ROLE OF GENDER IN TECHNOLOGY ADOPTION OF RICE PRODUCTION IN THAZI TOWNSHIP, DRY ZONE, MYANMAR

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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)

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The thesis attached here to, entitled "**Role of gender in technology adoption of rice production in Thazi Township, Dry zone, Myanmar**" was prepared and submitted by Khin Sandar Linn under the direction of the chairperson of the candidate supervisory committee and has been approved by all members of that committee and board of examiners as a partial fulfillment of requirements for the degree of **Master of Agricultural Science (Agricultural Economics).**

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DECLARATION OF ORIGINALITY

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

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DEDICATED TO MY BELOVED PARENTS,

U MYINT THEIN AND DAW CHO CHO OO

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ABSTRACT

This study was attempted to analyze the gender perspective in decision making for adoption of improved rice production technologies recommended by Department of Agriculture (DoA) in Thazi Township, to find out the constraints for rice growers regarding the improved rice production technology adoption, to identify the role of agricultural trainings with gender perspective in adoption and to examine factors influencing the role of gender in adoption of improved rice production technologies. Total rice producers of 121 male-headed households and 66 female-headed households from 11 villages in Thazi Township were chosen with purposive random sampling method and descriptive statistics were employed to fulfill the research objectives.

In adoption study, 16.7% of male-headed households and 9.1% of female-headed households were involved in high-adopters group in which 6 to 10 components of technology package were adopted. In partial-adopters group in which 1 to 5 components of technology package were adopted. Among ten recommended components of improved technology package, adoptions of seed rate, seedling age, time of checking and refilling, basal insecticide application and weed control were still weak in both household groups. Not only high-adopters have more family labor than partial-adopters but also more home assets of hand phone and television which favor to get information about production technologies. Most respondents own sprayer, and animal drawn plough, harrow and cart, thus they used traditional practices in their farming activities. In high-adopters groups, female migration was observed in more internal migration. Most of respondents used credit source from Myanmar Agricultural Development Bank (MADB).

According to the findings, male and female made joint decisions in all agricultural production activities but final decision maker was household’s head in both types of households. Serious constraints in rice production were water scarcity, labor scarcity, high price of seed and fertilizer and unavailability of quality seeds for both adopters groups. Although the same constraints were faced by both types of households in two adopters groups, highly-adopted households noticed more constraints in their rice production compared with partially-adopted households. High-adopters comparatively more participated in agricultural trainings and shared extension advice and technologies to other farmers than partial-adopters groups. Female heads were comparatively low participated in trainings in terms of training type and frequency. The main reason of participation in their rural communities and association by respondents was to achieve credit.

Regression results showed that age, education, family labor used and total gross benefit were positively correlated with adoption scores of both types of households. Family labor used was the significant and positively correlated factor among them. Total gross benefit was highly significantly correlated with adoption in male headed households.

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LIST OF ABBREVIATIONS

DoA	Department of Agriculture
DoP	Department of Population
FAO	Food and Agricultural Organization
FAS	Foreign Agricultural Service
FFS	Farmer Field School
GRiSP	Global Rice Science Partnership
ha	Hectare
HH	Household
HYV	High Yield Varieties
IFDC	International Fertilizer Development Center
IRRI	International Rice Research Institute
LIFT	Livelihoods and Food Security Trust
MADB	Myanmar Agricultural development Bank
MMK	Myanmar Kyat
MOAI	Ministry of Agriculture and Irrigation
MOALI	Ministry of Agriculture, Livestock and Irrigation
NGO	Non-government organization
Oxfam	Oxford Committee for Famine Relief
SRI	System of Rice Intensification
USD	US Dollar

LIST OF CONVERSION FACTORS

1basket of paddy	=	20.86 kilograms
1 hectare	=	2.47 acres
1ton	=	1000 kilograms
1USD	=	1199.7 MMK

CHAPTER I
INTRODUCTION

1.1 Importance of Rice Production Technology Worldwide

Rice is an economically important food crop in many developing countries and is also a major crop in developed countries. Rice production is needed to promote to meet the increasing world's demand of population. Many rice-producing countries still have a large gap between their present and potential yields. The main challenge for rice research and development in the world is to find ways and means to produce more food for the rapid growing population with limited use of land, labor, water and even chemical inputs. The extensive adoption of modern and improved production technologies could be accelerated through favorable government policy, expansion of irrigated areas, accessibility to agricultural credit, intensive extension services and the availability of agro-chemicals, especially fertilizers and herbicides (Tran 1997).

