DEMAND FUNCTION, MARKETING AND DISTRIBUTION OF RICE QUALITY SEED IN MAUBIN AND DAIK U TOWNSHIP

ZAR NI HLAING

OCTOBER 2016

DEMAND FUNCTION, MARKETING AND DISTRIBUTION OF RICE QUALITY SEED IN MAUBIN AND DAIK U TOWNSHIP

ZAR NI HLAING

A Thesis Submitted to the Post-Graduate Committee of the Yezin Agricultural University as a Partial Fulfillment of the Requirements for the Degree of Master of Agricultural Science (Agricultural Economics)

Department of Agricultural Economics

Yezin Agricultural University

OCTOBER 2016

The thesis attached here to, entitled **"DEMAND FUNCTION, MARKETING AND DISTRIBUTION OF RICE QUALITY SEED IN MAUBIN AND DAIK U TOWNSHIP"** was prepared under the direction of the chairman of the candidate supervisory committee and has been approved by all members of that committee and board of examiners as a partial fulfillment of requirements for the degree of **MASTER OF AGRICULTURAL SCIENCE (AGRICULTURAL ECONOMICS).**

Dr. Nay Myo Aung
Chairman
Supervisory Committee
Lecturer
Department of Agricultural Economics
Yezin Agricultural University
Yezin, Nay Pyi Taw

Daw Tin Tin Myint
External Examiner
Supervisory Committee
Deputy Director General
Department of Agricultural Research
Yezin, Nay Pyi Taw

Dr. Kyaw Kyaw Win
Member
Supervisory Committee
Professor and Head
Department of Agronomy
Yezin Agricultural University
Yezin, Nay Pyi Taw

Dr. Thanda Kyi
Member
Supervisory Committee
Director
ASEAN Division
Department of Planning
Nay Pyi Taw

Daw Ei Mon Thida Kyaw
Member
Supervisory Committee
Assistant Lecturer
Department of Agricultural Economics
Yezin Agricultural University
Yezin, Nay Pyi Taw

Dr. Cho Cho San
Professor and Head
Department of Agricultural Economics
Yezin Agricultural University
Yezin, Nay Pyi Taw

Date ----------

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

Dr. Myo Kywe

Rector

Yezin Agricultural University

Yezin, Nay Pyi Taw

Date ----------

DECLARATION OF ORGINALITY

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

Zar Ni Hlaing

Date ----------

DEDICATED TO MY BELOVED PARENTS,

U KYAW HLAING AND DAW MYA THAN HTAY

ACKNOWLEDGEMENTS

First and foremost, I sincerely wish to express my heartfelt thanks to Dr. Myo Kywe (Rector), Dr. Soe Soe Thein, Pro-rector (Academic) and Dr. Nangh Seng Hom, Pro-rector (Admin), Yezin Agricultural University for their permission to attend master degree and their review comments, invaluable suggestions and kind administrative support in criticizing the manuscript.

I wish to express my deeply grateful to U Kyaw Win, Director General (retired), and Dr. Ye Tint Tun, Director General, Department of Agriculture, Nay Pyi Taw for their kind permission for my study leave.

I wish to express my highly gratitude to Dr. Cho Cho San, Professor and Head, and Dr. Theingi Myint, Associate Professor, Department of Agricultural Economics, Yezin Agricultural University, for their inspiring guidance, motherly concern, critical review and constructive comments to improve this dissertation and throughout my studies.

I would like to express my most sincere thanks to my supervisor and chairman of the supervisory committee, Dr. Nay Myo Aung, Lecturer, Department of Agricultural Economics, Yezin Agricultural University, for his keen interest, guidance, invaluable advices, generous helps, motherly concern, encouragements, moral support, valuable supervisions and understanding to me throughout my study.

My sincere thanks are due to external examiner, Daw Tin Tin Myint, Deputy Director General, Department of Agriculture (DAR), Nay Pyi Taw for her warm encouragement, valuable suggestions and comments.

Sincere appreciation and gratitude go to supervisor committee members, Dr. Kyaw Kyaw Win, Professor and Head, Department of Agronomy, Yezin Agricultural University, Dr. Thanda Kyi, Director, ASEAN Division, Department of Planning, and Daw Ei Mon Thida Kyaw, Assistant Lecturer, Department of Agricultural Economics, Yezin Agricultural University, for their valuable suggestions, careful guidance, encouragement, generous helps and kindness, during the course of my study and for their critical reading and comments on this manuscript.

Thanks are also extended to the organization, ACIAR-IRRI, under the project of "Diversification and Intensification of Rice-based Cropping Systems in Lower Myanmar (My Rice)" for supporting the finance as research grant.

My special thanks also go to sampled farmers and market intermediaries at Maubin and Daik U Township for patiently answering my survey questionnaires. I really appreciate to Township Manager, village leaders and staffs of Department of Agriculture (Maubin and Daik U Township) for their kind help in data collection during the field survey.

My sincere thanks are also due to my classmates, Ma Kay Thi Khin, Ma Chan Myae Lwin and Ma Thandar Win for their kind help in data collection during the field survey.

I also wish to acknowledge with appreciation and thanks to my colleges and all the staff members from the Department of Agricultural Economics for their helps, kindness, valuable suggestions and assistance throughout my study period.

Finally, I would like to extend my heartfelt thanks to my beloved parents, U Kyaw Hlaing and Daw Mya Than Htay for their never-ending love, deep encouragement, kind understanding, invaluable moral support throughout my study.

ABSTRACT

In this study, the socio-economic characteristics, marketing, distribution and factors affecting the demand of quality seed for rice production were investigated. The survey was conducted from September to October, 2015 in Maubin and Daik U Township. The primary data were collected using stratified and purposive random sampling method from 120 farmers, 16 seed growers and 4 seed dealers. Descriptive analysis and demand function were used in data analysis. Based on the research findings, 71% of the seed used from informal seed sources was the main seed supply for Maubin and 80% for Daik U, followed by formal quality seed. Among many rice varieties, Hnan Kar, Sin Thu Kha and Thee Htat Yin varieties in Maubin and Hmawbi-2 and Sin Thu Kha varieties in Daik U were grown by farmers. The ways of seed distribution were farmers to farmers, seed dealers and rice millers to farmers, distribution by DoA (Township office), DoA (Seed farms), DAR and IO to seed growers then farmers or directly. Quality seed awareness indices of farmer were 63% in Maubin and 70% in Daik U showing high awareness on the effects of quality seeds. By means of the rice quality seed demand function in both areas (of 120 farmers) was explained by seven key variables such as current seed price; lagged rice price; awareness index; fertilizer quantity used; household head's schooling year and experience and cropping intensity. Specially, demand of quality seed was negatively influenced by household head's schooling year and current seed price in rice production. The cropping intensity, lagged rice price and awareness index were the important influencing factors positively affected to demand of rice quality seed. At the farm level, farmers in both study areas faced with labor scarcity and lack of storage facilities and then weakness of extension service in Maubin and climate change in Daik U. The constraints of seed growers were high wage rate of labor, lack of storage facilities and little technical knowledge. On the marketing side, shortage of rice seed, quality and seed storage were the major constraints for seed dealers. Based on the research findings, community based seed production with well functioning should be encouraged by extension personnel. Focus should also be on demand based decentralized source seed production and supply of quality seeds of improved choice varieties with greater involvement of private sector's capacity in to reduce mis-match in demand and supply. It is urgent need to strengthen the National Seed Committee (NSC) so that the farmers can protect from the unpurified rice seed of marketing actors.

TABLE OF CONTENTS

PAGE

ACKNOWLEDGEMENTS i
ABSTRACT iii
TABLE OF CONTENTS iv
LISTS OF TABLES vii
LIST OF FIGURES ix
LIST OF APPENDICES x
LIST OF ABBREVIATION xi
LIST OF CONVERSION FACTORS xi
CHAPTER I 1
INTRODUCTION 1
1.1 Rice Production in Myanmar 1
1.2 Role of Seed in Agricultural Production 2
1.3 Seed System of Myanmar 4
1.4 Marketing and Distribution of Rice Seed in Myanmar 5
1.5 Rationale of the Study 5
1.6 Objectives of the Study 8
CHAPTER II 10
LITERATURE REVIEW 10
2.1 Characteristics of Good Quality Seed 10
2.2 Seed Policy and Seed Law in Myanmar 10
2.3 Seed Marketing and Distribution 12
2.4 Seed Demand Function 15
2.5 Review of the Studies on Awareness 19
CHAPTER III 22
RESEARCH METHODOLOGY 22
3.1 General Description of the Study Areas 22
3.2 Data Source and Data Collection 22
3.3 Analytical Method 23
3.3.1 Descriptive analysis 23
3.3.2 Input demand function 23
3.3.3 Developing rice quality seed awareness index 24
CHAPTER IV 27

RESULTS AND DISCUSSION 27
4.1 Descriptive Statistics of Background Information of the Sample Respondents 27
4.1.1 Comparison of the demographic and social characteristics of the sample respondents 27
4.1.2 Farm size and different farm types of sample farm households 28
4.1.3 Farm size and different farm types of sample seed grower households 28
4.1.4 Comparison of farming apparatus of sample farm and seed grower households 28
4.2 Information of the Sample Respondents and Agricultural Characteristics 33
4.2.1 Varieties grown by sample farmers 33
4.2.2 Sources of rice seeds for sample farmers 33
4.2.3 Varieties grown by sample seed growers 40
4.2.4 Sources of rice quality seeds for sample seed growers 40
4.2.5 Varieties marketed by seed dealers in Maubin Township 40
4.2.6 Sources of rice quality seeds for sample seed dealers 43
4.2.7 Services received from Government Organization (GO)/ IO for rice production by sample respondents at the study areas 43
4.2.8 Comparison of benefit-cost ratio between farmers and seed growers in the study areas 45
4.3 Marketing Functions of the Sample Respondents in the Study Areas 47
4.3.1 Business size of the seed growers 47
4.3.2 Marketing activities of the seed growers of rice seed market in the study areas 49
4.3.3 Business size of the seed dealers 49
4.3.4 Marketing activities of the seed dealers of rice seed market in the study areas 51
4.3.5 Farmers' practices for own seed production in the study areas 51
4.4 Marketing Channels of Rice Quality Seed 52
4.4.1 Seed distribution and marketing channels of Sin Thu Kha rice variety in Maubin Township 52
4.4.3 Seed distribution and marketing channels of Hmawbi-2 rice variety in Daik U Township 57
4.4.4 Seed distribution and marketing channels of Sin Thu Kha rice variety in Daik U Township 58
4.5 Sources of Market Information Received by Seed Growers for Rice Seed in the Study Areas 58

4.6 Factors Influenced on Setting Seed Price....61
4.6.1 Factors influenced on setting rice seed price for seed growers and seed dealers in Maubin Township....61
4.6.2 Factors influenced on setting rice seed price for seed growers in Daik U Township....61
4.7 Awareness on Quality Seed by Sample Farmers....64
4.7.1 Awareness on quality seed by sample farmers in Maubin Township....64
4.7.2 Awareness on quality seed by sample farmers in Daik U Township....65
4.7.3 Awareness on quality seed by sample farmers of Maubin and Daik U Township....67
4.7.4 Farmers' perceptions to price, availability and satisfaction of formal rice seed use in the study areas....70
4.8 Factors Affecting the Demand of Quality Seed in Rice Production in the Study Areas....70
4.8.1 Descriptive statistics of dependent and independent variable of quality seed demand function in rice production....70
4.8.2 Descriptive statistics of dependent and independent variable of quality seed demand function in Sin Thu Kha rice production in Maubin Township....74
4.8.3 Descriptive statistics of dependent and independent variable of quality seed demand function in Thee Htat Yin rice production in Maubin Township....77
4.8.4 Descriptive statistics of dependent and independent variable of quality seed demand function in Hmawbi-2 rice production in Daik U Township....77
4.8.5 Descriptive statistics of dependent and independent variable of quality seed demand function in Sin Thu Kha rice production in Daik U Township....82
4.9 Constraints of Sample Respondents in Agricultural Production....85
4.9.1 Constraints of sample farmers in the study areas....85
4.9.2 Constraints of sample seed growers in the study areas....89
4.9.3 Constraints of sample seed dealers in Maubin Township....89
CHAPTER V....91
SUMMARY, CONCLUSION AND POLICY IMPLICATION....91
5.1 Summary of Findings and Conclusion....91
5.2 Policy Implication....94
REFERENCES....96
APPENDICES....101

LISTS OF TABLES

Table 1.1 Sown areas, yield and production of rice in Myanmar 3

Table 3.1 Quality seed awareness of rice farmers based on their knowledge 25

Table 3.2 Scoring system by the orientation of the statement 25

Table 4.1 Demographic characteristics of sample respondents in Maubin Township..30

Table 4.2 Demographic characteristics of sample respondents in Daik U Township ..30

Table 4.3 Farm size and different farm types of sample farm households 31

Table 4.4 Farm size and different farm types of sample seed grower households 31

Table 4.5 Percentage of the sample farmers who had farming apparatus.....32

Table 4.6 Common varieties and various seed sources for the sample farmers in Maubin Township 36

Table 4.7 Common varieties and various seed sources for the sample farmers in Daik U Township 37

Table 4.8 Classification of seed sources for the sample farmers in the study areas 38

Table 4.9 Seed sources for sample seed growers in the study areas 41

Table 4.10 Seed sources for sample seed dealers in Maubin Township.....41

Table 4.11 Services received from GO/NGOs for rice production by sample farmers at the study areas 44

Table 4.12 Services received from GO/NGOs for rice production by sample seed growers at the study areas 44

Table 4.13 Production and sale of rice seed growers in the study areas 48

Table 4.14 Marketing activities of the seed growers of rice seed market in the study areas 48

Table 4.15 Annual sale amount of rice quality seed by seed dealers in Maubin Township.....50

Table 4.16 Marketing activities of the seed dealers of rice seed market in Maubin Township.....50

Table 4.17 Farmers' practices for own seed production in the study areas 54

Table 4.18 Quality seed awareness scores by sample respondents in Maubin Township.....66

Table 4.19 Quality seed awareness index of sample respondents for the knowledge of quality seed in Maubin Township 66

Table 4.20 Quality seed awareness scores by sample respondents in Daik U township 68
Table 4.21 Quality seed awareness index of sample respondents in Maubin township 68
Table 4.22 Comparison of quality seed awareness index by sample farmers in the study areas 69
Table 4.23 Farmers' perception to price, availability and satisfaction of formal rice seed use in the study areas 69
Table 4.24 Descriptive statistics of dependent and independent variables in rice quality seed demand function 72
Table 4.25 Factors affecting the demand of quality seed for rice production in the study areas 73
Table 4.26 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Sin Thu Kha variety in Maubin Township 75
Table 4.27 Factors affecting the demand of quality seed for Sin Thu Kha rice production in Maubin Township 76
Table 4.28 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Thee Htat Yin variety in Maubin Township 78
Table 4.29 Factors affecting the demand of quality seed for Thee Htat Yin rice production in Maubin Township 79
Table 4.30 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Hmawbi-2 variety in Daik U Township 80
Table 4.31 Factors affecting the demand of quality seed for Hmawbi-2 rice production in Daik U Township 81
Table 4.32 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Sin Thu Kha variety in Daik U Township 83
Table 4.33 Factors affecting the demand of quality seed for Sin Thu Kha rice production in Daik U Township 84

LIST OF FIGURES

Figure 1.1 Seed production and distribution systems in Myanmar 9
Figure 4.1 Varieties grown by percent of farmers in Maubin Township 35
Figure 4.2 Varieties grown by percent of farmers in Daik U Township 35
Figure 4.3 Seed sources for the sample farmers in the study areas 39
Figure 4.4 Varieties grown by percent of seed growers in Maubin and Daik U 39
Figure 4.5 Varieties marketed by percent of seed dealers in Maubin Township 42
Figure 4.6 Comparison of benefit-cost ratios between farmers and seed growers in the study areas 46
Figure 4.7 Distribution and marketing channels of rice quality seed in the study areas 55
Figure 4.8 Seed distribution and marketing channels of Sin Thu Kha variety in Maubin Township 56
Figure 4.9 Seed distribution and marketing channels of Thee Htat Yin variety in Maubin Township 56
Figure 4.10 Seed distribution and marketing channels of Hmawbi-2 variety in Daik U Township 59
Figure 4.11 Seed distribution and marketing channels of Sin Thukha variety in Daik U Township 59
Figure 4.12 Sources of market information for rice seed of seed grower in Maubin Township 60
Figure 4.13 Sources of market information for rice seed of seed grower in Daik U Township 60
Figure 4.14 Factors influenced on setting rice seed price for seed growers in Maubin Township 62
Figure 4.15 Factors influenced on setting rice seed price for seed dealers in Maubin Township 63
Figure 4.16 Factors influenced on setting seed price for seed growers in Daik U Township 62
Figure 4.17 Constraints of sample farmers (%) in Maubin Township 88
Figure 4.18 Constraints of sample farmers (%) in Daik U Township 88
Figure 4.19 Constraints of seed growers (%) in the study areas 90
Figure 4.20 Constraints of seed dealers in Maubin Township 90

LIST OF APPENDIX

Appendix 1 Map of Maubin Township 101

Appendix 2 Map of Daik U Township 102

Appendix 3 Enterprise budget for Sin Thu Kha rice production in Maubin Township 103

Appendix 4 Enterprise budget for Thee Htat Yin rice production in Maubin Township.....104

Appendix 5 Enterprise budget for Hmawbi-2 rice production in Daik U Township.....105

Appendix 6 Enterprise budget for Sin Thu Kha production in Daik U Township 106

Appendix 7 Enterprise budget for Sin Thu Kha rice seed production in Maubin Township.....107

Appendix 8 Enterprise budget for Thee Htat Yin rice seed production in Maubin Township.....108

Appendix 9 Enterprise budget for Hmawbi-2 rice seed production in Daik U Township.....109

Appendix 10 Enterprise budget for Sin Thu Kha rice seed production in Daik U Township.....110

Appendix 11 Percent of sample respondents in quality seed awareness score.....111

Appendix 12 Summary demand functions of quality seed for rice production 112

LIST OF ABBREVIATION

ACIAR	=	Australian Centre for International Agricultural Research
ADB	=	Asia Development Bank
BCR	=	Benefit Cost Ratio
BS	=	Breeder Seed
CBSP	=	Community Based Seed Production
CS	=	Certified Seed
DAR	=	Department of Agricultural Research
DoA	=	Department of Agriculture
DoP	=	Department of Planning
FAO	=	Food and Agriculture Organization
FS	=	Foundation Seed
g	=	Gram
GDP	=	Gross Domestic Product
GO	=	Government Organization
ha	=	Hectare
HYV	=	High Yield Variety
IRRI	=	International Rice Research Institute
kg	=	Kilogram
km	=	Kilometer
MADB	=	Myanma Agricultural Development Bank
Md	=	Man day
MMK	=	Myanmar Kyat
MoAI	=	Ministry of Agriculture and Irrigation
IO	=	International Organization
NSC	=	National Seed Committee
RS	=	Registered Seed
SPSS	=	Statistical Packages for Social Science
TSC	=	Technical Seed Committee

LIST OF CONVERSION FACTORS

1 basket of paddy	=	20.86 kilograms
1 hectare	=	2.47 acres

CHAPTER I
INTRODUCTION

Seed is considered the most important input in crop production. High quality seeds are obtained from a good crop variety of high yield. The additional effects of inputs like fertilizer, pesticides, insecticides, irrigation and crop maintenance can be significantly realized with good quality so that it is considered as a vital input in crop production (Maji, 2008).

Lack of quality seed is one of the many challenges encountered by farmers in rice production in Myanmar. The growing population still relies on the rice as staple food. Therefore, the quality seeds of adapted and improved rice varieties are the most important technology to increase crop productivity and ensure food security.

Agriculture is a major sector that boosts the economy of Myanmar, providing about 32 percent of the GDP and employment for about 50 percent of the population (DoP 2015). The main actors in agricultural production are smallholder farmers who practice mostly subsistence farming.

1.1 Rice Production in Myanmar

Rice (paddy) is by far the most important crop, taking up approximately 8 million hectares and 40% of all food production (Baroang 2004). Rice is predominantly dominated by small holders under rain-fed conditions. Historically, rice has been categorized under the staple food crop rather than commercial/cash crop. However, in recent years with the rapid growth of cities and townships propelled by rapid population growth, the country has experienced enormous increase in rice demand. Most of rice demanded and consumed by the urban population is sourced from the rural rice producing areas that have stagnating production capacities. For this reason, rice has consequently been transformed into commercial crop. Due to climatic reasons, most of the wetlands which are major rice producing areas lack alternative food and cash crop making rice the only source of cash and staple food.

In order to boost rice production for the self-sufficiency and foreign exchange earnings, the summer rice program was introduced in 1992-93 by using high yielding varieties with proper irrigation system. Increasing new cropping areas through land

development, cultivation of multiple cropping to enhance the cropping intensity and sourcing water for crops are practiced in collaboration with farmers.

The total sown area of rice in Myanmar has decreased from 7.39 million hectares to 7.17 million hectares, but the total production increased from almost 27.68 million metric ton to about 28.19 million metric ton between 2005-2006 and 2014-2015. Average yield per hectare was also increased from 3.75 metric ton to 3.94 metric ton. Total rice sown area, yield and production in 10 years period from 2005-2006 to 2009-2010 are shown in Table 1.1 (DoP 2015).

The rice sector gives a good insight into the diversity of seed systems of the country. According to the Ministry of Agriculture and Irrigation's statics (2013): 1.5% is under hybrid varieties, 55% under high yielding varieties; 20% under high-quality varieties, while 23% is under local varieties. In 2013-2014, Department of Agriculture produced 3.77 MT of registered rice seeds from their 32 seed farms which was grown into 149,689 MT of certified seed by the Seed Model Villages, contact farmers and private companies (DoP 2015). These certified seeds can then be sold to local farmers who produce grain. However, it has been estimated that 200,000 MT of certified seed are needed to cover 4 million hectare of high potential land which is about half of the total rice growing area. Based on this data, the current certified seed distribution system covers less than 10 % of the estimated requirement (Tin Htut Oo and Tin Maung Shwe 2014).

1.2 Role of Seed in Agricultural Production

It is multidimensional, depending on the functions the seed performs: Biodiversity: the wide diversity in crops and varieties protects the farmers to sudden changes in agro-climatic condition and provides the input for the formal breeding programs. Cultural and traditions: seed often plays an important role in the local agricultural systems, in which seed is re-used, exchanged and bartered. Food security: seed is a key driver for achieving and maintaining food security, both at national and local level. Food security directly relates to seed security as without seed no crop can be grown. Business development: seed can also be a high-value commodity with substantial profits to be gained for seed companies and seed producer farmers (Louwaars 2007).

Seed is a key input for improving crop production and productivity. Increasing the availability and quality of seeds can increase yield of crops by significant folds and thus, is one of the most economical and efficient inputs to agricultural development (FAO 2006).

Table 1.1 Sown areas, yield and production of rice in Myanmar

Year	Sown Area (Million ha)	Yield (Mt/ha)	Production (Million Mt)
2005-2006	7.39	3.75	27.68
2006-2007	8.12	3.83	30.92
2007-2008	8.09	3.93	31.45
2008-2009	8.09	4.03	32.57
2009-2010	8.07	4.06	32.68
2010-2011	8.05	4.07	32.58
2011-2012	7.59	3.83	29.01
2012-2013	7.24	3.84	27.70
2013-2014	7.28	3.90	28.32
2014-2015	7.17	3.94	28.19

Source: DoP, Myanmar Agriculture at a Glance, 2015.

Seed is the basic, least expensive and most important input in agriculture, which holds the key to farm productivity and profitability. Quality seed largely determines the success of modern farming as other management and cultural practices come into play only after the germination of seeds and establishment of seedlings. In fact, seed is the real vehicle of production and other inputs like water and fertilizer can be regarded as fuel. Inputs such as fertilizer, manure and irrigation are needed to realize the potential of seed, whereas pesticides restrict the loss of output. A quality seed offers a great potential for boosting agricultural production (Hosmani 2007).

1.3 Seed System of Myanmar

There are three major groups of seed systems in the national seed sector of Myanmar. They are (a) the informal seed system (b) the intermediary seed system, and (c) the formal seed system. These seed systems are common in the crops they target, types of varieties, quality of seed and ways of seed marketing and dissemination. Overall, the specific seed demand of farmers is fulfilled by the different types of seed systems.

(a) Informal seed system

Over 95% of seed for most crops used by farmers is supplied by the informal seed system (ADB 2013). The informal seed systems are farm saved seed, or farmer to farmer exchange (as gift or barter) or buying grain for seed at the local market. Most of the varieties are local varieties, landraces or recycled varieties of food security and cash crops.

(b) Intermediary seed system

Community based seed production (CBSP) programs represent the intermediary seed system that is less dominant in Myanmar. To support the popularized newly released improved varieties, CBSP has been recently established by developmental organizations. The seed quality is either assured through certification or through farmers' own seed production practices.

(c) Formal seed system

Myanmar's formal seed system still supplies less than 5% of the quality seed demand of farmers (ADB 2013). The formal seed system is mostly focused on rice, which is largely within the public domain. The private seed sector which is yet at an infant stage, is concentrating on hybrid rice.

1.4 Marketing and Distribution of Rice Seed in Myanmar

The public sector stakeholders are dominant in the seed chain. There is limited involvement of the private seed sector. Private companies are involved in the last step of multiplication, i.e. certified seed production and distribution of certified seed of public varieties through the agro dealer network.

The Department of Agricultural Research (DAR) is responsible for breeder's seed production. DAR and DoA are both involved in foundation seed and registered seed production at the more than 40 government farms established across the different agro-ecological production zones (MoAI 2013). These government farms provide foundation and registered seed to seed village schemes, contact farmers, national private seed companies, NGO programs and millers who multiply to certified or quality seed.

In practice also a lot of seed farms (both DAR and DoA) produce certified seed directly for the market. The current production and distribution system of seed in Myanmar agricultural sector was observed three types (Figure 1.1) (Htin Aung Shein 2012). Among three systems, system III is currently widely used by DoA and farmers.

1.5 Rationale of the Study

In Myanmar agricultural sectors, the improve seed is one of the key factors to increased productivity. The public sector with the well-built human and physical resources to produce the major quantities of seed that would be required and, therefore, to expand the production and availability of such improved seed, it will necessary to significantly increase the role of the private sector, as is the case in most other countries.

Increased production of agricultural crops depends not only on the development of higher yielding varieties of seeds but also on the efficiency of the systems available to ensure that these seeds reach to the farmer on time. Effective seed marketing is thus an essential component of activities to improve food security.

In Myanmar, the formal seed supply system delivers certified seed to farmers, and farmers save part of the harvest for planting the next crop, in line with their customary seed replacement rate. Generally seed requirement is determined by multiplying land size and seed ratio. It is observed that dependency on commercial seed has increased over time.

Due to the economic constraints that have prevailed in the agricultural sector during the last decade, many farmers have modified their seed replacement rate by delaying the period for purchasing new seed. Procurement or exchange of seed from other

farmers in the community must have increased to the point of developing an embryo informal seed supply system. However, the formal system is still the major source of supply for farmers.

In agricultural sector, the human and physical resource based crop production is very substantial, but their full potentials are far from being realized. Myanmar farmers involved in crop production are capable and entrepreneurial but these skills are not applied to optimal effect. The land and water resources available for agriculture are under-utilized with great scope for expansion and diversification. The relatively low current crop productivity levels per units of land, water and labor offer considerable scope for greater efficiencies and for increased production all the way through good quality seed strengthening of the existing cultivated areas.

Smallholder farmers still rely on farmer saved seed and low rate of access to high quality seed due to inadequate supply of improved seeds. Farmers will need a genetically diverse portfolio of improved crop varieties, suited to a range of agro-ecosystems and farming practices. Moreover, low rate of rural financial services able to provide appropriate levels of production and farm development credit for all crops and related activities that are deemed credit worthy especially to increase fertilizer and other inputs use.

Research and extension programs including seed sector normally do not really take into account farmers' needs and constraints. The consequence of this approach is a low adoption rate for technical recommendations and quality seed even when they are available. The quality seed supply system requires an effective policy and regulatory framework, appropriate institutions, a continuing program of capacity development and, above all, farmer participation. A strong program of research, aimed at providing information, new techniques and materials, is also important.

The extensive use of research, seed and extension farms for commercial production with the scarcity of farm infrastructure (tractors, storage, irrigation) limit for research and trials. The capacity of domestic infrastructure is not very attractive foreign investment to handle distribution and marketing of seed and other related inputs.

