.

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).

Step 4: Calculations of Policy Effects

The PAM is developed by Monke and Pearson (1989) and augmented by Master and Winter-Nelson (1995), for measuring input use efficiency in production, comparative advantage, and the degree of government interventions. The basis of the PAM is a set of profit and loss identities in a matrix of two-way accounting identities (Nelson and Panggabean 1991). 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.

Monke and Pearson (1989) established the basic format of the PAM, as shown in Table 3.1 and the interpretation of PAM on policy effects was presented in Table 3.2. In empirical PAM analysis, the revenue and cost categories in private prices (entries A, B, and C) are based on data from farm enterprise budgets. The data in the first row provide a measure of private profitability (D), defined as the difference between observed revenue (A) and costs (B+C). The second row of the matrix calculates the social profit that reflects social opportunity costs. Social profits measure efficiency and comparative advantage. In addition, comparison of private and social (efficiency) profits provides a measure of efficiency. The third row of the matrix estimates the difference between the private and social values of revenues, costs and profits, which can be explained by policy interventions.

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.

Step 5: Calculations of Efficiency Coefficients

Important indicator for calculating the protection rate by different ratio such as Nominal Protection Coefficient for Output (NPCO), Nominal Protection Coefficient for Tradable Inputs (NPCI), Effective Protection Coefficient (EPC), and also Domestic Resource Cost (DRC), Private cost ratio (PCR), Subsidy Ratio to Producers (SCB) ratio for measuring comparative advantage were used in this study.

Comparative advantage or efficiency of producing different crops in agriculture is analyzed here using Domestic Resource Cost (DRC). DRC ratio is defined as the opportunity costs of domestic resources spent for a unit of foreign exchange earned from exporting commodities produced domestically or saved by substituting for imports. It measures the relative efficiency of domestic production by comparing the opportunity costs of domestic production with the value added it generates (Tsakok 1990). A country may have a number of efficient production opportunities but in order to maximize economic growth, should pursue those for which it exhibits the strongest comparative advantage i.e. highest net economic returns and/ or lowest domestic resource costs (The World Bank 1992). Whether it is efficient for a country to produce a commodity as opposed to importing it, depends on the opportunity cost of domestic production relative to the value added it creates in foreign currency.

DRC is 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 is 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.

Formally DRC defined as

$$DRC = \frac{\text{Cost of domestic resource and non−traded inputs for producing per unit of output}}{\text{Value of tradable output − Value of tradable inputs}}$$

The NPC is a simple indicator of the incentives or disincentives in place is defined as the ratio of domestic price to a comparable world (social) price. NPC can be calculated for both output (NPCO) and input (NPCI). NPCO is the ratio between private and social revenue of the output (i.e. the ratio of domestic market price of the product to its parity price at the farm-gate). NPCI is the ratio of private to social cost of tradable

Table 3.1 Policy Analysis Matrix (PAM)

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

Source: Monke and Pearson 1989

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)

Private cost ratio (PCR) = C/ (A - B)

Subsidy Ratio to Producers (SRP) = L/E

Table 3.2 Interpretation of PAM on Policy Effect

Policy Effect	Definition	Interpretation of Net Policy Effect
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 Effect of policy distortion from the divergence between domestic and border price of tradable inputs
Input policy (J)	B-F	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

inputs (i.e. the ratio of the private to the social values of all the tradable inputs). It shows the degree of tradable input transfer. The nominal protection rates reflects the impacts of commodity-specific price interventions such as domestic procurement and distribution system, import tariff, export taxes, and quantitative restrictions on domestic trade.

The Effective Protection Coefficient (EPC) can be defined as the ratio of distorted value added at market price to an undistorted value at border prices. EPC measures the total effects of intervention in both input and output markets. While NPC and NPCI measure the policy distortions in the product and tradable input markets individually, EPC measures the combined policy effects in both markets. This coefficient indicates the degree of policy transfer from output and tradable input distortions (Huang et al. 2002).

Step 6: Sensitivity analysis

Due to the static nature of the Policy Analysis Matrix, sensitivity analysis was carried out to provide a way of assessing the impact of changes in the main parameters on both private and social profitability (Monke and Pearson 1989). 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.

Sensitivity analysis is 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

Since minimizing the DRC is equivalent to maximizing social profits, if the DRC ratio is less than 1, the system uses domestic resources efficiently. If the DRC ratio is greater than 1, then the system shows inefficiency in domestic resource use and possesses a comparative disadvantage.

Table 3.3 represents the interpretation of policy coefficients. The appropriate value of DRC is between 1 and 0. 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.

In contrast, if DRC < 1, the value of domestic resources uses 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 NPCO can assume a range of numerical values showing the overall policy distortion. If NPCO > 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 NPCO 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 NPCO = 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.

Private Cost Ratio (PCR) shows the private efficiency of the processors and is an indication of how much one can afford to pay domestic factors (including a normal return to capital) and still remain competitive. Thus PCR less than1 indicates that entrepreneurs are earning excess profits while PCR greater than 1 implies entrepreneurs are making losses (Monke and Pearson 1989). PCR = 1 indicates the breakeven point.

Subsidy ratio to producer (SRP) is the net policy transfer as a proportion of total social revenues or SRP = L/E = (D - H)/E. The SRP shows the proportion of revenues in world prices that would be required if a single subsidy or tax were substituted for the entire set of commodity and macroeconomic policies. The positive value of SRP indicates the overall transfer from society to producer while negative value of SRP means overall transfer from producer to society and taxpayers.

3.6 Calculating the Labor Use Efficiency

The definition for efficiency is the quantity of value of production achieved per unit of resource employed. Calculating the labor use efficiency, the following equations were used. The information of the total crop production, man- day per labor used, cost of labor use, gross revenue of the selected crops of the study areas were taken directly from enterprise budgets.

$$LUE_1 = \frac{TPV}{TL} = \frac{Value\ of\ farm\ production\ (MMK)}{Total\ labor\ used\ (man-day)}$$

$$LUE_2 = \frac{TVP}{TCL} = \frac{Value\ of\ farm\ production\ (MMK)}{Total\ value\ of\ labor\ used\ (MMK)}$$

$$LUE_4 = \frac{TP}{TL} = \frac{Total\ crop\ production(kg)}{Total\ labor\ used\ \ (man-day)}$$

$$LUE_3 = \frac{TCL}{GR} \times 100 = \frac{Total\ value\ of\ labor\ used\ (MMK)}{Gross\ Revenue(MMK)} \times 100$$

$$LUE_5 = \frac{TCL}{TVC} \times 100 = \frac{Total\ value\ of\ Labor\ used(MMK)}{Total\ value\ of\ variable\ cost\ for\ production\ (MMK)} \times 100$$

(Kay et al. 2011)

Table 3.3 Interpretation of Policy Coefficients

Efficient/Policy	Coefficient	Indicators	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 (NPCO)	NPC = A/E	NPC > 1	domestic price higher than world market prices
		NPC < 1	disincentive 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
Private Cost Ratio (PCR)	PCR = C/ (A - B)	PCR > 1	competitive disadvantage
		PRC < 1	Competitiveness
Subsidy Ratio to Producers (SRP)	SRP = L/E	Positive value	the overall transfer from society to producer while
		Negative value	overall transfer from producer to society and taxpayers

Source: Monke and Pearson 1989

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Description of Sample Farmers

4.1.1 Socio – economic characteristics

Socio economic characteristics of rice based farmers in study areas are shown in Table 4.1 and 4.2. In Table 4.1, the age of farmers were classified into five groups. They were such as age group over 60 year, between 51-60 years, 41-50 years, 31-40 years and under 30 year. Among the respondents, 30% of farmers in Maubin Township were between age of 51 and 60 years, 27% were between 41-50 years and 22% were between 31-40 years. There were 5% of young farmers and 17% of old farmers in this area and their age were between 20-30 years and above 60 years respectively. In Daik U Township, 37% of farmers were between 41 and 50 years, 29% were between 51 and 60 years. The young farmers were the same like Maubin Township, (5% of sample respondents) and 12% of the old farmers were above 60 years. The remaining 18% of farmers were between 31 and 40 years. Most of farmers in Maubin Township were between 51 and 60 years and between 41-50 years in Daik U Township. The younger farmers were the least among them in both townships.

In this study, education level of sample farmers was classified in four groups according to their education status. About 52% of farmers in Maubin Township and 35% of farmers in Daik U Township had got only primary education level. It was the highest percentage among farmers in Maubin Township but middle education level was the highest percentage of farmers (40%) in Daik U Township. As for graduate education, 5% of farmers in Maubin Township and 12% of farmers in Daik U Township were found to attain graduate education. The remaining 15% and 13% of farmers obtained the high school level respectively in Maubin and Daik U townships (Table 4.2).

4.1.2 Land holdings and cropping patterns of sample farmers

The average land holdings for sample farmers are shown in Table 4.3. The average land holding for sample farmers was 3.6 ha in Maubin Township and 6.2 ha in Daik U Township. Land holding of sample farmers was classified into three groups according to their farm size. The farmers are categorized as small farmers if they belong to less than 3 ha, medium farmers if they have 3 -10 ha and large farmers if they have larger than 10 ha of land, based on their total landholding.

The majority of farmers in Maubin Township possessed less than 3 ha of land and it was 58% of total respondents. Under this area, 40% of farmers had between 3 and 10 ha

Table 4.1 Age Groups of Rice Base Farming System in Selected Areas

Age (year)	Maubin		Daik U	
	Frequency	Mean (%)	Frequency	Mean (%)
20-30	3	5	3	5
31-40	13	22	11	18
41-50	16	27	22	37
51-60	18	30	17	29
>60	10	17	7	12
Total	**60**	**100**	**60**	**100**

Table 4.2 Education Groups of the Rice Base Farming System in Selected Areas

Education (year)	Maubin		Daik U	
	Frequency	Mean (%)	Frequency	Mean (%)
Primary	31	52	21	35
Middle	17	28	24	40
High	9	15	8	13
Graduate	3	5	7	12
Total	**60**	**100**	**60**	**100**

Table 4.3 Farm Size of the Rice Base Farming System of the Study Areas

Farm size group (ha)	Maubin		Daik U	
	Frequency	Mean (%)	Frequency	Mean (%)
Small (< 3)	35	58	22	37
Medium (3 – 10))	24	40	30	50
Large (> 10)	1	2	8	13
Total	**60**	**100**	**60**	**100**

of land and only 2% of farmers owned more than 10 ha of land. In Daik U Township, 50% of farmers had occupied ranging from 3 to 10 ha and it was the most percentage among farmers. The other 37% of farmers possessed less than 3 ha, and 13% of farmers owned more than 10 ha of land respectively.

In the study areas, there were three rice based cropping patterns. The cropping patterns in the survey areas are showed in Table 4.4. The observed cropping patterns were monsoon rice solely, monsoon rice – summer rice, monsoon rice – pulses.

In Maubin Township, 55% of farmers carried out pattern of monsoon rice – pulses and 45% of respondent was cultivated monsoon rice - summer rice. In Daik U Township, about 15% of sample farmers grew only monsoon rice. The majority of farmers grew the cropping pattern of monsoon rice followed by pulses. The pattern of monsoon rice – summer rice was grown by 35% of the farmers. In these two areas, most of the farmers grew the pattern of monsoon rice – pulses because farmers can quickly get cash incomes from pulses during short time.

Table 4.5 presents percentage of rice area covered by commonly grown rice varieties in Maubin and Daik U Townships during 2014-2015. In Maubin Township, 34% of the total areas were covered by Hnan Kyar variety in monsoon season, which was followed by Sin Thu Kha (30%) and Sin Thwe Latt (16%). Thee Htat Yin variety was the most popular variety in summer season which covered 68% of total growing areas, followed by Sin Thu Kha (11%) and Vietnam (9%). In Daik U Township, Hmawbi 2 variety was the most popular variety in monsoon season occupying 50% of total rice areas and which followed by Sin Thu Kha (26%) and Manaw Thu Kha (14%). The most popular variety for summer rice in Daik U Township was Sin Thu Kha variety (60%) and which followed by Hmawbi 2 variety (26%) and Manaw Thu Kha variety (6%).

4.2 Resources Utilization and Yield of Selected Crops in Study Areas

The summarized basis statistics such as average yield levels attained by the sample farmers, sown areas of selected crops, amount and cost of seeds, cost of agro-chemical (Urea, Compound, T-super, Insecticide and Herbicide), fuel, cost of human labor and costs of machine and animal power for selected crops production of survey areas are shown from Table 4.7 to Table 4.13. The economic conditions of the sample respondents in relation to their performances of crops cultivation can be known from these tables.

Table 4.4 Rice Based Cropping Patterns of the Study Areas

Patterns	Maubin		Daik U	
	Frequency	Mean%	Frequency	Mean%
Rice – Fallow	_	-	9	15
Rice – Rice	27	45	21	35
Rice – Pulses	33	55	30	50
Total	**60**	**100**	**60**	**100**

Table 4.5 Percentage of Rice Area Covered by Commonly Grown Rice Varieties in Maubin and Daik U Townships during 2014-2015

Variety	Maubin		Daik U	
	Monsoon Rice	Summer Rice	Monsoon Rice	Summer Rice
Hnan Kar	34	-	-	-
Sin Thu Kha	30	11	26	64
Thee Htat Yin	2	68	-	-
Tawn Pyant	7	-	-	-
Sin Thwe Latt	16	1	-	-
Pyi Taw Yin	1	2	2	-
Paw San	3	-	2	-
Yay Anelo-4	-	5	-	-
Manaw Thu Kha	1	-	14	6
Ayar Min	2	-	-	-
Vietnam	3	9	-	2
Pale Thwe	-	3	-	-
Yae Amelo-1	1	1	-	-
Hmawbi 2	-	-	50	26
Yadanar Toe	-	-	4	2
Yar Kyaw		-	1	-
Kauk Hyinn	-	-	1	-
	100	100	100	100

4.2.1 Resources utilization and yield of monsoon rice production in Maubin and Daik U Townships

Resources used and yields of Monsoon rice cultivations for the sample farmers of selected areas are described in Table 4.7 and 4.8 respectively. The average sown areas of monsoon rice growers in Maubin Township was 3 ha ranging from 0.4 ha to 12.8 ha and that in Daik U Township was 5.89 ha ranging from 0.4 ha to 44.0 ha respectively.

Average seed rate was 104.30 kg/ha in Maubin Township and 118.64 kg/ha in Daik U Township. The recommended seed rate was ranged from 51.52 kg/ha to 77 kg/ha according to rice varieties. However, the actual seed rate of monsoon rice cultivated farmers in both areas was higher than recommended seed rate. Therefore, the average seed cost was 46,055 MMK/ha in Maubin Township and 30,348 MMK/ha in Daik U Township. Under this study, Daik U Township used more seed than Maubin Township but the price of seed in Daik U Township was cheaper than that in Maubin Township.

The average yield of these sample growing farmers was 3.37 MT/ha (67.40 baskets/ac) ranging from 1.56 MT/ha (31.2 baskets/ac) and 5.74 MT/ha (114.8 baskets/ac) in Maubin Township and 3.23 MT/ha (64.63 baskets/ac) ranging from 1.5 MT/ha (30 baskets/ac) and 4.75 MT/ha (95 baskets/ac) respectively. Average yield of the monsoon rice production in Maubin Township was higher than that of Daik U Township but it was lower than the target yield of rice, 5.61 MT/ha (100 baskets/ac). Yield of monsoon rice production in survey areas had found to be not much different due to their farm management practices, use of seeds, topography, natural conditions of the region (Table 4.7 and 4.8).