Rice sown area, yield and productions in Asian countries were as shown in Table 1.1. According to this table, the highest yield was produced by China. The world rice production reached a level of 478.70 million metric tons in 2014 (FAS 2016). In 1960, the 'Green Revolution' began to the dramatic increase cereal crop yields dramatically through modern agricultural inputs, irrigation, fertilizers, improved seeds, and pesticides. The rice varieties and technologies developed during the Green Revolution and world average rice yield was increased from 2 tons per hectare in 1960 to 4 tons per hectare in 2000 (GRiSP 2013).

Package of production technologies for transplanted rice was made at Philippines in 1970. The application of these packages helped to increase substantially rice yield and production. System of rice intensification (SRI) was also developed in Madagascar in early 1980. In 2002, IRRI scientists and Chinese collaborators conducted a series of field trials in China to evaluate the performance of SRI and conventional management (Nguyen 2014). Yields obtained from SRI even with traditional varieties are higher than the yield potential of HYV (10 t/ha for *Indica*, 15/ha for *Japonica*) and hybrid varieties (18 t/ha) as mentioned earlier. The conditions stated that agricultural productivity growth will not be possible without developing and disseminating improved production technologies because it is no longer possible to meet the needs of increasing world's population by expanding the cultivation area.

Table 1.1 Rice cultivated area, yield and productions in Asia (2014)

Country	Area (Million ha)	Yield (MT/ha)	Production (Million MT)
World	161.03	4.43	478.70
China	30.31	6.81	144.56
India	44.11	3.59	105.48
Indonesia	11.83	4.73	35.56
Bangladesh	11.79	4.39	34.50
Vietnam	7.82	5.76	28.17
Thailand	10.27	2.77	18.75
Myanmar	7.03	2.80	12.60
Philippines	4.71	4.02	11.92
Pakistan	2.85	3.63	6.90
Cambodia	3.03	2.43	4.70
Nepal	1.56	2.98	3.10
Sri Lanka	1.15	3.64	2.85
Laos	0.96	3.11	1.88
Malaysia	0.69	4.02	1.80

Source: FAS 2016

1.2 Importance of Rice Production Technology in Myanmar

In Myanmar, rice production is important for employment and income. Myanmar has large potential to produce more rice by improving rice yield on existing production areas. The Government of Myanmar expressed policy and strategy in the agricultural section of the current Five-Year Plan and in the Agriculture Long-term Plan 2001-2031. One of Government of Myanmar strategies to achieve sustained agricultural growth is the use of improved technologies, through generation and dissemination of modern production practices, including efficient cropping patterns, proper use of production inputs, proper extension methods, and development of high yielding varieties.

The Ministry of Agriculture and Irrigation (MOAI) pronounced three policies for the development of rural livelihood and poverty reduction in 2014. These are (1) seed jump; using special high yielding varieties in order to increase basic agricultural component, (2) technology jump; adopting advance agricultural technology during the process from cultivation to harvesting and (3) investment jump; supporting the basic needs of agricultural development. The establishment of modernized rice mills in Myanmar will be encouraged to increase Myanmar rice quality like Thailand and Vietnam (MOAI 2014).

In 2014-2015, paddy cultivated acreage was about 7,172,131 hectares. Sown area, harvested area, yield and production amount of paddy in Myanmar are shown in Table 1.2. According to these data, Ayeyarwady region is the largest sown areas of paddy in Myanmar but its yield was not the highest. The highest yield was produced in Nay Pyi Taw Council region, the second one was Magway region and the third one was Sagaing region (MOALI 2016). So, central dry zone has a potential to promote paddy production for the country.

According to paddy sown area in Central Dry Zone from 2008 to 2015, paddy sown areas in Central Dry Zone decrease gradually during 2008-2015 (Figure 1.1). Paddy sown area of Mandalay region was the highest (459,648 hectare) at Central Dry Zone in 2008-09 but the areas of lowest 245,450 hectares in 2014-15.