Areas of seed improvement generally include: seed physiology, seed production, seed processing, seed quality control, seed health, seed storage and packing and some aspects of biotechnology. Improved seed is required to go through a series of seed handling processes before it reaches the growers. These processes, which include seed processing, distribution, and marketing, require a certain level of seed standards.

For the agricultural researches to be efficient would require funding for research, with full participation of all research institutes, agricultural universities, private sector firms, NGOs and farmers' associations of the country. It would also require the development of strategies and programs, with the assignment of specific tasks and roles. Another vital aspect of the seed industry is the function of conditioning and storage, which must be adequate to preserve the physical characteristics of the seed specified by regulatory standards. The main problems confronted by seed distribution systems are related to storage, transport and handling of the seed. In Myanmar, seed marketing is also a weak link in the seed-production chain, limiting farmers' access to seed is observed based on the empirical studies.

Research, extension, input supply services, distribution and marketing are some of the major component of an effective seed supply system. The neglect of any one component in the seed development chain affects the entire seed supply system. Furthermore, changes in policies affecting one component may have adverse effects on the performance of others and jeopardize the development of an emerging seed supply system. Linkages in seed supply systems must be considered when defining appropriate seed strategies a country and the socio-economic circumstances of its farmers. In addition, it is important to be aware of potential negative repercussions to the seed supply sector if changes in other policies affect services offered to farmers.

The seed supply systems have a mutually dependent relationship with the research sector in the variety development phase. However, until varieties that correspond with farmers' needs are produced, and on-farm improved seed production is strengthened, the research system will continue to have little relevance to the informal seed supply systems in the region. As in many developing countries, seed marketing remains one of the weakest links in the seed supply chain, thus limiting farmer access to good quality seed.

Seeds are particularly important in farming systems where resources are scarce since a significant contribution to productivity can often be gained solely from the seed used, independent of other purchased inputs. Thus, the genetic potential of seed largely dictates crop yields and the productivity of other agricultural inputs and cultural practices. Conserved and improved materials will need to be available for variety development, and new varieties will have to be generated at a pace that meets changing demands and requirements. Timely delivery to farmers of suitably adapted materials, of the right quality and quantity, at an acceptable cost, is essential.

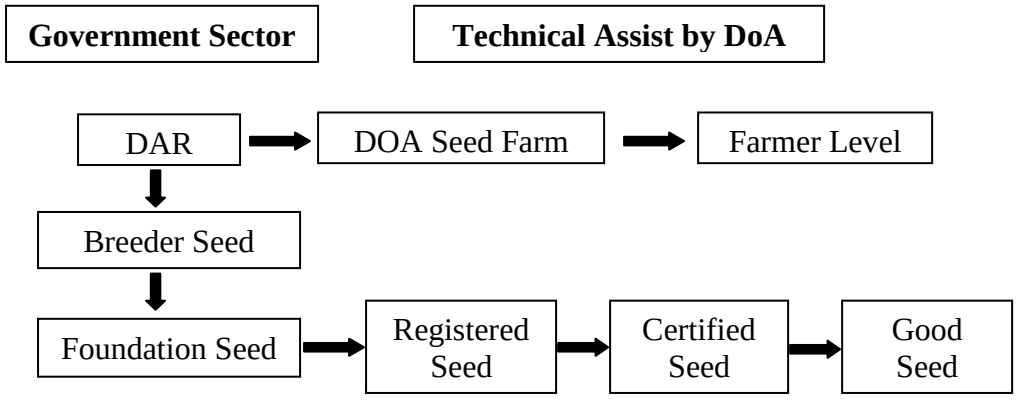
Maubin farmers are facing with the unavailability of the quality rice seeds even the Seed Village scheme was established. There are two seed farms under DoA in Daik U. However, the farmers do not access the certified seed in enough amounts in time. In fact, the role in influencing current seed and related inputs marketing and distribution are in a more corporate agricultural environment. Therefore, this study takes on a task of analyzing the seed marketing and distribution situation of Myanmar, especially in Maubin and Daik U Township.

1.6 Objectives of the Study

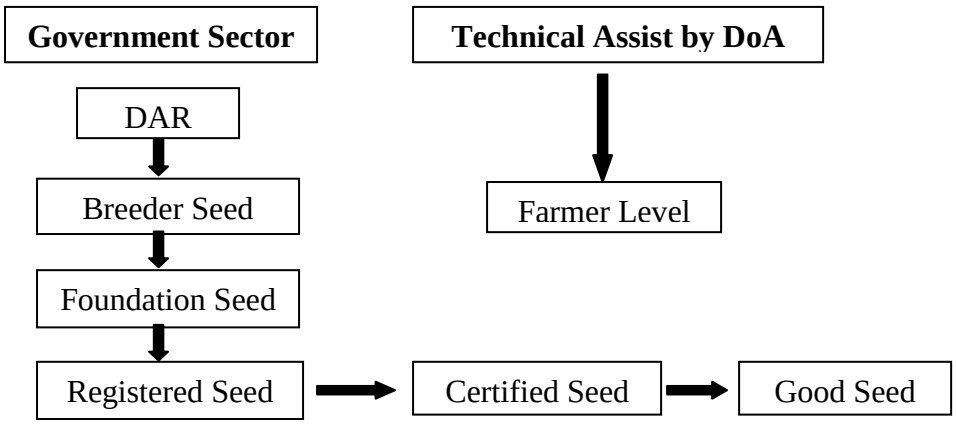
The overall objective of the study is to understand the marketing and distribution of rice quality seed through various stakeholders (farmers, rice seed growers, and rice seed dealers) in the Maubin Township, Ayarwaddy Region and Daik U Township, Bago Region. The specific objectives are as follows:

- to observe the rice quality seed marketing and distribution;
- to examine the awareness index of farmers on quality rice seed;
- to analyze the demand function for rice quality seed; and
- to investigate the constraints of rice quality seed marketing and distribution.

SYSTEM I



SYSTEM II



SYSTEM III

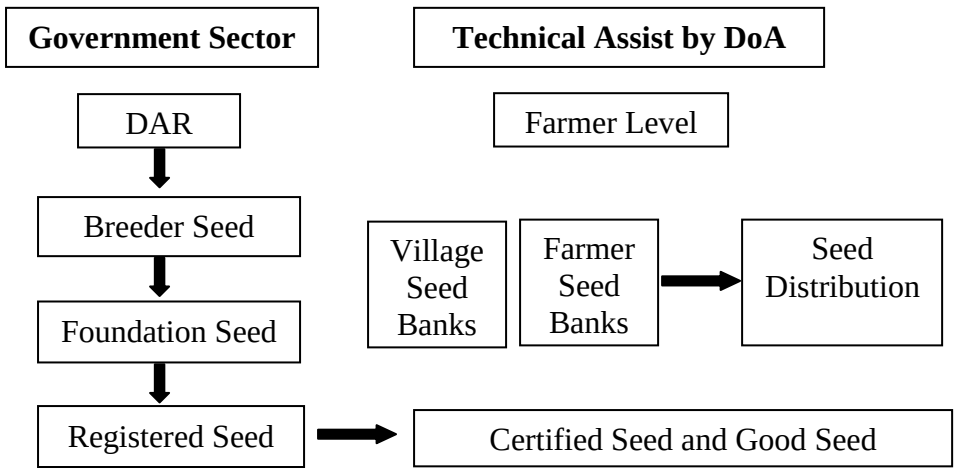


Figure 1.1 Seed production and distribution systems in Myanmar

CHAPTER II
LITERATURE REVIEW

2.1 Characteristics of Good Quality Seed

A quality seed is pure, clean and viable seed. Pure seed is without any mixture of other types or varieties whereas clean seed is free from weed seeds, litter stones and diseased, damaged or deformed grains. Viable seed is a healthy seed with appropriate moisture content and high germination potential.

Quality seed is considered the most important prerequisite for good crop production. It is recognized to account for an increase in crop productivity of at least 15% (Ajeigbe and Ousmane 2008). Quality seed contributes to about 12-20% total production depending on the crop (Dasgupta and Roy 2011). One of the FAO's strategies in attaining seed and food security during emergency operation is making available quality seeds of suitable crops and cultivars to farmers. This requires Project Managers to have an understanding of both technical and operational aspects of quality seed for this strategy to be achieved (FAO 2011). Quality seed for planting have desired characteristics which include genetic purity, free from pests and diseases, high germination percentage and vigor. Seed quality results from genetic, physical, physiological and phyto-sanitary characteristics.

Farmers' evaluation criteria may differ from criteria developed by breeders or those setting seed certification standards, both with respect to seed quality and varietal quality. In South Sudan, farmers were generally satisfied with germination quality and general performance of locally sourced seed (Jones et al. 2002). Remington et al. (2002) show that farmers; first sort and select seed by hand prior to planning reducing the need for pre-sorted seed; second may compensate for low germination vigor by increasing seeding rate, and third, judged germination quality and seedling vigor to be sufficiently high. In the rice seed system in Guinea, farmers did perceive purity as an important seed quality characteristic for which they actively sought (Okry et al. 2011).

2.2 Seed Policy and Seed Law in Myanmar

A new Seed Policy of Myanmar was recently developed in 2013, with the assistance of the FAO. This policy already gives a good insight into the future policy

paths of Myanmar's seed sector. According to Broek et al. (2015), there are some elements that are most noteworthy by the followings

The policy selects 16 crops for enhanced government programs and actions, i.e. rice, maize, black gram, green gram, chickpea, pigeon pea, cassava, sweet potato, yam, groundnut, sunflower, sesame, mango, banana, hot pepper and potato. Especially rice receives a lot of attention, targeting increased rice exports both in terms of quantity and quality;

The policy proposes a more clear distinction between public and private activities, whereby the private sector gradually takes up a greater role in terms of registered and certified seed production as well as internal quality assurance. The policy aims at gradually reducing "the role of the public sector from commercial operations to mainly provision of services and facilitation". This appears to be especially the case for (hybrid) rice and maize;

In the medium term, however, the government does see a catalytic role for public seed research, foundation seed production, the overall seed quality assurance system and seed extension. In particular the approach of Seed Villages is being highlighted, whereby it is envisaged that organized seed growers at village level produce certified seeds on a commercial basis. In this respect, the government aims to support the gradual shift from informal to formal seed production;

In terms of the public capacity, the government plans to provide adequate staff, facilities and budgets to DAR and the Seed Division (under DoA) to ensure the "timely supply of the required amounts of breeder's and foundation seed of public varieties; the proper upkeep and operations of all public seed processing and storage facilities; and increase the number of seed laboratories and recruit additional field inspectors in order to achieve sufficient seed quality control coverage";

In addition, the government envisages a more autonomous Seed Certification Unit, a specialized agency that will be responsible for the field inspections, seed testing as well as variety registration. In time, this Unit could become more self-financing as well, charging "appropriate" seed inspection, certification and testing fees;

With respect to Plant Variety Protection the policy envisages balancing breeder's and farmers' rights. In this line, "farmers will maintain their right to use, exchange, share or sell their farm-saved seed without any restriction, provided they do not commercialize the production emanating from proprietary varieties".

The Seed Law stipulates the rules governing seed breeding, registration, production, and quality assurance and seed sale in the country was enacted in January 2011. Through the seed policy was developed after the seed law, a number of important notions are included, providing flexibility for the implementation of the seed policy:

The opportunity for seed companies to establish own seed testing facilities and receive a government registration certificate for this; A number of specifications on the labeling of seed, including: trademark, variety name, weight and volume of seed, quality of seed, instruction for use, date for expiry, number and date of license, and warranty for seed quality;

Two committees have been established under the Seed Law: the National Seed Committee (NSC) and the Technical Seed Committee (TSC). The NSC is a coordinating body, tasked with the overall guidance to the seed sector in terms of policy directions, developing regulations for quality assurance and variety release, the strategic guidance to research and the seed division, as well as the seed chain coordination. In addition, the NSC approves the release of new varieties, registration of testing laboratories and decides on the composition of the TSC. The TSC in turn is tasked with preparing all technical reports and recommendations with respect to the release of new varieties, the registration of seed business and registration of seed testing laboratories.

2.3 Seed Marketing and Distribution

Marketing is a kind of systems in order to accelerate the moving of goods from the producers to the consumers. Marketing is getting the right goods and services to the right people at the right places at the right time at the right price (Timmer 1989).

Mumby (2007) defined seed marketing as activities aimed to satisfy the farmer's demand for reliable supply of a range of improved seed varieties of assured quality at an acceptable price. According to him, historically, physical aspects of seed production and storage were given more priority than the more complicated organizational issues that deals with managing sales and distribution. Mumby highlights following two factors for successful seed marketing:

- Farmers' needs must be satisfied, and
- Seed company's objectives must be realized.

Seed marketing and distribution involves a number of activities, such as transportation, promotion, field demonstrations, advertising, etc., to ensure that the right amount of seed of the appropriate variety reaches the farmer at the correct time. Equally

crucial is the requirement of informing farmers of the characteristics and agronomic performance of available varieties so as to enable appropriate and informed decision-making by farmers (Jaffee and Srivastava 1994).

As regards of Mac Robert (2009), seed is living, fragile and bulky and usually sold during a short period of the year. As such, the system of moving seed from the warehouse to the market must be conducive to the maintenance of seed viability, while simultaneously meeting customers' requirements for timely and adequate supplies. Seed marketing comprises demand forecast, marketing structure, storage of seeds, sales promotional activities and economics of seed production and seed prices.

In Ethiopia, seed marketing is a vital link between the seed producers and the farmers that ultimately use the seeds. Although significant public resources are invested in the public plant breeding and multiplication, the products are not reaching farmers (Alemu 2010).

Seed marketing is the most important as well as a challenging aspect of seed industry because of the nature of the product. Seed being a living organism, its quality deteriorate faster. Thus, its shelf life is limited and it must be marketed within the season. Another peculiar feature of seed is that it requires two to three years lead time to meet the specific requirements that is to meet the demand for particular seed, its production has to be organized at least two years in advance. The changes in the weather, price of crops, and price of competing crop, may change the prospects of demand for seed of particular variety at the commencement of sowing season (Singh 2004).

More than 90% of the farmers of Asia are either small-scale commercial farmers who have to sell their surplus production to the market, or subsistence farmers who grow crops for their own needs. Large commercial farms are few and dispersed within countries. This situation complicates the distribution and marketing of seeds and planting material. One of the major reasons why improved seed fails to reach farmers on time is the difficulty of distribution. Seed marketing infrastructure is not developed to a sufficient level in most countries of tropical Asia. In others, attempts have been made to establish peripheral distribution and marketing outlets at regional, district and town level, and in cases where the communication network is satisfactory, seed is even distributed at village level (FAO 1999).

According to Professor Imran Ali and Syed Mohammad Ali, seed marketing was a vital component of the seed industry across the world. Its effective management had protected the interests of not only the plant variety originating institutes and companies,

but also of seed producers, distributors and farmers. Effective seed marketing required advertizing, public relation work, sales aids, awareness and information related seminars, and investment in demonstration plots. The marketing of quality seeds also required an effective transportation and delivery system, quality storage and packing, and effective technical support. Neither public nor even private sector organizations paid sufficient attention to seed promotion activities, such as publicity of quality seeds, establishment of seed demonstration plots, or dissemination of relevant literature on seeds.

In the formal seed system, seed distribution and marketing involves a number of linked functions, including logistical operations such as handling and transport, market research, promotional activities (such field demonstrations), advertising, buying and selling functions associated with wholesaling and retailing, and the related facilitating functions of risk-bearing and financing (Jaffe and Srivastava 1992). Seed distribution and marketing can be carried out by any or all of the following: government agencies, private seed dealers, or local community-based organizations, including NGOs.

Seed system performance is often measured by the efficiency of seed distribution and marketing. This is because distribution connects all the previous stages of seed supply with seed demand, reflecting both the strengths and weaknesses of linkages between various components of the seed chain. Seed distribution is also an activity that potential seed users can directly observe and compare with alternative formal and informal distribution systems (Maredia et al. 1999).

Seed dissemination involves the mechanisms through which seed and information about it are moving from one to the other actor. Informal social networks serve as a means to share information. Understanding the preference of seed producers is useful to establish a sustainable seed supply system and influence the perception of seed producers and users favorably (Beyene 2010).

The distribution of free seed by NGOs and relief agencies has caused negative effects; creating dependency on free services, disrupting the informal farmers-to-farmers seed exchange system, and weakening sustainable development in the seed sub-sector (Abdisa et al. 2001).

Distribution is the process of moving packaged seed from the stores where it is held following processing and packing to the farmer. This may involve a single step, if sales are made directly to farmers, or a series of steps involving intermediate wholesalers and retailers (Mumby 2013).

Seed distribution systems are weak, leading to non-uniformity in rice seeds across farmers and regions. Field studies have suggested that improving uniformity in seeds may increase yields by 5-20%, as well as possibly increasing grain quality and market acceptability (Denning 2013).

The free distribution of seed is the standard approach to agricultural recovery. The predominance of this approach is partly attributable to the (1) perception that farmers' seed quality is poor, (2) insistence on seed certification, (3) promotion of researcher varieties, (4) misdiagnosis of unavailability, (5) difficulty accessing farmer seed, and (6) support for the commercial seed sector (Remington et al. 2002).

The importance of quality seeds in increasing yield has been widely recognized. With no market access to good quality seed, farmer-to-farmer exchange is generally the major source of seeds in Bangladesh. Continuous saving of seeds from own harvest for seed purpose without proper cleaning would seriously affect seed health leading to lower yields (Mew 1997).

In many developing countries, small farmers are not considered efficient contract seed growers, and some important crops grown by them are of limited commercial interest to seed companies (Venkatesan 1994). This limits the diffusion and use of improved varieties and quality seed by small farmers, thus contribution to low productivity.

Aline et al. (2012) stated that most marketing and awareness activities in the formal sector are undertaken by private sector seed companies, although NGOs and extension officers also participate. Agrodealer agents and stockists do some awareness, including demo plots on occasion, but generally they are not highly active in this area. Frequently the person staffing the retail shop is not very familiar with product attributes or benefits, and is not able to engage in marketing and awareness activities.

Seed distribution in Kenya typically occurs via a chain of distributors, agents (large, wholesalers), sub-agents, stockists (agrodealers), and sub-stockists. Seed is also distributed by other entities. These include: seed companies via direct outlet sales; NGOs; Kenya government, relief seed distributors; market traders; and individual farmers (Aline 2012).

2.4 Seed Demand Function

Demand is the quantity that buyers are willing and able to purchase at a particular price. This is called effective demand and is not the same as the seed requirement. It is

important to distinguish between the amount of seed farmers will actually buy and how much they would like to buy, or indeed how much the government would like them to buy. The total amount of certified or labeled seed sold may be quite a small proportion of the total requirement (FAO 1994). The demand for seed exhibits strong intra-annual and inter-annual fluctuations as a function of weather, prices and the amount of seed saved from the previous year (Minot et al. 2007). Seed demand forecasting is the process of marketing projections of demand for product by examining past and present performance levels, combined with an assessment of available products and markets. This may be carried out within the government service or by individual companies in a purely commercial context (FAO 1994).

Warjiyo and Huffman (1997) stated that costs insured that farmers' demand for most inputs depend not only on current exogenous factors but also on past use and expectations about future use. These were arguments that agricultural input demand functions, at least for the developed countries, are dynamic, requiring some time for full adjustment to exogenous economic shock to occur in United State of America.

Friesen et al. (1992) identified two different approaches to dynamic input demand. First, there were theory-based models where dynamics arise from optimal agent behavior and second, data-based dynamic models had been used where dynamics are used to describe the pattern of input use but do not arise from explicitly optimal agent behavior. The models leading to quasi-fixed inputs in agriculture for developed countries were ones built largely upon a hypothesis of significant internal costs associated with resource adjustment (Nichell 1986; Barro and Sala-i-Martin 1995).

Patricia and Okunade (1988) investigated that neoclassical duality between cost and production functions to derive and estimate a set of factor input demand functions using data on Louisiana rice farms. The demand for rice inputs were derived from the output demand for rice because rice farmers tented to select the least cost mix of inputs for a given level of output, their derived demand for inputs depended on the level of downstream demand for rice output, market-determined relative prices of all inputs, and the substitution possibilities among inputs allowed by the production technology in use. The conditional factor demand equations were derived based on the assumption of cost minimization for rice farmers.

Maximum likelihood parameters estimated of the joint generalized least square regression of the factor shares and flexible Leontief cost equations were obtained. The observed results suggested that; the significant substitution of capital, seeds and fertilizer

for hired farm labor on rice farms might moderate the threat of prolonged labor strikes and dampen the wage bargaining power of organized farm labor, during the present period of low capacity utilization and high unemployment on Louisiana farms, policies that increase real interest rates for financing farm capital or those that escalate the cost of fertilizer use relative to farm wage rates would increased labor input use in rice production, the presence of limited factor substitutions suggested that certain minimum threshold levels of each input were required to produce rice on a typical Louisiana farm, the small numerical magnitudes of direct price and cross-price elasticities of factor demands generally suggested that rice farms could not be relied upon to improve the employment of labor, capital, fertilizer, seeds, and chemical inputs in Louisiana's agricultural sector. The technical change was significantly seed using, new varieties of rice strains should find ready market on Louisiana rice farms.

The quantity of a commodity demanded is a function of factors referred to as determinants of demand. The demand function in its implicit form can be presented as:

$Q_d = f(P, T, P_r, Y, F)$

Where: Q_d = quantity of product demanded by a consumer

P = product price

T = taste and preference of consumers

P_r = price of related products

Y = consumers' income

F = family (household) size

On the basis of *ceteris paribus*, other variables (determinants) can be held constant to observe the effect that a particular variable exert on demand. Price is a major determinant of effective demand (Ebong et al. 2006).

The analysis of seed demand was conducted in terms of its proximate determinants and quantitative estimates for selected crops. A proximate analysis implies the recognition of the presence of inexactitudes limiting the drawing of hard inferences and conclusions in certain instances (Ayoola 2001).

Institution and programs will influence farmer decisions regarding the use of saved versus commercial seed. Several factors affect this decision, including: (1) farmer's ability to produce and save seed; (2) the type of crop; (3) the yield or quality advantage of purchased seed; (4) the cost of seed (purchase price plus the cost of procuring seeds from distribution outlets); (5) the price and availability of complementary inputs; (6) the

relative price of crops; and (7) the farmer's forecast of weather conditions and output prices (Pray and Ramaswami 1991).

According to Alemu et al. (1998), many variables can influence farmers' awareness and adoption of new varieties: human capital variables such as literacy; farm size; information sources such as agricultural extension or the research station; and distance from seed sources. Farmers with more land had a higher probability of adoption, probably because they are wealthier and have more land to experiment with improved varieties. Extension visit also resulted in a higher probability of adoption by raising farmers' awareness of new varieties and providing information about agricultural practices to accompany them. Oxen ownership increased the probability that farmers would adopt improved varieties. Oxen owners usually participate more frequently in a demonstration, which gives them access to information on new technologies.

Distance is a major obstacle for adoption of technologies in developing countries. The impediment posed by distance is likely to decline with the spread of wireless communication technologies. It is a greater challenge to adopt technologies across different latitudes and varying ecological conditions (Sunding et al. 2000)

Farmers with some education attainment are likely to adopting the technology choices: the marginal effect of the education variable is significantly positive for the probability of adoption. More educated households are commonly well informed and receptive, which translates to a higher likelihood of engaging in new technologies. This finding is in line with several previous studies which point out innovation is positively related to farmers' abilities to decipher and analyze information (Ersado et al. 2003).

Recent years have witnessed a proliferation of NGO and research support to local level seed production and dissemination activities. These activities have a wide range of objectives including improved dissemination of modern varieties, preserving genetic diversity and quality, improving seed availability (time, place, quantity), and reducing the cost of seed and dependence on external sources (Soniia 2004).

In principle, a farmer views an improved seed as a derived input embodying production attributes and a technology embodying consumption characteristics and jointly decides on its adoption and the quantity of seed required planting a predetermined area. Consequently, different approaches have been used for estimating farm level seed demand in developing countries. A.S. Langyintuo et al. (2006) employed a unified methodology for estimating the demand for improved seed at the farm level in the developing agriculture. The demand model results suggest that adoption rate, household

wealth, distance to market, and input support programs (or free seed distribution) significantly influence farmers' seed purchase decisions. Moreover, the researchers suggested that wealth has a direct impact on seed demand and could be achieved through asset accumulation, credit access or competitive grain markets and to improve adoption rates and subsequently seed demand, it was recommended that agricultural extension activities should emphasize field demonstrations to show the superiority of improved varieties over the local ones in terms of yield and resistance to pests. Making seeds available to farmers at short distances also improved adoption rate.

Magana et al. (2011) examined the factors that affect smallholder farmers' demand for purchased fertilizer and seed using cross section data from 160 farmers in Lilongwe District, Malawi. The study found that education, field size (plot of land cultivated) and household size have significant negative relationship with the share of fertilizer purchased and positively related with share of seed. The results from the study, both price of seed and fertilizer are significant at 1% with a positive association on share of fertilizer and negative association on share of seed, showing that the price of this inputs significantly affect farmers demand for purchased inputs.

2.5 Review of the Studies on Awareness

Aline (2012) stated that field interviews uncovered a strong lack of awareness on the part of farmers and agrodealers about new varieties. NGO such as FIPS-Africa and One Acre Fund are working to address these knowledge gaps and are meeting with success although scaling up the work is difficult and time-consuming.

It is evident across SSA that farmers are eager to try new varieties themselves once they have seen successful demos. For farmers who are then growing the improved varieties, satisfaction rates are extremely high. The data below is from a survey of 1,542 farmers in 6 countries in SSA, including Kenya, in areas where farmers had the opportunity to plant new varieties. As can be seen, 91% of the farmers stated that the new varieties was at least 50% better yielding than their prior unimproved variety, with 36% stating that it was at least double the yield.

V.Kamal and T. Garima (2015) studied on the awareness levels of farmers on important inputs. The proportion of farmers correctly responding the recommended levels of seed rate was 12% for paddy, 21.7% for sugarcane, 14.1% for wheat and 62.5% for cotton. The proportion was much higher for cotton where the private companies were more active due to the hybrid nature of seed. Farmer's knowledge was determined on

sources of purchasing inputs such as seeds, seed treatment, fertilizers, agro-chemicals, harvesting machinery. It was found that in case of purchase of seeds, 72% of the farmers (N=1505) reported buying from market, 3% (N=63) from cooperative society, 16% (N=330) from fellow farmers, 21% (N=439) from own and 26% (N=537) buying from Agri Department. According to this data, market appears to be the most dominant source for purchase of the seed.

Chauhan et al. (2002) conducted a survey of 160 farmers in the villages of Hisar and Kurukshetra districts to know the level of adoption of quality seeds of paddy, cotton, and wheat by the farmers. It was resulted that the adoption level of quality seed of paddy in Kurukshetra district was 13.38%, which is higher than the average adoption in the state, which is 11.69%. Out of 80 farmers, 38 farmers or 47.50% of the total farmers used the certified seed. In this study, a multiple response of supportive and hindering factors in the use of quality seed was observed. Among the supportive factors, awareness has maximum impact in the acceptance of quality seed of paddy reported by 77.50% of the total number of farmers. The availability of paddy seed is the second most important supportive factor reported by 57.5% of the total number of farmers. Yield difference and purity of seed are also important supportive factors in the acceptance of quality seed. Non-availability of desired variety seed was found to be the most hindering factor in paddy. Higher price of quality seed is also an important hindering factor, which negatively influenced the acceptance of quality seed in paddy.

Ayoola et al. (2014) examined the knowledge of farmers about improved seeds, local seeds, grain and subsidy by surveying in six geo-political zones of Nigeria. It was observed that about 67% of farmers generally had a good knowledge of seed and its difference from grain; with the South West, North East and North West indicating 96.7%, 91.4% and 89.3% respectively. A similar result was obtained in respect of farmers' knowledge about seed subsidy policy and difference between local and improved seed varieties, whereby 61.7% and 69.95% of respondents demonstrated their knowledge in each case. These results implied that the low demand for improved agricultural seeds in Nigeria might not be attributed to lack of knowledge about improve seed and seed policy by the majority of farmers.

Thi Thi Soe Hlaing and Theingi Myint (2011) observed that awareness of the DAR of the 86 selected farmers in Nay Pyi Taw as 98% of sample farmers knew well DAR and seed distribution system and 94% of selected farmers noticed that seed is the important factor for higher yield of rice production. However, the major seed sources of

the selected farmers were from neighbor (35%), own saved (34%) and DAR (30%). The only one percent of farmers bought the rice seed from DoA. The reasons of chosen seed source were mentioned that about half of the farmers (58%) chosen seed source for getting pure seed, and another reasons were trust, availability, high yield, reliability and low cost.