Urea fertilizer was used by 78.33% of monsoon rice growers in Maubin Township and 38.33% of growers in Daik U Township. The average amount and cost were 110 kg/ha and 50,707 MMK/ha in Maubin Township and 108 kg/ha and 50,885 MMK/ha in Daik U Township (Table 4.6, 4.7 and 4.8).

Among the respondents in each township, only 23% of sample monsoon rice growers in Maubin Township applied compound fertilizer, but 60% of sample farmers utilized that fertilizer. The average compound fertilizer used was 98 kg/ha and their cost was 51,289 MMK/ha in Maubin Township. In Daik U Township, the sample farmers applied 139 kg/ha on average and 72,604 MMK were incurred for cost of compound fertilizer per hectare (Table 4.6, 4.7 and 4.8).

Only 30% of sample farmers used 86 kg/ha and 41,965 MMK/ha was paid for T-super fertilizer in Maubin Township, however, no use of T-super fertilizer was observed

Table 4.6 Rate of Fertilizer Usage of Rice Production in Study Areas

Fertilizer Name	Unit	Mean	Minimum	Maximum
Maubin Monsoon rice				
Urea	kg/ha	110	13	375
Compound	kg/ha	98	13	125
T-super	kg/ha	86	25	125
Maubin Summer rice				
Urea	kg/ha	216	63	313
Compound	kg/ha	140	63	250
T-super	kg/ha	130	50	250
Daik U Monsoon rice				
Urea	kg/ha	108	13	375
Compound	kg/ha	139	13	375
Daik U Summer rice				
Urea	kg/ha	125	125	125
Compound	kg/ha	141	12	370

Table 4.7 Summary Statistics for Monsoon Rice Production of the Sample Farmers in Maubin Township

N=60

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	60	3.37		1.56	5.74
	(Bsk/ac)		**(67.40)**		**(31.20)**	**(114.80)**
Sown area	ha	60	3.00		0.40	12.80
Seed rate	Kg/ha	60	104.30		52.15	260.75
	(Bsk/ac)		**(2.00)**		**(1.00)**	**(5.00)**
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	60	46,055	(9%)	13,875	112,500
Urea	MMK/ha	47	50,707	(9%)	5500	210,000
Compound	MMK/ha	16	51,289	(7%)	7500	100,000
T-super	MMK/ha	18	41,965	(1%)	9750	80,000
Insecticide	MMK/ha	9	6,122	(3%)	1000	10,000
Herbicide	MMK/ha	9	15,306	(4%)	2500	25,000
Diesel	MMK/ha	42	22,396	(17%)	4375	61,250
Costs of family labor	MMK/ha	60	97,625	31%)	11,250	387,500
Costs of hired labor	MMK/ha	58	180,434	(14%)	7500	656,250
Costs of machine power	MMK/ha	60	78,544	(5%)	20,000	205,000
Costs of animal power	MMK/ha	21	28,929	(9%)	12,500	55,000

Table 4.8 Summary Statistics for Monsoon Rice Production of the Sample Farmers in Daik U Township

N=60

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	60	3.23		1.50	4.75
	(Bsk/ac)		**(64.63)**		**(30.00)**	**(95.00)**
Sown area	Ha	60	5.89		0.40	44.00
Seed rate	kg/ha	60	118.64		52.15	182.53
	(Bsk/ac)		**(2.27)**		**(1.00)**	**(3.50)**
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	60	30,348	(3%)	9,500	61,250
Urea	MMK/ha	23	50,885	(5%)	5250	105,000
Compound	MMK/ha	36	72,604	(8%)	5500	202,500
Insecticide	MMK/ha	15	14,842	(2%)	2500	46,250
Herbicide	MMK/ha	12	22,990	(2%)	5625	62,500
Diesel	MMK/ha	30	14,000	(1%)	7500	62,500
Costs of family labor	MMK/ha	57	65164	(7%)	6562	270937
Costs of hired labor	MMK/ha	59	126102	(13%)	18,750	234,375
Costs of machine power	MMK/ha	60	101,948	(11%)	25,000	187,500
Costs of animal power	MMK/ha	44	45,057	(47%)	12,500	162,500

in Daik U Township. The average cost of insecticide and herbicide were 6,122 MMK and 15,306 MMK/ha in Maubin Township and 14,842 MMK and 22,990 MMK in Daik U Township. There was more cost for agro-chemical use in Daik U Township (Table 4.7 and 4.8).

In this study, machinery has been used for land preparation, irrigation and threshing by all of rice growing farmers in both townships. About 70% of sample farmers in Maubin Township and 50% of sample farmers in Daik U Township used diesel with the average cost of 22,396 MMK/ha and 14,000 MMK/ha respectively. The diesel has been used for pumping water for irrigation, land preparation and threshing purposes. The average cost of machine power was 78,544 MMK/ha in Maubin Township and 101,948 MMK/ha in Daik U Township (Table 4.7 and 4.8).

In Maubin Township, the average opportunity cost of family labors employed in monsoon rice cultivation was 97,625 MMK/ha and that of animal power was 78,544 MMK/ha. The sample farmers used the hired labor with the average cost of 180,434 MMK/ha. About 65,164 MMK/ha was cost for family labors and 126,102 MMK was also paid for hired labors in Daik U. For the utilization of animal power, it was about 45,057 MMK/ha (Table 4.7 and 4.8).

4.2.2 Resource utilization and yield of summer rice production in study areas

Sample farmers' resources uses and yield of summer rice production by sample farmers in selected areas are summarized in Table 4.9 and Table 4.10. In this study, 45% of sample farmers in Maubin Township and 35% of sample farmers in Daik U Township planted the summer rice followed by monsoon rice. According to the collected data, the average sown areas of summer rice cultivation in Maubin Township were 2.32 ha with the range of 0.8 ha to 7.2 ha. About average 3.03 ha was grown for summer rice production in Daik U Township ranging from 0.8 ha to 16 ha.

In summer rice production, average yield of sample farmers had 4.62 MT/ha and its minimum rate was 2.61 MT/ha and its maximum rate was 6.52 MT/ha in Maubin Township. However, the average yield of summer rice in Daik U Township was only 3.51 MT/ha with the range of 1.8 MT and 5.25 MT per hectare. According to these records, Maubin Township yielded more yield in summer rice cultivation than that of Daik U Township. The yield of summer rice production was higher than that of monsoon rice; however, they were lower than the national target yield in both townships (Table 4.9 and 4.10).

Table 4.9 Summary Statistics for Summer Rice Production of the Sample Farmers in Maubin Township

N=27

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	27	4.62		2.61	6.52
	(Bsk/ac)		(92.40)		(52.20)	(130.40)
Sown area	ha	27	2.32		0.80	7.20
Seed rate	kg/ha	27	132.31		78.23	156.45
	(Bsk/ac)		(2.54)		(1.50)	(3.00)
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	27	45,004	(6%)	6,250	90,000
Urea	MMK/ha	24	88,464	(12%)	27,500	134,375
Compound	MMK/ha	14	69,259	(9%)	28,125	200,000
T-super	MMK/ha	11	58,886	(8%)	21,500	125,000
Insecticide	MMK/ha	19	30,487	(4%)	4500	95,000
Herbicide	MMK/ha	19	26,566	(4%)	2500	125,000
Diesel	MMK/ha	27	51,690	(7%)	8750	175,000
Costs of family labor	MMK/ha	27	113194	(15%)	17,500	260,000
Costs of hired labor	MMK/ha	26	98,154	(13%)	7500	181,250
Costs of machine power	MMK/ha	27	134,509	(18%)	53,750	287,500
Costs of animal power	MMK/ha	3	18,333	(2%)	15,000	25,000

Table 4.10 Summary Statistics for Summer Rice Production of the Sample Farmers in Daik U Township

N=21

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	21	3.51		1.80	5.25
	(Bsk/ac)		**(70.20)**		**(36.00)**	**(105.00)**
Sown area	ha	21	3.03		0.80	16.00
Seed rate	kg/ha	21	118.90		78.23	182.53
	(Bsk/ac)		**(2.28)**		**(1.50)**	**(3.50)**
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	21	30,310	(6%)	14,250	60,000
Urea	MMK/ha	3	59,167	(12%)	51,250	67,500
Compound	MMK/ha	15	102,792	(20%)	31,250	185,000
Insecticide	MMK/ha	7	13,793	(3%)	800	47,500
Herbicide	MMK/ha	3	13,750	(3%)	10,000	21,250
Diesel	MMK/ha	15	26,400	(5%)	4375	175,000
Costs of family labor	MMK/ha	19	57,000	(11%)	7500	255,000
Costs of hired labor	MMK/ha	20	84,000	(16%)	12,500	263,750
Costs of machine power	MMK/ha	18	95,347	(19%)	17,500	162,500
Costs of animal power	MMK/ha	12	31,458	(6%)	12,500	75,000

The average seed rate for summer rice growing in Maubin Township was 132.31 kg/ha and for Daik U was 118.90 kg/ha respectively. The average seed cost of Maubin Township was 45,004 MMK in Maubin Township and the sample farmers in Daik U Township paid 30,310 MMK for the cost of growing seeds. Although the seed rate in summer rice production was used more than that of monsoon rice production, seed cost was little difference because of lowering the seed price in summer season compare with monsoon season in both townships (Table 4.9 and 4.10).

Urea fertilizer was applied by 88.89% of the respondents in Maubin Township but only 14.29% of respondents applied urea in Daik U Township. Average amount and cost were 216 kg/ha and 88,464 MMK/ha in Maubin Township. However, the sample farmers in Daik U Township charged 125 kg/ha and 59,167 MMK/ha (Table 4.6, 4.9 and 4.10).

About 52% of sample farmers in Maubin Township and 71% of sample farmers in Daik U Township used compound fertilizers with the range of 140 kg/ha and 370 kg/ha respectively. Their average cost was 69,259 MMK in Maubin Township and 102,792 MMK in Daik U Township for one hectare. In these townships, T-super fertilizer was used by the sample farmers in Maubin Township only. The average cost of that was 58,886 MMK and the average rate was 130 kg/ha. Among the fertilizers, the application of urea fertilizer was the highest in Maubin Township and that of compound fertilizer was the highest in Daik U Township (Table 4.6, 4.9 and 4.10).

In Maubin Township, 70% of sample summer growing farmers utilized insecticide and herbicide. Their average costs were 30,487 MMK and 26,566 MMK/ha. Only 33% and 14% of sample summer rice cultivators in Daik U Township were consumed the insecticide and herbicide and 13,793 MMK and 13,750 MMK were incurred for that (Table 4.9 and 4.10).

All of the sample respondents in Maubin Township used machine for land preparation, irrigation and threshing. The average cost of fuel was 51,690 MMK and average cost of machine power was 134,506 MMK for covering one hectare in this township. For Daik U Township, 85% of summer rice growers used machine power. Their average cost was 95,347 MMK and 26,400 MMK for fuel per hectare (Table 4.9 and 4.10).

In summer rice production, the opportunity cost of family labor was 113,194 MMK/ha and cost for animal power was 18,333 MMK/ha in Maubin Township. The average opportunity cost of family labor employed in summer rice production was 57,000 MMK and 31,458 MMK/ha was incurred for animal power cost. The average hired labor cost was 98154 MMK/ha in Maubin Township and 84,000 MMK/ha in Daik U Township (Table 4.9 and 4.10).

4.2.3 Resource utilization and yield of black gram production in survey areas

Table 4.11 and Table 4.12 show the summary of resource uses and yield of black gram production in Maubin and Daik U townships.

According to the observation, 68% of respondents grew the pulses after harvesting the monsoon rice in Maubin Township and 67% of respondents also planted the pluses in Daik U Township. All respondents of pulses growers planted black gram in Maubin Township and only 38% of pulses producers in Daik U Township grew black gram.

The average sown area of black gram was 3.10 ha ranging from 0.4 ha to 10.0 ha in Maubin Township and that of black gram in Daik U Township were 2.68 ha with its minimum area was 1.2 ha and its maximum area was 4.8 ha.

The target yield of black gram was 1.64 MT/ha (20 baskets/ac) regarding to the sensitivity analysis of government's policy. However, the actual average yield of black gram in Maubin Township was 0.71 MT/ha with the range of 0.04 MT/ha to 1.31 MT/ha. In Daik U Township, the average yield was 0.77 MT/ha for black gram. The average yield of black gram for both townships was not much different but they were a bit far from national target yield.

Average seed rate of black gram was 57.8 kg/ha in Maubin Township and 80.66 kg/ha in Daik U Township. Therefore the average seed cost was 79,541 MMK/ha in Maubin Township and 108,917 MMK/ha in Daik U Township. The usage of black gram seed rate in Daik U Township was higher than Maubin Township. So the average seed cost in Daik U Township was higher than Maubin Township.

In black gram production, 78% of sample producers in Maubin Township and 87% of sample farmers used foliar fertilizer. About 10,898 MMK was used for that in Maubin Township and 35,365 MMK was paid in Daik U Township for incurring one hectare. The insecticides were applied only 49% of farmers and the average cost cost was 4,038 MMK in Maubin Township and 40% of black gram production farmers applied insecticides and paid 22,292 MMK/ha and only 20% of Daik U Township black gram respondents used insecticides and the average cost was 12,438 MMK/ha for utilization of insecticide. There was no used of herbicides in both seasons in Daik U Township, however, 5% of farmers in Maubin Township used herbicide and their cost was 30.000 MMK/ha. Comparing the total use of agro-chemical inputs in two study areas, Daik U Township applied more than that of Maubin Township in black gram production.

Table 4.11 Summary Statistics for Black Gram Production of the Sample Farmers in Maubin Township

N=41

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	41	0.71		0.04	1.31
	(Bsk/ac)		**(8.74)**		**(0.5)**	**(16)**
Sown area	ha	41	3.10		0.40	10.00
Seed rate	kg/ha	41	57.80		32.7	139.79
	(Bsk/ac)		**(0.71)**		**(0.40)**	**(1.71)**
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	41	79,541	(22%)	45,000	192,375
Fertilizer	MMK/ha	32	10,898	(3%)	2500	37,500
Insecticide	MMK/ha	20	4,038	(1%)	4500	137,500
Herbicide	MMK/ha	2	30,000	(8%)	20,000	40,000
Diesel	MMK/ha	30	15,608	(4%)	2625	43,750
Costs of family labor	MMK/ha	41	57,939	(16%)	7500	135,000
Costs of hired labor	MMK/ha	41	105,259	(29%)	45000	240,000
Costs of machine power	MMK/ha	39	45,275	(12%)	7500	80,000
Costs of animal power	MMK/ha	20	17,650	(5%)	5000	75,000

Table 4.12 Summary Statistics for Black Gram Production of the Sample Farmers in Daik U Township

N=15

Variables	Unit	Sample No.	Mean		Minimum	Maximum
Yield	MT/ha	15	0.77		0.41	1.23
	(Bsk/ac)		**(9.38)**		**(5.00)**	**(15.00)**
Sown area	Ha	15	2.68		1.20	4.80
Seed rate	kg/ha	15	80.66		40.88	122.63
	(Bsk/ac)		**(0.99)**		**(0.50)**	**(1.50)**
Costs of seed, chemical input and diesel						
Seed cost	MMK/ha	15	108,917	(24%)	56,250	150,000
Fertilizer cost	MMK/ha	13	35,365	(8%)	6,000	150,000
Insecticide	MMK/ha	6	22,292	(5%)	3125	38,750
Diesel	MMK/ha	14	19,250	(4%)	7,500	43,750
Costs of family labor	MMK/ha	14	87,232	(19%)	41,250	200,000
Costs of hired labor	MMK/ha	15	93,750	(21%)	15,000	165,000
Costs of machine power	MMK/ha	15	47,250	(11%)	12,500	90,000
Costs of animal power	MMK/ha	12	34,375	(8%)	25,000	100,000

The average cost of machine power in black gram production was 45,275 MMK/ha in Maubin Township and 47,250 MMK/ha in Daik U Township and their fuel cost were 15,608 MMK and 19,250 MMK/ha.

The average opportunity cost of family labor employed in black gram production was 57,939 MMK/ha and of animal power was 17,650 MMK/ha in Maubin Township. In Daik U Township, 87,232 MMK was paid for family labor and 34,375 MMK was also used for animal power in black gram production. The hired labor cost was 105,259 MMK/ha for black gram in Maubin Township and 93,750 MMK/ha in Daik U Township.

4.3 Calculations of Economic Export and Import Parity Price

Export and import parity prices were calculated to estimate the economic value of tradable commodities. This estimated economic value was obtained by adjusting all relevant charges from F.O.B prices (Free on Board) and C.I.F (Cost, Insurance, and Freight) factor price at the point of border (Muse and Yangon) to the farm gate.

4.3.1 Economic export parity prices for monsoon rice, summer rice and pulses in study areas

Appendix 1 and 2 indicate the calculation of export parity price for monsoon rice, summer rice and black gram in Maubin Township. Conversion from foreign currency into domestic currency, the average (shadow) exchange (1303 MMK/USD) was used for calculating export parity price of the selected crops in study areas. Export parity price of monsoon rice USD/MT (317,922 MMK/MT) was derived from international world market price by subtraction of the port charges, stevedoring and loading, packaging, handling and processing cost and transport cost from farm gate to respective township and from township to border point (Muse). Conversion factor for monsoon rice was 0.96, which was calculated by dividing the border prices of that crop (317,992 MMK/MT) to domestic price at the farm gate (228,000 MMK/MT). The same calculation steps were used to get export parity prices and conversion factors for summer rice and black gram. Export parity price of summer rice and black gram were 317,922 MMK/MT and 1,174,166 MMK/MT and their conversion factors were 1.05 and 1.11 which was obtained by dividing border price to their farm gate prices (208,000 MMK/MT and 1,017,379 MMK/MT).

Calculations of export parity price for monsoon rice, summer rice and black gram in Daik U Township are described in Appendix 3 and 4. The calculated steps were similar to those of Maubin Township. In this study, FOB price of above crops were the same in both townships and their domestic farm gate prices were 235,000 MMK/MT for monsoon rice, 208,000 MMK/MT for summer rice and 1,080,407 MMK/MT for black gram respectively. Therefore the conversion factors were 0.99, 1.12 and 1.04 for monsoon rice, summer rice and black gram in Daik U Township.

4.3.2 Economic import parity prices in selected areas

Appendix 5 to 10 show the calculation of import parity price of urea, compound, T-super, foliar fertilizer, insecticide, weedicide and diesel. The calculation steps were based on the border import prices (C.I.F) which were available from Department of Trade and diesel importing company in Yangon at the time of survey. These C.I.F price in foreign currencies were converted into domestic currencies by using average exchange rate from central bank of Myanmar (1083 MMK/USD) on May, 2015.

To obtain whole sale prices of these chemical inputs, all handling, port charges, custom duty and transportation costs to the relevant local wholesale markets were added to the based C.I.F price. In Maubin Township, the wholesale price of urea, T-super and compound were 248,216 MMK/MT, 410,636 MMK/MT and 291,528 MMK/MT respectively, which were evaluated from F.O.B Muse prices. Economic farm gate prices of these fertilizers were calculated by deducting the local marketing costs and the transportation costs from wholesale markets to farm gate. So, the import parity prices were 420,000 MMK/MT, 485,382 MMK/MT and 500,000 MMK/MT for urea, T-super and compound fertilizer in Maubin Township. To calculate conversion factor, the border prices were divided by their relative domestic prices. Therefore the conversion factors of these types of fertilizers were 0.48, 0.80 and 0.49 respectively in Maubin Township (Appendix 5).

As for Daik U Township, all of the calculation steps of import parity price were the same as above. Import parity of urea and compound fertilizer in Daik U Township were the same with Maubin Township and the financial farm gate values (market prices) of these fertilizers were 420,000 MMK/MT and 500,000 MMK/MT. Therefore the conversion factors for urea and compound fertilizers were 0.52 and 0.53 in Daik U Township (Appendix 6). Similarly, import parity prices of folia fertilizer, weedicide and insecticide were 1694 MMK/kg, 5912 MMK/L and 2826 MMK/L respectively in both study areas. Therefore, the conversion factors were (0.50) foliar fertilizer, (0.70) weedicide and (0.70) insecticide (Appendix 7, 8 and 9). The conversion factor of fuel was 0.31 in Maubin Township and 0.37 in Daik U Township which was obtained by dividing that import parity price (1100 MMK/gal in Maubin and 1300 MMK/gal in Daik U

Township) to the domestic farm gate prices (3500 MMK/gal in both townships) (Appendix 10).

4.4 Determining Private Prices and Social Prices

The private cost component is generally based on market prices that face individuals. Market price is a price at which a good or service is actually exchanged for another good or service with 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.

Shadow prices for domestic inputs (labor, land, water and some part of machineries) are usually, assumed to be as same as domestic prices (Masters and Winter–Nelson, 1995). Shadow price is an opportunity of an activity to a society, computed where the actual price is not known. The social costs of labor and cattle using in rice production and black gram cultivation were estimated, by using opportunity costs for domestic factors. Calculations of weighted annual average labor cost using for rice and black gram production in selected townships are shown in Table 4.13 to Table 4.18.

In Maubin Township, the labor cost of peak period such as transplanting and harvesting time in rice production for both season and black gram production were 8,000 MMK/day. The labor costs in slack time such as land preparation, seeding, irrigation, sprayings insecticide and weedicide and fertilizer application were 4,000 MMK/day for rice production in both seasons (Table 4.13 and 4.14) and 3,900 MMK/day for black gram production (Table 4.15) in Maubin Township in this time. Therefore the average labor cost and weighed average labor cost for Maubin Township were 6000 MMK/day and 6680 MMK/day for monsoon rice (Table 4.13), 6000 MMK/day and 6600 MMK/day for summer rice (Table 4.14) and 5950 MMK/day and 7221 MMK/day for black gram (Table 4.15). The opportunity cost was obtained by dividing the average labor cost to weighted average shadow labor cost. Therefore, the opportunity costs of labor were 0.9 for monsoon rice (Table 4.13), 0.91 for summer rice (Table 4.14) and 0.82 for black gram (Table 4.15) in Maubin Township respectively.

As shown in Table 4.16, 4.17 and 4.18, the labor cost in peak labor time for all selected crops were 8,000 MMK/day in Daik U Township. The labor used in slack time was 3,300 MMK/day for monsoon rice (Table 4.16), 4,500 MMK/day for summer rice (Table 4.17) and 3300 MMK/day for black gram (Table 4.18) in Daik U Township. The average labor cost was 5,650 MMK/day and the weighted average shadow labor cost was 5,979 MMK/day for monsoon rice in Daik U Township (Table 4.16). The average

Table 4.13 Calculation of Weighted Average Labor Cost in Monsoon Rice Production in Maubin Township (Financial Term)

N=60

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	67	5360
2	Slack labor time	4000	33	1320
3	Average Labor cost	6000	100	6680
	Opportunity cost			**0.90**

Table 4.14 Calculation of Weighted Average Labor Cost in Summer Rice Production in Maubin Township (Financial Term)

N=27

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	65	5200
2	Slack labor time	4000	35	1400
3	Average Labor cost	6000	100	6600
	Opportunity cost			**0.91**

Table 4.15 Calculation of Weighted Average Labor Cost in Black Gram Production in Maubin Township (Financial Term)

N=41

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	81	6480
2	Slack labor time	3900	19	741
3	Average Labor cost	5950	100	7221
	Opportunity cost			**0.82**

Table 4.16 Calculation of Weighted Average Labor Cost in Monsoon Rice Production in Daik U Township (Financial Term)

N=60

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	57	4560
2	Slack labor time	3300	43	1419
3	Average Labor cost	5650	100	5979
	Opportunity cost			**0.94**

Table 4.17 Calculation of Weighted Average Labor Cost in Summer Rice Production in Daik U Township (Financial Term)

N=21

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	65	5200
2	Slack labor time	4500	35	1575
3	Average Labor cost	6250	100	6775
	Opportunity cost			**0.92**

Table 4.18 Calculation of Weighted Average Labor Cost in Black Gram Production in Daik U Township (Financial Term)

N=15

No	Particular	Market labor cost (MMK/day)	Labor used (%)	Weighted average shadow labor cost (MMK/day)
1	Peak labor time	8000	74	5920
2	Slack labor time	3300	26	858
3	Average Labor cost	5650	100	6778
	Opportunity cost			**0.83**

Table 4.19 Calculation of Weighted Average Cattle Cost in Selected Crops Production in Maubin and Daik U Townships (Financial Term)

No	Particular	Animal power cost (market) MMK/day	Animal used (%)	Weighted average shadow animal power cost (MMK/day)
1	Peak labor time	10000	50	5000
2	Slack labor time	10000	50	5000
3	Average animal power cost	10000	100	10000
	Opportunity cost			**1.00**

Table 4.20 Average Private and Social Prices of Major Inputs and Outputs Associated with Monsoon Rice and Summer Rice Productions in Study Areas

Items	Unit	Monsoon Rice		Summer Rice	
		Maubin	Daik U	Maubin	Daik U
Private (Market) Price					
Rice Selling Price	MMK/kg	228	235	208	208
Seed Price	MMK/kg	442	253	349	252
Urea	MMK/kg	461	440	426	473
Compound Fertilizer	MMK/kg	523	525	494	516
T- Super	MMK/kg	485	-	455	-
Diesels	MMK/gal	3500	3500	3500	3891
Machine	MMK/plough	6000	6000	6000	6000
Hired Labor	MMK/day	3400	3150	3450	3000
Hired Cattle	MMK/day	10000	10000	10000	10000
Social (Economic) Price					
Rice Selling Price	MMK/kg	219	233	218	233
Seed Price	MMK/kg	442	253	349	252
Urea	MMK/kg	221	229	205	246
Compound Fertilizer	MMK/kg	256	278	242	273
T- Super	MMK/kg	388	-	364	-
Diesels	MMK/gal	1100	1300	1100	1445
Machine	MMK/plough	6000	6000	6000	6000
Hired Labor	MMK/day	3060	2961	3140	2760
Hired Cattle	MMK/day	10000	10000	10000	10000

Table 4.21 Average Private and Social Prices of Major Inputs and Outputs Associated with Black Gram Production in Study Areas

Items	Unit	Black Gram	
		Maubin	Daik U
Private (Market) Price			
Rice Selling Price	MMK/kg	1017	1080
Seed Price	MMK/kg	1376	1356
Folia Fertilizer	MMK/kg	3000	3000
Diesels	MMK/gal	3405	3369
Machine	MMK/plough	6000	6000
Hired Labor	MMK/day	3400	3000
Hired Cattle	MMK/day	10000	10000
Social (Economic) Price			
Pulses Selling Price	MMK/kg	1129	1123
Seed Price	MMK/kg	1376	1356
Foliar Fertilizer	MMK/kg	1500	1500
Diesels	MMK/gal	1260	1247
Machine	MMK/plough	6000	6000
Hired Labor	MMK/day	2788	2490
Hired Cattle	MMK/day	10000	10000

labor cost and average shadow labor cost for summer rice in Daik U Township were 6,250 MMK/day and 6,775 MMK/day (Table 4.17) and that for black gram in Daik U Township was 5,650 MMK/day and 6,778 MMK/day (Table 4.18). Therefore, the opportunity costs of labor were 0.94 for monsoon rice (Table 4.16), 0.92 for summer rice (Table 4.17) and 0.83 for black gram (Table 4.18) in Daik U Township. The weighted average of shadow cost in animal power was also 10,000 MMK/day. The opportunity cost for animal power in selected crops in survey areas was 1.00 (Table 4.19).

The social price of inputs and output were calculated by multiplying the respective private prices with their respective conversion factors. These calculation tables of selected crops are shown in Appendix 9 to11 for Maubin Township and Appendix 12 to 15 for Daik U Township.

The average price of major inputs and outputs in terms of private (market) prices and social (economic) prices associated with monsoon and summer rice productions in Maubin and Daik U townships are stated in Table 4.20 and Table 4.21 also show for black gram production in both areas.

4.5 Output Policy and Input Policy for Rice and Black Gram

Output Policy and Input Policy for Rice and Black Gram can be analyzed by PAM analysis. The results of PAM parameters are presented in Table 4.22 and 4.23. These tables indicate the divergences between private and social revenues, costs of tradable inputs and domestic factors and profits for monsoon rice, summer rice and black gram in both Townships.

Divergence between private and social valuations appeared from the category of market failures-factor, market imperfections, distorting policies, reveal constraints and monopolies and externalities, including public goods. A market failure occurred if a market fails to provide a competitive outcome and an efficient price. A distortion policy was as government intervention forcing a market price to diverge from its efficient value. It could occur due to trade restrictions, price regulation, taxes and subsidies. The more widespread causes of divergence are the existence of distorting government policies.

Detail analysis of the sources of market distortions showed that both output and input markets were distorted. The private farm revenue was greater than social farm revenue in monsoon rice production in the study areas, as indicated by a positive output transfer of 10,724 MMK/ha in Maubin Township (Table 4.22) and 7,591 MMK/ha in Daik U Township (Table 4.23). This positive output transfer suggested that there were favorable conditions to farmers for rice sold in this season. Because most rice produced in

Table 4.22 Calculation of Policy Analysis Matrix for Rice Based Cropping Production in Maubin Township

N=60

Items	Unit	Maubin Township		
		Monsoon rice (N=60)	**Summer rice (N=27)**	**Black gram (N=41)**
Revenues				
@Private prices (A)	MMK	768,360	960,960	726,567
@Social prices (E)	MMK	737,626	1,006,799	806,490
Output policy (I)	MMK	30,734	-45,839	-79,922
Relative divergences (A-E)/E in %		4.17	-4.55	-9.91
Cost of Tradable Inputs of FRC				
@Private prices (B)	MMK	187,785	325,351	60,545
@Social prices (F)	MMK	104,986	179,469	34,753
Input policy (J)	MMK	82,800	145,882	25,792
Relative divergences (B-F)/F in %		78.87	81.29	74.22
Cost of Domestic Factors				
@Private prices (C)	MMK	433,393	395,333	267,907
@Social prices (G)	MMK	405,012	376,393	238,531
Factor cost (K)	MMK	28,381	18,941	29,376
Relative divergences (C-G)/G in %		7.01	5.03	12.32
Profits				
Private profit (D)	MMK	147,182	240,276	398,116
Social profit (H)	MMK	227,628	450,937	533,207
Net policy (L)	MMK	-80,446	-210,661	-135,091
Relative divergences (D-H)/H in %		-35.34	-46.72	-25.34

Table 4.23 Calculation of Policy Analysis Matrix for Rice Based Cropping Production in Daik U Township

N=60

Items	Unit	Daik U Township		
		Monsoon rice (N=60)	**Summer rice (N=21)**	**Black gram (N=15)**
Revenues				
@Private prices (A)	MMK	759,050	730,080	828,766
@Social prices (E)	MMK	751,460	817,690	861,917
Output policy (I)	MMK	7,591	-87,610	-33,151
Relative divergences (A-E)/E in %		1.01	-10.71	-3.85
Cost of Tradable Inputs of FRC				
@Private prices (B)	MMK	175,321	215,901	76,907
@Social prices (F)	MMK	96,644	114,345	42,726
Input policy (J)	MMK	78,677	101,556	34,181
Relative divergences (B-F)/F in %		81.41	88.82	80.00
Cost of Domestic Factors				
@Private prices (C)	MMK	407,505	321,608	306,147
@Social prices (G)	MMK	396,165	310,681	279,117
Factor cost (K)	MMK	11,340	10,926	27,030
Relative divergences (C-G)/G in %		2.86	3.52	9.68
Profits				
Private profit (D)	MMK	176,225	192,571	445,712
Social profit (H)	MMK	258,651	392,663	540,074
Net policy (L)	MMK	-82,426	-200,092	-94,362
Relative divergences (D-H)/H in %		-31.87	-50.96	-17.47

monsoon season is domestically demanded varieties. Therefore, a large percentage of monsoon rice is traded in regional market. Divergence of monsoon rice production in Maubin Township was the highest value among the rice production in two areas. However, negative value of divergence between private and social revenue was indicated in summer rice and black gram productions in both townships. The negative output transfer means that producers received the price lower than what could have earned at international market. This is sometimes interpreted as an implicit tax or market failure.