CHAPTER III
RESEARCH METHODOLOGY

3.1 General Description of the Study Areas

Maubin Township is situated between latitude 16˚ 30' north and east longitudes 95˚ 24'. The area of Maubin Township was 133,540 hectares and the cultivated area was 86,538 hectares, 67.71 % of total area. The area of paddy land (Le) was about 57,348 hectares and dry land (Yar) was about 33,747 hectares. A map of the study area is shown in Appendix 1.

Daik U Township is situated between latitude 87˚ 50' north and east longitudes 97˚ 48'. The area of Daik U Township was 90,236 hectares and the cultivated area was 80,820 hectares, 89.57 % of total area. The area of paddy land (Le) was about 77,984 hectares and dry land (Yar) was about 897 hectares. A map of the study area is shown in Appendix 2.

3.2 Data Source and Data Collection

Primary data were collected in Maubin and Daik U Township from October to November 2015. The stratified random sampling method was used to select the seed growers, seed dealers and farmers. A total of 16 sample seed growers were interviewed in which 14 and 2 seed growers from Maubin and Daik U Township and 4 seed dealers from Maubin township were also interviewed with different set of structured questionnaires to get clear understanding of the current marketing channel of rice seed sector. The household level survey was carried out in four villages in Maubin Township and three villages in Daik U Township. A total of 120 sample farmers were personally interviewed in which 67 farmers from Maubin Township and 53 farmers from Daik U Township with a set of structured questionnaires to obtain the primary data using purposive random sampling method.

Demographic characteristics of rice seed growers, dealers and farmers such as age, household head‘s education level, household head's experience rice/ rice seed production and marketing, family size and family labor were collected. And also cultural practices of production such as land owned, rice production area, seed source, varieties used, seed rate per hectare, cropping patterns, animal husbandry, utilization of fertilizer, seed, pesticide were collected.

Detail costs (hired labor cost, non-labor input cost, interest on cash cost) and returns of rice production, constraints and perspective of rice farmers, seed growers and seed dealers were also composed in data collection. The relevant secondary information was taken from official records of Ministry of Agriculture and Irrigation (MoAI) and Department of Agriculture (DoA).

3.3 Analytical Method

Collected data were compiled in the Microsoft Excel program. The analysis was employed with demographical approach, descriptive method, and regression model using Excel Software and Statistical Packages for Social Science (SPSS) version 16. The analytical techniques included descriptive analysis and input demand functions for rice quality seed for rice production.

3.3.1 Descriptive analysis

Descriptive analysis was used to know farmer and market participant social characteristics and to describe their knowledge on agricultural inputs such as seed and farmers' and market participants' practices in rice production, rice seed production and marketing. Mean, percentages and frequency counts were included in descriptive measurement. Also the problems and constraints faced by the farmers and market participants in production and marketing were described by descriptive statistics methods.

3.3.2 Input demand function

The demand for production inputs is a derived demand based on the demand for the final product. To analyze the agricultural input demand functions of rice production, farmers' demands for rice quality seed represent a vital factor market. Demand decisions for inputs are accordingly represented by many factors.

To determine the factors affecting the demand of seed of the rice production, linear regression function was used. The dependent variable was applied quantity of quality seed in rice production by sample farmers and independent variables were year of farm experience in rice production, schooling year, total family labor, current seed price, lagged rice price, quantity of fertilizer, awareness index, distance, extension service access, farm income, other income, buying seed in credit transaction, cropping intensity, sown area and seed renewal period.

The regression function was as follow:

Demand Function for Quality Seed in Rice Production

$$\text{Ln DS} = \beta_0 + \beta_1 \text{Ln } X_{1i} + \beta_2 \text{Ln } X_{2i} + \beta_3 \text{Ln } X_{3i} + \beta_4 \text{Ln } X_{4i} + \beta_5 \text{Ln } X_{5i} + \beta_6 \text{Ln } X_{6i} + \beta_7 \text{Ln } X_{7i} + \beta_8 \text{Ln } X_{8i} + \beta_9 \text{Ln } X_{9i} + \beta_{10} \text{Ln } X_{10i} + \beta_{11} \text{Ln } X_{11i} + \beta_{12} \text{Ln } X_{12i} + \beta_{13} \text{Ln } X_{13i} + \beta_1 D_{1i} + \beta_2 D_{2i} + \mu i$$

Where,

Ds	=	Applied quantity of quality rice seed in production (kg/ha)
X_{1i}	=	Household head's schooling year (year)
X_{2i}	=	Household head's farming experience (year)
X_{3i}	=	Total family labor (no./HH)
X_{4i}	=	Cropping intensity (%)
X_{5i}	=	Current seed price (MMK/kg)
X_{6i}	=	Lagged grain price (MMK/kg)
X_{7i}	=	Awareness index
X_{8i}	=	Distance to seed sources (km)
X_{9i}	=	Fertilizer quantity (kg/ha)
X_{10i}	=	Farming income (MMK/year)
X_{11i}	=	Other income (MMK/year)
X_{12i}	=	sown area (ha)
X_{13i}	=	seed renewal period (year)
D_{1i}	=	Extension access (yes=1, no=0)
D_{2i}	=	Buying seed in credit transaction (yes=1, no=0)
Ln	=	Natural logarithm
μ_i	=	Disturbance term

3.3.3 Developing rice quality seed awareness index

To increase the productivity for the sustainable self-sufficiency of the nation and to establish the major rice exporter in global marketplace, question of rice quality seed is come to the fore. But in most of the developing countries, this basic input gets minimum attention to the farmers. It is mainly depending on the farmer's behavior. The farmer's behavior is regulated by their awareness and it can vary based on many factors. The quality seed awareness and attitudes towards the higher yielding by the local farmers were investigated. The data included socio-economic and demographical contexts.

Quality seed awareness was calculated as index score by using a set of questionnaire based on their knowledge on quality seed (13 questions). These statements are mentioned in Table 3.1.

Table 3.1 Quality seed awareness of rice farmers based on their knowledge

No.	Statement
1	Do you know the difference between seed and grain?
2	Do you know the benefit of using quality seeds?
3	Do you know the quality seed is more important than the other inputs?
4	Do you know the use of quality seed will give you a higher yield?
5	Do you know if you use quality seed, the seed rate can be reduced than current seed rate?
6	Do you know the source of quality seed to buy?
7	Do you know to test the germination percentage of quality seed?
8	Do you know the identification of the quality seed?
9	Do you know the certified seeds?
10	Do you know the approved seed certificate by Government is important?
11	Do you know the importance of the field inspection and laboratory test for quality seed production?
12	Do you know how to manage the quality seed production?
13	Do you know how to manage the seed to maintain quality after getting from others?

Table 3.2 Scoring system by the orientation of the statement

Level of agreement	Scores for positive statement
Good Knowledge	3
Poor Knowledge	2
No Knowledge	1

The level of agreement on each given statement was scored accordingly to the orientation of the questions. For instance the option, “Good Knowledge” is scored as “3 point” for the positive question while “1 point” for “No Knowledge” in Table 3.2.

Then the scores were summed and the awareness index was calculated by using the following formula (Mudombi 2013).

$$\text{AI} = \frac{\text{SS} - \text{min. possible scores}}{\text{difference between max. and min. possible scores}}$$

AI = Awareness Index

SS= Sum of Scores

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Descriptive Statistics of Background Information of the Sample Respondents

4.1.1 Comparison of the demographic and social characteristics of the sample respondents

The social characteristics of the respondent households were described for three main groups: farmer households, seed grower households and seed dealer households in Maubin Township (Table 4.1) and two main groups: farmer households and seed grower households in Daik U Township (Table 4.2).

In Maubin Township, the average age of farmer, seed grower and seed dealer households were 49, 50 and 42 years, respectively. Respondents' working experience also plays an important role in agricultural chain activities. Experience of farming, seed production and marketing was 24, 4 and 5 years respectively for farmer, seed grower and seed dealer households. The average family members were about 4, 4 and 5 for farmer, seed grower and seed dealer households.

In Daik U Township, the average age of farmer and seed grower households were 51 and 49 years, respectively. Experience of farming and seed production was 26 and 7 years respectively for farmer and seed grower households. Both for farmers and seed growers, the average family members were about 5.

The level of education of the respondents was important for decision making of farming system and marketing practices. In this study, education level of the sample respondents was categorized into four groups: (1) "Monastery education" referred informal schooling although they could read and write; (2) "Primary level" referred formal schooling up to 5 years; (3) "Secondary level" intended formal schooling up to 9 years, and (4) "High school and above level " referred the formal schooling up to 11 years and above (received degree from college or university). The education level of farmers was assumed to determine decision making of their farming system.

In Maubin Township, 1%, 16%, 53% and 30% of farm households attained monastery, primary, secondary and high school and above education level, respectively. In Daik U Township, 6%, 40%, 26% and 28% of farm households attained monastery, primary, secondary and high school and above education level, respectively. Therefore,

the respondents from Maubin Township had comparatively better education level than that of Daik U Township.

In Maubin, 71 % of seed grower households had attained the secondary education level. The remaining 7% and 22% of seed growers obtained primary and high school and above education level, respectively. In Daik U, all seed growers had reached the high school and above education level.

The majority of seed dealers (75%) in Maubin had attained high school and above education level. About 25% of seed dealer households received the secondary education level.

4.1.2 Farm size and different farm types of sample farm households

Land ownership or farm size is an important factor for adopting modern rice production technologies. In general, farmers owing large size farm apply diversified cropping system and adopt new technologies earlier. Hence, these farmers are assumed as earlier adopter.

Farm size and different farm types of sample respondents are shown in Table 4.3. In Maubin Township, average irrigated farm size of sample respondents was 2.5 hectare with ranging from 0.6 to 13.0 hectare. Rain-fed farm size was 4.5 hectare with ranging from 0.4 to 40.5 hectare. In Daik U Township, 7.3 hectare and 5.8 hectare were the average farm size for irrigated and rain-fed area. The range for irrigated farm size was 0.8 to 26.3 hectare whereas rain-fed area was ranged from 0.4 to 44.5 hectare. Therefore, Daik U Township was more accessible to irrigation.

4.1.3 Farm size and different farm types of sample seed grower households

Table 4.4 displays the farm size and different farm types of sample seed grower households. In Maubin Township, there was 3.2 hectare and 3.0 hectare of average farm size for irrigated and rain-fed area and ranging from 1.2 to 5.3 hectare and from 1.2 to 6.1 hectare. In Daik U Township, there was only rain-fed area having 2.6 hectare of average farm size and ranging from 1.2 to 4.0 hectare.

4.1.4 Comparison of farming apparatus of sample farm and seed grower households

The farming apparatus of the sample farm and seed grower households are shown in Table 4.5. About 22% and 21% of farm and seed grower households in Maubin and 49% and 50% of farm and seed grower household in Daik U owned the cattle as draught

animal. Buffalo was also hold as draught animal and possessed by 3% and 30% of farm and seed grower households in Maubin and only possessed by 7% of farm households in Daik U. Then, farm and seed grower households (25% and 36%) in Maubin and (51% and 50%) in Daik U owned bullock cart for transportation crops from field to home and for travelling from village to village. About 4% of farm households had tractor in Maubin and about 4% farm households and 50% of seed grower households in Daik U. The power tillers were had in 52% and 57% of farm and seed grower households in Maubin and 38% and 100% in Daik U. In 16% and 7% of farm and seed grower households in Maubin and 4% and 50% in Daik U, the threshers were hold. Only 2% and 50% of farm and seed grower households had the combine harvester in Daik U. About 34% and 43% of farm and seed grower households in Maubin and 77% and 100% in Daik U possessed the ploughs. About 36% and 50% and 79% and 100% of farm and seed grower households in Maubin and Daik U were the owner of harrows. At 7% and 21% of farm and seed grower households and only 4% of farm households, there were seeders. About 73% and 57% and 81% and 100% of farm and seed grower households in Maubin and Daik U respectively hold the sprayers. Most of farmers had the water pumps in the study areas. Specifically, 51% and 7% of farm and seed grower households in Maubin and 43% and 100% in Daik U possessed the water pumps. To store the seeds, the farm households (28%) and seed grower households (21%) in Maubin had paddy/seed storage. Also in Daik U, about 15% and 100% of farm and seed grower households were the owner of paddy/seed storage.

Table 4.1 Demographic characteristics of sample respondents in Maubin Township

No.	Item	Units	Farmers (N=67)	Seed growers (N=14)	Seed dealers (N=4)
1.	Average household head's age	Yr	49	50	42
	SD		11	11	6.98
2.	Average farm/ seed production / marketing experience	Yr	24	4	5
	SD		12	2.67	2.16
3.	Average family size	No.	4	4	5
	SD		2	1	1.26
4.	Education level of household head	Percent			
	Monastery level		1	-	-
	Primary level		16	7	-
	Secondary level		53	71	25
	High school and above level		30	22	75

Table 4.2 Demographic characteristics of sample respondents in Daik U Township

No.	Item	Units	Farmers (N=53)	Seed growers (N=2)
1.	Average household head's age	Yr	51	49
	SD		10	1.41
2.	Average farm/ seed production / marketing experience	Yr	26	7
	SD		9.5	4.94
3.	Average family size	No.	5	5
	SD		2	2.82
4.	Education level of household head	Percent		
	Monastery level		6	-
	Primary level		40	-
	Secondary level		26	-
	High school and above level		28	100

Table 4.3 Farm size and different farm types of sample farm households

	Maubin (N=67)		Daik U (N=53)	
	Irrigated area (ha)	**Rain-fed area (ha)**	**Irrigated area (ha)**	**Rain-fed area (ha)**
Average	2.5	4.5	7.3	5.8
Maximum	13.0	40.5	26.3	44.5
Minimum	0.6	0.4	0.8	0.4
SD	6.5	15.5	17.8	17.5

Table 4.4 Farm size and different farm types of sample seed grower households

	Maubin (N=14)		Daik U (N=2)	
	Irrigated area (ha)	**Rain-fed area (ha)**	**Rain-fed area (ha)**	
Average	3.2	3.0	2.6	
Maximum	5.3	6.1	4.0	
Minimum	1.2	1.2	1.2	
SD	4.5	3.7	4.9	

Table 4.5 Percentage of the sample farmers who had farming apparatus

Items	Percentage of farmers		Percentage of seed growers	
	Maubin (N=67)	Daik U (N=53)	Maubin (N=14)	Daik U (N=2)
Oxen	22	49	21	50
Buffalo	3	30	7	-
Cart	25	51	36	50
Tractor	4	4	-	50
Power Tiller	52	38	57	100
Thresher	16	4	7	50
Combine harvester	-	2	-	50
Plough	34	77	43	100
Harrow	36	79	50	100
Seeder	7	4	21	-
Sprayer	73	81	7	100
Water pump	51	43	57	100
Paddy/Seed storage	28	15	21	100

4.2 Information of the Sample Respondents and Agricultural Characteristics

4.2.1 Varieties grown by sample farmers

There were different varieties cultivated by sample farmers in the study areas as shown in Figure 4.1 and 4.2. Among various varieties, Hnan Kar (46%), Sin Thu Kha (46%) and Thee Htat Yin (45%) varieties were grown by most of the farmers in Maubin. The other varieties such as Tawn Pyant, Sin Thwe Latt, Pyi Taw Yin, Paw Sann, Yay Anelo-4, Manaw Thukha, Yay Myoke Kan-2, Ayar Min, Vietnam, Pale Thwe and Yay Anelo-1 were also cultivated.

In Daik U, the major varieties planted by sample farmers were Hmawbi-2 (67%) and Sin Thu Kha (58%). Manaw Thukha, Sin Thwe Latt, Pyi Taw Yin, Yadanar Toe, Kyaw Zeya, Paw Sann Yin, Yar Kyaw, Kauk Hyinn, Vietnam and Pale Thwe varieties were also grown.

4.2.2 Sources of rice seeds for sample farmers

Farmers could get rice quality seeds from different sources. As revealed in the Table 4.6 for Maubin, the different sources for grown rice varieties were contact farmers or seed growers, other farmers, rice millers, seed dealers, Department of Agriculture (DoA) Township Office, Department of Agricultural Research (DAR) and international organization (IO, IRRI). The seeds from IO were given without charge to the farmers. The farmers also used their owned seed from previous year. There were different types of rice varieties grown in Maubin Township. Among these, farmers widely used Hnan Kar, Sin Thu Kha and Thee Htat Yin varieties. Seed sources of traditional local adaptable rice varieties were buying from other farmers and own seed for Hnan Kar (42 and 52%), Tawn Pyant (50% each) and Paw Sann (50 and 33%). Improved short duration rice varieties such as Sin Thu Kha, Thee Htat Yin, Sin Thwe Latt, Manaw Thukha and Ayar Min were received in varying accessibilities from contact and other farmers, DoA (Township office) and own seeds. Sources of Ayar Min were contact and other farmers (50% each). Manaw Thukha was kept by farmers (33%) and some bought from DoA (Township office) (33%) and other farmers (34%). Pyi Taw Yin, Yay Myoke Kan-2, Yay Anelo-1 and Yay Anelo-4 might be newly introduced and distributed by IO (83% to 100%). As Pale Thwe was an introduced hybrid rice by DoA, seed source was DoA (Township office) (100%). For Vietnam variety, contact and other farmers were two major sources of rice seeds.

Table 4.7 explains the seed sources for sample farmers in Daik U. In this table, the farmers purchased the seeds from the same sources used in Maubin except rice dealers and DAR (Research farms). The farmers received the seeds from DoA (Seed farms) and also from IO as free. The farmer owned seeds were also applied as the seeds for next crops. Hmawbi-2, Sin Thu Kha and Manaw Thukha varieties were commonly grown in Daik U Township. Farmers usually kept their own seeds for Manaw Thukha (58%), Hmawbi-2 (50%) and Sin Thu Kha (48%). Some (14 to 37%) received these rice seeds from other farmers. Seed sources of Yadanar Toe and Paw Sann Yin were also other farmers and individual farmers themselves. IO was the major source of Sin Thwe Latt and Pyi Taw Yin (100% each) which were grown by few farmers.

Among the rice seed sources, there were formal seed sources including DoA (Township office), DoA (Seed farm), IO and DAR and informal sources such as farmer themselves, other farmers, contact farmer/seed grower, rice miller and seed dealers (Table 4.8). In this table, 71% of the seed used from informal seed sources was the major seed supply for Maubin and 80% for Daik U whereas 29% and 20% of formal sources were other seed supply in Maubin and Daik U, respectively. Therefore, the seed sector in both areas was dominant by informal seed system. Farmers were used to keep their rice seeds for next seasons and it was more profound in Daik U Township. Key strengths of this seed system are that the varieties are well adapted to the farmers' production system, the quality is known by farmers, and the seed is affordable due to the existence of local exchange and dissemination mechanisms (Broek et al. 2015).

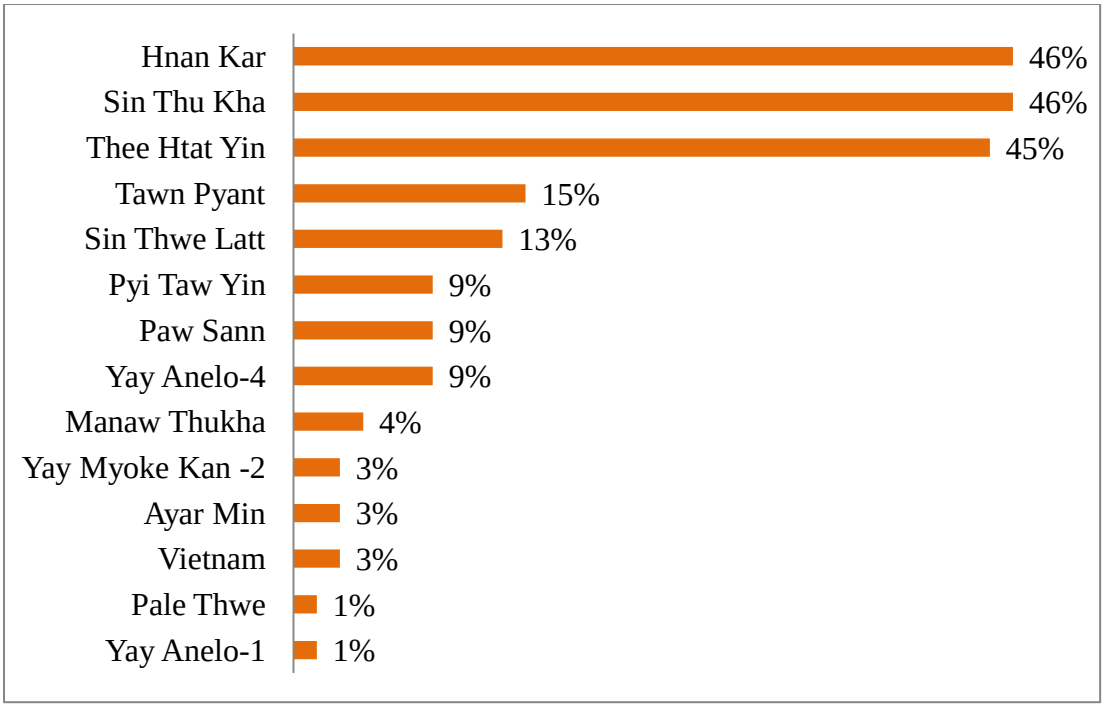


Figure 4.1 Varieties grown by percent of farmers in Maubin Township (N=67)

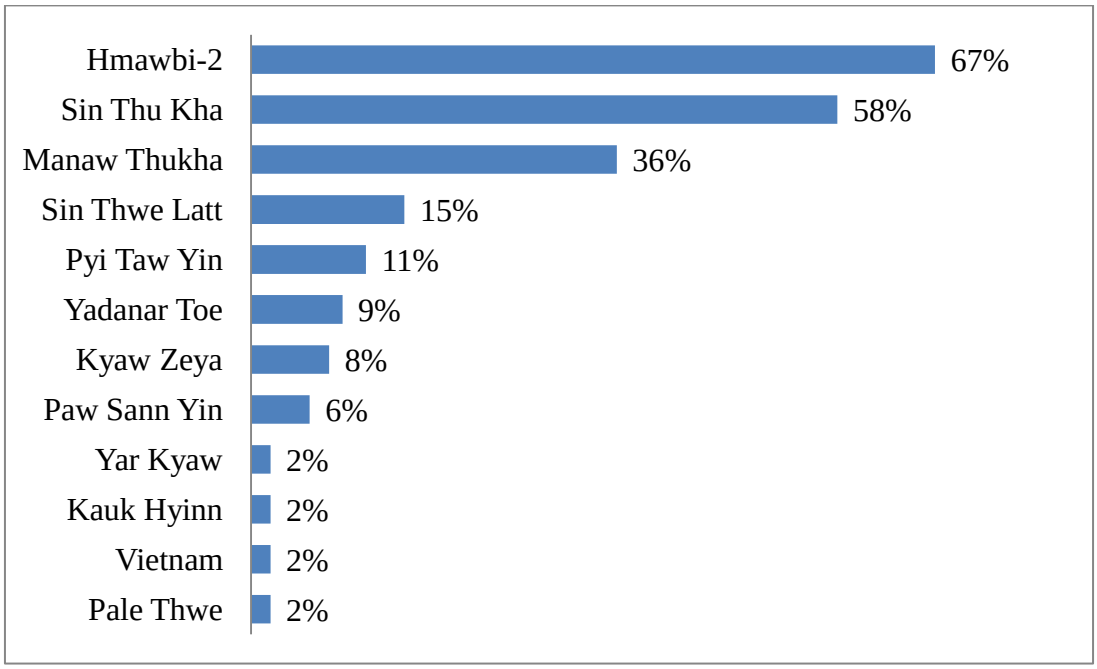


Figure 4.2 Varieties grown by percent of farmers in Daik U Township (N=53)

Table 4.6 Common varieties and various seed sources for the sample farmers in Maubin Township

Variety	N	Percentage of Seed Sources								
		Contact farmers/ Seed growers	Other farmers	Rice millers	Seed dealers	DoA (Township office)	DAR (Research farms)	IO	Own seed	Total
Hnan Kar	31	-	42	6	-	-	-	-	52	100
Sin Thu Kha	31	16	13	-	3	45	3	-	20	100
Thee Htat Yin	30	17	28	-	3	21	-	-	31	100
Tawn Pyant	10	-	50	-	-	-	-	-	50	100
Sin Thwe Latt	9	33	-	-	11	22	11	11	12	100
Pyi Taw Yin	6	-	-	17	-	-	-	83	-	100
Paw Sann	6	17	50	-	-	-	-	-	33	100
Yay Anelo-4	6	-	-	-	-	-	-	100	-	100
Manaw Thukha	3	-	34	-	-	33	-	-	33	100
Yay Myoke Kan-2	2	-	-	-	-	-	-	100	-	100
Ayar Min	2	50	50	-	-	-	-	-	-	100
Vietnam	2	50	50	-	-	-	-	-	-	100
Pale Thwe	1	-	-	-	-	100	-	-	-	100
Yay Anelo-1	1	-	-	-	-	-	-	100	-	100

Table 4.7 Common varieties and various seed sources for the sample farmers in Daik U Township

Variety	N	Percentage of Seed Sources							
		Contact farmers/ Seed growers	Other farmers	Rice millers	DoA (Township office)	Own seed	DoA (Seed farms)	IO	Total
Hmawbi-2	35	14	14	-	-	50	22	-	100
Sin Thu Kha	30	6	16	6	-	48	24	-	100
Manaw Thukha	19	-	37	5	-	58	-	-	100
Sin Thwe Latt	8	-	-	-	-	-	-	100	100
Pyi Taw Yin	6	-	-	-	-	-	-	100	100
Yadanar Toe	5	-	40	-	-	40	20	-	100
Kyaw Zeya	4	-	-	25	-	75	-	-	100
Paw Sann Yin	3	-	33	-	-	67	-	-	100
Kauk Gyi	1	-	-	-	-	100	-	-	100
Yar Kyaw	1	-	100	-	-	-	-	-	100
Vietnam	1	-	-	-	100	-	-	-	100
Pale Thwe	1	-	-	-	100	-	-	-	100

Table 4.8 Classification of seed sources for the sample farmers in the study areas

Seed source	Percentage of seed sources	
	Maubin	**Daik U**
Formal seed sources		
DoA (Township office)	17	2
DoA (Seed farm)	-	16
IO	11	2
DAR (Research farms)	1	-
Total	**29**	**20**
Informal seed sources		
Farmer owned seed	29	50
Other farmer	26	19
Contact farmers/seed growers	11	7
Rice miller	3	4
Seed dealer	2	-
Total	**71**	**80**

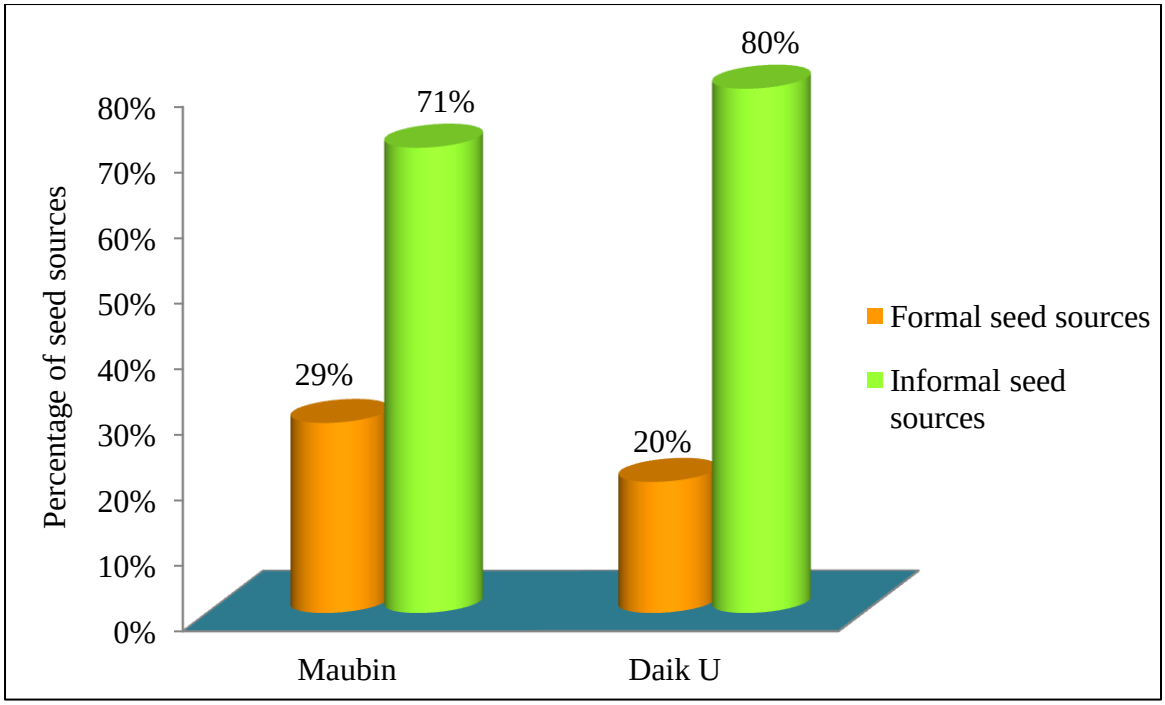


Figure 4.3 Seed sources for the sample farmers in the study areas

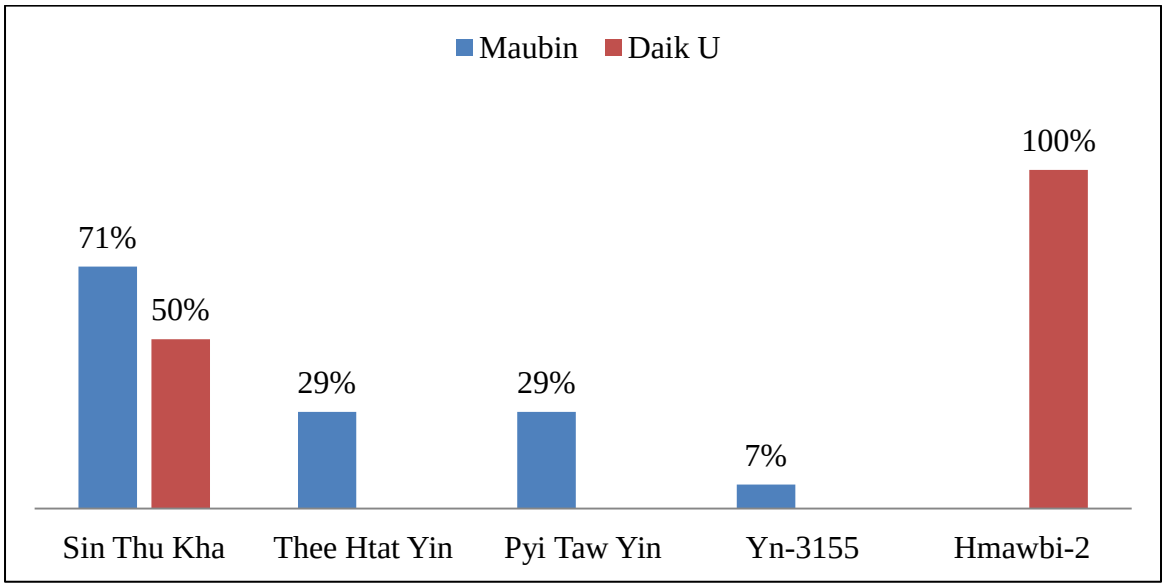


Figure 4.4 Varieties grown by percent of seed growers in Maubin (N=14) and Daik U (N=2)

4.2.3 Varieties grown by sample seed growers

The sample seed growers planted four varieties of rice to produce and sell good quality seeds in Maubin and two varieties in Daik U as exhibited in Figure 4.4. The cultivated varieties by seed growers were Sin Thu Kha (71%), Thee Htat Yin (29%), Pyi Taw Yin (29%), Yn-3155 (7%) in Maubin and Hmawbi-2 (100%) and Sin Thu Kha (50%) in Daik U.