Most of the rice grown in summer season is domestically not preferable ones. Therefore, farmers sell almost all of their productions. They even do not store for home consumption. Local trader bought summer rice with lower price than they deserve. Then majority of summer rice were exported. Summer rice production in Myanmar is more for international trade. Furthermore, harvesting time for summer rice falls during the rainy days, and farmers do not used drying machines for better quality grains that they sell the rice with high RH and received very low price. Percentages of relative divergences in revenues of summer rice and black gram were -4.55% and -9.91% in Maubin Township (Table 4.22) and -10.71% and -3.85%in Daik U Township (Table 4.23).

In addition, the private farm costs of tradable inputs for all crops in both townships were higher than the corresponding social farm costs because the farmers were taxed directly or indirectly by purchasing the tradable inputs. The crop producers were paying private cost 78.87%, 81.28% and 74.22% in Maubin Township (Table 4.22) and 81.44%, 88.82% and 80.00 % in Daik U Township (Table 4.23) for the crops of monsoon rice, summer rice and black gram. This occurred because tradable inputs were available from under restrictions of imports. Then, there were unreasonable costs in tradable inputs supply chain because of weakness in laws and restrictions concerning with tradable inputs. The prices paid by farmers for tradable inputs were very high because the government did not subsidize and fertilizers to farmers. In all selected crops, the highest divergences were found in summer rice production in Daik U Township.

The domestic factor markets were also distorted, as revealed by a positive factor transfer of the values of divergences in all selected crops under the study areas. 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 all selected crops production under the study areas. In other words, the private costs of domestic factors were higher than the social costs because the social values of human labors (MMK/day) were calculated from their weighted average marginal values and these were lower than private values.

In this study, divergences in private and social profits or net transfer (L) showed negative values for rice and black gram productions in both townships. These divergences measured the total of net distortions in both input and output markets. The negative values in divergences indicated that the domestic prices were lower than export parity prices or production was more profitable socially than privately and positive values showed vice vasa.

The negative divergences between private and social profits of monsoon rice, summer rice and black gram were -35.34%, -46.72% and -25.34% in Maubin Township (Table 4.22) and -31.87%, -50.96% and 17.47% in Daik U Township (Table 4.23). These values of percentage implied that the net effect of interventions reduced 35.34%, 46.72% and 25.34% in Maubin Township and 31.87%, 50.96%and 17.47% of private profitability of monsoon rice, summer rice and black gram productions in both townships. One of the reasons of low level private profit was high private cost of inputs and low private revenues in relative production. Among them, summer rice in Daik U Township had the highest divergences values (50.96%) and it means that farmers who grown this crop less 50.96% of private price than social price under government interventions.

4.6 Profitability of Rice and Black Gram Productions and Policy Effects

By filling in the elements of the PAM for each activity, it is possible to measure the extent of policy effects as well as the inherent economic efficiency or comparative advantage of the production system. According to Monke and Pearson (1989), PAM was suitable for agricultural 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 4.24 and 4.25 describe the summary of the divergences between private and social value and results of policy analysis matrix indicators namely Domestic Resource Cost (DRC) ratios, Private Cost Ratio (PCR), Subsidy Ratio to Producer (SRP), Nominal Protection Coefficients for Output (NPCOs), Nominal Protection Coefficients for Tradable Inputs (NPCIs), and Effective Protection Coefficients (EPCs) for selected corps in both Townships.

Domestic Resource Cost (DRC) is an indicator that measures the ratio of domestic factors (at social price) to the value-added to the system at social prices (total revenue less cost of tradable inputs). 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. In this study, the DRC was used as a measure of comparative advantage.

DRC ratios for all selected crops in both Townships were ranging from 0.31 for black gram in Maubin Township to 0.64 for monsoon rice in Maubin Township. It can be interpreted that the values of domestic resources used to produce all selected crops were lower than its value added at social prices. Therefore, both townships had comparative advantage in producing all selected crops. The private and social benefit-cost ratios of for both productions were greater than 1 (Table 4.26) therefore it was desirable to produce and expand the production of these crops from the social point of view.

Based on the results of DRC ratios in Table 4.24 and 4.25, Maubin Township had less comparative advantage in rice production than that of Daik U Township. But there was more comparative advantage in black gram production of Maubin Township than that of Daik U Township. The values of monsoon rice, summer rice and black gram for Maubin and Daik U Townships were 0.64, 0.45 and 0.31 and 0.61, 0.44 and 0.34 respectively. Comparing the selected crops in both townships, black gram production in Maubin Township had the highest comparative advantage with the respect to world markets, current situations because of its lowest DRC ratio (0.31). The social benefit-cost ratio of that crop was also uppermost in all crops and its value was 2.23 (Appendix 13).

Comparison of DRC ratios, social and private benefit-cost ratios of selected crops in both townships are mentioned in Table 4.26 and Figure 4.1. In Maubin Township, black gram had the lowest DRC ratios and highest profit in the results of social and private benefit-cost ratios and the second lowest crops in DRC ratio was summer rice and monsoon rice was the highest (Figure 4.1). Lower DRC ratio indicated less uses of domestic resources compared with other crops. Similarly, black gram had also the most comparative advantage and then followed summer rice and monsoon rice. Therefore, monsoon rice production had very low profitable in private and social price (Figure 4.1).

The PCR of all selected crops production in both townships were less than one. Their values were 0.75 and 0.70 for monsoon rice and 0.62 and 0.63 for summer rice and 0.40 and 0.41 for black gram in the study areas (Table 4.24 and 4.25). This result indicated that these crops cultivations were profitable and thus competitive.

The SRP indicator shows the level of transfers from divergences as a proportion of the undistorted value of the system revenues. The SRP values were -0.11 for monsoon rice and -0.21 and 0.24 for summer rice and -0.17 and -0.11 for black gram in both

Table 4.24 Summary of Policy Analysis Matrix (PAM) Indicators in Maubin Township

Policy Analysis Matrix Indicators	Maubin Township		
	Monsoon Rice	**Summer rice**	**Black Gram**
Domestic Resource Cost ratio DRC = G/(E-F)	0.64	0.45	0.31
Private Cost Ratio PCR = C/ (A-B)	0.75	0.62	0.40
Subsidy Ratio to Producer SRP = L/E	-0.11	-0.21	-0.17
Nominal Protection Coefficient for Revenue NPCO = A/E	1.04	0.95	0.90
Nominal Protection Coefficient for Tradable Inputs NPCI = B/F	1.79	1.81	1.74
Effective Protection Coefficient EPC = (A-B)/ (E-F)	0.92	0.77	0.86

Table 4.25 Summary of Policy Analysis Matrix (PAM) Indicators in Daik U Township

Policy Analysis Matrix Indicators	Daik U Township		
	Monsoon rice	**Summer rice**	**Black gram**
Domestic Resource Cost ratio DRC = G/(E-F)	0.61	0.44	0.34
Private Cost Ratio PCR = C/ (A-B)	0.70	0.63	0.41
Subsidy Ratio to Producer SRP = L/E	-0.11	-0.24	-0.11
Nominal Protection Coefficient for Revenue NPCO = A/E	1.01	0.89	0.96
Nominal Protection Coefficient for Tradable Inputs NPCI = B/F	1.81	1.89	1.80
Effective Protection Coefficient EPC = (A-B)/ (E-F)	0.89	0.73	0.92

Table 4.26 Comparison of DRC and Benefit Cost Ratios for Selected Crops in Study Areas

Crops	Mabin			Daik U		
	DRC	B/C based on social value	B/C based on private value	DRC	B/C based on social value	B/C Based on private value
Monsoon rice	0.64	1.30	1.12	0.61	1.40	1.21
Summer rice	0.45	1.63	1.22	0.44	1.70	1.25
Black gram	0.31	2.23	1.74	0.34	1.96	1.65

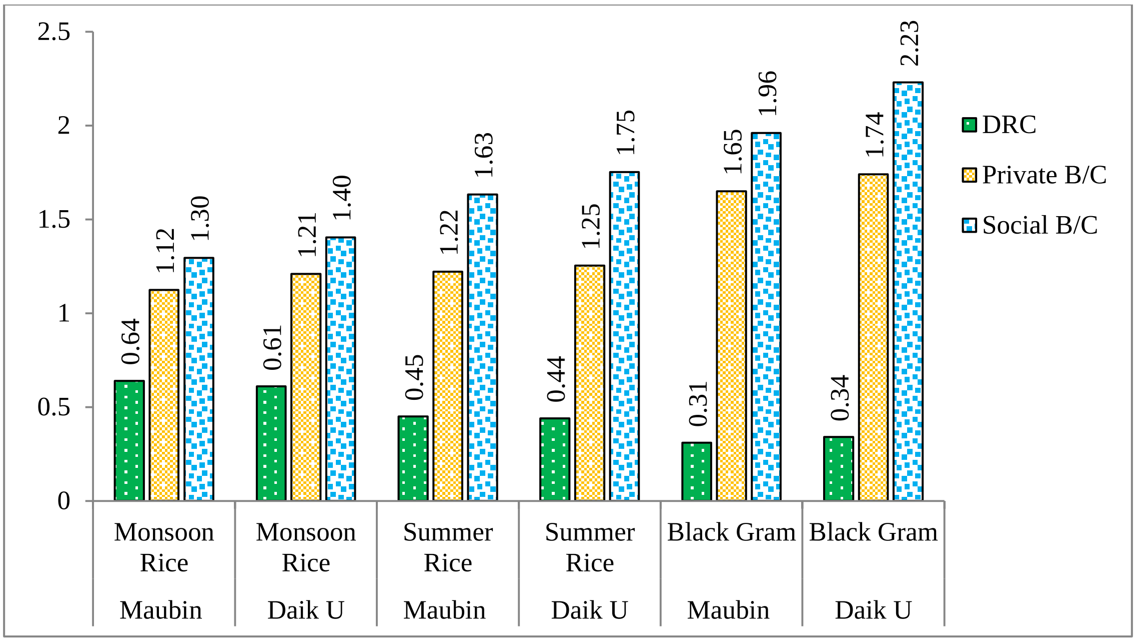

Figure 4.1 DRC and Benefit Cost Ratios for Monsoon Rice, Summer Rice and Black Gram Production in Maubin and Daik U Townships

townships (Table 4.24 and 4.25). The negative SRP indicated that the producers were taxed in the production of the commodity.

Nominal protection coefficient in outputs (NPCO) is an indicator of inefficiencies within tradable output market. This ratio measures prevailing incentives and disincentives for the production of the commodity, as induced by government policies in output markets.

According to the results of Table 4.24 and 4.25, the values of NPCOs were higher than one in monsoon rice and lower than one in summer rice and black gram production in both townships. This means that domestic price was higher than the comparative world price and positive protection occurred for monsoon rice farmers under this system. So, the government policy for the production of rice in wet season give more favor to domestic producers. However, there was negative protection for summer rice and black gram farmers in both townships. This means that domestic price for these crops were lower than world price.

The NPCO values of monsoon rice, summer rice and black gram were 1.04, 0.95 and 0.90 in Maubin Township (Table 4.24) and 1.01, 0.89 and 0.96 in Daik U Township (Table 4.25). The value of Nominal Protection Coefficient for Revenue of monsoon rice (1.04 and 1.01) indicated that output private prices of 4% in Maubin Township and 1% in Daik U Township were higher than social prices. Summer rice and black gram (0.95 and 0.90 in Maubin Township and 0.89 and 0.96) implied that private price of output were 5% and 10% lower than socially in Maubin and 11% and 4% in Daik U Township.

The NPCO value could be explained that the trade margin could contribute a large difference in farm gate price received by farmer and export price received by traders. These divergences could be affected by market imperfection.

The ratio of Nominal Protection Coefficient on Tradable Inputs (NPCI) measures prevailing encouragements and discouragements for the production of a specific commodity, as induced by government policies in tradable input markets. The values of NPCI of all selected crops in study areas were greater than unity. Their values in Maubin and Daik U Townships were 1.79 and 1.81 for monsoon rice, 1.81 and 1.89 for summer rice, 1.74 and 1.80 in black gram respectively as shown in Table 4.24 and 4.25. The results indicated that the price of tradable inputs used by farmers were greater than the social prices. This mean that the farmers paid directly and indirectly taxed on the price of tradable inputs by purchasing due to the distortion of foreign exchange policy.

In the present study, Effective Protection Coefficient (EPC) was estimated as the ratio of value added in private prices to value added in social prices. The EPC indicates the combined effects of policies in the tradable commodities markets. The values of EPC in all selected crops production were less than unity. This 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.

EPC for monsoon rice was 0.92 and 0.89 and 0.77 and 0.73 for summer rice and 0.86 and 0.92 for black gram in both Maubin and Daik U Townships (Table 4.24 and Table 4.25): these indicated that producers were taxed between 10% and 25% on value added at world reference prices.

4.7 Sensitivity Analyses on DRC ratios

The comparative advantage measures were known as static in nature. Among the measures, PAM overcomes this shortcoming to some extent but not fully. So, by sensitivity analysis, can be determined the degree to which factors affect the comparative advantage. The sensitive factors can help for planning to give more importance on those factors to maintain or to increase comparative advantage of that product. Thus, it is important to determine the probable effect of changes in any of these basic assumptions/factors to the comparative advantages in future.

Sensitivity analysis on DRC ratios were conducted with different levels of yields, different reference world prices and different exchange rates. To conduct the sensitivity analyses, the required data were obtained from own survey data and other related records. The required data such as the domestic resource costs, tradable input costs, labor and cattle costs and the prices of the products were assumed as a constant to conduct the sensitivity analyses.

For rice production in the study areas, the calculation were based on different average yields levels (3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0) MT/ha, the current Myanmar FOB price (294 USD/MT), the current world average FOB price (373 USD/MT) and the current best quality rice FOB price (735 USD/MT) and the minimum, current and maximum exchange rate from central bank of Myanmar (850, 1198, 1311) MMK/USD during January 2012 to August 2016 (Appendix 17 to 20).

In Maubin Township, if the farmers obtained the average yield of rice 3.0 MT/ha and sold at the lowest border price (294 USD/MT) and minimum exchange rate (850 MMK/USD), there was no comparative advantage (DRC = 1.11) (Appendix 17). In summer rice of this study area, there was also no comparative advantage (DRC = 1.30, 1.02) when producing the average yield levels of 3.0 and 3.5 MT/ha with the border price of (294 USD/MT) and minimum exchange rate (850 MMK/USD) (Appendix 18).

All of the DRC values were between zero and one based on the above scenarios in rice production for both seasons in Daik U Township (Appendix 19 and 20). The values indicated there were be comparative advantage. If the farmers obtained the average yield of rice 6 MT/ha and sold at the highest border price (735 USD/MT) and maximum exchange rate (1,311 MMK/USD), the highest comparative advantage (DRC ratios = 0.06 and 0.07) would be achieved in both monsoon rice and summer rice of the study areas.

For black gram production, the sensitivity analyses were similarly calculated like rice productions which were shown in Appendix 21 and 22. The average yield level (0.32, 0.65, 0.98, 3.31 and 1.64 MT/ha) and current FOB price (901 USD/MT), the lowest FOB price (825 USD/MT) and the highest FOB price (1245 USD/MT) and the minimum, current and maximum exchange rate from central bank of Myanmar (850, 1198, 1311) MMK/USD during January 2012 to August 2016 were used.

The current average yields 0.98 MT/ha and 1.31 MT/ha, the current FOB price (901 USD/MT) and the current exchange rate (1198 MMK/USD), the good comparative advantage was obtained by production of black gram for the study areas due to their DRC ratios based on the scenarios were between 0.47 and 0.14 (Appendix 21 and 22). However, there was no comparative advantage for black gram production in both townships if the farmer had got the lowest yields 0.65 MT/ha (8 bsk/ac) at the lowest FOB price (825 USD/MT) and the lowest exchange rate (850 MMK/USD). Their DRC value was reached above the unity (DRC=1.35 and 1.67).

According to the regarding results on DRC values, DRC ratios became smaller and smaller if the yield and exchange rate increased. In rice production, the comparative advantage was more favorable if farmers sold at the FOB price of quality rice, increased exchange rate and different levels of yields. The black gram production in both areas was also obtained higher and higher comparative advantage if the FOB price was got greater than current scenarios.

4.8 Calculation of the Labor Use efficiency of Selected Crops in the Study Areas

Table 4.27 presents the labor use efficiency of all selected crops in both townships. Labor efficiency is computed by dividing total labor cost by gross revenue. Labor productivity was calculated by dividing the total production to the total labor used. The data were based on the gross revenue, total variable cost, number of labor use, cost for labor delivering from calculating the farm budgets of relative crop. If labor efficiency is relatively high and labor productivity is relatively low, it may indicate that the farm is going to have difficulty supporting all of the farm employees. In this condition, they should evaluate whether a farm has excess labor.

According to the results of Table 4.28, labor use efficiency was 36% in Maubin Township and 30% in Daik U Township and gross revenue per working was 9,370 MMK and 10,577 MMK for monsoon season rice production (Figure 4.4). This indicated that a man working per season obtained 9,370 MMK in Maubin Township and 10,577 MMK could be obtained by working a man per season. To get 100 MMK of the revenue, farmers used 36 MMK for total labor in Maubin Township and 30 MMK of that cost in Daik U Township. Its production was 41kg of rice per man in Maubin Township and 54 kg of rice per man in Daik U Township during the monsoon season (Figure 4.3).

In dry season rice production, a man during the season could be produced 76 kg in Maubin Township and 75 kg in Daik U Township (Figure 4.3). Therefore, 15,753 MMK and 15,534 MMK could be paid by using a man-day per season during summer rice production (Figure 4.4). Their labor use efficiency was 22% and 19 % for study areas. In black gram cultivation, the crop production and value per man was 15 kg and 15,137 MMK in Maubin Township and 14 kg and 16,567 MMK in Daik U Township (Figure 4.3 and 4.4). The percentages of cost for labor used per gross revenue were 22% in Maubin Township and 19% in Daik U Township respectively.

Comparing the labor use efficiency with the selected crops in both townships, labor productivity of dry season rice production was the highest in Maubin Township, and however, that of black gram production was the highest in Daik U Township. The percentages of labor use efficiency were equal in both the production of summer rice and black gram in study areas. In both townships, the percentage of labor use efficiency in Daik U was higher than that of Maubin Township.

Table 4.27 Labor Use Efficiency of Selected Crops in the Study Areas

Methods of labor use efficiency (LUE)	Monsoon Rice		Summer Rice		Black gram	
	Maubin	Daik U	Maubin	Daik U	Maubin	Daik U
Total value of production (MMK)/Total value of labor used (MMK)	2.8	3.4	4.6	5.1	4.5	5.2
Total crop production(kg)/Total labor used(Man - day)	41.1	53.8	75.7	74.7	14.9	14.5
Value of farm production (MMK)/Total labor used (Man - day)	9,370	10,577	15,753	15,534	15,137	15,637
Total value of labor used (MMK)/Gross Revenue (MMK)	36%	30%	22%	19%	22%	19%
Total value of labor use (MMK)/ Total variable cost for production (MMK)	41%	30%	27%	24%	39%	32%

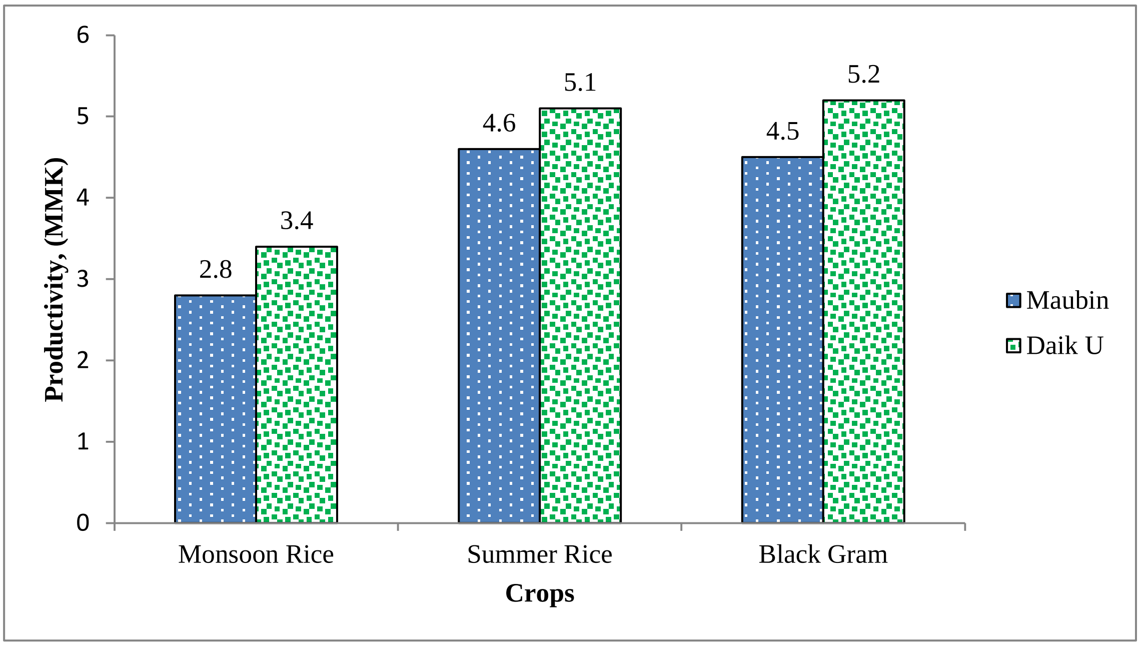

Figure 4.2 Labor Use Efficiency of Rice and Black Gram by Using the Method of the Total Value of Production to Total Value of Labor Used in Maubin and Daik U Townships

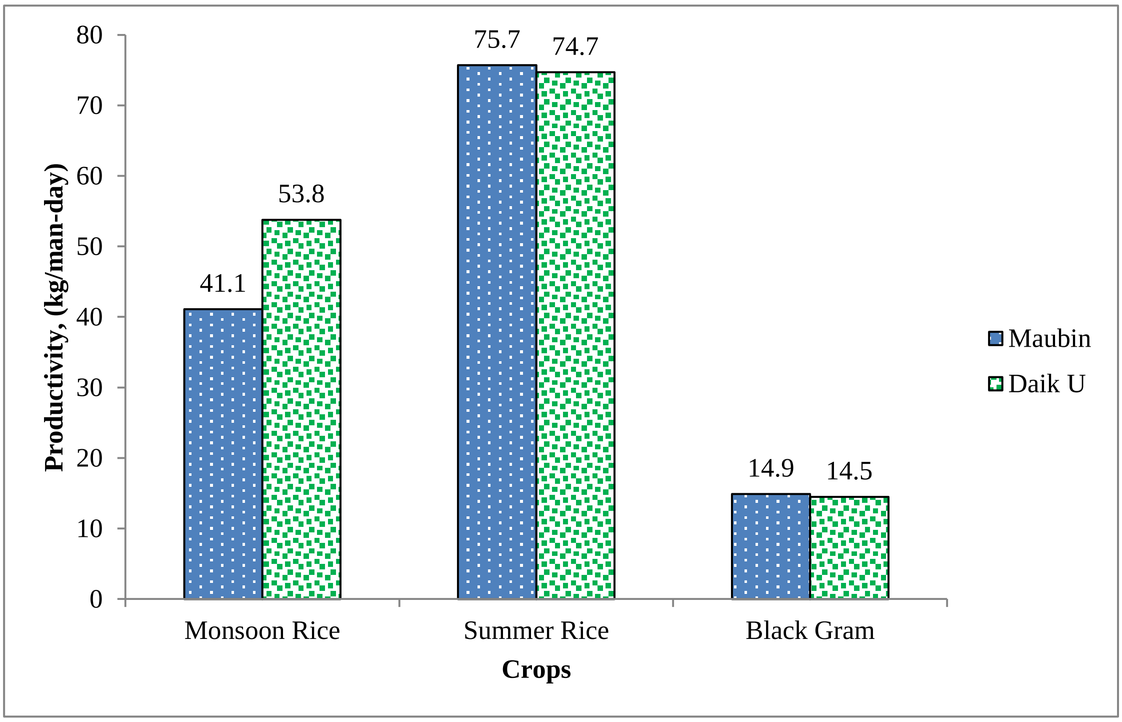

Figure 4.3 Labor Use Efficiency of Rice and Black Gram by Using the Ratio of the Total Crop Production to Total Labor Used in Maubin and Daik U Townships

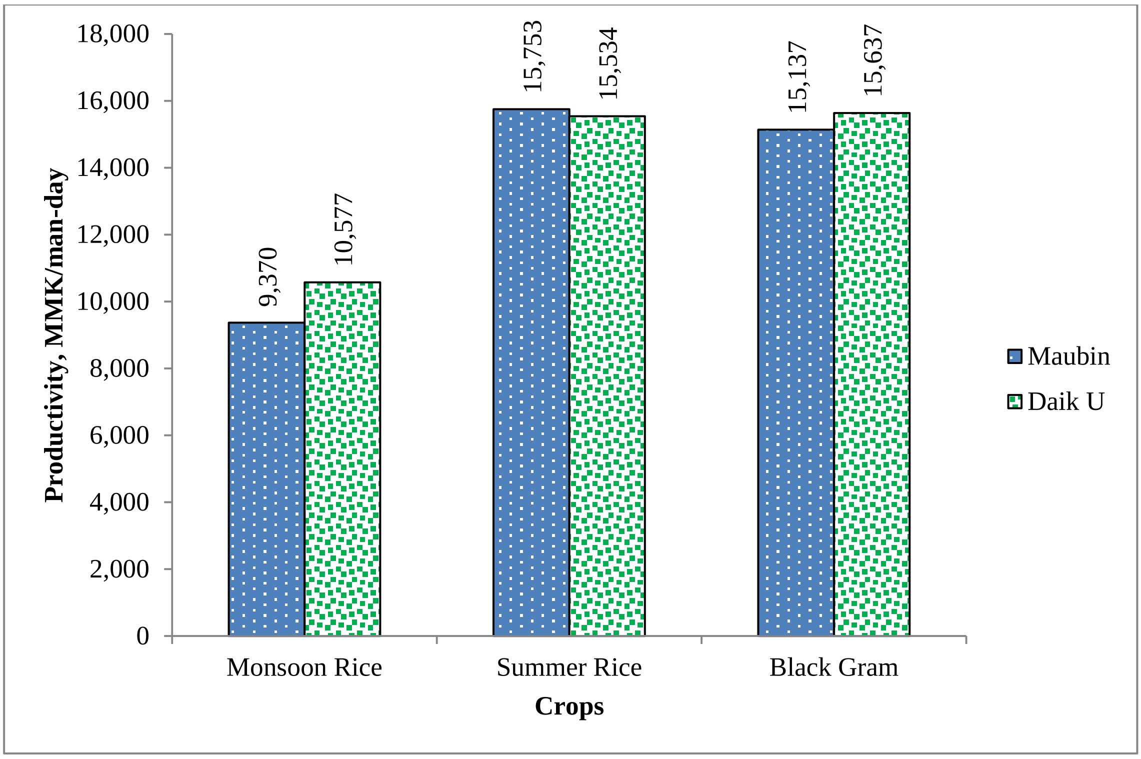

Figure 4.4 Labor Use Efficiency of Rice and Black Gram by Using the Ratio of the Value of Farm Production to Total Labor Used in Maubin and Daik U Townships

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The survey was carried out in Maubin and Daik U Townships in October to November, 2015. The objective of the study was to ascertain whether the rice and pulses producers in the study area are efficient producers in term of comparative advantage. Primary data were collected from 120 respondents in four villages of each township and secondary data were taken from published and official records of Ministry of Agriculture and Irrigation (MOAI), Department of Agriculture (DoA), Department of Planning (DoP), Ministry of Commence (MOC) and other related documents. After collecting the primary and secondary data, Microsoft Excel program and the Statistical Packages for Social Science (SPSS) version 19 software were used for descriptive analysis of actual farm data. Comparative advantages or efficiency of producing selected crops were analyzed by using Domestic Resource Cost (DRC) derived from Policy Analysis Matrix (PAM) approach.

According to the Cost and Benefit analysis, both private and social benefit-cost ratios were greater than one for all selected crops in both townships. Therefore it can be concluded that the activities of selected crops cultivations were financially and economically feasible in the study areas. The social benefit-cost ratio of black gram in Maubin Township was the highest and it was 2.23.

From the results of PAM analysis, DRC ratios for all of selected crops, monsoon rice, summer rice and black gram in the study areas described between one and zero. In Maubin Township, black gram was the most comparative advantaged crop because the value of DRC was 0.31 and then followed by summer rice (DRC = 0.45) and monsoon rice (DRC = 0.64). Similarly, in Daik U Township, it was found that the most comparative advantage in black gram due to the lowest DRC value (0.34). After that summer rice (DRC = 0.44) and monsoon rice (DRC = 0.61) were followed. The lower the DRC ratios the higher the comparative advantages. Higher comparative advantage of summer rice and black gram were due to the higher output values resulted mainly from higher price of these crop comparing with monsoon rice.

There were positive divergences between private and social values of output for monsoon rice production in both areas. This indicated that rice farmers who grow in wet season sold their outputs at export parity price. Negative divergences in revenues occurred in both summer rice and black gram production of the study areas which mean the producers of these crops sold their outputs at lower prices than export parity price by the trade distortion.

The positive divergences indicated in tradable input in all selected crops for both townships. This indicated that the private cost of tradable input were higher than that of social cost. This was because of most tradable inputs were obtained under restrictions of import. So the effect of input policy affected the producers by paying high price for purchasing tradable inputs and government did not subsidize any tradable input in the study areas. Although farmers paid higher price for tradable inputs, they usually do not get quality inputs, which deserve with high price due to weak in law enforcement and institutional weaknesses.

The positive divergences in domestic factor cost were found for all selected crops in both townships because of distortions in prices of non-tradable inputs due to high labor requirement in peak season. Therefore the private prices of labor were greater than social price in the study areas. It can be said that the policy effect on domestic factors were respectively high due to high labor wage rate.

There were negative divergences between private and social profits in all selected crops production in the study areas. These indicated that farmers had been receiving profits due to the net effect of policy interventions. The crop productions were more profitable socially than privately because of high use of tradable inputs and domestic factors with high prices. However, crop yields were quite lower than the national target yields and received low prices during the harvesting season.