4.2.4 Sources of rice quality seeds for sample seed growers

As shown in Table 4.9, the seed growers grew Sin Thu Kha, Thee Htat Yin, Pyi Taw Yin and Yn-3155 varieties for seed production and distribution in Maubin and Hmawbi-2 and Sin Thu Kha varieties in Daik U. The seed growers chose these varieties because there is high demand for farmers growing Thee Htat Yin rice variety in summer season: Sin Thu Kha variety is short duration so that it is in time for next crop particularly green gram and black gram growing: Pyi Taw Yin and Yn-3155 varieties give high yield: most of farmers plant Hmawbi-2 as local variety for monsoon rice. The seed sources were DoA (Township office) (100%) for Sin Thu Kha in both study areas, DoA (Township office) (75%) and rice miller (25%) for Thee Htat Yin, 100% of IO especially International Rice Research Institute (IRRI) for both of Pyi Taw Yin and Yn-3155 in Maubin. Hmawbi-2 variety used by seed growers came fully from DoA (Seed farms) in Daik U.

4.2.5 Varieties marketed by seed dealers in Maubin Township

Figure 4.5 describes the varieties marketed by seed dealers in Maubin. The varieties that were marketed by seed dealers were Thee Htat Yin, Sin Thu Kha, Pyi Taw Yin, Yay Anelo-4 and Yn-3155 in monsoon season and Sin Thu Kha and Thee Htat Yin in summer season. Each 50% of Thee Htet Yin, Sin Thu Kha and Yn-3155 and each 25% of Pyi Taw Yin and Yay Anelo-4 was put on the market in monsoon season. In summer season, the seed dealers sold the seeds of Thee Htat Yin (50%) and Sin Thu Kha (50%).

Table 4.9 Seed sources for sample seed growers in the study areas

Variety	Maubin				Daik U	
	N	DoA (Township office)	IO	Rice millers	N	DoA (Seed farm)
Sin Thu Kha	10	100	-	-	1	100
Thee Htat Yin	4	75	-	25	-	-
Pyi Taw Yin	4	-	100	-	-	-
Hmawbi-2	-	-	-	-	2	100
Yn-3155	1	-	100	-	-	-

Table 4.10 Seed sources for sample seed dealers in Maubin Township

Variety	Monsoon season				Summer season		
	N	DAR (Research farm)	Contact farmers	Farmers	N	Contact farmers	Farmers
Sin Thu Kha	3	67	33	-	2	-	100
Thee Htat Yin	3	67	33	-	2	50	50
Pyi Taw Yin	1	-	100	-			
Yae Anaelo-4	1	-	100	-			
Yn-3155	2	-	50	50			

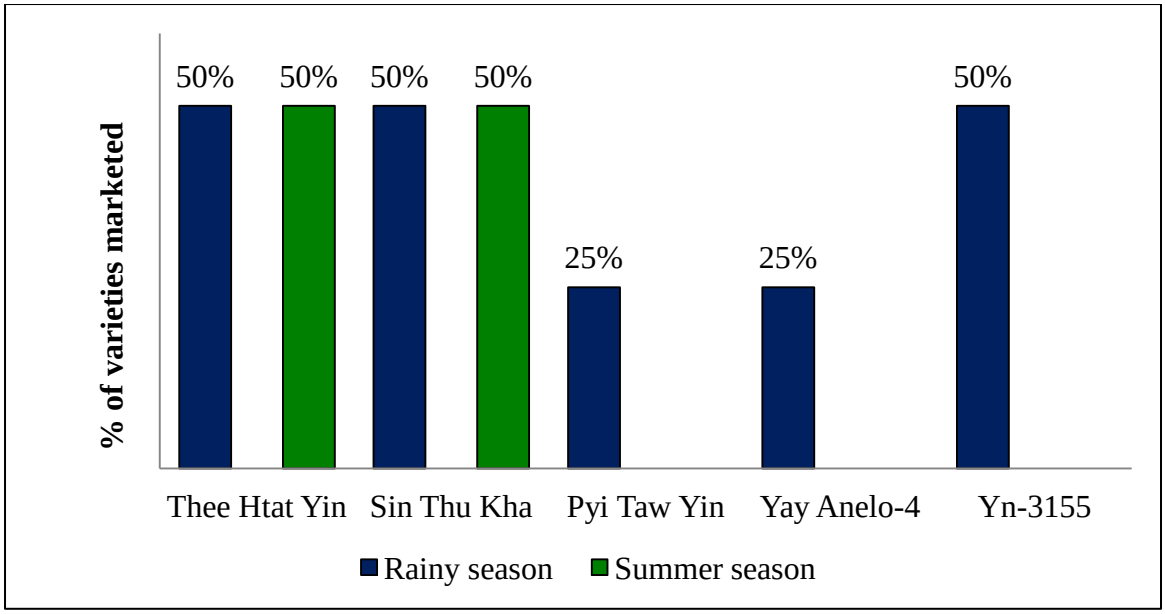


Figure 4.5 Varieties marketed by percent of seed dealers in Maubin Township (N = 4)

4.2.6 Sources of rice quality seeds for sample seed dealers

The sources of buying rice quality seed marketed by seed dealers are exhibited in Table 4.10. The dealers in Maubin bought the rice quality seeds from DAR (Research farms), contact farmers or seed growers and farmers. For monsoon season, the seed dealers obtained directly the seeds from 67% of DAR (Research farm), each 33% of contact farmers for Sin Thu Kha and Thee Htat Yin. Pyi Taw Yin and Yae Anaelo-4 varieties got from contact farmers with fully percentage. About each 50% of contact farmers and farmers was the seed source of Yn-3155 to be marketed. For summer season, Sin Thu Kha variety was fully acquired from farmers and each 50% of contact farmers and farmers was the seed source of Thee Htat Yin. Most of the seed dealers had a good linkage with formal institutions produced quality seeds. Therefore, they could buy the seeds in direct way with this institution and there was a monopolized market in seed.

4.2.7 Services received from Government Organization (GO)/ IO for rice production by sample respondents at the study areas

The selected respondents got the services such as input (seed), extension education, training especially for rice seed production and credit from GO or IO for production of crop according to Table 4.11 and 4.12.

In Table 4.11, about 22% of the farmers received the seed from IO particularly IRRI; 42% had an opportunity to attend extension service delivered by the cooperation of GO and IO; 21% learned the rice seed production by the mutual aid of GO and IO and 87% of farmers got the credit from GO (Myanma Agricultural Development Bank, MADB and Cooperative) in Maubin. There was 26% of farmers getting the seeds from IRRI; 45% obtaining the extension service and 23% learning the seed production from GO and IO cooperation; 74% of farmers acquiring the credit from GO in Daik U.

In Table 4.12, 86%, 71% and 100% of seed growers received the extension education, training (rice seed production) and credit respectively in Maubin. The extension education, rice seed production training and credit were given to seed growers with fully percentage in Daik U Township.

According to these tables, IO also was one of the major organizations for crop production. The respondents could get the more knowledge in systematically crop and seed production by the services. The respondents possessing land tenure certificate (Form-7) got the credit with two times for a year in which one time is for monsoon season and another time is for winter by MADB.

Table 4.11 Services received from GO/IO for rice production by sample farmers at the study areas

Items	Maubin (N=67)		Daik U (N=53)	
	Farmers (%)	Org.	Farmers (%)	Org.
Input (Seed)	22	IO	26	IO
Extension education	42	GO+IO	45	GO+IO
Training (rice seed production)	21	GO+IO	23	GO+IO
Credit	87	GO	74	GO

Table 4.12 Services received from GO/IO for rice production by sample seed growers at the study areas

Items	Maubin (N=67)		Daik U (N=53)	
	Seed grower (%)	Org.	Seed grower (%)	Org.
Extension education	86	GO+IO	100	GO+IO
Training (rice seed production)	71	GO+IO	100	GO+IO
Credit	100	GO	100	GO

Note: GO = Government Organization, IO = International Organization

4.2.8 Comparison of benefit-cost ratio between farmers and seed growers in the study areas

In order to understand the economic conditions of the sample farmers and seed growers in relation to their performances of rice cultivations, cost and return analysis of crop production can be compared between the farmers and rice seed growers as shown in Appendix 3 to 10.

Figure 4.6 demonstrates the comparison of benefit-cost ratio (BCR) between farmers and seed growers in Maubin and Daik U Township. In this figure, Sin Thu Kha and Thee Htat Yin in Maubin and Sin Thu Kha and Hmawbi-2 in Daik U were the used varieties to compare the BCR. The BCRs of Sin Thu Kha rice variety by farmers and seed growers were 1.51 and 2.51 and that of Thee Htat Yin were 1.58 and 2.75 respectively in Maubin Township. The BCRs, 1.27 and 1.50 were Sin Thu Kha and Hmawbi-2 by farmers and 2.90 and 3.05 by seed growers in Daik U Township.

Theoretically, lower yield could be expected that although the cost of production and seed price would be higher if seed growers follow the guidelines of quality seed production. However, in this research, the BCRs for seed growers showed nearly twice if compared with BCRs for farmers because most of seed growers did not follow systematically the guidelines under the quality rice seed production manual. Specially, they did not make the raised-seed-beds and some seed growers broadcasted the seeds instead of transplanting. Even though most of the seed growers transplanted, they used more than two seedlings per hole. Actually, they will have to transplant one or two seedlings per hole if they follow the manual. There was also no field inspection at each stage of production and the seeds were sold immediately after threshing. By doing so, most of seed growers reduced the production costs and post-harvest (drying, hauling, packaging, storage, etc) processing costs.

Besides, the seed growers who have good linkage with government institutional persons might have more chances to get the quality seed from formal seed sector than the ordinary farmers who do not have linkage with extension staffs. Generally, farmers have trust on the seeds that were obtained from the seed growers who used the seeds from public institutions like DAR or DoA (Seed farms / Township office). So, the seed growers are having good opportunities to produce rice quality seeds without following the guided activities consequently making low production cost. Therefore, this leaded to more BCRs for seed growers than BCRs for farmers.

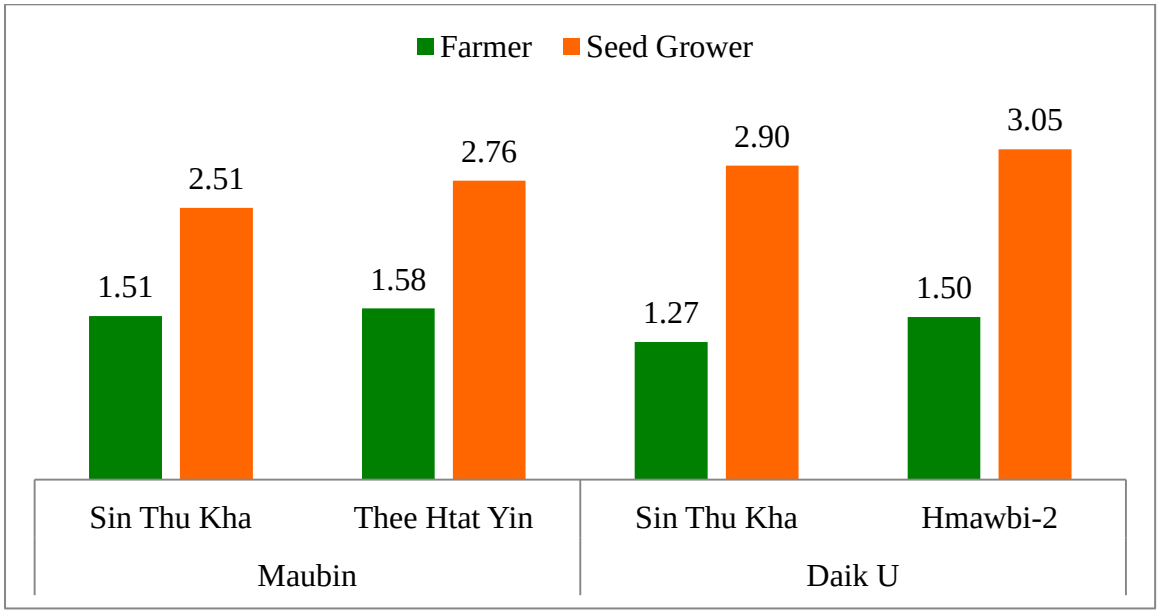


Figure 4.6 Comparison of benefit-cost ratios between farmers and seed growers in the study areas

4.3 Marketing Functions of the Sample Respondents in the Study Areas

4.3.1 Business size of the seed growers

In this study, 16 seed growers were interviewed to determine the rice seed production, marketing functions and marketing channels in the study areas. Business sizes of seed growers were distinguished according to the annual sale amounts of rice quality seeds (Table 4.13). In the rice seed market, Maubin and Daik U Township, seed growers were marketing registered improved rice seeds except Yn-3155. Even though this variety, Yn-3155, was introduced by IRRI for trial, the farmers preferred to grow this variety because of high yielding.

Based on the survey data, the amounts of total annual production by the sampled seed growers in Maubin and Daik U were 138.06 MT and 11.50 MT, respectively. The amounts of total annual sale were 138.06 MT in which all production of these varieties except Sin Thu Kha were sold as seeds in Maubin. About 60% of Sin Thu Kha was wholesaled as quality seeds and 40% as grain. In Daik U, only 63% of both Hmawbi-2 and Sin Thu Kha varieties was sold as good seeds and 37% as grain.

The results of the study revealed that the seed growers could not bring all production to the market as good quality seeds due to the lack of advanced storage facilities and poor post harvest processing.

Table 4.13 Production and sale of rice seed growers in the study areas

Variety	Sown area (ha)	Production (MT)	Sale as quality seed (MT)	Sale as grain (MT)
Maubin (N=14)				
Thee Htat Yin	12.75(31)	58.00(32)	58.00 (100)	-
Sin Thu Kha	25.10(61)	104.73(58)	63.03(60)	41.70 (40)
Pyi Taw Yin	2.02(5)	10.13(6)	10.13 (100)	-
Yn-3155	1.20(3)	6.90(4)	6.90 (100)	-
Total	41.07(100)	179.76 (100)	138.08(77)	41.79(23)
Daik U (N=2)				
Hmawbi-2	4.45(85)	15.05(83)	9.41(63)	5.64(37)
Sin Thu Kha	0.80(15)	3.14(17)	2.09(67)	1.05(33)
Total	5.25(100)	18.18(100)	11.50(63)	6.69(37)

Note: Figures in the parentheses represent percentage.

Table 4.14 Marketing activities of the seed growers of rice seed market in the study areas

Marketing Activities	Maubin (Percentage)	Daik U (Percentage)
Main Buyer		
Seed dealer	65	-
Farmer	35	100
Type of transaction (selling)		
Cash down payment	100	100
Mode of transport		
By trailer	89	100
By boat	11	-
Type of storage		
Storage	21	100
Storage with bamboo granary	33	-
Storage with polyethylene bag	67	100
N	14	2

4.3.2 Marketing activities of the seed growers of rice seed market in the study areas

Table 4.14 shows the marketing activities of seed growers of rice seed market. All seed growers grew and sold four varieties of rice seed in Maubin and two varieties in Daik U. The main buyers were seed dealers (65%) and farmer (35%) in Maubin and farmer (100%) in Daik U. All seed growers in both townships sold by cash down payment transaction.

Mode of transportation system was especially by trailer in the study areas. The rice seeds were stored in 33% and 67% of bamboo granary and polyethylene bag at the silo or home by 21% of the seed growers in Maubin. All seed growers in Daik U stored the seeds in polyethylene bags at the silo or home.

As regards of Table 4.14, although about 79% of seed growers in Maubin put up for sale the rice seed directly from threshing without labeling, guarantee and certification on polyethylene packages, all seed growers in the study areas sold the seeds without any trademark on packaging. The farmers believed the seeds by observing the fields that were containing a little off-type plants, uniformity and other aspects of plant characteristics. But, the quality could be reduced by post harvest processing that was not done systematically.

4.3.3 Business size of the seed dealers

In this study, there were 4 seed dealers in only Maubin that were questioned to verify the rice seed marketing functions and marketing channels. Regarding to the sale amounts of rice quality seeds in a year, business sizes of seed dealers were recognized in Table 4.15. In this table, seed dealers sold the rice seeds to farmers and private companies (Agro-chemical Company).

Based on the survey data, the seed dealers could sell all the seeds purchased in both seasons. The amounts of total marketed seeds were 67.57 MT in monsoon season and 55.39 MT in summer season.

The seed dealers sold Sin Thu Kha, Thee Htat Yin, Pyi Taw Yin, Yay Anelo-4 and Yn-3155 which were 43%, 27%, 14%, 4% and 12% in monsoon season and Sin Thu Kha (15%) and Thee Htat Yin (85%) in summer season. According to this result, Sin Thu Kha was the most marketed variety in monsoon season and Thee Htat Yin variety in summer season.

Table 4.15 Annual sale amount of rice quality seed by seed dealers in Maubin Township (N=4)

Variety	Monsoon season		Summer season	
	Purchasing (MT)	Selling (MT)	Purchasing (MT)	Selling (MT)
Sin Thu Kha	29.26(43)	29.26(43)	8.36(15)	8.36(15)
Thee Htat Yin	18.39(27)	18.39(27)	47.03(85)	47.03(85)
Pyi Taw Yin	9.40(14)	9.40(14)	-	-
Yae Nay Lo-4	2.09(4)	2.09(4)	-	-
Yn-3155	8.36(12)	8.36(12)	-	-
Total	67.57(100)	67.57(100)	55.39(100)	55.39(100)

Note: Figures in the parentheses represent percentage.

Table 4.16 Marketing activities of the seed dealers of rice seed market in Maubin Township (N=4)

Marketing Activities	Monsoon Season (Percentage)	Summer Season (Percentage)
Source of rice seed		
DAR	20	-
Contact farmer	70	40
Farmer	-	20
Own seed	10	40
Main Buyer		
Farmer	78	100
Private company	22	-
Type of transaction (purchasing)		
Cash down payment	100	100
(selling)		
Cash down payment	75	50
Credit	25	50
Mode of transport – by trailer	100	100
Type of storage		
At home, storage with polyethylene bag	100	100

4.3.4 Marketing activities of the seed dealers of rice seed market in the study areas

As illustrated in Table 4.16, all seed dealers sold five varieties of rice seed in monsoon season and two varieties in summer season. They bought the seeds from contact farmers (70%) and DAR (20%) and farmers (10%) in monsoon season and farmer (60%) and contact farmers (40%) in summer season.

In monsoon season, the main buyers were 78% of farmer and 22% of private company and in summer season, full percentage of farmer was main buyer. All seed dealers bought by cash down payment transaction. In selling for monsoon season crop, about 75% was cash down payment and 25% was credit payment transaction. In summer season, each 50 % was cash down and credit payment transaction.

Mode of transportation system was mainly by trailer in the study areas. All rice seeds were stored in polyethylene bags at the home.

Regarding to this results, the seed dealers bought the largest portion of the seeds for monsoon season from contact farmers who used the quality seeds from the relevant formal institutions. The contact farmers were also key farmers for training, extension education and development programs. In summer season, most of the seeds marketed by seed dealers came from farmers. Similar to the seed growers, the seeds were sold without any trademark on packaging.

4.3.5 Farmers' practices for own seed production in the study areas

Farmer owned seed was the most one among many sources as cited in Table 4.8 because of seed costs and availability. And on-farm seed production can solve the problems of ineffective seed distribution and poor seed availability by rural seed programs at the farmer and village level. For that reasons, the practices by farmers to use the seeds for next crop were the important role in crop production.

Table 4.17 explains the farmers' practices for own seed production in the study areas. In seed selection, the farmers chose the seeds from specific field (20%), good panicles from the field (17%) and good panicles after harvesting (63%) in Maubin and from specific field (40%), good panicles from the field (27%) and good panicles after harvesting (33%) in Daik U. Weeding was done by 13% of Maubin farmers and 7% of Daik U farmers and rouging by 47% and 79% of farmers in Maubin and Daik U, respectively. In Maubin and Daik U, 40% and 14% of farmers did not do any weeding and rouging. About 79% and 76% of farmers in Maubin and Daik U processed the post harvest activities specific for seed. As storage facilities, the farmer used the polyethylene

bag (79%), earthen pot (2%) and bamboo granary (19%) in Maubin township and the polyethylene bag (24%), earthen pot (14%), tin (2%) and bamboo granary (60%) in Daik U. The average storage duration was 4.5 months ranging from 1 to 6 months in Maubin and 4.8 months ranging from 2 to 7 months in Daik U.

Regarding to this table, there are two points in the quality of rice seeds was reduced in Maubin rather than in Daik U (1) seed selection was mostly done just after harvesting; (2) weeding and rouging was done by some farmers; and all the farmers in both townships did not apply super grain bags which can maintain good quality while seeds are stored.

4.4 Marketing Channels of Rice Quality Seed

Marketing channels are set of interdependent organizations involved in the process of making a product or service available for use (Kolter 2001). A linkage from producer to other participants or to ultimate users is accomplished by marketing intermediaries. There is a role of channel to complete the gap between production to utilization in particular time, place, quantity and quality. Market intermediaries perform various functions in order to bridge these gaps. Seed marketing channels were observed for understanding the commodity flow from institutions or agents to market intermediaries and to final user farmers. Figure 4.7 shows the rice quality seed marketing channels in the study areas. According to the market survey, most of the rice seeds came from farmers' own seed stored from previous season of harvests. Most of the farmers usually replace the seed at once in three years as the seed renewal period. The renewal seed normally comes from seed growers, other (peer or fellow) farmers, contact farmers, seed dealers, DoA (Township office), DoA (Seed Farm) and DAR (Research farms).

4.4.1 Seed distribution and marketing channels of Sin Thu Kha rice variety in Maubin Township

Figure 4.8 shows the rice seed distribution and marketing channels of Sin Thu Kha in Maubin. According to the market survey, the seeds were flowed originally from DAR (Research farms) as registered seed (RS) then DoA (Township office) distributed to contact farmers and seed growers. The certified seeds (CS) produced by seed growers flowed via seed dealers and other farmers or directly to the farmers. DAR (Research farms) also delivered directly to seed dealers and selected farmers.

Based on the survey data, the farmers purchased the seeds from 45% of DoA (Township office), 16% of seed growers, 13% of other farmers, each 3% of DAR (Research farms) and seed dealers. These farmers also used the seeds from 20% of their own seeds. All seed growers got the seeds from DoA (Township office) and other farmers received the seeds from 54% of seed growers and 46% of contact farmers. The seed dealers obtained the seeds from 67% of DAR (Research farms) and 33% of seed growers. DoA (Township office) received fully the seeds from DAR (Research farms).

Table 4.17 Farmers' practices for own seed production in the study areas

Item	Maubin (N=48)	Daik U (N=42)
	Frequency	Frequency
Seed selection from		
Specific field*	10 (20)	17 (40)
Good panicles from the field	8 (17)	11 (27)
Good panicles after harvesting	30 (63)	14 (33)
Agronomic practices before harvesting		
Weeding	6 (13)	3 (7)
Rouging	23 (47)	33 (79)
None	19 (40)	6 (14)
Specific post-harvest processing for seed		
Yes	38 (79)	32 (76)
No	10 (21)	10 (24)
Storage facility		
Polyethylene bag	38 (79)	10 (24)
Earthen pot	1 (2)	6 (14)
Tin	-	1 (2)
Bamboo granary	9 (19)	25 (60)
Storage duration (month)		
Average	4.5	4.8
Maximum	6	7
Minimum	1	2

Note: Figures in the parentheses represent percentage.

*Specific field means the field which is indented to use for seed production.

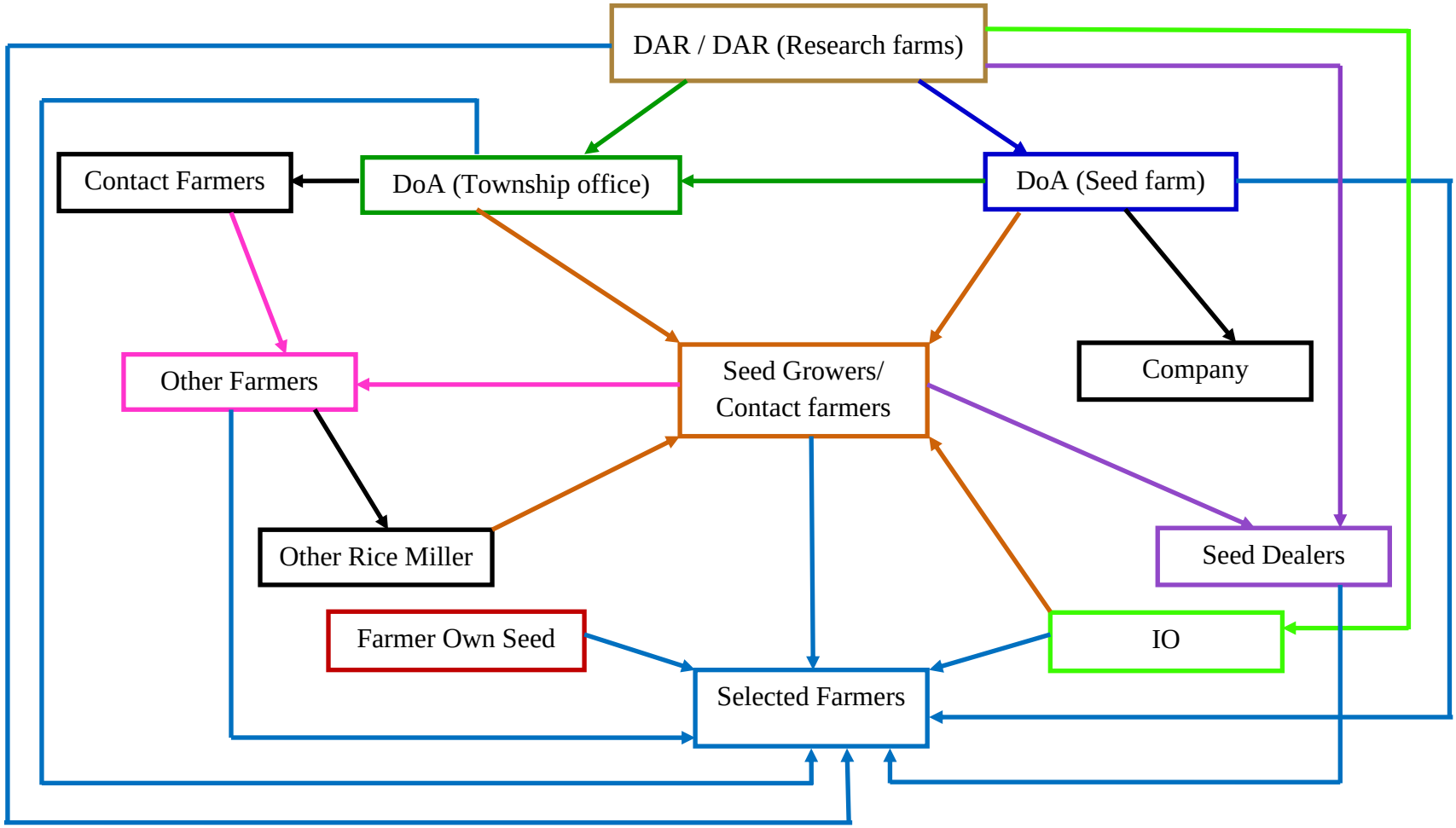


Figure 4.7 Distribution and marketing channels of rice quality seed in the study areas

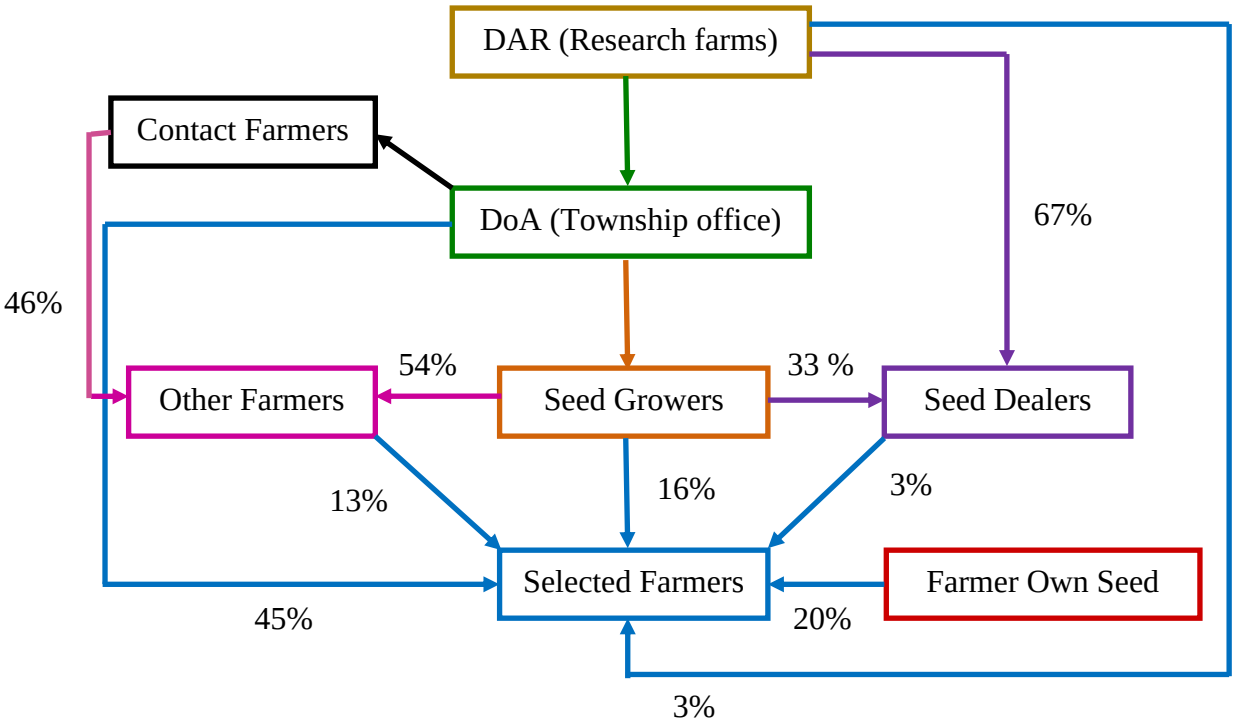


Figure 4.8 Seed distribution and marketing channels of Sin Thu Kha variety in Maubin Township (N=31)

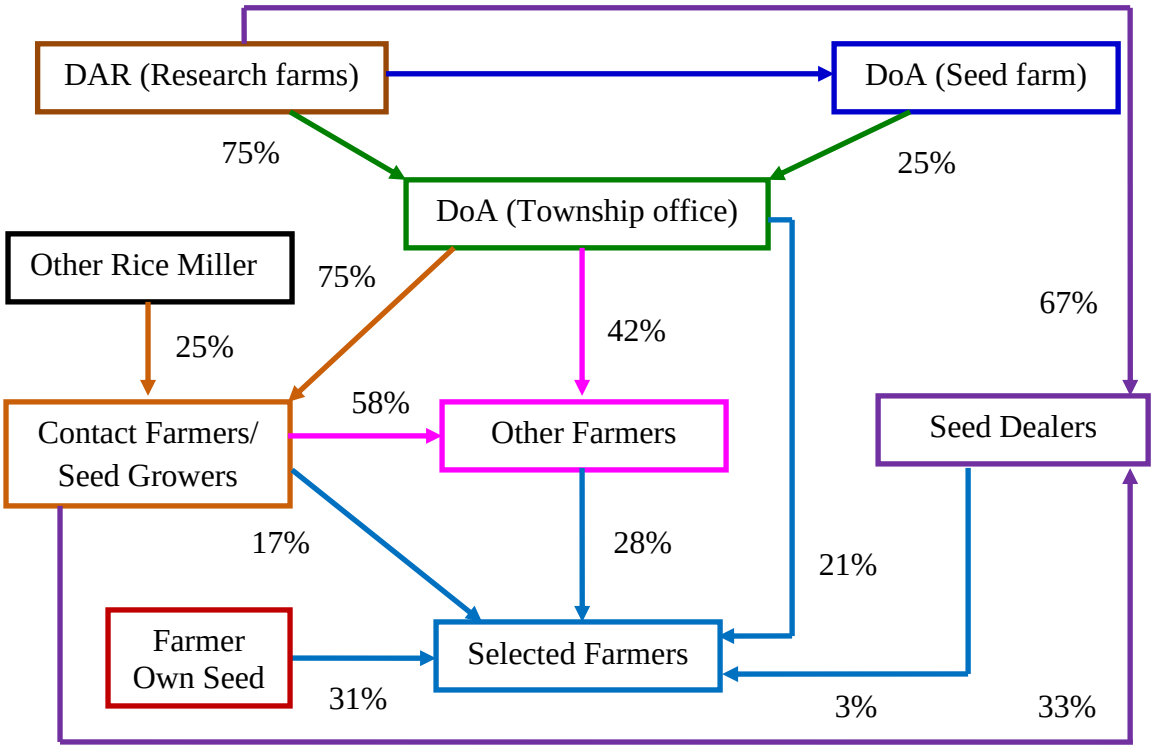


Figure 4.9 Seed distribution and marketing channels of Thee Htat Yin variety in Maubin Township (N=30)

4.4.2 Seed distribution and marketing channels of Thee Htat Yin rice variety in Maubin Township

Figure 4.9 presents the rice seed distribution and marketing channels of Thee Htat Yin in Maubin. According to the market survey, the seeds were delivered originally from DAR (Research farms) as registered seed (RS) then DoA (Township office) distributed to contact farmers and seed growers. The certified seeds (CS) produced by contact farmers was flowed via from seed dealers to the farmers or directly to the farmers. DAR (Research farms) also distributed directly to seed dealers. Rice miller located from other township distributed directly the seeds to the seed growers that producing good seeds.

Based on the survey data, the seeds were delivered from other farmers (28%), DoA (Township office) (21%), contact farmers or seed growers (17%) and seed dealers (3%) to the farmers. Also farmer owned seeds (31%) were used by farmers. About 75% of DoA (Township office) and 25% of rice miller offered the seeds to contact farmers or seed growers. Other farmers utilized the seeds from 58% of contact farmers or seed growers and 42% of DoA (Township office). The seeds from 67% of DAR (Research farms) and 33% of seed growers were delivered to seed dealers. DoA (Township office) got the registered seeds from two supplies that were DAR (Research farms) (75%) and DoA (Seed farm) (25%).

4.4.3 Seed distribution and marketing channels of Hmawbi-2 rice variety in Daik U Township

Figure 4.10 displays the rice seed distribution and marketing channels of Hmawbi-2 variety in Daik U. According to the market survey, the seeds were flowed originally from DAR as breeder seed (BS) and foundation seed (FS) then DoA (Seed farms) distributed to seed growers, farmers and company located in other region. If there was high demand, the certified seeds were produced directly by both DAR (Research farms) and DoA (Seed farms) for the market. The good seeds produced by seed growers distributed to the farmers.

In these marketing and distribution channels, the farmers used the rice quality seeds from 50% of their saved seeds, 22% of DoA (Seed farms), each 14% of seed growers and other farmers. The other farmers offered the good seeds to selected farmers had the sources that were DoA (Seed farms) (83%) and seed growers (17%). Seed growers received completely the good quality seed from DoA (Seed farms) based on the survey data.

4.4.4 Seed distribution and marketing channels of Sin Thu Kha rice variety in Daik U Township

Figure 4.11 illustrates the rice seed distribution and marketing channels of Sin Thu Kha variety in Daik U. According to the market survey, the seeds were flowed originally from DAR as breeder seed (BS) and foundation seed (FS) then DoA (seed farms) supplied to seed growers and farmers. In practice also both DAR and DOA seed farms produce certified seed directly for the market. The good seeds produced by seed growers flowed to the farmers.

In these marketing and distribution channels, the seeds from 48% of farmer own seeds, 24% of DoA (Seed farms), 16% of other farmers and each 6% of seed growers and rice miller. DoA (Seed farms) distributed the seeds to seed growers and other farmers with fully percentage.

4.5 Sources of Market Information Received by Seed Growers for Rice Seed in the Study Areas

Figure 4.12 illustrates the sources of market information received by seed growers for the rice seed in Maubin Township. In this figure, the seed growers received the market information from farmers (36%), extension workers (64%) and broker (21%). According to this result, the role of extension workers is important for information because most of seed growers were contact farmers having a good linkage with them.

Figure 4.13 describes the sources of market information received by seed growers for the rice seed in Daik U Township. In this, there were two sources, extension workers and farmers, giving the marketing information concerned with good quality rice seeds equally (each 50%).

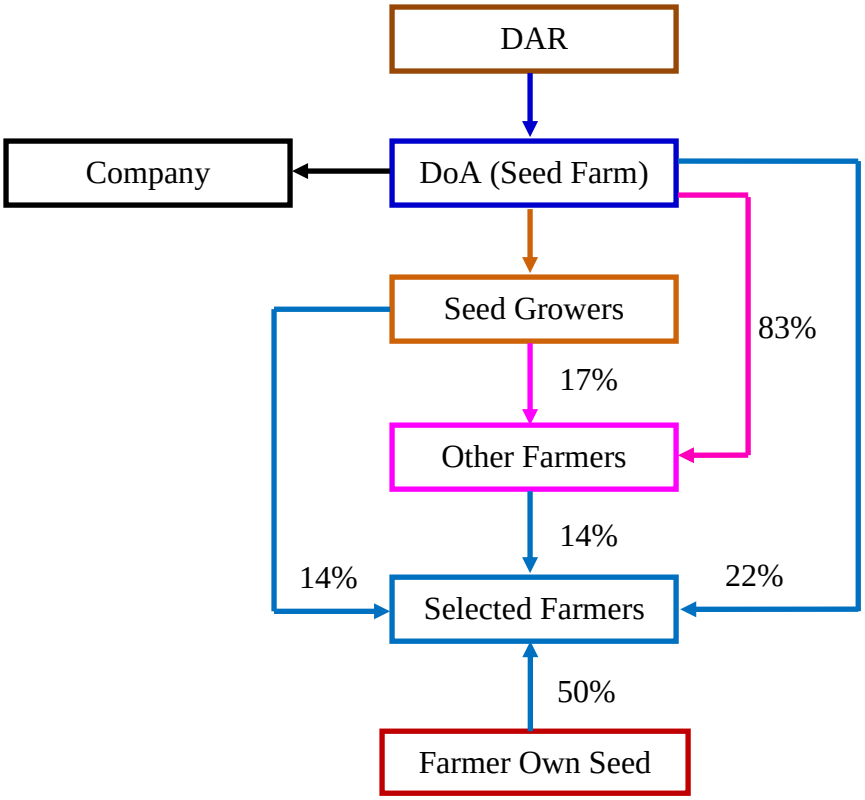


Figure 4.10 Seed distribution and marketing channels of Hmawbi-2 variety in Daik U Township (N=35)

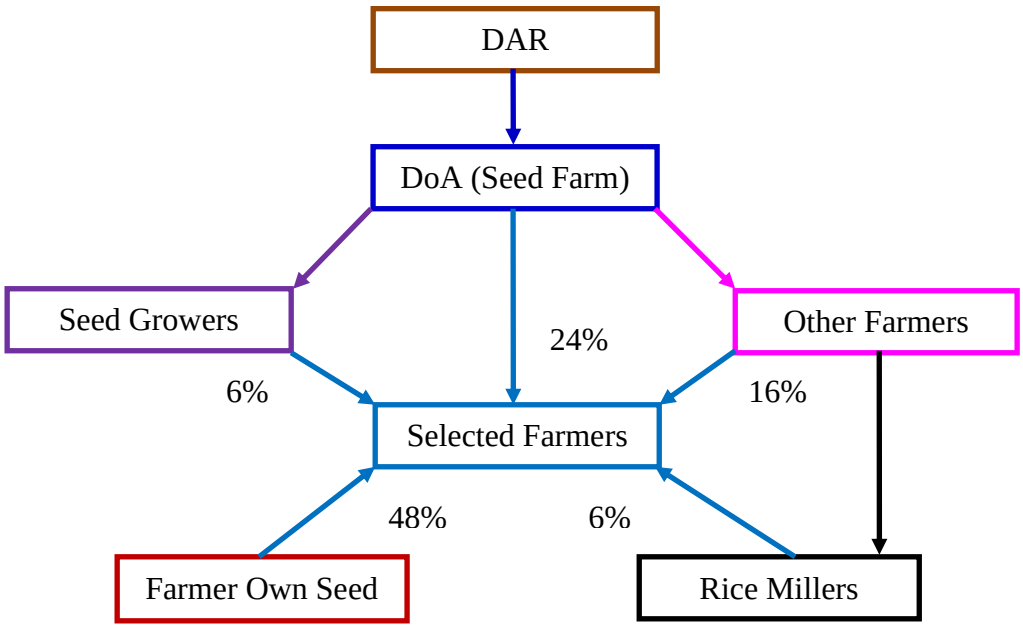


Figure 4.11 Seed distribution and marketing channels of Sin Thu Kha variety in Daik U Township (N=30)

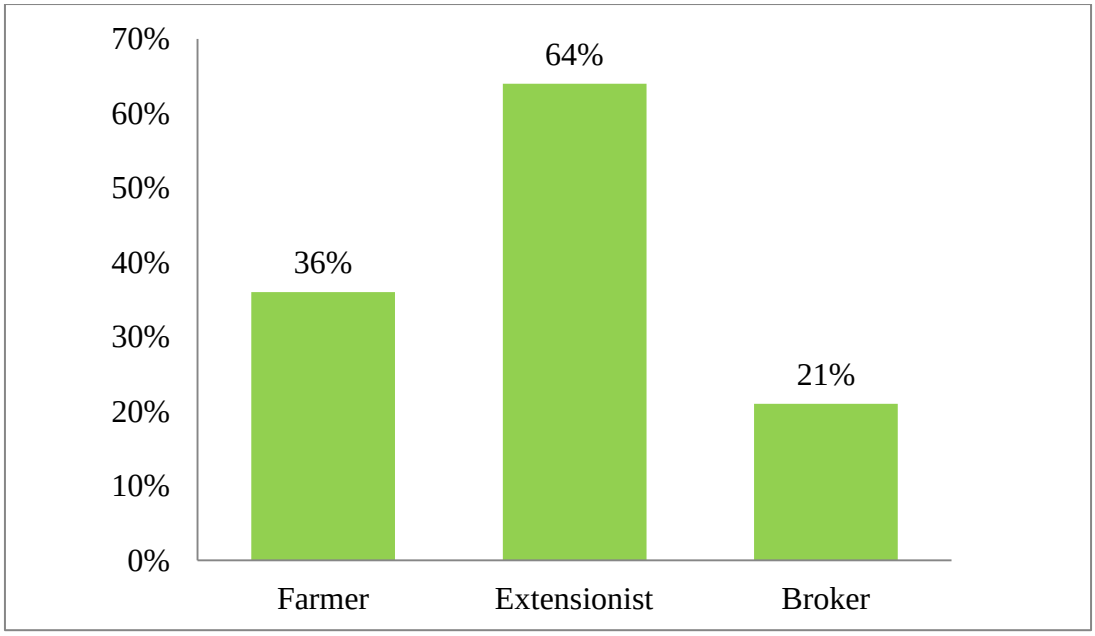


Figure 4.12 Sources of market information received by seed growers for rice seed in Maubin Township (N=14)

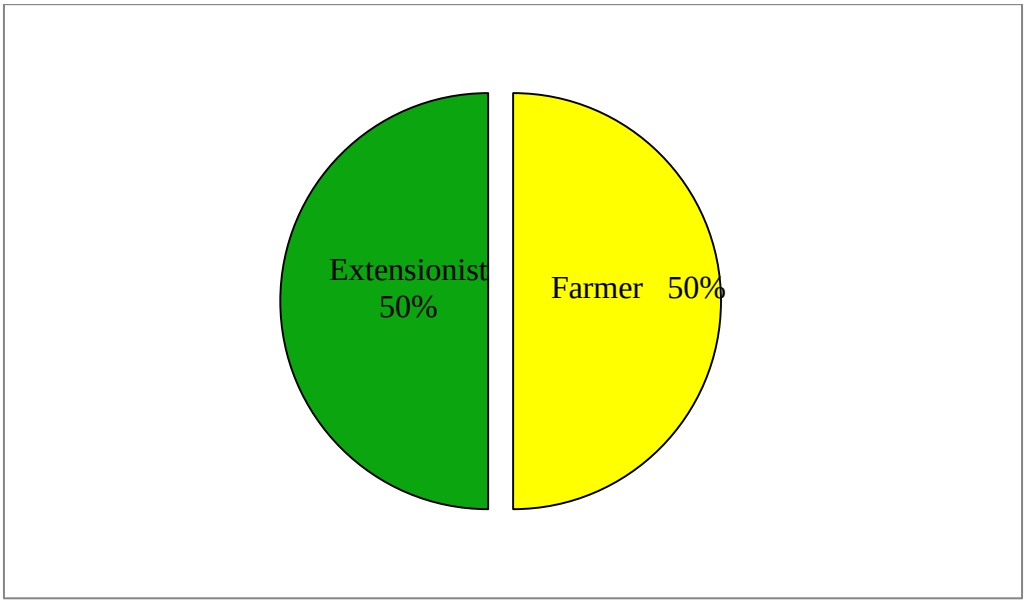


Figure 4.13 Sources of market information received by seed growers for rice seed in Daik U Township (N=2)

4.6 Factors Influenced on Setting Seed Price

Price is one of the most effective marketing tools available to seed producers.

4.6.1 Factors influenced on setting rice seed price for seed growers and seed dealers in Maubin Township

In Maubin, the setting price of rice seeds can be determined by many factors. They are seed price of other variety, demand of seed, type of variety and quality of seeds as shown in Figure 4.14. Regarding to the survey data, the quality (37%) was the major dominance on seed price determination. If the seed is lack of other varieties, dusts, diseased seeds and weeds, the yield can be increased to 5-20% (IRRI). The demand of seed, type of variety and seed price of other varieties were the same proportion to become the seed price. In this area, the seed growers were price takers because the major buyers were seed dealers.

The seed dealers were price searchers for the product (rice quality seed). They decided the price of rice seed to set depending on the quality of seeds, demand of seed and type of variety concerning with Figure 4.15. The quality (50%) was also the major factor for seed price determination and following evenly the demand and variety, 25% in each.

4.6.2 Factors influenced on setting rice seed price for seed growers in Daik U Township

Figure 4.16 shows off the setting seed price determination for seed growers in the study area. In this figure, the determination of seed price was powered by equally ratio of the quality and demand.

According to these results, there were more determinants of seed prices in Maubin than that of seed prices in Daik U. This was because there were more market intermediaries and rice varieties in Maubin Township.

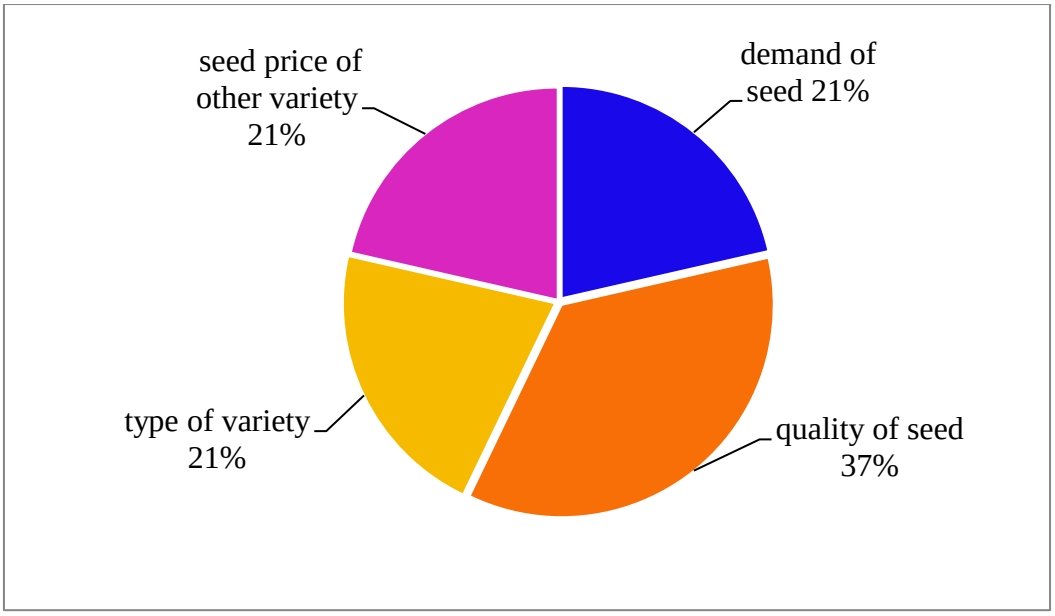


Figure 4.14 Factors influenced on setting rice seed price for seed growers in Maubin Township (N=14)

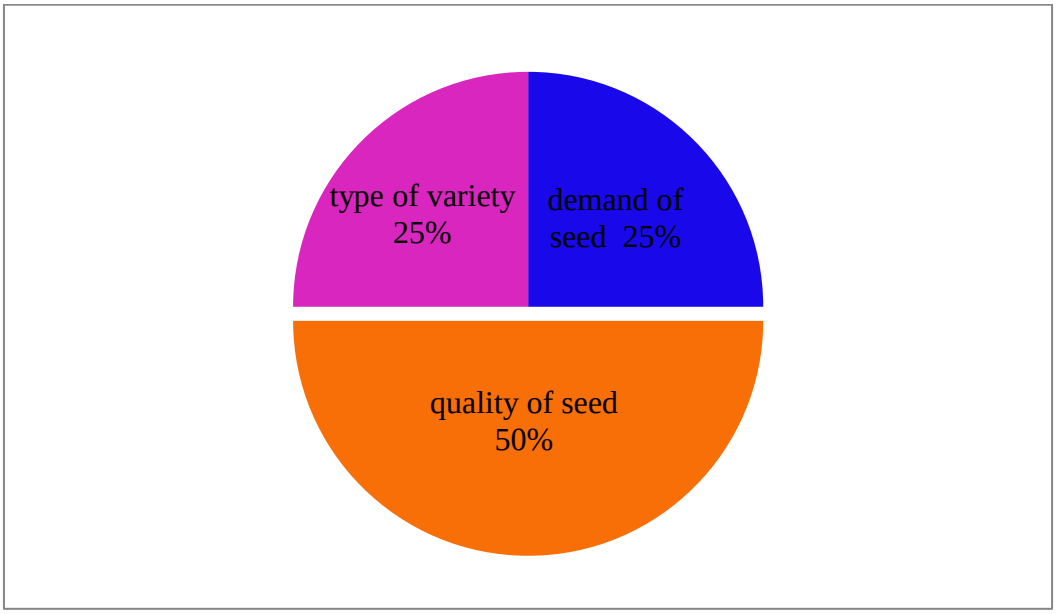


Figure 4.15 Factors influenced on setting rice seed price for seed dealers in Maubin Township (N = 4)

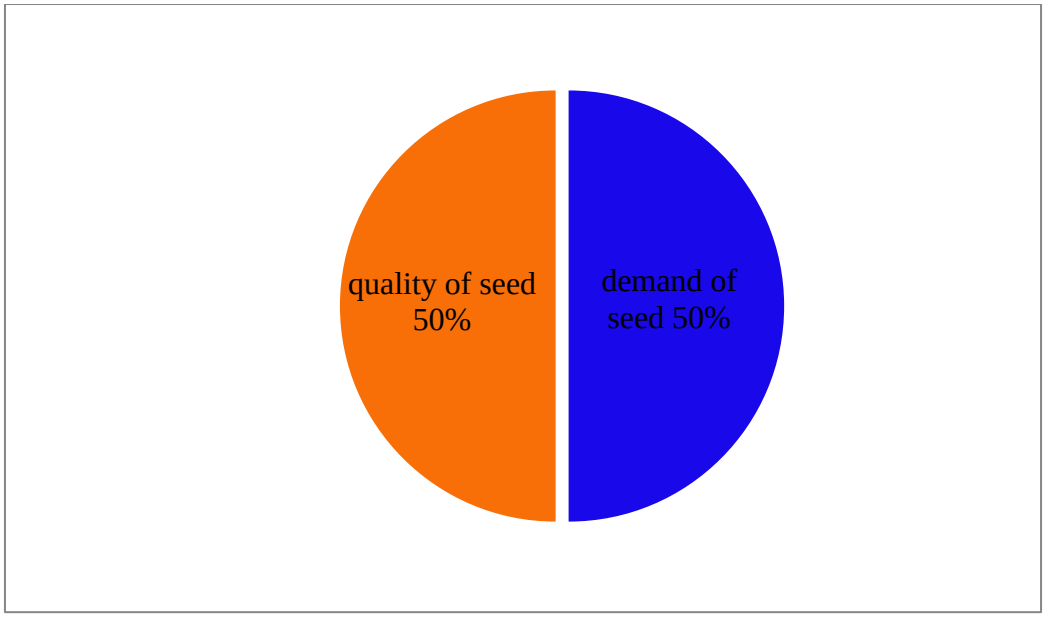


Figure 4.16 Factors influenced on setting seed price for seed growers in Daik U Township (N=2)

4.7 Awareness on Quality Seed by Sample Farmers

4.7.1 Awareness on quality seed by sample farmers in Maubin Township

This is the main part of the objective 3 and it is to find the awareness on quality seed by measuring their attitudes and perceptions based on their agricultural knowledge. The purpose of the study is to find out the factors or situations which might have a relationship with their awareness on quality seed.

Table 4.18 indicates average, minimum and maximum scores of sample farmers' awareness on quality seed in Maubin Township. The average awareness score of sample farmers was 2.63 about the difference between seed and grain (statement number 1). It explained that sample farmers had a good knowledge of seed and its difference from grain.

The average score for statement number (2) that is the benefit of using quality seeds was 2.97. They had knowledge about good quality seeds leads to lower seed rate, better emergence, more uniformity, less replanting, and vigorous early growth which helps to increase resistance to insects and diseases, and decrease weeds resulting in higher yield.