The NPC (NPCO and NPCI) measures the ratio of domestic to border price. The results of policy transfer and protection coefficient of output in monsoon rice production in both townships were greater than one but summer rice and black gram were less than one. The NPCO values of monsoon rice in the study areas were 1.04 and 1.01 which meant that monsoon rice producers were received higher price in domestic comparing with world price when they sold their products, 4% higher in Maubin Township and 1% higher in Daik U Township. The NPCO for summer rice and black gram were 0.95 and 0.90 in Maubin Township and 0.89 and 0.96 in Daik U Township which indicated the black gram farmers received 5% and10% lower price than relatively world price in Maubin Township and 11% and 4% lower than world price in Daik U Township.

On the input side, Nominal Protection Coefficient on Input (NPCI) all selected crops were greater than 1. This showed that the policy regime negatively protects to farmers and high the cost of tradable inputs to some extent. NPCI for monsoon rice, summer rice and black gram were 1.79, 1.81 and 1.74 which described the farmers paid 79%, 81% and 79% more than world prices by purchasing their tradable inputs. In Daik U Township, the prices of tradable inputs used by farmers were also greater than the social prices. The farmers paid 81% in monsoon rice, 89% in summer rice and 80% in black gram production taxed on the price of tradable inputs by purchasing due to the distortion of foreign exchange policy and government interventions.

The Effective Protection Coefficient (EPC) shows the joint effect of policy transfers affecting both tradable inputs and tradable outputs. The EPC values indicated that all selected crops were less than unity which implied that all selected farmers in both townships had direct or indirect taxes from the policies in tradable commodities markets.

According to the sensitivity analyses on DRC ratios, monsoon rice in Maubin Township were had respective comparative advantages at different yield levels [3.5 MT/ha (70 bsk/ac) to 6 MT/ha (120 bsk/ac)], different FOB prices (294, 373, 735 USD/MT) and different exchange rates (850, 1198, 1311) MMK /USD. The lowest yield level of 3 MT/ha had no comparative advantage for Mubin's monsoon rice production. In summer rice production in Maubin Township, DRC ratios of all different yield levels, different FOB prices and different exchange rates except 3 MT/ha and 3.5 MT/ha at the lowest exchange rate were between zero and one. In Daik U Township, both wet and dry rice producers had comparative advantage at the range of yield levels from 3 MT/ha to 6 MT/ha, different FOB prices and differ exchange rates because their DRC ratios were less than one.

Under the different yield levels (from 0.65 MT/ha to 1.64 MT/ha), three kinds of FOB prices (825, 910 and 1245) USD/MT and three exchange rates (850, 1198, 1311) MMK/USD, all DRC ratios for black gram in Maubin Township were less than one. This showed that even the lowest yield, price and exchange rate can obtain comparative advantage. But there was no comparative for black gram producers in Daik U Township at the lowest yield level with lowest exchange and lowest FOB price.

According to the sensitivity analyses on DRC ratios, the selected crops in both townships had comparative advantage at the current average yield between 3.5 MT/ha (70 bsk/ac) and 4 MT/ha (80 bsk/ac) for rice and between 0.98 MT/ha (12 bsk/ac) and 1.31 (16 bsk/ac), current FOB price (294 USD/MT in rice and 901 USD/MT), the current exchange rate of 1198 MMK/USD. So, domestic resources used in both rice and pulses productions were efficient under the existing production system. The most comparative advantage was found at the highest world price of quality rice, highest yield level and highest exchange rate. At lower world price and lower exchange rate, it was need to reduce the cost of tradable inputs.

The overall results of the study showed that there was comparative advantage under the current production system in all selected crops in both townships. Among them black gram production has the most comparative advantage for export market and then followed by summer rice and monsoon rice. The market distortions in selected crops cultivations had in both outputs and inputs in the study areas. This study found that monsoon rice producers received reinforcement but summer rice and black gram had been poorly subsidized and rare protected under existing production and policy. Financial returns to domestic summer rice and black gram producers were also attractive even though there were distortions in market prices and other contains.

The values of total labor used for producing rice per ha was the highest in monsoon season and was the same in summer rice and black gram. In both areas, Maubin Township was more used labor than that of Daik U Township. Therefore Daik U' farmers could use the labor more efficient according to the results of most indicators. Both of these crops productions have a potential to increase the income of farmers and to reduce poverty of the nation and also to contribute to foreign exchange earnings. Among these two crops, black gram production had the largest comparative advantage for export market and its financial return was the highest in all selected crops. Although black gram had the most comparative advantage, it was found to be a labor intensive crop based on the results of labor use efficiency. This can be because of labor intensive nature of harvesting the crop.

In Myanmar, rice is the policy crop and pulses are the main export earning crops. From this survey, it was found that rice was less profitable although higher resource use comparing with black gram. In export market, Myanmar got lower prices in agricultural products than other competitive export countries. In this study, policy maker would found out that both rice and pulses had potential comparative for export market and can provide benefits for country. Therefore policy makers should ruminate the ways to get more profits for these products in both domestic market and world market.

To high comparative advantages in production of rice in both wet and dry seasons, high quality export rice varieties should be recommended by supporting the better technologies for production, providing suitable crop production loan, improving technical efficiency. The summer rice and black gram production should also be more emphasized, because it needs less inputs and more profitable crop. Summer rice production also should be great potential to expand the area wherever it has irrigation facilities. The areas of black gram production should be expanded and the black gram producers should be supported more the capital loan and irrigation facilities like rice production.

To reduce the input costs, the government should support the suitable and smooth flow of agricultural inputs market and it can reduce costs and increase farm incomes. Based on the result of domestic factor cost, labor requirement and cost of labor were high in the peak season. Therefore to overcome this problem, farm mechanization technologies should be promoted by supporting more moderate fame machines such as transplanter, combined harvester and power thresher to reduce labor intensive activities.

The government should persuade and inspire the farmers to choose the least costly and most profitable crop production. Policy makers should provide more accurate market information to participants on production, consumption, exports, and prices in order to allow a smooth functioning of the rice and pulses markets and enable more informed policy decisions. Trade policy should be enhanced predictability. Export bans should be avoided. Once issued, export licenses should not be canceled or subject to higher taxes. All export procedures and port costs should be revised with a view toward improving the competitiveness of Myanmar rice and pulses. Foreign exchange rate should be favorable condition by allowing the forces of supply and demand to work in the economy. In this study there are some limitations such as the average monthly value of FOB prices was used to estimate the DRC ratios of both monsoon rice and summer rice productions. Actually, it would be better if we can utilize it would be different FOB prices for different seasons. Therefore, further studies should be conducted by using proper FOB prices for different rice varieties and different seasons.

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Appendix 1 Calculation of Export Parity Price of Rice for Maubin Township

No	Step in Calculation	Unit	Monsoon rice	Summer rice
1	Export price FOB Muse (average monthly value in 2015) [a]	USD/MT	244	244
2	Exchange rate MMK per USD (average daily value in December, 2015)	MMK/USD	1,303	1,303
3	Export price in domestic currency	MMK/MT	317,922	317,922
4	(-) Port charges, stevedoring and loading	MMK/MT	10,000	10,000
5	(-) Packaging, handling and processing cost	MMK/MT	15,000	15,000
6	(-) Transport from Muse (Wholesale) to export point	MMK/MT	5,000	5,000
7	(-) Transport from Yangon (Wholesale) to Muse	MMK/MT	35,000	35,000
8	(-) Transport from Maubin to Yangon (Wholesale) point	MMK/MT	15,000	15,000
9	(-) Packaging, handling and processing cost in Maubin	MMK/MT	15,000	15,000
10	(-) Transport from farm gate to Maubin	MMK/MT	5,000	5,000
11	Economic farm gate value of rice	MMK/MT	217,922	217,922
12	Economic farm gate value of rice	USD/MT	167	167
13	Financial farm gate value of rice [b]	MMK/MT	228,000	208,000
14	**Conversion factor (CF)**		**0.96**	**1.05**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw

[b]= Derived from farm survey data, 2015

Appendix 2 Calculation of Export Parity Price of Black Gram for Maubin Township

No	Step in Calculation	Unit	Black gram
1	Export price FOB Yangon (average monthly value in 2015) [a]	USD/MT	901
2	Exchange rate MMK per USD (average daily value in December, 2015)	MMK/USD	1,303
3	Export price in domestic currency	MMK/MT	1,174,166
4	(-) Port charges, stevedoring and loading	MMK/MT	5,000
5	(-) Packaging, handling and processing cost	MMK/MT	10,000
6	(-) Transport from Yangon (Wholesale) to export point	MMK/MT	3,000
7	(-) Transport from Maubin to Yangon (Wholesale) point	MMK/MT	15,000
8	(-) Packaging, handling and processing cost in Maubin	MMK/MT	10,000
9	(-) Transport from farm gate to Maubin	MMK/MT	5,000
10	Economic farm gate value of rice	MMK/MT	1,126,166
11	Economic farm gate value of rice	USD/MT	864
12	Financial farm gate value of rice [b]	MMK/MT	1,017,379
13	**Conversion factor (CF)**		**1.11**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw

[b]= Derived from farm survey data, 2015

Appendix 3 Calculation of Export Parity Price of Rice for Daik U Township

No	Step in Calculation	Unit	Monsoon rice	Summer rice
1	Export price FOB Muse (average monthly value in 2015) [a]	USD/MT	244	244
2	Exchange rate MMK per USD (average daily value in December, 2015)	MMK/USD	1,303	1,303
3	Export price in domestic currency	MMK/MT	317,922	317,922
4	(-) Port charges, stevedoring and loading	MMK/MT	10,000	10,000
5	(-) Packaging, handling and processing cost	MMK/MT	15,000	15,000
6	(-) Transport from Muse (Wholesale) to export point	MMK/MT	5,000	5,000
7	(-) Transport from Daik U to Muse (Wholesale) point	MMK/MT	30,000	30,000
8	(-) Packaging, handling and processing cost in Daik U	MMK/MT	15,000	15,000
9	(-) Transport from farm gate to Daik U	MMK/MT	10,000	10,000
10	Economic farm gate value of rice	MMK/MT	232,922	232,922
11	Economic farm gate value of rice	USD/MT	179	179
12	Financial farm gate value of rice [b]	MMK/USD	235,000	208,000
13	**Conversion factor (CF)**		**0.99**	**1.12**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw

[b]= Derived from farm survey data, 2015

Appendix 4 Calculation of Export Parity Price of Black Gram for Daik U Township

No	Step in Calculation	Unit	Black Gram
1	Export price FOB Yangon (average monthly value in 2015) [a]	USD/MT	901
2	Exchange rate MMK per USD (average daily value in December, 2015)	MMK/USD	**1,303**
3	Export price in domestic currency	MMK/MT	1,174,166
4	(-) Port charges, stevedoring and loading	MMK/MT	5,000
5	(-) Packaging, handling and processing cost	MMK/MT	10,000
6	(-) Transport from Yangon (Wholesale) to export point	MMK/MT	3,000
7	(-) Transport from Daik U to Yangon (Wholesale) point	MMK/MT	15,000
8	(-) Packaging, handling and processing cost in Daik U	MMK/MT	10,000
9	(-) Transport from farm gate to Daik U	MMK/MT	5,000
10	Economic farm gate value of rice	MMK/MT	1,126,166
11	Economic farm gate value of rice	USD/MT	864
12	Financial farm gate value of rice [b]	MMK/MT	1,080,407
13	**Conversion factor (CF)**		**1.04**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw

[b]= Derived from farm survey data, 2015

Appendix 5 Calculation of Import Parity Price of Urea, T-super, Compound Fertilizer for Maubin Township

No.	Steps in Calculation	Unit	Value per MT		
			Urea	T-super	Compound
1	Based import price CIF Muse, Yangon [a]	USD/MT	220	370	260
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083	1,083	1,083
3	Import price of fertilizer in domestic currency	MMK/MT	238,216	400,636	281,528
4	(+) Handling, Port charges and custom duty	MMK/MT	5,000	5,000	5,000
5	Landed cost of fertilizer at Muse, Yangon	MMK/MT	243,216	405,636	286,528
6	(+) Transport from port to ex-warehouse	MMK/MT	5,000	5,000	5,000
7	Price of fertilizer at ex-warehouse (wholesale price)	MMK/MT	248,216	410,636	291,528
	(-) Transport from Muse to Yangon	MMK/MT	25,000	-	25,000
8	(-) Transport from Yangon to Maubin	MMK/MT	20,000	20,000	20,000
9	(-) Transport from Maubin to farm gate	MMK/MT	3,000	3,000	3,000
10	Economic farm gate value of fertilizer	MMK/MT	200,216	387,636	243,528
11	Economic farm gate value of fertilizer	USD/MT	185	358	225
12	Financial farm gate value of fertilizer	MMK/MT	420,000	485,382	500,000
13	**Conversion factor (CF)**		**0.48**	**0.80**	**0.49**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw, 2015

[b]= Derived from farm survey data, 2015

Appendix 6 Calculation of Import Parity Price of Urea, Compound Fertilizer for Daik U Township

No.	Steps in Calculation	Unit	Value per MT	
			Urea	Compound
1	Based import price CIF Muse [a]	USD/MT	220	260
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083	1,083
3	Import price of fertilizer in domestic currency	MMK/MT	**238,216**	**281,528**
4	(+) Handling, Port charges and custom duty	MMK/MT	5,000	5,000
5	Landed cost of fertilizer at Muse	MMK/MT	243,216	286,528
6	(+) Transport from port to ex-warehouse	MMK/MT	5,000	5,000
7	Price of fertilizer at ex-warehouse (wholesale price)	MMK/MT	248,216	291,528
8	(-) Transport from Muse to Daik U	MMK/MT	25,000	25,000
9	(-) Transport from Daik U to farm gate	MMK/MT	3,000	3,000
10	Economic farm gate value of fertilizer	MMK/MT	**220,216**	**263,528**
11	Economic farm gate value of fertilizer	USD/MT	203	243
12	Financial farm gate value of fertilizer[b]	MMK/MT	420,000	500,000
13	**Conversion factor (CF)**		**0.52**	**0.53**

Source: [a]= Price derived from Department of Trade, Nay Pyi Taw, 2015

[b]= Derived from farm survey data, 2015

Appendix 7 Calculation of Import Parity Price of Foliar Fertilizer for Maubin and Daik U Townships

No.	Steps in Calculation	Unit	Value of foliar fertilizer
1	Based import price CIF Muse [a]	USD/kg	1.50
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083
3	Import price of foliar fertilizer domestic currency	MMK/kg	1,624
4	(+) Handling, Port charges and custom duty	MMK/kg	100
5	Landed cost of at Muse	MMK/kg	1,724
6	(+) Transport from port to ex-warehouse	MMK/kg	3
7	Price of foliar fertilizer at ex-warehouse (wholesale price)	MMK/kg	1,727
	(-) Transport from Muse to Yangon	MMK/kg	200
8	(-) Transport from Yangon to Maubin, Daik U	MMK/kg	30
9	(-) Transport from Maubin, Daik U to farm gate	MMK/kg	3
10	Economic farm gate value of foliar fertilizer	MMK/kg	1,494
11	Economic farm gate value of foliar fertilizer	USD/kg	1.38
12	Financial farm gate value of foliar fertilizer [b]	MMK/kg	3,000
13	**Conversion factor (CF)**		**0.50**

Source: [a]= Price derived from private fertilizer importing company, October, 2015

[b]= Derived from farm survey data, 2015

Appendix 8 Calculation of Import Parity Price of Herbicide for Maubin and Daik U Townships (Glyphosate)