The average score relating to the more important of quality seed than the other inputs (statement number 3) was 2.82. It mentioned that the knowledge upon the role of quality seeds by the sample farmers was good. For statement number (4) concerned with higher yield by using quality seeds, the average score was 3. It represented that the sample farmers comprehended absolutely this statement.

In statement number (5), the sample farmers knew that the rice seed used can be reduced if the seeds are quality according to the average score, 2.97. In statement number (6), the average score was 2.82. It explained that the farmers knew the source of quality seed to buy.

The sample farmers had a poor knowledge on the statement number (7) that is testing the germination percentage of quality seed because the average score was 2.30. This statement is technical issue. If there was a good extension service, the farmers will know to test the germination percentage after getting the seeds to grow. The statement number (8) was how to identify the quality seeds. In this statement, the average score was 2.48 that caused the farmers who had a weak knowledge about this.

Most of the sample farmers knew a little about the certified seeds because of average score (1.2) in statement number (9). Only very few farmers knew the certified seeds by participating the rice seed production training. The mean score was 2.33 in

statement number (10) that do you know the approved seed certificate by Government is important? Only some of the sample farmers knew the importance of certificate by government upon the seeds. In statement number (11) concerning with the importance of the field inspection and laboratory test for quality seed production, the average score was 2.43. It stated that the sample farmers had a poor knowledge on how the importance of the field inspection and laboratory test for quality seed production.

The statement number (12) was how to manage the quality seed production. In this, the average score was 2.06 happening to a little knowledge by sample farmers. The last statement of Table 4.21 was how to manage the seed to maintain quality after getting from others. In this case, the sample farmers had a poor knowledge on the management for maintaining the quality after receiving the rice seeds from others.

Table 4.19 shows awareness index of sample farmers by range. Higher awareness index means more knowledge on quality seed by sample farmers. Three different ranges of awareness index were separated with frequency distribution. According to the response of sample farmers, the highest awareness index was 1.00 and the lowest index was 0.31. Average index of 0.77 means there was high awareness of quality seed knowledge by sample farmers. The sample farmers (36%) have the range of 0.35 to 0.69 of medium awareness index. High awareness index (0.70 - 1.00) was found in responses of 63% of sample farmers. There were only 1% of sample farmers who had limited awareness.

4.7.2 Awareness on quality seed by sample farmers in Daik U Township

As revealed in Table 4.20, there were also 13 statements to become the aware of quality seed by sample farmers like Maubin. These statements were whether or not to know about (1) the difference between seed and grain, (2) the benefit of using quality seed, (3) the more importance of quality seed than the other inputs, (4) giving higher yield by the use of quality seed, (5) reduction in the seed rate by using quality seed, (6) source of quality seed to buy, (7) testing the germination percentage of quality seed, (8) the identification of the quality, (9) knowing the certified seeds, (10) the importance of certificate by Government upon the seeds, (11) the importance of the field inspection and laboratory test for quality seed production, (12) management of quality seed production and (13) management for maintaining quality after getting the seeds from others.

Table 4.18 Quality seed awareness scores by sample respondents in Maubin Township

No.	Statement	Mean	Min.	Max.
1	Do you know the difference between seed and grain?	2.63	1	3
2	Do you know the benefit of using quality seeds?	2.97	2	3
3	Do you know the quality seed is more important than the other inputs?	2.82	1	3
4	Do you know the use of quality seed will give you a higher yield?	3.00	3	3
5	Do you know if you use quality seed, the seed rate can be reduced than current seed rate?	2.97	2	3
6	Do you know the source of quality seed to buy?	2.82	1	3
7	Do you know to test the germination percentage of quality seed?	2.30	1	3
8	Do you know the identification of the quality seed?	2.48	1	3
9	Do you know the certified seeds?	1.82	1	3
10	Do you know the approved seed certificate by Government is important?	2.33	1	3
11	Do you know the importance of the field inspection and laboratory test for quality seed production?	2.43	1	3
12	Do you know how to manage the quality seed production?	2.06	1	3
13	Do you know how to manage the seed to maintain quality after getting from others?	2.27	1	3

Table 4.19 Quality seed awareness index of sample respondents for the knowledge of quality seed in Maubin Township (N= 67)

Range of Awareness Index	Definition	Percent of respondents
0.00 – 0.34	Limited Awareness	1
0.35 – 0.69	Medium Awareness	36
0.70 – 1.00	High Awareness	63
Total		**100**

In the statement number 1,2,3,4,5,6, 8 and 11, the sample farmers had a good know-how concerned with each statement since the average scores were 2.77, 2.89, 2.92, 2.91, 2.85, 2.77,2.58 and 2.72, respectively.

The average score was 2.36 in statement number 7. It represented that the sample farmers had a poor knowledge to test the seed germination percentage. Most of farmers knew a very little about the certified seeds according to the average score (1.79) in the statement number 9. As the average score was 2.47 in statement number 10, the sample farmers had a weak knowledge related to the importance of certificate by government on seed. Regarding to the management of quality seed production and for maintaining the quality after getting the seeds from others (statement number 12 and 13), the average scores were 2.09 and 2.38. It explained that there was a poor knowledge on these statements by sample farmers.

Table 4.21 explains awareness index of sample farmers by range. According to the response of sample farmers, the highest awareness index was 1.00 and the lowest index was 0.08. Average index of 0.79 that means there was high awareness of quality seed knowledge by sample farmers. Majority of sample farmers (70%) have the range of 0.70 to 1.00 of awareness index. This range was also a high awareness index by responses of sample farmers. There were 26% of sample farmers having medium awareness and 4% of sample farmers who had limited awareness on quality seed.

4.7.3 Awareness on quality seed by sample farmers of Maubin and Daik U Township

In this study, it involved farmers' awareness on quality seed in Maubin and Daik U Township. Table 4.22 states the comparison of quality seed awareness index and the average awareness index by sample farmers of Maubin and Daik U Township. Based on the townships, the maximum awareness index was 1.00. In addition, the minimum awareness index of sample farmers in Maubin and Daik U were 0.31 and 0.80, respectively. Regarding the data received from the studied areas, the average awareness index of sample farmers of Daik U (0.79) was nearly the same with that of Maubin (0.77).

Table 4.20 Quality seed awareness scores by sample respondents in Daik U Township

No.	Statement	Mean	Min.	Max.
1	Do you know the difference between seed and grain?	2.77	1	3
2	Do you know the benefit of using quality seeds?	2.89	1	3
3	Do you know the quality seed is more important than the other inputs?	2.92	1	3
4	Do you know the use of quality seed will give you a higher yield?	2.91	1	3
5	Do you know if you use quality seed, the seed rate can be reduced than current seed rate?	2.85	1	3
6	Do you know the source of quality seed to buy?	2.77	1	3
7	Do you know to test the germination percentage of quality seed?	2.36	1	3
8	Do you know the identification of the quality seed?	2.58	1	3
9	Do you know the certified seeds?	1.79	1	3
10	Do you know the approved seed certificate by Government is important?	2.47	1	3
11	Do you know the importance of the field inspection and laboratory test for quality seed production?	2.72	1	3
12	Do you know how to manage the quality seed production?	2.09	1	3
13	Do you know how to manage the seed to maintain quality after getting from others?	2.38	1	3

Table 4.21 Quality seed awareness index of sample respondents for the knowledge of quality seed in Daik U Township (N= 53)

Range of Awareness Index	Definition	Percent of respondents
0.00 – 0.34	Limited Awareness	4
0.35 – 0.69	Medium Awareness	26
0.70 – 1.00	High Awareness	70
Total		**100**

Table 4.22 Comparison of quality seed awareness index for the knowledge of quality seed by sample farmers in the study areas

Quality Seed Awareness Index	Township	
	Maubin (N=67)	Daik U (N=53)
Mean	0.77	0.79
Maximum	1.00	1.00
Minimum	0.31	0.80
Standard Deviation	0.16	0.20

Table 4.23 Farmers' perceptions to price, availability and satisfaction of formal rice seed use in the study areas

Issues	Percentage of sample farmers			
	Strongly Agree	Agree	Disagree	Neutral
Maubin (N=67)				
Quality seeds are generally expensive	7	60	21	12
Quality seeds are not readily available	15	66	15	4
Quality seeds give satisfaction for yield	12	57	22	9
Daik U (N=53)				
Quality seeds are generally expensive	19	43	30	8
Quality seeds are not readily available	15	57	21	8
Quality seeds give satisfaction for yield	17	53	19	11

4.7.4 Farmers' perceptions to price, availability and satisfaction of formal rice seed use in the study areas

The results on Table 4.23 showed that about 60%, 66% and 57% of farmers respectively agreed with the notions that quality seeds are generally expensive, not readily available and give satisfaction for yield in Maubin Township while 43%, 57% and 53% of farmers in Daik U also agreed with these three facts. Although the farmers had an agreement on quality seeds that were expensive, they had a wiliness to buy. And the famers were facing unavailability of quality seeds from formal sectors. The farmers accepted the fact that the production will be increased by quality seed with favorable environment such as fair climate, low incidence of pests, etc.

4.8 Factors Affecting the Demand of Quality Seed in Rice Production in the Study Areas

To determine the factors affecting the demand of agricultural quality seed, linear regression function was employed. The specific input demand function of rice production was estimated by using these variables: household head's experience, household head's education, family labor, current seed price, lagged grain price, distance to seed sources, awareness index, fertilizer quantity used, farm income, other income, cropping intensity, access to extension service and payment system (buying seed in credit).

4.8.1 Descriptive statistics of dependent and independent variable of quality seed demand function in rice production

According to the descriptive statistics, average quantity of seed applied by sample farmers was 119 (kg/ha), average household head's education level (schooling year) was 8 years, average household head's experience was 25 years, average family labor was 3 persons, average current seed price was 289 (MMK/kg), average lagged grain price was 188 (MMK/kg), average distance to seed sources was 6 km, average awareness index was 0.61, average fertilizer quantity used was 113 (kg/ha), average farm income was 6,620,329 (MMK/year), average other income was 1,554,554 (MMK/year) and average cropping intensity was 165% as revealed in Table 4.24.

Based on the results shown in Table 4.25, rice quality seed demand per unit area was negatively affected by household head's schooling year at highly significant level. It means that if household head's schooling year increases by 1%, quality seed demand will be 0.271% decreased. It showed that the farmers decided that there was a more benefit by reducing the amount of quality seed (52 or 103 kg/ha) than usual amount (i.e. 182 or 208

kg/ha). Demand quantity of quality seed was positively related to cropping intensity lagged grain price and awareness index at 5% level. If cropping intensity increases by 1% seed demand will increase by 0.248%. If lagged grain price increases by 1%, quality seed demand will be increased by 0.545%. Other things being equal, 1% increase in awareness index will increase quality seed demand by 0.141%. The applied quantity of quality seed was negatively related to the current seed price at 5% level. It indicates that if current seed price increases by 1%, quality seed demand will be 0.263% decreased. In the case of price elasticity, the unstandardized B was less than unity (B<1), implying that the demand for quality seed was inelastic. The seed demand for rice production was positively affected by fertilizer quantity and negatively by household head's experience at 10% level. If the fertilizer amount used is increased by 1%, the seed will be increased by 0.044%.. In the case of household head's experience, 1% increase in experience, quality seed amount will be 0.086% decreased. It is implying that most of aged farmers use the required amount instead of more using amount because they know the agro-climatic conditions particularly weather condition by their experience.

Table 4.24 Descriptive statistics of dependent and independent variables in rice quality seed demand function

Variables	Unit	Min.	Max.	Mean	Std. Deviation
Demanded quantity of rice quality seed	kg/ha	52	261	119	33.36
Household head's schooling year	Year	4	14	8	2.83
Household head's experience	Year	3	55	25	11.07
Cropping intensity	Percent	163	478	289	66.50
Family labor	Number	1	6	3	1.06
Current seed price	MMK/kg	163	478	289	66.50
Lagged grain price	MMK/kg	144	287	188	21.87
Distance to seed sources	km	0	160	6	15.84
Awareness index		0.05	1	0.61	0.19
Fertilizer quantity used	kg/ha	0	247	113	65.11
Farm income	MMK/yr	630000	37080000	6620329	6932662
Other income	MMK/yr	0	25000000	1554554	3327756

N = 120

Table 4.25 Factors affecting the demand of quality seed for rice production in the study areas

Independent variables	Unstandardized coefficient (β)	Standardized coefficient (B)	t-value	Sig.
(Constant)	4.223***		3.436	.001
Household head's experience	-.086*	-.183	-1.723	.088
Household head's schooling year	-.271***	-.359	-3.594	.000
Cropping intensity	.248**	.231	2.512	.014
Total family labor	.103^{ns}	.147	1.576	.118
Current seed price	-.263**	-.218	-2.047	.043
Lagged grain price	.545**	.222	2.356	.020
Distance to seed sources	.035 ^{ns}	.152	1.479	.142
Awareness index	.141**	.208	2.025	.045
Fertilizer quantity used	.044*	.151	1.664	.099
Farm income	.042 ^{ns}	.132	1.319	.190
Other income	.004 ^{ns}	.083	.935	.352
Access to extension service	.075 ^{ns}	.138	1.340	.183
Payment system (buying seed in credit)	.090 ^{ns}	.043	.478	.634

Note: R^2 = (0.277), F = (0.128)

4.8.2 Descriptive statistics of dependent and independent variable of quality seed demand function in Sin Thu Kha rice production in Maubin Township

Table 4.26 shows that the descriptive statistics of dependent and independent variables of quality seed demand function for Sin Thu Kha rice production. Average quantity of seed applied by sample farmers was 114 (kg/ha), average household head's education level (schooling year) was 7 years, average household head's experience was 26 years, average family labor was 3 persons, average current seed price was 360 (MMK/kg), average lagged grain price was 182 (MMK/kg), average distance to seed sources was 13.6 km, average awareness index was 0.62, average fertilizer quantity used was 105 (kg/ha), average farm income was 6,369,945 (MMK/year), average other income was 712,612 (MMK/year) and average cropping intensity was 173%.

The results of the estimation of demand function of quality seed for sample farmers were described in Table 4.27. Demand quantity of rice quality seed was positively influenced by distance to seed sources at highly significant level. The farmers will use the seed by 0.160% increased if the distance to seed sources will be near by 1%. Distance is a major obstacle for adoption of technologies in developing countries. It is a greater challenge to adopt technologies across different latitudes and varying ecological conditions (Sunding et al. 2000). Much of the sluggish uptake of quality seed would be explained by the current seed price and household head's experience. This implied that lower current seed price and more household head's experience would likely lead to increased demand for quality seeds and decreased quality seed demand. Specifically, 1% decrease in current seed price will lead to increase 0.514% of quality seed demand and 1% increase in household head's experience, the quality seed demand will be 0.097% decreased.

Table 4.26 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Sin Thu Kha variety in Maubin Township

Independent variables	Unit	Min.	Max.	Mean	Std. Deviation
Demanded quantity of rice quality seed	kg/ha	52	156	114	31.41
Household head's schooling year	Year	5	12	7	2.06
Household head's experience	Year	4	48	26	11.84
Cropping intensity	Percent	100	200	173	35.73
Family labor	Number	1	5	3	0.93
Current seed price	MMK/kg	191	478	360	108.29
Lagged grain price	MMK/kg	153	191	182	8.89
Distance to seed sources	km	0	160	13.6	28.02
Awareness index		0.36	0.92	0.62	0.19
Fertilizer quantity used	kg/ha	32	205	105	44.47
Farm income	MMK/yr	1622000	28820000	6369945	5350222
Other income	MMK/yr	0	4950000	712612	999367

N = 31

Table 4.27 Factors affecting the demand of quality seed for Sin Thu Kha rice production in Maubin Township

Independent variables	Unstandardized coefficient (β)	Standardized coefficient (B)	t-value	Sig.
Constant	8.134***		3.136	.006
Household head's experience	-.097 ns	-.201	-.629	.538
Household head's schooling year	-.288 ns	-.242	-1.129	.275
Cropping intensity	-.328 ns	-.219	-1.122	.278
Total family labor	.133 ns	.158	.899	.381
Current seed price	-.514*	-.418	-1.989	.063
Lagged grain price	.134 ns	.049	.268	.792
Distance to seed sources	.160***	.731	3.499	.003
Awareness index	.510**	.498	2.534	.021
Fertilizer quantity used	.110 ns	.229	1.370	.189
Farm income	.009 ns	.024	.092	.928
Other income	.005 ns	.086	.504	.621
Access to extension service	-.016 ns	-.016	-.101	.921
Payment system (buying seed in credit)	.029 ns	.016	.065	.949

Note: R^2 = (0.659), F = (2.522)

4.8.3 Descriptive statistics of dependent and independent variable of quality seed demand function in Thee Htat Yin rice production in Maubin Township

As described in Table 4.28, average quantity of seed applied by sample farmers was 134 (kg/ha), average household head's education level (schooling year) was 7 years, average household head's experience was 21 years, average family labor was 3 persons, average current seed price was 303 (MMK/kg), average lagged grain price was 178 (MMK/kg), average distance to seed sources was 4.43 km, average awareness index was 0.58, average fertilizer quantity used was 127 (kg/ha), average farm income was 4,729,698 (MMK/year), average other income was 1,089,733 (MMK/year) and average cropping intensity was 159%.

The results of the estimation of demand function of quality seed for sample farmers were described in Table 4.29. Demand quantity of rice quality seed was negatively influenced by cropping intensity at 5% level. The seed demand will be decreased by 0.692% if there is a 1% increase in cropping intensity. The demand of quality seed will be increased by 0.336% while the awareness index is increased by 1% because of positive relationship between seed demand and awareness index.

4.8.4 Descriptive statistics of dependent and independent variable of quality seed demand function in Hmawbi-2 rice production in Daik U Township

As revealed in Table 4.30, average quantity of seed applied by sample farmers was 130 (kg/ha), average household head's education level (schooling year) was 8 years, average family labor was 3 persons, average current seed price was 288 (MMK/kg), average lagged grain price was 191 (MMK/kg), average distance to seed sources was 0.48 km, average awareness index was 0.68, average fertilizer quantity used was 113 (kg/ha), average farm income was 9,244,687 (MMK/year), average other income was 2,915,667 (MMK/year) and average cropping intensity was 139%, average sown area was 6 hectare and average seed renewal period was 2 years.

According to the results described in Table 4.31, the sown area and the farm income influenced positively the quality seed demand at 5% level. The seed demand will be increased by 0.272% if there is a 1% increase in sown area. Similarly, a 1% increase in farm income will lead to increase the seed demand by 0.311%. The rice quality seed demand was negatively correlated with family labor at 10% level. In particular, 1% increase in family labor, the quantity of seed will be 0.366% decreased.

Table 4.28 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Thee Htat Yin variety in Maubin Township

Independent variables	Unit	Min.	Max.	Mean	Std. Deviation
Demanded quantity of rice quality seed	kg/ha	78	182	134	30.44
Household head's schooling year	Year	4	14	7	3.06
Household head's experience	Year	3	48	21	12.10
Cropping intensity	Percent	100	200	159	39.18
Family labor	Number	1	5	3	0.92
Current seed price	MMK/kg	191	454	303	63.86
Lagged grain price	MMK/kg	162	200	177	10.98
Distance to seed sources	km	0	19.20	4.43	7.14
Awareness index		0.31	0.92	0.58	0.18
Fertilizer quantity used	kg/ha	10	247	127	80.09
Farm income	MMK/yr	630000	14000000	4729698	3931284
Other income	MMK/yr	0	4950000	1089733	1162827

N = 30

Table 4.29 Factors affecting the demand of quality seed for Thee Htat Yin rice production in Maubin Township

Independent variables	Unstandardized coefficient (β)	Standardized coefficient (B)	t-value	Sig.
Constant	9.864***		3.544	.002
Household head's experience	.090^{ns}	.220	.620	.544
Household head's schooling year	-.169^{ns}	-.235	-.780	.446
Cropping intensity	-.692**	-.635	-2.936	.009
Total family labor	-.048^{ns}	-.057	-.223	.826
Current seed price	-.016^{ns}	-.013	-.049	.961
Lagged grain price	-.205^{ns}	-.065	-.325	.749
Distance to seed sources	.020^{ns}	.087	.342	.737
Awareness index	.336*	.383	1.873	.078
Fertilizer quantity used	.045^{ns}	.104	.381	.708
Farm income	-.055^{ns}	-.166	-.590	.563
Other income	-.003^{ns}	-.074	-.424	.677
Access to extension service	.171^{ns}	.305	1.317	.205

Note: R^2 = (0.691), F = (3.174)

Table 4.30 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Hmawbi-2 variety in Daik U Township

Independent variables	Unit	Min.	Max.	Mean	Std. Deviation
Demanded quantity of rice quality seed	kg/ha	52	209	130	35.31
Household head's schooling year	Year	4	14	8	3.17
Sown area	Hectare	1	16	6	4.87
Cropping intensity	Percent	100	200	139	31.23
Family labor	Number	1	5	3	1.13
Current seed price	MMK/kg	239	383	288	50.84
Lagged grain price	MMK/kg	167	215	191	10.55
Distance to seed sources	km	0	3.20	0.48	0.81
Awareness index		0.05	1	0.68	0.19
Fertilizer quantity used	kg/ha	40	185	113	45.50
Farm income	MMK/yr	1450000	35010000	9244687	9202728
Other income	MMK/yr	0	25000000	2915667	5655924
Seed renewal period	Year	1	3	2	0.40

N = 30

Table 4.31 Factors affecting the demand of quality seed for Hmawbi-2 rice production in Daik U Township

Independent variables	Unstandardized coefficient (β)	Standardized coefficient (B)	t-value	Sig.
Constant	1.766 ns		.433	.671
Household head's schooling year	-.047 ns	-.079	-.288	.777
Cropping intensity	-.082 ns	-.076	-.283	.781
Total family labor	-.366*	-.636	-2.051	.058
Sown Area	.273**	.960	2.195	.044
Current seed price	.638 ns	.387	1.499	.155
Lagged grain price	-.707 ns	-.227	-.911	.377
Distance to seed sources	-.052 ns	-.181	-.684	.505
Awareness index	.088 ns	.194	.771	.453
Fertilizer quantity used	.011 ns	.023	.088	.931
Farm income	.311**	1.215	2.596	.020
Other income	.002 ns	.042	.180	.860
Access to extension service	-.201 ns	-.422	-1.490	.157

Note: R^2 = (0.519), F = (1.154)

4.8.5 Descriptive statistics of dependent and independent variable of quality seed demand function in Sin Thu Kha rice production in Daik U Township

Table 4.32 describes that the descriptive statistics of dependent and independent variables of quality seed demand function for Sin Thu Kha rice production. Average quantity of seed applied by sample farmers was 131 (kg/ha), average household head's education level (schooling year) was 8 years, average household head's experience was 27 years, average current seed price was 260 (MMK/kg), average lagged grain price was 181 (MMK/kg), average distance to seed sources was 3.97 km, average awareness index was 0.68, average fertilizer quantity used was 98 (kg/ha), average farm income was 9,546,050 (MMK/year), average other income was 2,167,767 (MMK/year), average cropping intensity was 150%, average sown area was 4 hectare and average seed renewal period was 2 years.

The regression results were shown in Table 4.33. According to these, farm income related positively to the demand of quality seed like Sin Thu Kha variety. The seed demand will be increased by 0.196% when the farm income was increased by 1%. The quality seed demand was negatively influenced by cropping intensity and sown area. If the sown area was increased by 1%, the applied amount of quality seed was decreased by 0.21%. Like this, 1% increase in cropping intensity, the quantity of quality seed demanded will be decreased by 0.346%.

Table 4.32 Descriptive statistics of dependent and independent variables in rice quality seed demand function for Sin Thu Kha variety in Daik U Township

Independent variables	Unit	Minimum	Maximum	Mean	Std. Deviation
Demanded quantity of rice quality seed	kg/ha	105	261	131	35.31
Household head's schooling year	Year	4	14	8	3.39
Household head's experience	Year	3	41	27	9.93
Sown area	Hectare	1	13	4	3.10
Cropping intensity	Percent	100	200	150	39.94
Current seed price	MMK/kg	191	383	260	51.71
Lagged grain price	MMK/kg	144	201	181	14.70
Distance to seed sources	km	0	24	3.97	8.54
Awareness index		0.28	1	0.68	0.18
Fertilizer quantity used	kg/ha	0	247	98	50.10
Farm income	MMK/yr	940000	35010000	9546050	9289467
Other income	MMK/yr	0	15462000	2167767	3870273
Seed renewal period	Year	1	3	2	0.82

N=30

Table 4.33 Factors affecting the demand of quality seed for Sin Thu Kha rice production in Daik U Township

Independent variables	Unstandardized coefficient (β)	Standardized coefficient (B)	t-value	Sig.
Constant	1.230^{ns}		.375	.713
Household head's experience	-.054^{ns}	-.168	-.722	.482
Household head's schooling year	-.079^{ns}	-.173	-.689	.502
Cropping intensity	-.346*	-.491	-1.804	.091
Sown Area	-.210*	-.985	-2.020	.062
Current seed price	.224^{ns}	.191	.731	.476
Lagged grain price	.367^{ns}	.137	.654	.523
Distance to seed sources	-.029^{ns}	-.163	-.687	.503
Awareness index	.208^{ns}	.342	1.317	.208
Fertilizer quantity used	-.009^{ns}	-.043	-.175	.863
Farm income	.196**	.961	2.216	.043
Other income	-.005^{ns}	-.127	-.575	.574
Seed renewal period	-.111^{ns}	-.269	-1.034	.318
Access to extension service	-.032^{ns}	-.078	-.318	.755
Easy access of quality seed	-.049^{ns}	-.104	-.452	.658

Note: R^2 = (0.519), F = (1.154)

4.9 Constraints of Sample Respondents in Agricultural Production

4.9.1 Constraints of sample farmers in the study areas

In rice cultivation, all of the sample farmers in the study areas had to face different constraints. Figure 4.18 and 4.19 show the farmers' perception of constraints in rice production.

Small landholding problem

Landholding was a problem for rice sector in Maubin and Daik U Township. About 4% and 17% of respondents in Maubin and Daik U answered small landholding as a problem (Table 4.34). Farmers already knew the profit of producing rice and they wanted to expand their cultivation for higher profit.

Difficulty to access quality seed

About 40% and 38% of sample farmers in Maubin and Daik U mentioned that there was difficulty for accessing rice quality seed. This was because the supply of improved rice seeds by formal sectors did not meet with the demanded amount and the formal relevant institutions encouraged producing more the seeds of hybrid varieties.

Weakness of extension service

The extension service can give awareness and information concerned with updated high production technologies, new released crop varieties and market information. But, about 49% and 51% of farmers in Maubin and Daik U were facing the weakness of extension services. Most of farmers who were not facing this constraint were the key farmers of the villages

Poor technology for production

About 12% and 21% of sample farmers answered their production technologies were poor. The farmers did not take any risk by new technologies if there were no any demonstration farms.

High input price

High input price was a common problem for rice production. About 18% and 45% of sample respondents in Maubin and Daik U faced the high price of inputs – fertilizer, pesticide, herbicide and machine that were essential for crop yield. Therefore, most of farmers used the low quality of inputs especially fertilizer imported by China.

Poor irrigation facilities

Nowadays, the climate change is happening more and more. During growing time, the fields need to apply the water. Even though the water can irrigate from the reserved

and natural water sources if the raining is not enough, 21% and 38% of farmers in Maubin and Daik U did not have advanced irrigation system.

Insufficient capital

In the study areas, insufficiency of investment was one of the problems for all farmers. But only 33% of sample farmers in Maubin and 42% in Daik U stated this as a problem. Due to less of capital, nearly all of the farmers borrowed money with high interest rate for running of their production. They had to repay for their loan after harvesting their crops.

Limited access of market information

It is not acceptable for an issue that the rice production is high if there is a lack of market. About 9% and 15% of selected respondents answered that they had a limited access of the market information. The market participants (broker, retailer and wholesaler) can get the benefit under this situation.

Scarcity of labor

The current problem for agricultural sector facing by sample farmers in Maubin and Daik U was shortage of labor. Many of the people in these areas migrated to other townships for many job opportunities that will give regular income. As a result, hired labor rate are very high and sometimes farmers could not hire labor at all.

Lack of storage facilities

If there is a bumper year for rice, the farmers can have an opportunity for greater return. But, they have to store the product after harvesting to obtain that chance. In Maubin and Daik U, 69% and 70% of farmers did not have storage facilities. This lack of storage facilities caused the price of rice to be low during harvesting time.

Price fluctuation

The reason for low income of farmers is the price fluctuation. About 30% of farmers in Maubin and 49% in Daik U answered the price fluctuation as a problem. This was because of supply and demand. If the production is early as possible, farmers always earned more income because of selling at high price and when the supply was high in the market, the price became low.

Climate change

About 34% and 75% of selected respondents were challenging with climate change in Maubin and Daik U. The farmers used flood or drought resistant varieties of rice to cope the changing climate. If the local varieties were applied, the farmers managed the sowing time depending on climate even though it is very risk.

Inadequacy of machines

As a result of farming labor shortage, most of farmers utilized the machines for farming activities such as land preparation, irrigation, harvesting and threshing. In Maubin and Daik U, about 30% and 21% of sample farmers who do not own some machines faced inadequacy of machines because the farming activities are at the same time. Hence, the farmers paid the higher operating cost to finish the activities on time.

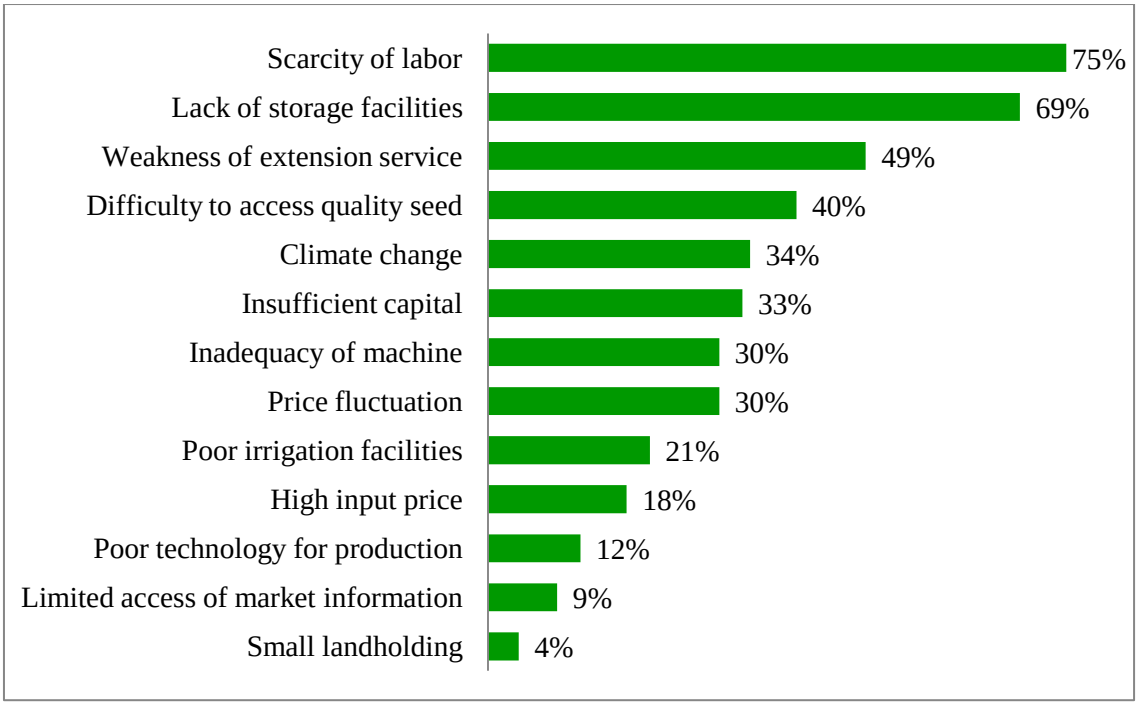


Figure 4.17 Constraints of sample farmers (%) in Maubin Township (N=67)

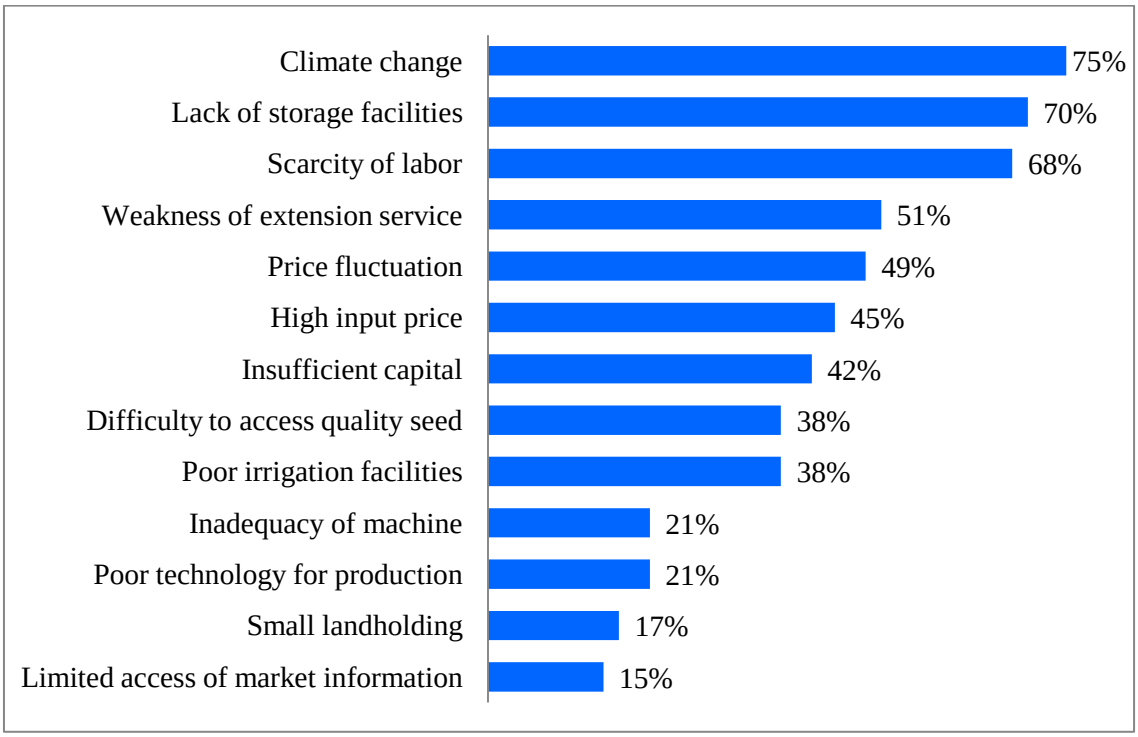


Figure 4.18 Constraints of sample farmers (%) in Daik U Township (N=53)

4.9.2 Constraints of sample seed growers in the study areas

Figure 4.20 explain constraints raised by seed growers in their business activities. Climate change, limited capital, poor irrigation facilities and high price of inputs were common problems for seed growers. Moreover, about 69% of the respondents in the study areas answered that they paid the high labor wage rate. This was because there was a migration of farm labor to other regions and there was a devil of farming activities (e.g. raised seed bed preparation, planting two plants per hole, rouging).

Another vital problem confronted by seed producers was poor storage facilities. About 50% of seed producers answered about this fact. The quality of rice seed can be reduced by humidity, incidence of rats, placing together with other varieties or chemicals if there are no advanced storage facilities.

Little technical knowledge concerned with seed production was a problem for 38% of seed growers. The rice seeds produced by growers will be quality by following the recommended guidelines.

The seed growers (6%) in the study areas had a problem related to low market price of farmers' seed. Most of farmers in the study areas usually changed their seeds after two or three years and then they preferred to purchase the seeds from other farmers whose fields were uniform in appearance. Rice quality seeds are the foundation for potential of getting quality product. However, 6% of seed growers dealt with limited access of quality seeds produced and distributed by DAR, DoA (Seed farms) and DoA (Township offices).

4.9.3 Constraints of sample seed dealers in Maubin Township

There were five kinds of constraints conveyed by seed dealers in Maubin Township (Figure 4.21). They were shortage of rice seed, problems for quality, difficulty in seed storage and delayed payment from customers. Each 75% of seed dealers answered that there was a shortage of rice seed and problem for quality. These were because the dealers could not buy all rice seed produced by seed growers who performed poor management in cultural practices and post-harvest processing for rice quality seeds. Although all seed dealers did not possess specific seed storage, only 50% replied the difficulty in seed storage as a problem. Other 50% of dealers made an engagement of the seed growers (suppliers) and farmers (buyers) who monitored the fields for quality. About 25% of respondents answered that they faced delayed payment from their customers. Delayed payment might lead to low trust between each other.

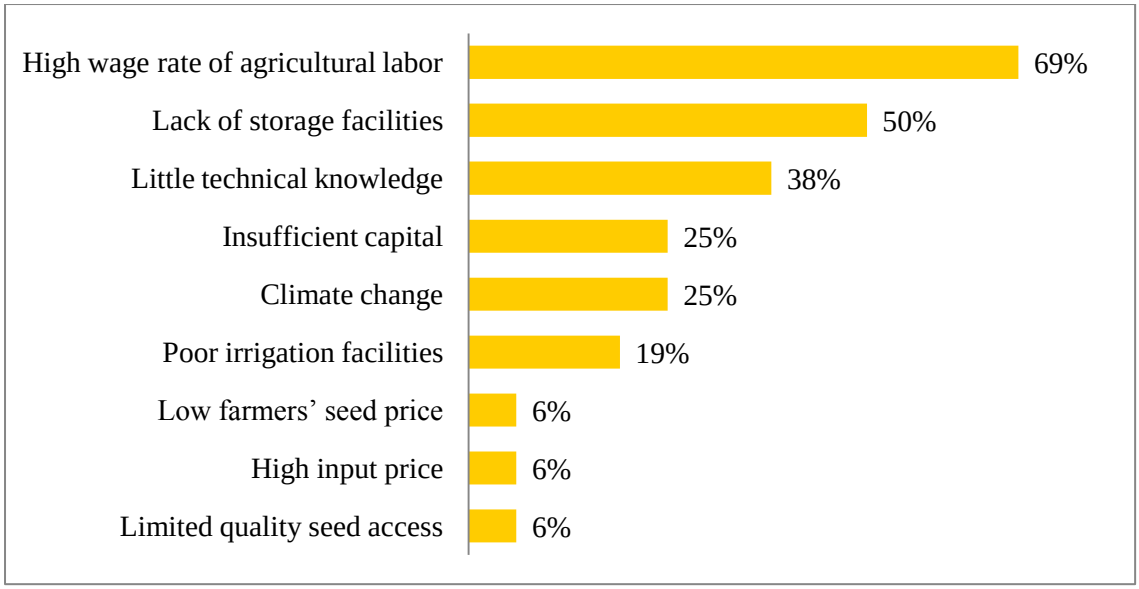


Figure 4.19 Constraints of seed growers (%) in the study areas (N=16)

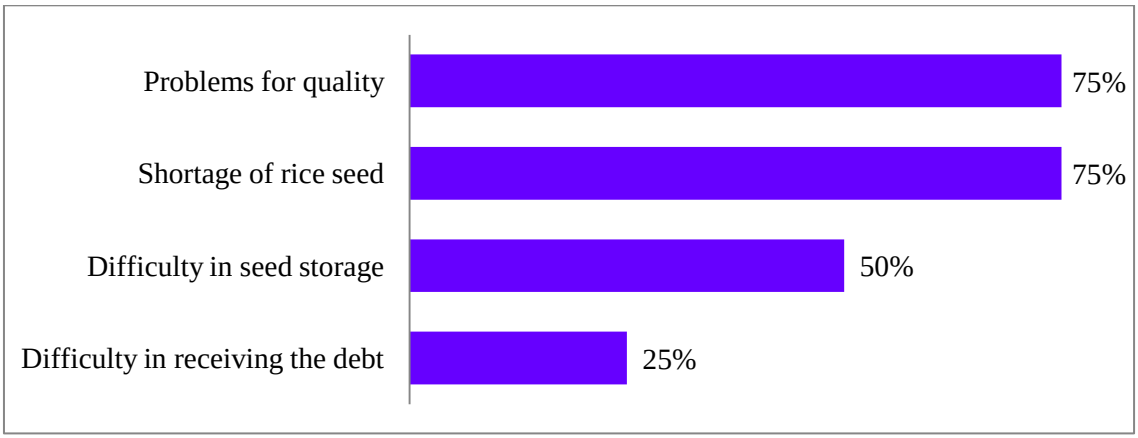


Figure 4.20 Constraints of seed dealers in Maubin Township (N=4)

CHAPTER V
SUMMARY, CONCLUSION AND POLICY IMPLICATION

5.1 Summary of Findings and Conclusion

Myanmar, being predominantly agricultural based, has to depend on agriculture sector for contribution to output and also for generating employment opportunities to its population. For achieving increased crop production through accessing the quality seed, quality seeds constitute a key component of the modern farm technology. As a consequence, the application of quality seed with the appropriate fertilizer and expansion of irrigation facility would result in increased food production. In this occasion, it is important to apply quality seed in rice production and practices of inputs application is influenced on the crop production as well. In this study, the demographic characteristics, rice quality seed marketing and distribution system and factors affecting the demand of quality seed for rice production were studied.

The results indicated that average age of the sample farmer; rice seed growers and seed dealers were around 49, 50 and 42 years, respectively in Maubin and around 51 years of sample farmers and 49 years of seed growers were the average age in Daik U. The average experiences were 24 years of Maubin farmers and 26 years of Daik U farmers in their farming; 4 years of Maubin seed growers and 7 years of Daik U seed growers in seed production and marketing and around 5 years were the average seed marketing experience of seed dealers in Maubin. The secondary education level, 53% and 71% was the highest for both farmers and seed growers and 75% of high school level was the highest for seed dealers in Maubin. In Daik U, most of the farmers were in primary education level (40%) and all seed growers were in higher education level. The sample farmers possessed the farm size in average, i.e. 2.5 hectare and 7.3 hectare of irrigated area and 4.5 hectare and 5.8 hectare of rain-fed area in Maubin and Daik U, respectively. The average farm sizes of sample seed growers were 3.2 hectare of irrigated area and 3.0 hectare of rain-fed area in Maubin and in Daik U, there was only rain-fed area that was farm size, 2.6 hectare in average.

In the marketing channels of rice quality seed, there were three main market actors (seed growers, seed dealers and farmers) in Maubin and most of seed dealers were the extension workers. In Daik U Township, two main market actors (seed growers and farmers) involved in rice quality seed marketing channels according to the market survey. Regarding to the result findings of the two areas, farmers were the most important

participants because farmers used the rice seeds from their own seeds from previous harvests and bought the seeds from the other farmers.

There were two main high yielding varieties in each township. They were Sin Thu Kha, Thee Htat Yin in Maubin and Hmawbi-2 and Sin Thu Kha in Daik U. The rice quality seed was distributed through various channels including government, IO, local markets and farmer own production. The quality seed was flowed from DAR/ DAR (Research farms) to DoA (Seed farms) then to DoA (Township office) to seed growers/contact farmers to seed dealers/other farmers to selected farmers or directly from DAR/DAR (Research farms), DoA (Township office) and seed growers for HYV in Maubin. The quality seed is also distributed from DAR/ DAR (Research farms) to DoA (seed farms) to seed growers and/or other farmers to selected farmers or directly from seed farms and seed growers for HYV in Daik U. Farmers and seed growers usually prefer the channel that was obtaining their seeds directly through government agencies. However, informal seed sources (71% for Maubin and 80% for Daik U) were the major sources providing opportunities to improve farmers' access to good seed, adapted to local requirements but there exists no appropriate system. It is questionable for quality of such informal seeds causing a limiting factor for production increment if the quality is sub-standard.

The seed growers got the market information from extension workers, farmers and brokers. Determination of seed price for seed growers were quality of seed, demand of seed, seed price of other variety and type of variety and for seed dealers quality, demand and variety. In cost and return analysis, the benefit-cost ratios of seed growers were nearly twice in comparison of that of farmers in both areas.

In the marketing activities of the seed growers, they grew and sold the rice quality seeds on cash down payment system in both Maubin and Daik U Township. However, they could not sell entire seed because of lack of advanced storage facilities and poor post harvest processing. For seed dealers in Maubin, they practiced buying and selling with both cash down and credit system. Their main transportation vehicle was trailer. In both townships, all seeds were sold by market participants without labeling: guarantee and any trademarks on packaging. Most of the farmers in Maubin selected the seeds for next crop from good panicles after harvesting and in Daik U, the farmers used the seeds from specific field. The majority of farmers in both study areas did rouging the other varieties but did not weed. All farmers processed post harvest activities specific for seed. The

seeds were stored in polyethylene bags by farmers in Maubin and in bamboo granary by farmers in Daik U.

According to the results of awareness on quality seed and index of sample respondents, it was found that the majority of sample farmers had awareness of quality seed effects on the production in the study areas. The farmers' quality seed awareness index stated that nearly half of sample farmers had medium and high awareness of quality seed in Maubin Township. In Daik U, over two third of sample respondents had high awareness of quality seed and nearly one third had medium awareness.

Among factors affecting the input demand functions, demand of quality seed was negatively influenced by household head's schooling year at highly significant level, positively affected by lagged grain price and awareness index and negatively related to current seed price and cropping intensity at 5% level. Demand of quality seed was positively correlated to fertilizer quantity and negatively to household head's experience at 1% level. For Sin Thu Kha variety of rice in Maubin, distance to seed sources was the most influencing factor in quality seed demands at highly significant level. Demand of quality seed of Sin Thu Kha rice was positively associated to awareness index at 5% level and negatively to current seed price at 1% level. The cropping intensity was the principle component thus constituting the factors affecting the quality seed demand of Thee Htat Yin variety in Maubin Township. Quality seed demand of this variety was also positively related to the awareness index. The factors affecting the quality seed demand functions were analyzed for two varieties, Hmawbi-2 and Sin Thu Kha, in Daik U Township. For Hmawbi-2, the seed demand was positively influenced by farm income and negatively by sown area at 5% level and negatively related to family labor at 1% level. The quality seed demand for Sin Thu Kha rice was positively associated to farm income at 5% level and negatively to cropping intensity and sown area at 1% level.

Constraints hindering the development of rice seed sector were found in all stages. At the farm level, farmers in Maubin had to face with scarcity of labor as the highest, lack of storage facilities and then weakness of extension service. Daik U farmers also had to face climate change, lack of storage facilities and scarcity of labor. The constraints of seed growers were high wage rate of agricultural labor, lack of storage facilities and little technical knowledge. On the marketing side, shortage of rice seed, problems for quality and difficulty in seed storage were the major constraints for seed dealers.

5.2 Policy Implication

Given the current potential and demand in production, marketing and consumption of rice, both at domestic and foreign markets, improving the production and productivity of rice through using of rice quality seed of improved varieties is needed. Some valuable findings emerged from this study can be useful for future policy implications. A number of policy options can be suggested for accessing the quality seed at an affordable price and for promoting livelihoods of rural farm households.

Lack of entrepreneurship skills by the market participants was one of the main causes of low production and productivity of rice. Therefore, seed marketing skills should be enhanced by developing institutional base for seasonal forecast of quality seed demand and supply and training seed entrepreneurs and support local institutions to plan and market quality seed.

Informal seed flows have been left out of government or donor efforts geared to improve the seed sector in the region. Strengthening these important seed flows could make a substantial contribution to the overall development of the seed sector. Government should recognize the informal seed sector and be committed to strengthening its capabilities.

In quality seed distribution and marketing channels, farmers were the major participants. Although majority of the farmers select seeds from the portion of the field with good crop stand, and practice rouging and floatation, the quality of the rice seeds that farmers saved from the harvest for use in the next season is not of high standard. Thus, community based seed production should be encouraged by extension personnel to be well functioning in informal seed system. If the conducive policy environment is established, farmers can be more effective in playing their role as managers of agricultural biodiversity.

At both national and regional levels, there is a need to adopt an integrated rice seed sector development approach, aiming to promote diversified seed systems, meeting the seed needs of all of Myanmar's rice farmers.

The current research and extension services and public support measures are inadequate, poorly targeted and ineffective in meeting the quality seed needs of choice varieties of the farmers. Presently, research in seed production and marketing system is not a prioritized activity in overall seed system in Myanmar. Therefore, special emphasis should be given to invest on research and support services for improving access of quality seed of choice varieties in adequate quantity at affordable price to small farmers through

improved distribution system, efficient marketing and effective quality assurance services. Seed produced by state-owned firms continued to dominate seed markets with effective monopoly power, despite poor cost recovery, high costs to agrarian producers and limited varietal offerings. Most of farmers use the seed from the informal seed sources (farmer own seeds). The quality of farmer own seed can improve through reduced rates of re-use of this seed, which can be achieved by improving farmers' access to the varieties of their choice, for reasonable prices. Hence, focus should be on demand based decentralized source seed production and supply of choice varieties with greater involvement of private sector's capacity in to reduce mis-match in demand and supply and enhance efficiency in production and supply of quality seeds of improved varieties.

The storage devices used by the farmers and seed producers were not found to be satisfactory. Thus, seed storage at each level continues to be improved. Considerable advances have been made due to the impact of several on-farm storage improvement programs and projects which have imparted very effective storage technologies to farmers. The emergence of village seed banks with supportive storage structures has also assisted in boosting seed-storage techniques in the rural communities.

There was a lack of licensing of seed sellers, inspection of retailers to check adulteration. Therefore, it is urgent need to strengthen the National Seed Committee (NSC) that is the body responsible for seed quality assurance and the supply of seeds and planting materials to farmers.

There is a need to strengthen the capacity of both seed growers by training on quality seed production and postharvest management as well as regulatory officers to implement improved seed inspection and certification.

Training on improved practices of rice on production, packaging, transportation, storing and marketing of seeds is very important in improving knowledge and skills of the rice seed market actors. Therefore, linkage and synergy with stakeholders in seed production, marketing and consumption must be established. This could be achieved by creating linkage and capacitating building on farmers training centre, contact with DoA, and traders and cooperatives.

Coordination and linkages among all actors and stockholders is need strengthening to foster rapid, orderly and effective growth to get strong coordination and linkages among actors in the system for seed development, production, multiplication and distribution so that the seed sector is able to meet farmers need in terms of timing of seed supply.

REFERENCES

Ajeigbe, H. A. and B. Osmane 2008. Cowpea and groundnut seed production. In: Legume and cereal seed production for improved crop yield in Nigeria Spencer, D, 2012. Issues of Food Security and Cash Crop Production in Sierra Leone.

Alemu, D. 2010. Seed System Potential in Ethiopia: Constraints and opportunities for enhancing the Seed Sector. International Food Policy Research Institute.

Alemu, H., V. Hugo, M. Wilfred, and Y. Asmare 1998. Farmers' wheat seed source and seed management in the Enebessie area, Ethiopia. pp. 48.

Ali, I., and S. A. Mohammad 2004. A note on the seed business in Pakistan. Lahore University of Management Sciences.

Aline, O. C., and A. K. W. Funk 2012. Kenya Seed Industry Study (KSIS).

Assa, M., M. Abure, N. Kisa, M. Elizabeth, and G. Paul 2011. Determinants of smallholder farmers' demand for purchased inputs in Lilongwe District, Malawi: evidence from Mitundn extension planning area. Bunda College of Agriculture.

Augustine, S. L., H. Petan, N. Edah, and M. Mulugetta 2006. A Unified Methodology for Estimating the Demand for Improved Seed at the farm level in Developing Agriculture.

Ayoola, G. B. 2001. Essays on the Agricultural Economy: A book of Readings on Agricultural Policy and Administration in Nigeria; TMA Publishers.

Ayoola, J. S., G. B. Ayoola, and R. O. Oyeleke 2014. Proximate Determinants of seed demand – a panacea for formulation of agricultural input policy for Nigeria. International Journal of Development Research. Vol. 4, Issue, 5. pp. 1062 – 1067, May.

Barro, R. J., and X. Sala-i-Martin 1995. Economic Growth. McGraw-Hill, N.Y.

Beyene, F. 2010. The role of NGO in informal seed production and dissemination: The case of eastern Ethiopia. Journal of Agriculture and Rural Development in the Tropics and Subtropics 111 (2): 79-88.

Broek, J.V.D., F. Jongeleen, A. Subedi, and N. L. Oo 2015. Pathways for Developing the Seed Sector of Myanmar: A Scoping Study. Center for Development Innovation. Wageningen.

Chauham, R. S., K. N. Rai, and S. D. Chamola 2002. Estimation of Demand and Supply and Adoption of Quality Seed in Haryana. Indian Journal of Agricultural Economics. Vol. 57. No. 3. July-Sept.

Chembezi, D.M. 1990. Estimating fertilizer demand and output supply for Malawi's Stallholder Agriculture. Agricultural Systems. Volume 33. Page 293-314.

Dasgupta, S., and I. Roy 2011. Good Agricultural Governance. A resource guide focused on smallholder crop cultivation.

Denning, G., K. Baroang, and T. M. Sandar 2013. Rice Productivity Improvement in Myanamr. USAID/Burma: MSU-MDRI-(Owen, Russel.).

DoP (Department of Planning). 2005. Myanmar Agriculture in Brief. Ministry of Agriculture and Irrigation.

Ebong, V. O., and M.V. Ebong 2006. Demand for fertilizer technology by smallholder crop. Farmers for sustainable agricultural development in Akwa Ibom State, Nigeria. International Journal of Agriculture and Biology, Volume 8. No. 6, Page 728-731.

Ersado, L., A. Gregori and A. Jeffrey 2003. Productivity and land enhancing technologies in Northern Ethiopia; Health, Public investment and sequential adoption, Environment and production technology division, International food policy institute, Washington DC 2006 USA. pp 23.

FAO (Food and Agricultural Organization). 1994. Seed marketing. http:// www.fao. org/docrep/V4450E/V4450E00.htm.

FAO (Food and Agricultural Organization). 1999. Seed Policy and Programs for Asia and the Pacific. In: Seed production and improvement: Assessment for Asia and the Pacific. Seed and Plant Genetic Resources Service. Plant Production and Protection Division.

FAO (Food and Agricultural Organization). 2006. Fruits and Vegetables for Health. Report of A Joint of FAO/WHO Workshop.

FAO (Food and Agricultural Organization) / WFP (World Food Program). 2006. Crop and Food Supply Assessment Mission to Ethiopia.

FAO (Food and Agricultural Organization). 2011. Save and Grow. A Policymaker's guide to Sustainable Intensification of Smallholder Crop Production.

Friesen, J., S. Capalbo, M. Denny 1992. Dynamic factor demand equations in US and Canadian agriculture. Agricultural Economics 6, 251-266.

Gemeda, A., A. Girma, V. Hugo, and M. Wilfred 2001. Farmers' maize seed systems in Western Oromia, Ethiopia. Maxico, D.F: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

Geraldine, A., V. Chirawat, B. Francois, and T. Guy 2010. Participatory Modelling and Simulaiton of the rice seed system in Northeast Thiland. ISDA, Montpellier: France.

Hosmani, R. 2007. Vegetable Seed marketing in Belgaum District an Analysis of Market Structure and Farmer Preferences. M.Sc. Thesis, University of Agricutlural Science, Belgaum.

Jaffee, S. and J. Srivastava. 1992. Seed System Development: the Appropriate Roles of the Private and Public Sectors. World Bank Discussion Paper 67. Washington, D.C: The World Bank.

Jaffee, S. and J. Srivastava. 1994. The roles of the private and public sector in enhancing the performance of seed systems. The World Bank Research Observer 9(1): 97-117.

Jones, R. B., P. Bramel, C. Longley, and T. Remington 2002. The Need to Look Beyond the Production and Provision of Relief Seed: Experiences from Southern Sudan. Disasters 26 (4): 302-315.

Kamal, V., and T. Garima 2015. Farmers' awareness, perceptions and knowledge gaps: looking for innovations in agricultural extension technical paper no. 1. Centers for International Porjects Trust.

Koji, K. Rice Policies in Myanmar: A Comparative Analysis with Vietnam.

Kotler, P. 2001. Marketing Management, Millennium edition. Upper Saddle River, NJ: Prentice Hall International.

Louwaars, N. 2007. Seeds of confusion: The impact of policies on seed systems, PhD Dissertation, Wageningen, the Netherlands.

Maredia, M., J. Howard, D. Boughton, N. Anwar, W. Mariah, and K. Kajisa 1999. Increasing seed system efficiency in Africa: Concepts, Strategies and Issues: Department of Agricultural Economics and the Department of Economic, Michigan State University. East Lansing, Michigan 48824-1039, USA.

Mew, T. W. 1997. Seed Health Testing: Progress Towards 21st Century, In: Hutchins and Ruccs (eds.), Development in Rice Seed Health Testing Policy, 129-138.

Ministry of Agriculture and Irrigation (MoAI). 2013. Activities of Department of Agriculture, Republic of the Union of Myanmar.