No.	Steps in Calculation	Unit	Value of Glyphosate
1	Based import price CIF Yangon [a]	USD/L	5.35
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083
3	Import price of weedicide in domestic currency	MMK/L	5,793
4	(+) Handling, Port charges and custom duty	MMK/L	135
5	Landed cost of at Yangon	MMK/L	5,928
6	(+) Transport from port to ex-warehouse	MMK/L	10
7	Price of weedicide at ex-warehouse (wholesale price)	MMK/L	5,938
8	(-) Transport from Yangon to Maubin, Daik U	MMK/L	20
9	(-) Transport from Maubin, Daik U to farm gate	MMK/L	6
10	Economic farm gate value of weedicide	MMK/L	5,912
11	Economic farm gate value of weedicide	USD/L	5.46
12	Financial farm gate value of weedicide [b]	MMK/L	8,500
13	**Conversion factor (CF)**		**0.70**

Source: [a]= Price derived from private fertilizer importing company, October, 2015

[b]= Derived from farm survey data, 2015

Appendix 9 Calculation of Import Parity Price of Insecticide for Maubin and Daik U Townships

No.	**Steps in Calculation**	**Unit**	**Value of insecticide**
1	Based import price CIF Yangon [a]	USD/L	5.36
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083
3	Import price of insecticide in domestic currency	MMK/L	5,804
4	(+) Handling, Port charges and custom duty	MMK/L	135
5	Landed cost of at Yangon	MMK/L	5,939
6	(+) Transport from port to ex-warehouse	MMK/L	10
7	Price of insecticide at ex-warehouse (wholesale price)	MMK/L	5,949
8	(-) Transport from Yangon to Maubin, Daik U	MMK/L	20
9	(-) Transport from Maubin, Daik U to farm gate	MMK/L	6
10	Economic farm gate value of insecticide	MMK/L	5,923
11	Economic farm gate value of insecticide	USD/L	5.47
12	Financial farm gate value of insecticide [b]	MMK/L	8,500
13	**Conversion factor (CF)**		**0.70**

Source: [a]= Price derived from private fertilizer importing company, October, 2015

[b]= Derived from farm survey data, 2015

Appendix 10 Calculation of Import Parity Price of Diesel for Maubin and Daik U Townships

No.	Steps in Calculation	Unit	Diesel value per gallon	
			Maubin	DaiK U
1	Based import price CIF Yangon [a]	USD/gal	1.48	1.48
2	Exchange rate MMK per USD (average daily value in May 2015)	MMK/USD	1,083	1,083
3	Import price of diesel in domestic currency	MMK/gal	1,600	1,600
4	(+) Handling, Port charges and custom duty	MMK/gal	200	200
5	Landed cost of Diesel at Yangon	MMK/gal	1,800	1,800
6	(+) Transport from port to ex-warehouse	MMK/gal	300	300
7	Price of diesel at ex-warehouse (wholesale price)	MMK/gal	2,100	2,100
8	(-) Transport from Yangon to Maubin and Daik U	MMK/gal	700	500
9	(-) Transport from Maubin and Daik U to farm gate	MMK/gal	300	300
10	Economic farm gate value of diesel	MMK/L	1,100	1,300
11	Economic farm gate value of diesel	USD/gal	1.02	1.20
12	Financial farm gate value of diesel [b]	MMK/gal	3,500	3,500
13	**Conversion factor (CF)**		**0.31**	**0.37**

Source: [a]= Price derived from private diesel importing company, October, 2015

[b]= Derived from farm survey data, 2015

Appendix 11 Costs and Return Analysis in Terms of Private and Social Values for Monsoon Rice Production in Maubin Township

N=60

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross return (Yield)*(Price)	T	768,360	737,626	0.96
2	Non cash return		206,621	206,621	
	Home consumption	NT	159,069	159,069	
	Reserved seed	NT	47,552	47,552	
3	Crop sale(1)-(2)	T	561,739	531,004	
	Cash return	T	561,739	531,004	
4	Material Inputs(purchased)				
	Seed	T	46,055	46,055	
	Urea	T	50,707	24,340	0.48
	Compound fertilizer	T	51,289	25,132	0.49
	T-super	T	41,965	33,572	0.80
	Insecticide	T	6,122	4,286	0.70
	Herbicide	T	15,306	10,714	0.70
	Diesels	T	22,396	6,943	0.31
	Total material cash cost		233,840	151,040	
5	Hired labor	NT	180,200	161,856	
	Human labor used	NT	180,200	161,856	0.90
6	Power used (hired)	NT	90,878	90,878	
	Machine power used	NT	61,593	61,593	
	Animal power used	NT	29,286	29,286	1.00
7	Interest on cast cost		16,763	13,405	
8	Total cash cost(4)+(5)+(6)+(7)		521,681	417,180	
9	Family labor cost	NT	98,600	88,563	
	Human labor used	NT	98,600	88,563	0.90
10	Power used (owned)	NT	63,714	63,714	
	Machine power used	NT	35,500	35,500	
	Animal power used	NT	28,214	28,214	1.00
11	**Total non-cash cost(9)+(10)**		**162,314**	**152,277**	
12	**Total variable cost(8)+(11)**		**683,996**	**569,457**	
13	**Return above variable cost(1)-(12)**		**84,364**	**168,169**	
14	**Return above cash cost(1)-(8)**		**246,679**	**320,446**	
15	**Benefit- Cost ratio (1)/(12)**		**1.12**	**1.30**	
16	**Return per unit of cash cost(1)/(8)**		**1.47**	**1.77**	

Appendix 12 Costs and Return Analysis in Terms of Private and Social Values for Summer Rice Production in Maubin Township

N=27

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross return (Yield)*(Price)	T	960,960	1,006,799	1.05
2	Non cash return		144,705	144,705	
	Home consumption	NT	107,762	107,762	
	Reserved seed	NT	36,943	36,943	
3	Crop sale(1)-(2)	T	816,255	862,093	
	Cash return	T	816,255	862,093	
4	Material Inputs(purchased)				
	Seed	T	46,160	46,160	
	Urea	T	88,464	42,463	0.48
	Compound fertilizer	T	69,259	33,937	0.49
	T-super	T	58,886	47,109	0.80
	Insecticide	T	30,487	21,341	0.70
	Herbicide	T	26,566	18,596	0.70
	Diesels	T	51,690	16,024	0.31
	Total material cash cost		371,512	225,630	
5	Hired labor	NT	113,850	103,604	
	Human labor used	NT	113,850	103,604	0.91
6	Power Used (Hired)	NT	112,220	112,220	
	Machine power used	NT	92,220	92,220	
	Animal power used	NT	20,000	20,000	1.00
7	Interest on cast cost		19,840	14,656	
8	Total cash cost(4)+(5)+(6)+(7)		617,421	456,109	
9	Family labor cost	NT	96,600	87,906	
	Human labor used	NT	96,600	87,906	0.91
10	Power Used (Owned)	NT	72,663	72,663	
	Machine power used	NT	57,663	57,663	
	Animal power used	NT	15,000	15,000	1.00
11	**Total non-cash cost(9)+(10)**		**169,263**	**160,569**	
12	**Total variable cost(8)+(11)**		**786,684**	**616,678**	
13	**Return above variable cost(1)-(12)**		**174,276**	**390,120**	
14	**Return above cash cost(1)-(8)**		**343,539**	**550,690**	
15	**Benefit- Cost ratio (1)/(12)**		**1.22**	**1.63**	
16	**Return per unit of cash cost(1)/(8)**		**1.56**	**2.21**	

Appendix 13 Costs and Return Analysis in Terms of Private and Social Values for Black Gram Production in Maubin Township

N=41

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross return (Yield)*(Price)	T	726,567	806,490	1.11
2	Non cash return		87,336	87,336	
	Reserved seed	NT	87,336	87,336	
3	Crop sale(1)-(2)	T	639,232	719,154	
	Cash return	T	639,232	719,154	
4	Material Inputs(purchased)				
	Seed	T	79,541	79,541	
	fertilizer	T	10,898	6,155	0.56
	Insecticide	T	4,038	2,827	0.70
	Herbicide	T	30,000	20,866	0.70
	Diesels	T	15,608	4,905	0.31
	Total material cash cost		140,086	114,294	
5	Hired labor	NT	105,400	86,428	
	Human labor used	NT	105,400	86,428	0.82
6	Power Used (Hired)	NT	51,812	51,812	
	Machine power used	NT	35,491	35,491	
	Animal power used	NT	16,321	16,321	1.00
7	Interest on cast cost		9,870	8,384	
8	Total cash cost(4)+(5)+(6)+(7)		307,169	260,918	
9	Family labor cost	NT	57,800	47,396	
	Human labor used	NT	57,800	47,396	0.82
10	Power Used (Owned)	NT	52,894	52,894	
	Machine power used	NT	35,109	35,109	
	Animal power used	NT	17,786	17,786	1.00
11	**Total non-cash cost(9)+(10)**		**110,694**	**100,290**	
12	**Total variable cost(8)+(11)**		**417,863**	**361,209**	
13	**Return above variable cost(1)-(12)**		**615,873**	**706,199**	
14	**Return above cash cost(1)-(8)**		**419,399**	**545,572**	
15	**Benefit- Cost ratio (1)/(12)**		**1.74**	**2.23**	
16	**Return per unit of cash cost(1)/(8)**		**2.37**	**3.09**	

Appendix 14 Costs and Return Analysis in Terms of Private and Social Values for Monsoon Rice Production in Daik U Township

N=60

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross Return (Yield* Price)	T	759,050	751,460	0.99
2	Non cash return		157,446	137,110	
	Home consumption	NT	124,028	103,692	
	Reserved seed	NT	33,418	33,418	
3	Crop sale(1)-(2)	T	601,604	614,349	
	Cash return	T	601,604	614,349	
4	Material Inputs(purchased)				
	Seed	T	30,001	30,001	
	Urea	T	50,885	26,460	0.52
	Compound fertilizer	T	72,604	38,480	0.53
	Insecticide	T	14,842	10,389	0.70
	Herbicide	T	22,990	16,114	0.70
	Diesels	T	14,000	5,200	0.37
	Total material cash cost		205,322	126,645	
5	Hired labor	NT	126,000	118,440	
	Human labor used	NT	126,000	118,440	0.94
6	Power Used (Hired)	NT	123,713	123,713	
	Machine power used	NT	85,657	85,657	
	Animal power used	NT	38,056	38,056	
7	Interest on cast cost		15,107	12,244	
8	Total cash cost(4)+(5)+(6)+(7)		470,142	381,042	1.00
9	Family labor cost	NT	63,000	59,220	
	Human labor used	NT	63,000	59,220	0.94
10	Power Used (Owned)	NT	94,792	94,792	
	Machine power used	NT	48,452	48,452	
	Animal power used	NT	46,339	46,339	1.00
11	**Total non-cash cost(9)+(10)**		**157,792**	**154,012**	
12	**Total variable cost(8)+(11)**		**627,934**	**535,054**	
13	**Return above variable cost(1)-(12)**		**131,116**	**216,406**	
14	**Return above cash cost(1)-(8)**		**288,908**	**370,417**	
15	**Benefit- Cost ratio (1)/(12)**		**1.21**	**1.40**	
16	**Return per unit of cash cost(1)/(8)**		**1.61**	**1.97**	

Appendix 15 Costs and Return Analysis in Terms of Private and Social Values for Summer Rice Production in Daik U Township

N=21

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross Return (Yield* Price)	T	730,080	817,690	1.12
2	Non cash return		232,462	232,462	
	Home consumption	NT	182,813	182,813	
	Reserved seed	NT	49,649	49,649	
3	Crop sale(1)-(2)	T	497,618	585,228	
	Cash return	T	497,618	585,228	
4	Material Inputs(purchased)				
	Seed	T	30,095	30,095	
	Urea	T	59,167	30,767	0.52
	Compound fertilizer	T	102,792	54,480	0.53
	Insecticide	T	13,793	9,655	0.70
	Herbicide	T	13,750	9,638	0.70
	Diesels	T	26,400	9,806	0.37
	Total material cash cost		245,996	144,440	
5	Hired labor	NT	84,000	77,491	
	Human labor used	NT	84,000	77,491	0.92
6	Power Used (Hired)	NT	123,906	123,906	
	Machine power used	NT	85,156	85,156	
	Animal power used	NT	38,750	38,750	1.00
7	Interest on cast cost		15,070	11,482	
8	Total cash cost(4)+(5)+(6)+(7)		468,972	357,319	
9	Family labor cost	NT	57,000	52,583	
	Human labor used	NT	57,000	52,583	0.92
10	Power Used (Owned)	NT	56,701	56,701	
	Machine power used	NT	28,889	28,889	
	Animal power used	NT	27,813	27,813	1.00
11	**Total non-cash cost(9)+(10)**		**113,701**	**109,284**	
12	**Total variable cost(8)+(11)**		**582,674**	**466,603**	
13	**Return above variable cost(1)-(12)**		**147,406**	**351,086**	
14	**Return above cash cost(1)-(8)**		**261,108**	**460,371**	
15	**Benefit- Cost ratio (1)/(12)**		**1.25**	**1.75**	
16	**Return per unit of cash cost(1)/(8)**		**1.56**	**2.29**	

Appendix 16 Costs and Return Analysis in Terms of Private and Social Values for Black Gram Production in Daik U Township

N=15

No.	Outputs and Inputs	Classification of inputs and outputs	Private value (MMK/ha)	Social value (MMK/ha)	CF
1	Gross return (Yield*Price)	T	828,766	861,917	1.04
2	Non cash return		128,294	128,294	
	Reserved seed	NT	128,294	128,294	
	Crop sale(1)-(2)	T	700,473	733,623	
3	Cash return	T	700,473	733,623	
4	Material Inputs(purchased)				
	Seed	T	107,139	107,139	
	fertilizer	T	35,365	19,972	0.56
	Insecticide	T	22,292	15,604	0.70
	Diesels	T	19,250	7,150	0.37
	Total material cash cost		184,046	149,865	
5	Hired labor	NT	90,000	74,700	
	Human labor used	NT	90,000	74,700	0.83
6	Power Used (Hired)	NT	92,981	92,981	
	Machine power used	NT	42,981	42,981	
	Animal power used	NT	50,000	50,000	1.00
7	Interest on cast cost		12,185	10,543	
8	Total cash cost(4)+(5)+(6)+(7)		379,212	328,088	
9	Family labor cost	NT	69,000	57,270	
	Human labor used for whole season	NT	69,000	57,270	0.83
10	Power Used (Owned)	NT	54,167	54,167	
	Machine power used	NT	25,000	25,000	
	Animal power used	NT	29,167	29,167	1.00
11	**Total non-cash cost(9)+(10)**		**123,167**	**111,437**	
12	**Total variable cost(8)+(11)**		**502,379**	**439,525**	
13	**Return above variable cost(1)-(12)**		**326,388**	**422,392**	
14	**Return above cash cost(1)-(8)**		**449,554**	**533,829**	
15	**Benefit- Cost ratio (1)/(12)**		**1.65**	**1.96**	
16	**Return per unit of cash cost(1)/(8)**		**2.19**	**2.63**	

Appendix 17 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Monsoon Rice Production in Maubin Township

Yield			DRC at different world price (USD/MT) and exchange rates (MMK/USD)								
			USD 294			USD 373			USD 735		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
3.0	3129	60	1.11	0.59	0.51	0.71	0.41	0.36	0.51	0.17	0.16
3.5	3651	70	0.92	0.50	0.43	0.59	0.35	0.31	0.43	0.15	0.13
4.0	4172	80	0.78	0.43	0.37	0.51	0.30	0.27	0.37	0.13	0.12
4.5	4694	90	0.68	0.38	0.33	0.44	0.27	0.24	0.33	0.11	0.10
5.0	5215	100	0.60	0.33	0.29	0.39	0.24	0.21	0.29	0.10	0.09
5.5	5737	110	0.54	0.30	0.26	0.36	0.21	0.19	0.26	0.09	0.08
6.0	6258	120	0.49	0.27	0.24	0.32	0.20	0.17	0.24	0.08	0.08

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 18 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Summer Rice Production in Maubin Township

Yield			DRC at different world price (USD/MT) and exchange rates (MMK/USD)								
			USD 294			USD 373			USD 735		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
3.0	3129	60	1.30	0.62	0.53	0.75	0.42	0.36	0.26	0.17	0.15
3.5	3651	70	1.02	0.51	0.44	0.61	0.35	0.30	0.22	0.14	0.13
4.0	4172	80	0.84	0.43	0.37	0.52	0.30	0.26	0.19	0.12	0.11
4.5	4694	90	0.72	0.37	0.32	0.45	0.26	0.23	0.16	0.11	0.10
5.0	5215	100	0.62	0.33	0.29	0.40	0.23	0.20	0.15	0.10	0.09
5.5	5737	110	0.55	0.30	0.26	0.35	0.21	0.18	0.13	0.09	0.08
6.0	6258	120	0.50	0.27	0.23	0.32	0.19	0.17	0.12	0.08	0.07

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 19 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Monsoon Rice Production in Daik U Township

Yield			DRC at different world price (USD/MT) and exchange rates (MMK/USD)								
			USD 294			USD 373			USD 735		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
3.0	3129	60	0.94	0.54	0.47	0.63	0.38	0.34	0.25	0.17	0.15
3.5	3651	70	0.78	0.45	0.40	0.53	0.32	0.29	0.21	0.14	0.13
4.0	4172	80	0.67	0.39	0.34	0.45	0.28	0.25	0.18	0.12	0.11
4.5	4694	90	0.58	0.34	0.30	0.40	0.25	0.22	0.16	0.11	0.10
5.0	5215	100	0.52	0.31	0.27	0.35	0.22	0.20	0.15	0.10	0.09
5.5	5737	110	0.47	0.28	0.24	0.32	0.20	0.18	0.13	0.09	0.08
6.0	6258	120	0.42	0.25	0.22	0.29	0.18	0.16	0.12	0.08	0.07

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 20 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Summer Rice Production in Daik U Township

Yield			DRC at different world price (USD/MT) and exchange rates (MMK/USD)								
			USD 294			**USD 373**			**USD 735**		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
3.0	3129	60	0.77	0.43	0.38	0.51	0.31	0.27	0.20	0.13	0.12
3.5	3651	70	0.64	0.36	0.32	0.42	0.26	0.23	0.17	0.11	0.10
4.0	4172	80	0.54	0.31	0.27	0.36	0.22	0.20	0.15	0.10	0.09
4.5	4694	90	0.47	0.27	0.24	0.32	0.20	0.17	0.13	0.09	0.08
5.0	5215	100	0.42	0.24	0.21	0.28	0.18	0.16	0.12	0.08	0.07
5.5	5737	110	0.37	0.22	0.19	0.25	0.16	0.14	0.10	0.07	0.06
6.0	6258	120	0.34	0.20	0.18	0.23	0.14	0.13	0.10	0.06	0.06

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 21 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Black Gram Production in Maubin Township

Yield			DRC at different world prices (USD/MT) and exchange rates (MMK/USD)								
			USD 825			USD 901			USD 1245		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
0.32	324	4	1.35	0.88	0.79	1.21	0.80	0.72	0.82	0.55	0.50
0.65	654.00	8	0.61	0.41	0.37	0.55	0.37	0.34	0.82	0.26	0.24
0.98	981.00	12	0.39	0.27	0.24	0.36	0.24	0.22	0.38	0.17	0.16
1.31	1308.00	16	0.29	0.20	0.18	0.26	0.18	0.17	0.25	0.13	0.12
1.64	1635.00	20	0.23	0.16	0.14	0.21	0.14	0.13	0.19	0.10	0.09

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 22 Sensitivity of Different Yield Levels, World Prices, and Exchange Rates on DRC ratios for Black Gram Production in Daik U Township

Yield			DRC at different world prices (USD/MT) and exchange rates (MMK/USD)								
			USD 825			USD 901			USD 1245		
MT/ha	**kg/ha**	**bsk/ac**	**850***	**1198***	**1311***	**850***	**1198***	**1311***	**850***	**1198***	**1311***
0.32	324	4	1.67	1.07	0.96	1.47	0.96	0.86	0.98	0.66	0.59
0.65	654.00	8	0.73	0.49	0.44	0.65	0.44	0.40	0.45	0.31	0.28
0.98	981.00	12	0.47	0.32	0.29	0.42	0.29	0.26	0.29	0.20	0.18
1.31	1308.00	16	0.35	0.24	0.21	0.31	0.21	0.19	0.22	0.15	0.14
1.64	1635.00	20	0.27	0.19	0.17	0.25	0.17	0.15	0.17	0.12	0.11

*= exchange rates

Source: @ Exchange Rate of Central Bank of Myanmar (Jan 2012 – Aug 2016)

Appendix 23 Enterprise Budget for Monsoon Rice Production in Maubin Township

N=60

No.	Outputs and Inputs	Classification of inputs and outputs	Unit	Amount per ha	Price per unit (MMK)	Private value (MMK/ha)
1	Gross return (Yield)*(Price)	T	kg	3370	228	768,360
2	Non cash return					206,621
	Home consumption	NT	kg	698	228	159,069
	Reserved seed	NT	kg	108	442	47,552
3	Crop sale(1)-(2)	T				561,739
	Cash return	T				561,739
4	Material Inputs(purchased)					
	Seed	T	kg	104.3	442	46,055
	Urea	T	Bag	2	23,054	50,707
	Compound fertilizer	T	Bag	2	26,125	51,289
	T-super	T	Bag	2	24,269	41,965
	Insecticide	T				6,122
	Herbicide	T				15,306
	Diesels	T	gal	6	3,500	22,396
	Total material cash cost	T				233,840
5	Hired labor	NT				180,200
	Human labor used	NT	M/day	53	3,400	180,200
6	Power used (hired)	NT				90,878
	Machine power used season	NT				61,593
	Animal power used	NT				29,286
7	Interest on cast cost		MMK	0.03		16,763
8	Total cash cost(4)+(5)+(6)+(7)					521,681
9	Family labor cost	NT				98,600
	Human labor used	NT	M/day	29	3,400	98,600
10	Power used (owned)	NT				63,714
	Machine power used	NT				35,500
	Animal power used	NT				28,214
11	**Total non-cash cost(9)+(10)**					**162,314**
12	**Total variable cost(8)+(11)**					**683,996**
13	**Return above variable cost(1)-(12)**					**84,364**
14	**Return above cash cost(1)-(8)**					**246,679**
15	**Benefit- Cost ratio (1)/(12)**					**1.12**
16	**Return per unit of cash cost(1)/(8)**					**1.47**

Appendix 24 Enterprise Budget for Summer Rice Production in Maubin Township

N=27

No.	Outputs and Inputs	Classification of inputs and outputs	Unit	Amount per ha	Price per unit (MMK)	Private value (MMK/ha)
1	Gross return (Yield)*(Price)	T	kg	4620	208	960,960
2	Non cash return					144,705
	Home consumption	NT	kg	548	197	107,762
	Reserved seed	NT	kg	106	349	36,943
3	Crop sale(1)-(2)	T				816,255
	Cash return	T				816,255
4	Material Inputs(purchased)					
	Seed	T	kg	132	349	46,160
	Urea	T	Bag	4	21,317	88,464
	Compound fertilizer	T	Bag	3	24,704	69,259
	T-super	T	Bag	3	22,728	58,886
	Insecticide	T				30,487
	Herbicide	T				26,566
	Diesels	T	gal	15	3,500	51,690
	Total material cash cost					371,512
5	Hired labor	NT				113,850
	Human labor used	NT	M/day	33	3,450	113,850
6	Power Used (Hired)	NT				112,220
	Machine power used	NT				92,220
	Animal power used	NT				20,000
7	Interest on cast cost		MMK	0.03		19,840
8	Total cash cost(4)+(5)+(6)+(7)					617,421
9	Family labor cost	NT				96,600
	Human labor used for whole season	NT	M/day	28	3,450	96,600
10	Power Used (Owned)	NT				72,663
	Machine power used	NT				57,663
	Animal power used	NT				15,000
11	**Total non-cash cost(9)+(10)**					**169,263**
12	**Total variable cost(8)+(11)**					**786,684**
13	**Return above variable cost(1)-(12)**					**174,276**
14	**Return above cash cost(1)-(8)**					**343,539**
15	**Benefit- Cost ratio (1)/(12)**					**1.22**
16	**Return per unit of cash cost(1)/(8)**					**1.56**

Appendix 25 Enterprise Budget for Black Gram Production in Maubin Township

N=41

No.	**Outputs and Inputs**	**Classification of inputs and outputs**	**Unit**	**Amount per ha**	**Price per unit (MMK)**	**Private value (MMK/ha)**
1	Gross return (Yield)*(Price)	T	kg	714	1,017	726,567
2	Non cash return					87,336
	Reserved seed	NT	kg	63	1,376	87,336
3	Crop sale(1)-(2)	T				639,232
	Cash return	T				639,232
4	Material Inputs(purchased)					
	Seed	T	kg	58	1,376	79,541
	fertilizer	T				10,898
	Insecticide	T				4,038
	Herbicide	T				30,000
	Diesels	T	gal	5	3,405	15,608
	Total material cash cost					140,086
5	Hired labor	NT				105,400
	Human labor used for whole season	NT	M/day	31	3,400	105,400
6	Power Used (Hired)	NT				51,812
	Machine power used	NT				35,491
	Animal power used	NT				16,321
7	Interest on cast cost		MMK	0.03		9,870
8	Total cash cost(4)+(5)+(6)+(7)					307,169
9	Family labor cost	NT				57,800
	Human labor used	NT	M/day	17	3,400	57,800
10	Power Used (Owned)	NT				52,894
	Machine power used	NT				35,109
	Animal power used	NT				17,786
11	**Total non-cash cost(9)+(10)**					**110,694**
12	**Total variable cost(8)+(11)**					**417,863**
13	**Return above variable cost(1)-(12)**					**615,873**
14	**Return above cash cost(1)-(8)**					**419,399**
15	**Benefit- Cost ratio (1)/(12)**					**1.74**
16	**Return per unit of cash cost(1)/(8)**					**2.37**

Appendix 26 Enterprise Budget for Monsoon Rice Production in Daik U Township

N=60

No.	Outputs and Inputs	Classification of inputs and outputs	Unit	Amount per ha	Price per unit (MMK)	Private value (MMK/ha)
1	Gross Return (Yield* Price)	T	kg	3230	235	759,050
2	Non cash return					157,446
	Home consumption	NT	kg	528	235	124,028
	Reserved seed	NT	kg	132	253	33,418
3	Crop sale(1)-(2)	T				601,604
	Cash return	T				497,483
4	Material Inputs(purchased)					
	Seed	T	kg	119	253	30,001
	Urea	T	bag	2	25,443	50,885
	Compound fertilizer	T	bag	3	26,130	72,604
	Insecticide	T				14,842
	Herbicide	T				22,990
	Diesels	T	gal	4	3,500	14,000
	Total material cash cost					205,322
5	Hired labor	NT				126,000
	Human labor used	NT	M/day	40	3,150	126,000
6	Power Used (Hired)	NT				123,713
	Machine power used	NT				85,657
	Animal power used	NT				38,056
7	Interest on cast cost		MMK	0.0332		15,107
8	Total cash cost(4)+(5)+(6)+(7)					470,142
9	Family labor cost	NT				63,000
	Human labor	NT	M/day	20	3,150	63,000
10	Power Used (Owned)	NT				94,792
	Machine power used	NT				48,452
	Animal power used	NT				46,339
11	**Total non-cash cost(9)+(10)**					**157,792**
12	**Total variable cost(8)+(11)**					**627,934**
13	**Return above variable cost(1)-(12)**					**131,116**
14	**Return above cash cost(1)-(8)**					**288,908**
15	**Benefit- Cost ratio (1)/(12)**					**1.21**
16	**Return per unit of cash cost(1)/(8)**					**1.61**

Appendix 27 Enterprise Budget for Summer Rice Production in Daik U Township

N=21

No.	Outputs and Inputs	Classification of inputs and outputs	Unit	Amount per ha	Price per unit (MMK)	Private value (MMK/ha)
1	Gross Return (Yield* Price)	T	kg	3510	208	730,080
2	Non cash return		kg			232,462
	Home consumption	NT	kg	880	208	182,813
	Reserved seed	NT	kg	197	252	49,649
3	Crop sale(1)-(2)	T				497,618
	Cash return	T				497,618
4	Material Inputs(purchased)					
	Seed	T	kg	119	252	30,095
	Urea	T	bag	3	23,667	59,167
	Compound fertilizer	T	bag	4	25,799	102,792
	Insecticide	T				13,793
	Herbicide	T				13,750
	Diesels	T	gal	7	3,891	26,400
	Total material cash cost					245,996
5	Hired labor	NT				84,000
	Human labor used	NT	M/day	28	3,000	84,000
6	Power Used (Hired)	NT				123,906
	Machine power used	NT				85,156
	Animal power used	NT				38,750
7	Interest on cast cost		MMK	0.03		15,070
8	Total cash cost(4)+(5)+(6)+(7)					468,972
9	Family labor cost	NT				57,000
	Human labor used	NT	M/day	19	3,000	57,000
10	Power Used (Owned)	NT				56,701
	Machine power used	NT				28,889
	Animal power used	NT				27,813
11	**Total non-cash cost(9)+(10)**					**113,701**
12	**Total variable cost(8)+(11)**					**582,674**
13	**Return above variable cost(1)-(12)**					**147,406**
14	**Return above cash cost(1)-(8)**					**261,108**
15	**Benefit- Cost ratio (1)/(12)**					**1.25**
16	**Return per unit of cash cost(1)/(8)**					**1.56**

Appendix 28 Enterprise Budget for Black Gram Production in Daik U Township

N=15

No.	Outputs and Inputs	Classific-ation of inputs and outputs	Unit	Amou-nt per ha	Price per unit (MMK)	Private value (MMK/ha)
1	Gross return (Yield*Price)	T	kg	767	1,080	828,766
2	Non cash return					128,294
	Reserved seed	NT	kg	95	1,356	128,294
	Crop sale(1)-(2)	T				700,473
3	Cash return	T				700,473
4	Material Inputs(purchased)					
	Seed	T	kg	79	1,356	107,139
	fertilizer	T				35,365
	Insecticide	T				22,292
	Diesels	T	gal	6	3,369	19,250
	Total material cash cost					184,046
5	Hired labor	NT				90,000
	Human labor used for whole season	NT	M/day	30	3,000	90,000
6	Power Used (Hired)	NT				92,981
	Machine power used	NT				42,981
	Animal power used	NT				50,000
7	Interest on cast cost		MMK	0.03		12,185
8	Total cash cost(4)+(5)+(6)+(7)					379,212
9	Family labor cost	NT				69,000
	Human labor	NT	M/day	23	3,000	69,000
10	Power Used (Owned)	NT				54,167
	Machine power used	NT				25,000
	Animal power used	NT				29,167
11	**Total non-cash cost(9)+(10)**					**123,167**
12	**Total variable cost(8)+(11)**					**502,379**
13	**Return above variable cost(1)-(12)**					**326,388**
14	**Return above cash cost(1)-(8)**					**449,554**
15	**Benefit- Cost ratio (1)/(12)**					**1.65**
16	**Return per unit of cash cost(1)/(8)**					**2.19**