Minot, M., M. Smale, C. Eicher, T. Jayne, J. Kling, D. Homa, and R. Myers 2007. Seed development programs in Sub-Saharan Africa: A review of experiences: Rockefeller Foundation. Nairobi, Kenya.

Mumby, G. 1994. Seed Marketing. FAO of the Un (online). Accessed from: http://www.fao.org/docrep/V4450E/V4450E00.

Nichell, S. J. 1986. Dynamic Models of Labor Demand. In: Ashenfelter, O., Layard, R. (Eds.), Handbook of Labor Economics. Vol. I. North Holland, N.Y,pp. 473-522.

Okry, F., P. V. Mele, E. Nuijten, P. C. Struik, and R. L. Mongbo 2011. Organizational analysis of the seed sector of rice in Guinea: stakeholders, perception and institutional linkages. Experimental Agriculture, 47(01), 137-157.

Patricia, E., and A. A. Okunade 1988. Factor demands of Louisiana rice producers: an econometric investigation. Southern Journal of Agricultural Economics.

Pray, C., and B. Ramaswami 1991. A framework for Seed Policy Analysis in Developing Countries. International Food Policy Research Institute, Washington D.C.

Remington, T., J. Maroko, S. Walsh, P. Omanga, and E. Charles 2002. Getting Off the Seeds–and–tools Treadmill with CRS Seed Vouchers and Fairs. Disasters, 26(4), 316-328.

Singh, S. 2004. Rural marketing focus on agricultural inputs, IRM Stanton, W.J, 1998. Fundamentals of Marketing, McGraw-Hill, New York.

Soniia, D. 2004. Farmer seed enterprises: A sustainable approach to seed delivery. Agricultural and Human Values 21: 387-397, 2004. Kluwer Academic Publishers. The Netherlands, June 4.

Sunding, D. and Z. David 2000. Research and technology adoption in a changing agricultural sector, Handbook of Agricultural Economics, University of California at Berkeley. pp. 105.

Thi Thi Soe Hlaing and Theingi Myint. 2011. Ex-Post Evaluation of Rice Research and Extension Expenditure of Ministry of Agriculture and Irrigation in Myanmar. M. Agr. Sc Thesis, Yezin Agricultural University, Myanmar.

Timmer, C. P. 1989. Food Price Policy: The Rationale for Government Intervention. Food Policy, 14. pp. 17-42.

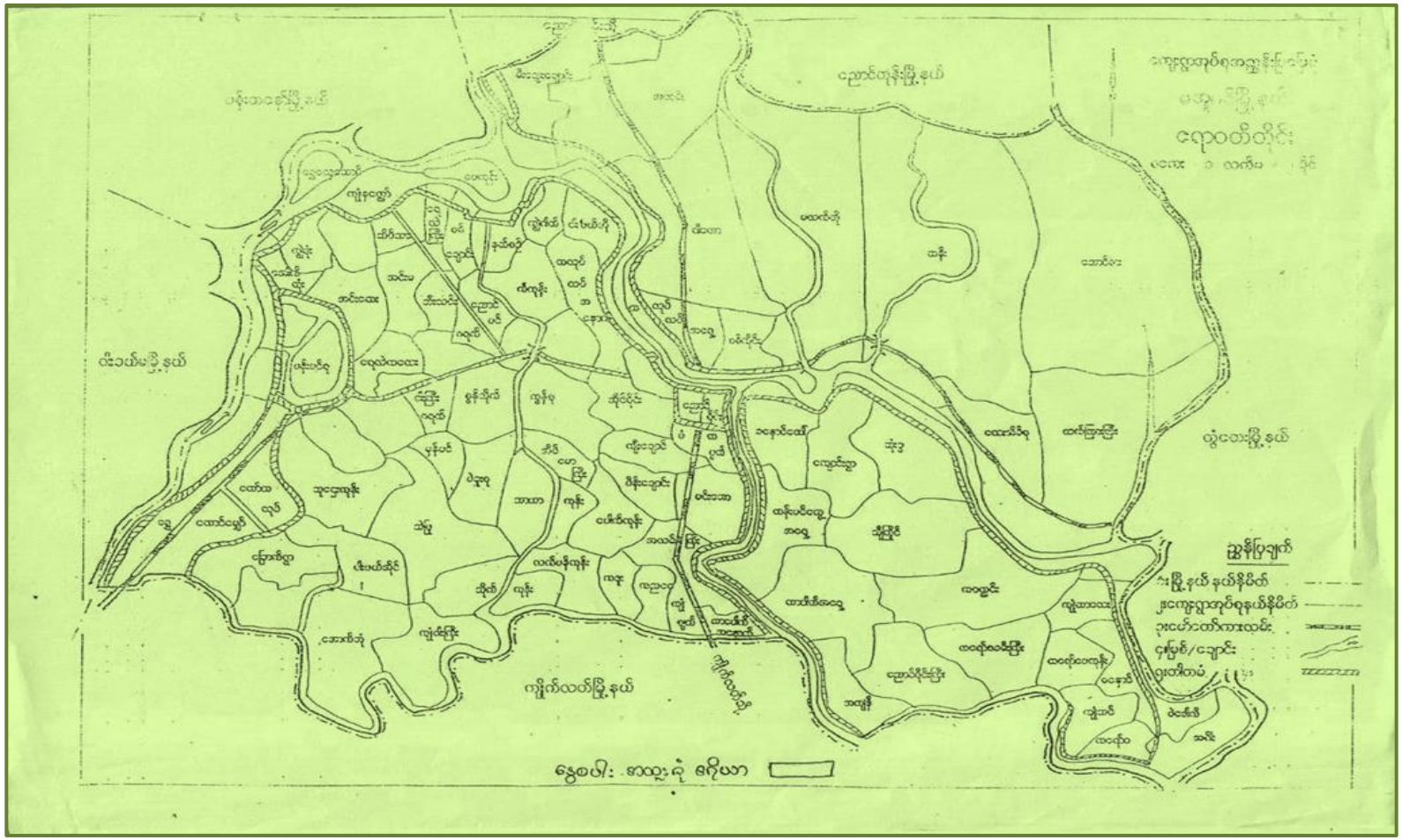
Tin Htut Oo and Tin Maung Shwe. 2014. Role of Seed in Transforming of Agriculture in Myanmar.

Venkatesan, V. 1994. Seed Systems in Sub-Saharan Africa: Issues and Options. Discussion Paper No. 266. Technical Department, Africa Region. Washington, D.C: World Bank.

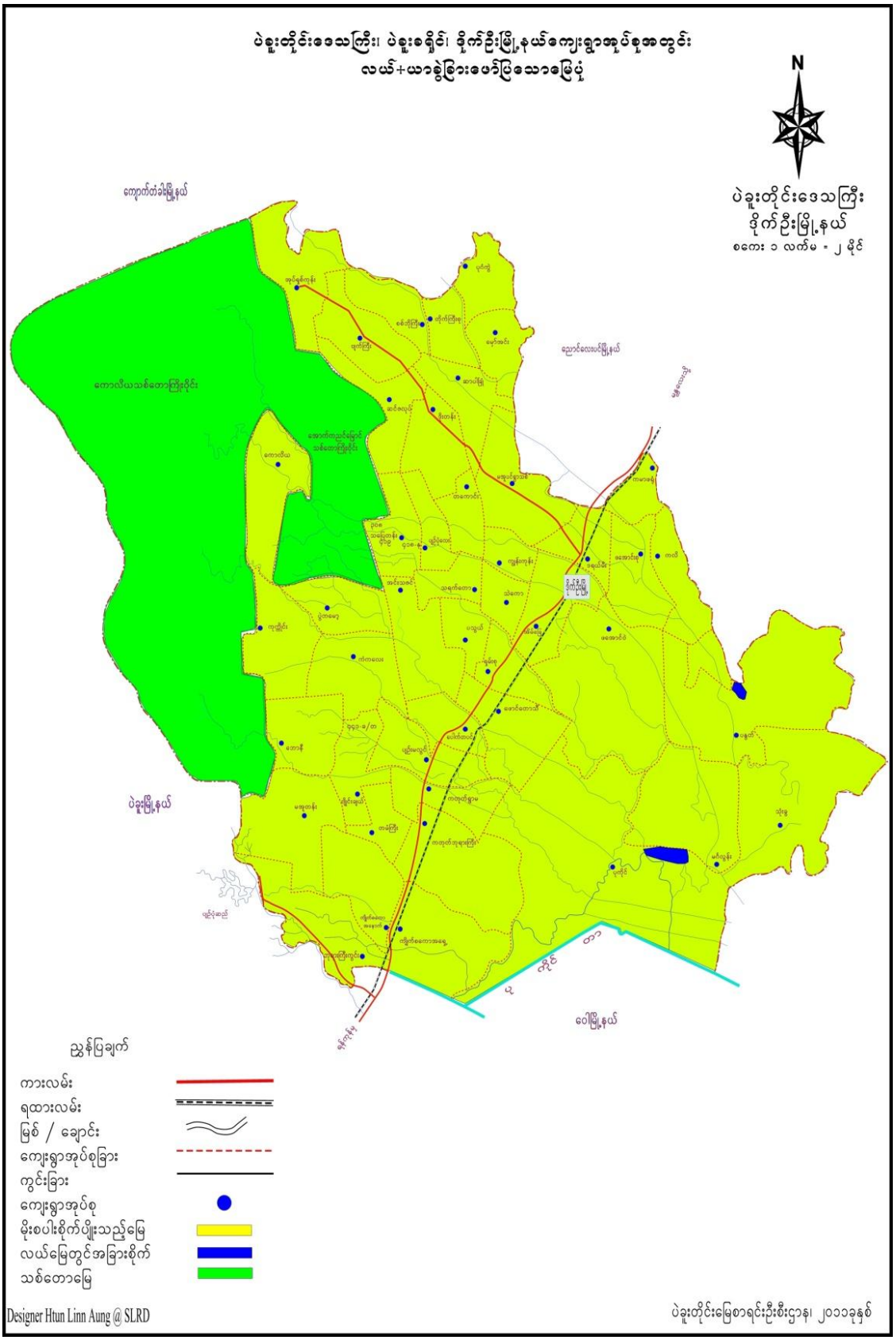
Warjiyo, P., and W. E. Huffman 1997. Dynamic Input Demand Functions and Resource Adjustment for U.S Agriculture: State evidence; Agricultural Economics, Volume 17, Page 223-237.

APPENDICES

Appendix 1 Map of Maubin Township



Appendix 2 Map of Daik U Township



Appendix 3 Enterprise budget for Sin Thu Kha rice production in Maubin (MMK/ha) (N=31)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	4039.33
2	Average producer price	MMK/kg	464.94
3	Gross return {(1)*(2)}		1878048.02
4	Material cost		
	Seed	kg/ha	95758.35
	Fertilizer	50kg/ha	63596.71
	Insecticide		29876.54
	Herbicide		22716.05
	Fuel	gallon/ha	16716.05
	Total material cash cost		228663.70
5	Hired labor		
	Seedling establishment (labor)	Md/ha	27378.36
	Land preparation (labor)	Md/ha	22349.42
	Crop establishment (labor)	Md/ha	101573.58
	Cultural Practices (labor)	Md/ha	71452.09
	Harvesting by manually (labor)	Md/ha	63027.94
	Harvesting by combine harvester (labor)	Md/ha	8148.15
	Post harvest processing (labor)	Md/ha	83813.08
	Land preparation to transportation (machine power)		199507.62
	Land preparation to transportation (animal power)		74142.66
	Total hired labor cost		651392.90
6	Interest on cash cost	MMK/ha	26401.70
7	Total cash cost {(4)+(5)+(6)}		906458.30
8	Family labor		
	Seedling establishment (labor)	Md/ha	34528.81
	Land preparation (labor)	Md/ha	28865.37
	Crop establishment (labor)	Md/ha	54835.39
	Cultural Practices (labor)	Md/ha	54280.57
	Harvesting by manually (labor)	Md/ha	29629.63
	Harvesting by combine harvester (labor)	Md/ha	9567.90
	Post harvest processing (labor)	Md/ha	73825.05
	Land preparation to transportation (machine power)		102101.93
	Land preparation to transportation (animal power)		111831.28
	Total family labor cost (total non cash cost)		499465.94
9	Total variable cost {(7)+(8)}	MMK/ha	1405924.23
10	Return above variable cost {(3)-(9)}	MMK/ha	472123.78
11	Return above cash cost {(3)-(7)}	MMK/ha	1219430
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	1.34
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	2.07

Appendix 4 Enterprise budget for Thee Htat Yin rice production in Maubin (MMK/ha) (N=30)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	9757.50
2	Average producer price	MMK/kg	220.95
3	Gross return {(1)*(2)}		2155870.67
4	Material cost		
	Seed	kg/ha	105679.78
	Fertilizer	kg/ha	98939.86
	Insecticide	unit/ha	18437.47
	Herbicide	g/ha	17586.98
	Fuel	gallon/ha	42251.85
	Total material cash cost		282895.95
5	Hired labor		
	Seedling establishment (labor)	Md/ha	7744.11
	Land preparation (labor)	Md/ha	20925.93
	Crop establishment (labor)	Md/ha	96790.12
	Cultural Practices (labor)	Md/ha	53600.82
	Harvesting by manually (labor)	Md/ha	71487.36
	Harvesting by combine harvester (labor)	Md/ha	8504.80
	Post harvest processing (labor)	Md/ha	70767.74
	Land preparation to transportation (machine power)	MMK/ha	242067.17
	Land preparation to transportation (animal power)	MMK/ha	16049.38
	Total hired labor cost		587937.44
6	Interest on cash cost	MMK/ha	26125.00
7	Total cash cost {(4)+(5)+(6)}		896958.38
8	Family labor		
	Seedling establishment (labor)	Md/ha	55135.80
	Land preparation (labor)	Md/ha	29128.65
	Crop establishment (labor)	Md/ha	9876.54
	Cultural Practices (labor)	Md/ha	82761.16
	Harvesting by combine harvester (labor)	Md/ha	9523.81
	Post harvest processing (labor)	Md/ha	74627.67
	Land preparation to transportation (machine power)	MMK/ha	142680.78
	Land preparation to transportation (animal power)	MMK/ha	77469.14
	Total family labor cost (total non cash cost)		481203.54
9	Total variable cost {(7)+(8)}	MMK/ha	1378161.92
10	Return above variable cost {(3)-(9)}	MMK/ha	777708.75
11	Return above cash cost {(3)-(7)}	MMK/ha	1258912.29
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	1.56
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	2.40

Appendix 5 Enterprise budget for Hmawbi-2 rice production in Daik U (MMK/ha) (N=35)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	3324.83
2	Average producer price	MMK/kg	571.12
3	Gross return {(1)*(2)}		1898894.21
4	Material cost		
	Seed	kg/ha	86022.23
	Fertilizer	kg/ha	67000.73
	Insecticide	unit/ha	14403.29
	Herbicide	g/ha	25179.01
	Fuel	gallon/ha	18024.69
	Total material cash cost		221710.54
5	Hired labor		
	Seedling establishment (labor)	Md/ha	33546.01
	Land preparation (labor)	Md/ha	30920.31
	Crop establishment (labor)	Md/ha	119426.81
	Cultural Practices (labor)	Md/ha	44864.04
	Harvesting by manually (labor)	Md/ha	67943.81
	Harvesting by combine harvester (labor)	Md/ha	7407.41
	Post harvest processing (labor)	Md/ha	75337.56
	Land preparation to transportation (machine power)	MMK/ha	211080.66
	Land preparation to transportation (animal power)	MMK/ha	50000
	Total hired labor cost		640526.60
6	Interest on cash cost	MMK/ha	25867.11
7	Total cash cost {(4)+(5)+(6)}		888104.26
8	Family labor		
	Seedling establishment (labor)	Md/ha	35777.03
	Land preparation (labor)	Md/ha	30294.40
	Crop establishment (labor)	Md/ha	6790.12
	Cultural Practices (labor)	Md/ha	18600.82
	Harvesting by combine harvester (labor)	Md/ha	7407.41
	Post harvest processing (labor)	Md/ha	66681.36
	Land preparation to transportation (machine power)	MMK/ha	116587.30
	Land preparation to transportation (animal power)	MMK/ha	105781.89
	Total family labor cost (total non cash cost)		387920.34
9	Total variable cost {(7)+(8)}	MMK/ha	1276024.60
10	Return above variable cost {(3)-(9)}	MMK/ha	622869.61
11	Return above cash cost {(3)-(7)}	MMK/ha	1010789.95
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	1.50
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	2.17

Appendix 6 Enterprise budget for Sin Thu Kha production in Daik U (MMK/ha) (N=30)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	3598.58
2	Average producer price	MMK/kg	482.40
3	Gross return {(1)*(2)}		1735981.98
4	Material cost		
	Seed	kg/ha	77549.15
	Fertilizer	kg/ha	59797.17
	Insecticide	unit/ha	10253.08
	Herbicide	g/ha	20965.20
	Fuel	gallon/ha	17805.21
	Total material cash cost		186369.83
5	Hired labor		
	Seedling establishment (labor)	Md/ha	25137.70
	Land preparation (labor)	Md/ha	25030.86
	Crop establishment (labor)	Md/ha	121128.94
	Cultural Practices (labor)	Md/ha	44526.75
	Harvesting by manually (labor)	Md/ha	65925.93
	Harvesting by combine harvester (labor)	Md/ha	12775.09
	Post harvest processing (labor)	Md/ha	82821.87
	Land preparation to transportation (machine power)	MMK/ha	206002.86
	Land preparation to transportation (animal power)	MMK/ha	82716.04
	Total hired labor cost		666066.06
6	Interest on cash cost	MMK/ha	25573.08
7	Total cash cost {(4)+(5)+(6)}		878008.97
8	Family labor		
	Seedling establishment (labor)	Md/ha	27253.84
	Land preparation (labor)	Md/ha	25140.29
	Crop establishment (labor)	Md/ha	30899.47
	Cultural Practices (labor)	Md/ha	36162.11
	Harvesting by manually (labor)	Md/ha	9382.71
	Harvesting by combine harvester (labor)	Md/ha	7877.71
	Post harvest processing (labor)	Md/ha	78477.36
	Land preparation to transportation (machine power)	MMK/ha	166428.09
	Land preparation to transportation (animal power)	MMK/ha	102818.93
	Total family labor cost (total non cash cost)		484440.55
9	Total variable cost {(7)+(8)}	MMK/ha	1362449.53
10	Return above variable cost {(3)-(9)}	MMK/ha	373532.46
11	Return above cash cost {(3)-(7)}	MMK/ha	857973.01
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	1.27
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	1.98

Appendix 7 Enterprise budget for Sin Thu Kha rice seed production in Maubin (MMK/ha) (N=10)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	4246.22
2	Average producer price	MMK/kg	719.34
3	Gross return {(1)*(2)}		3054498.24
4	Material cost		
	Seed	kg/ha	100533.50
	Fertilizer	kg/ha	90000.00
	Insecticide	unit/ha	8888.88
	Fuel	gallon/ha	22633.74
	Total material cash cost		222056.13
5	Hired labor		
	Seedling establishment (labor)	Md/ha	35802.469
	Land preparation (labor)	Md/ha	26200.27
	Crop establishment (labor)	Md/ha	97942.38
	Cultural Practices (labor)	Md/ha	28747.79
	Harvesting by manually (labor)	Md/ha	60905.34
	Harvesting by combine harvester (labor)	Md/ha	9259.25
	Post harvest processing (labor)	Md/ha	72942.38
	Land preparation to transportation (machine power)	MMK/ha	204279.84
	Land preparation to transportation (animal power)	MMK/ha	33333.33
	Total hired labor cost		569413.09
6	Interest on cash cost	MMK/ha	23744.08
7	Total cash cost {(4)+(5)+(6)}		815213.30
8	Family labor		
	Seedling establishment (labor)	Md/ha	35905.34
	Land preparation (labor)	Md/ha	25925.92
	Crop establishment (labor)	Md/ha	21296.29
	Cultural Practices (labor)	Md/ha	37636.68
	Harvesting by manually (labor)	Md/ha	14814.81
	Harvesting by combine harvester (labor)	Md/ha	7407.40
	Post harvest processing (labor)	Md/ha	63621.39
	Land preparation to transportation (machine power)	MMK/ha	92345.67
	Land preparation to transportation (animal power)	MMK/ha	103497.94
	Total family labor cost (total non cash cost)		402451.50
9	Total variable cost {(7)+(8)}	MMK/ha	1217664.80
10	Return above variable cost {(3)-(9)}	MMK/ha	1836833.44
11	Return above cash cost {(3)-(7)}	MMK/ha	2239284.94
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	2.51
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	3.75

Appendix 8 Enterprise budget for Thee Htat Yin rice seed production in Maubin (MMK/ha) (N=4)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	3612.34
2	Average producer price	MMK/kg	871.28
3	Gross return {(1)*(2)}		3147386.07
4	Material cost		
	Seed	kg/ha	107529.30
	Bag		24691.35
	Fertilizer	kg/ha	136419.75
	Insecticide	unit/ha	8888.88
	Herbicide		24691.35
	Fuel	gallon/ha	21913.58
	Total material cash cost		324134.24
5	Hired labor		
	Seedling establishment (labor)	Md/ha	35390.94
	Land preparation (labor)	Md/ha	28395.06
	Crop establishment (labor)	Md/ha	111111.11
	Cultural Practices (labor)	Md/ha	9259.25
	Harvesting by manually (labor)	Md/ha	64814.81
	Post harvest processing (labor)	Md/ha	102057.61
	Land preparation to transportation (machine power)	MMK/ha	93415.64
	Land preparation to transportation (animal power)	MMK/ha	24691.35
	Total hired labor cost		469135.80
6	Interest on cash cost	MMK/ha	23798.10
7	Total cash cost {(4)+(5)+(6)}		817068.14
8	Family labor		
	Seedling establishment (labor)	Md/ha	32510.28
	Land preparation (labor)	Md/ha	37037.03
	Crop establishment (labor)	Md/ha	19753.08
	Cultural Practices (labor)	Md/ha	27263.37
	Post harvest processing (labor)	Md/ha	44135.80
	Land preparation to transportation (machine power)	MMK/ha	103292.18
	Land preparation to transportation (animal power)	MMK/ha	59259.25
	Total family labor cost (total non cash cost)		323251.03
9	Total variable cost {(7)+(8)}	MMK/ha	1140319.17
10	Return above variable cost {(3)-(9)}	MMK/ha	2007066.90
11	Return above cash cost {(3)-(7)}	MMK/ha	2330317.93
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	2.76
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	3.85

Appendix 9 Enterprise budget for Hmawbi-2 rice seed production in Daik U (MMK/ha) (N=2)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	3483.33
2	Average producer price	MMK/kg	826.98
3	Gross return {(1)*(2)}		2880658.44
4	Material cost		
	Seed	kg/ha	121932.60
	Bag		12098.76
	Fertilizer	kg/ha	64814.81
	Insecticide	unit/ha	6419.75
	Herbicide		39506.17
	Fuel	gallon/ha	20370.37
	Total material cash cost		265142.48
5	Hired labor		
	Seedling establishment (labor)	Md/ha	30864.19
	Land preparation (labor)	Md/ha	25925.92
	Crop establishment (labor)	Md/ha	109259.25
	Cultural Practices (labor)	Md/ha	62962.96
	Harvesting by combine harvester		18518.51
	Post harvest processing (labor)	Md/ha	65432.09
	Land preparation to transportation (machine power)	MMK/ha	144444.44
	Land preparation to transportation (animal power)	MMK/ha	
	Total hired labor cost		457407.41
6	Interest on cash cost	MMK/ha	21676.50
7	Total cash cost {(4)+(5)+(6)}		744226.38
8	Family labor		
	Seedling establishment (labor)	Md/ha	24691.35
	Land preparation (labor)	Md/ha	37037.03
	Crop establishment (labor)	Md/ha	6172.83
	Cultural Practices (labor)	Md/ha	7407.40
	Post harvest processing (labor)	Md/ha	4938.27
	Land preparation to transportation (machine power)	MMK/ha	46913.58
	Land preparation to transportation (animal power)	MMK/ha	74074.07
	Total family labor cost (total non cash cost)		201234.57
9	Total variable cost {(7)+(8)}	MMK/ha	945460.95
10	Return above variable cost {(3)-(9)}	MMK/ha	1935197.49
11	Return above cash cost {(3)-(7)}	MMK/ha	2136432.06
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	3.05
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	3.87

Appendix 10 Enterprise budget for Sin Thu Kha rice seed production in Daik U (MMK/ha) (N=1)

No.	Item	Unit	Average Value (MMK)
1	Average yield	kg/ha	3870.37
2	Average producer price	MMK/kg	708.84
3	Gross return {(1)*(2)}		2743484.22
4	Material cost		
	Seed	kg/ha	121932.60
	Bag		12345.67
	Fertilizer	kg/ha	70370.37
	Insecticide	unit/ha	0
	Herbicide		39506.17
	Fuel	gallon/ha	29629.62
	Total material cash cost		273784.45
5	Hired labor		
	Seedling establishment (labor)	Md/ha	34567.90
	Land preparation (labor)	Md/ha	7407.40
	Crop establishment (labor)	Md/ha	125925.92
	Cultural Practices (labor)	Md/ha	51851.85
	Harvesting by manually (labor)	Md/ha	0
	Harvesting by combine harvester		22222.22
	Post harvest processing (labor)	Md/ha	86419.75
	Land preparation to transportation (machine power)	MMK/ha	138271.60
	Land preparation to transportation (animal power)	MMK/ha	0
	Total hired labor cost		466666.67
6	Interest on cash cost	MMK/ha	22213.53
7	Total cash cost {(4)+(5)+(6)}		762664.65
8	Family labor		
	Seedling establishment (labor)	Md/ha	27160.49
	Land preparation (labor)	Md/ha	37037.03
	Crop establishment (labor)	Md/ha	6172.83
	Cultural Practices (labor)	Md/ha	7407.40
	Post harvest processing (labor)	Md/ha	0
	Land preparation to transportation (machine power)	MMK/ha	44444.44
	Land preparation to transportation (animal power)	MMK/ha	61728.39
	Total family labor cost (total non cash cost)		183950.62
9	Total variable cost {(7)+(8)}	MMK/ha	946615.27
10	Return above variable cost {(3)-(9)}	MMK/ha	1796868.96
11	Return above cash cost {(3)-(7)}	MMK/ha	1980819.57
12	Benefit-Cost ratio {(3)/(9)}	MMK/ha	2.90
13	Return per unit of cash cost {(3)/(7)}	MMK/ha	3.60

Appendix 11 Percent of sample respondents in quality seed awareness score

Question No.	Percent of respondents in knowledge					
	Maubin (N=67)			Daik U (N=53)		
	No	Poor	Good	No	Poor	Good
1	15	7	78	9	4	87
2	0	3	97	4	4	92
3	6	6	88	2	4	94
4	0	0	100	4	2	94
5	0	3	97	6	4	90
6	6	6	88	9	4	87
7	31	8	61	28	8	64
8	19	14	67	19	4	77
9	49	20	31	57	8	35
10	27	13	60	23	8	69
11	19	18	63	11	6	83
12	36	22	42	36	19	45
13	33	9	58	28	6	66

Appendix 12 Summary demand functions of quality seed for rice production

Dependent variable / Independent variables	Quality seed	Maubin		Daik U	
		Quality seed of STK	Quality seed of THY	Quality seed of HB-2	Quality seed of STK
Household head's experience	* (-)	ns (-)	ns (+)		ns (-)
Household head's schooling year	*** (-)	ns (-)	ns (-)	ns (+)	ns (-)
Cropping intensity	** (+)	ns (-)	** (-)	ns (-)	* (-)
Total family labor	ns (+)	ns (+)	ns (-)	* (-)	
Sown area				** (+)	* (-)
Current seed price	** (-)	* (-)	ns (-)	ns (+)	ns (+)
Lagged grain price	** (+)	ns (+)	ns (-)	ns (-)	ns (+)
Distance to seed sources	ns (+)	*** (+)	ns (+)	ns (-)	ns (-)
Awareness index	** (+)	** (+)	* (+)	ns (+)	ns (+)
Fertilizer quantity	* (+)	ns (+)	ns (+)	ns (+)	ns (-)
Farm income	ns (+)	ns (+)	ns (-)	** (+)	** (+)
Other income	ns (+)	ns (+)	ns (-)	ns (+)	ns (-)
Seed renewal period					ns (-)
Extension service	ns (+)	ns (-)	ns (+)	ns (-)	ns (-)
Buying credit in transaction	ns (+)	ns (+)			
Easy access of quality seed					ns (-)
N	**120**	**31**	**30**	**30**	**30**

Note: STK = Sin Thu Kha, THY = Thee Htat Yin, HB-2 = Hmawbi-2