Table 1.2 Paddy production and productivity by States and Regions in Myanmar (2014-2015)

No.	States/Regions	Paddy sown area (ha)	Paddy harvested area (ha)	Yield (MT/ha)	Total Yield (MT)
1	Nay Pyi Taw	72,478	72,478	4.52	327,601
2	Kachin	180,770	180,752	3.40	614,557
3	Kayah	40,109	40,109	3.42	137,173
4	Kayin	261,592	261,592	3.61	944,347
5	Chin	37,789	37,732	2.33	87,916
6	Sagaing	778,093	776,204	4.30	3,337,677
7	Tanintharyi	106,633	106,633	3.56	379,613
8	Bago	1,224,706	1,217,646	3.96	4,821,878
9	Magway	351,932	349,828	4.38	1,532,247
10	Mandalay	245,450	244,610	4.22	1,032,254
11	Mon	291,491	291,491	3.39	988,154
12	Rakhine	454,713	447,710	3.51	1,571,462
13	Yangon	561,354	561,343	3.57	2,003,995
14	Shan	549,584	549,089	3.94	2,163,411
15	Ayayarwady	2,015,437	2,015,300	3.88	7,819,364
	Union	7,172,131	7,152,517	3.73	27,761,648

Source: MOALI 2016

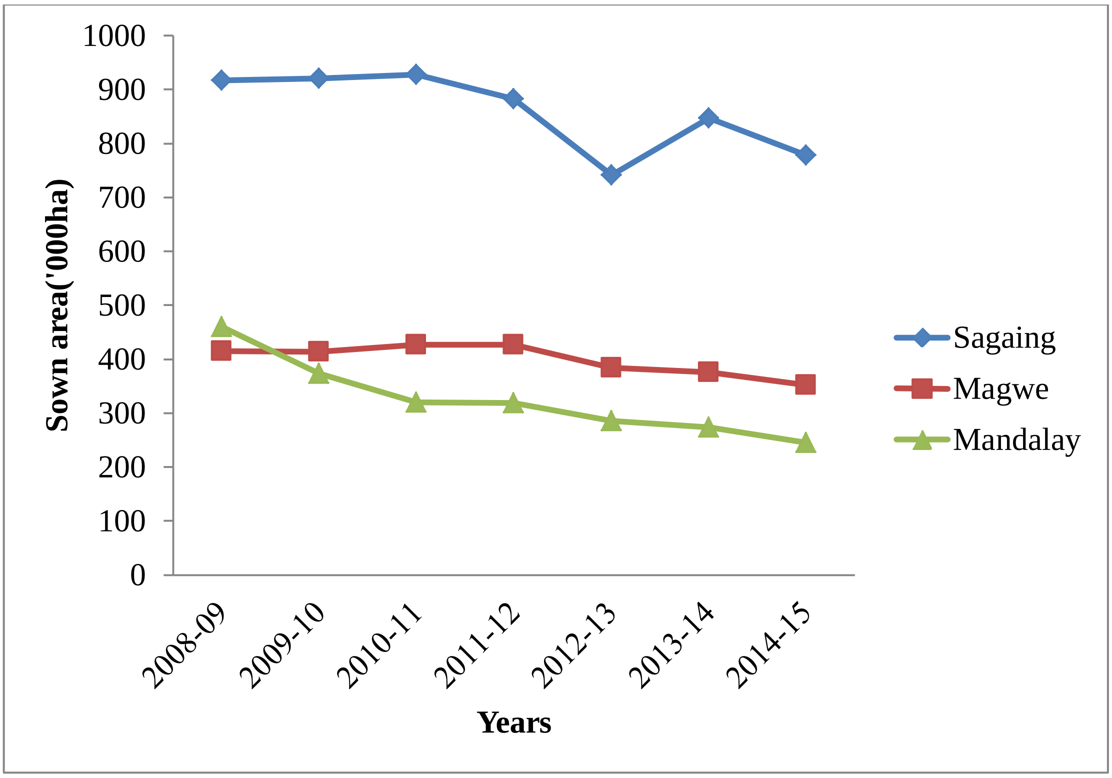

Figure 1.1 Paddy sown area in Central Dry Zone

Source: MOALI 2016

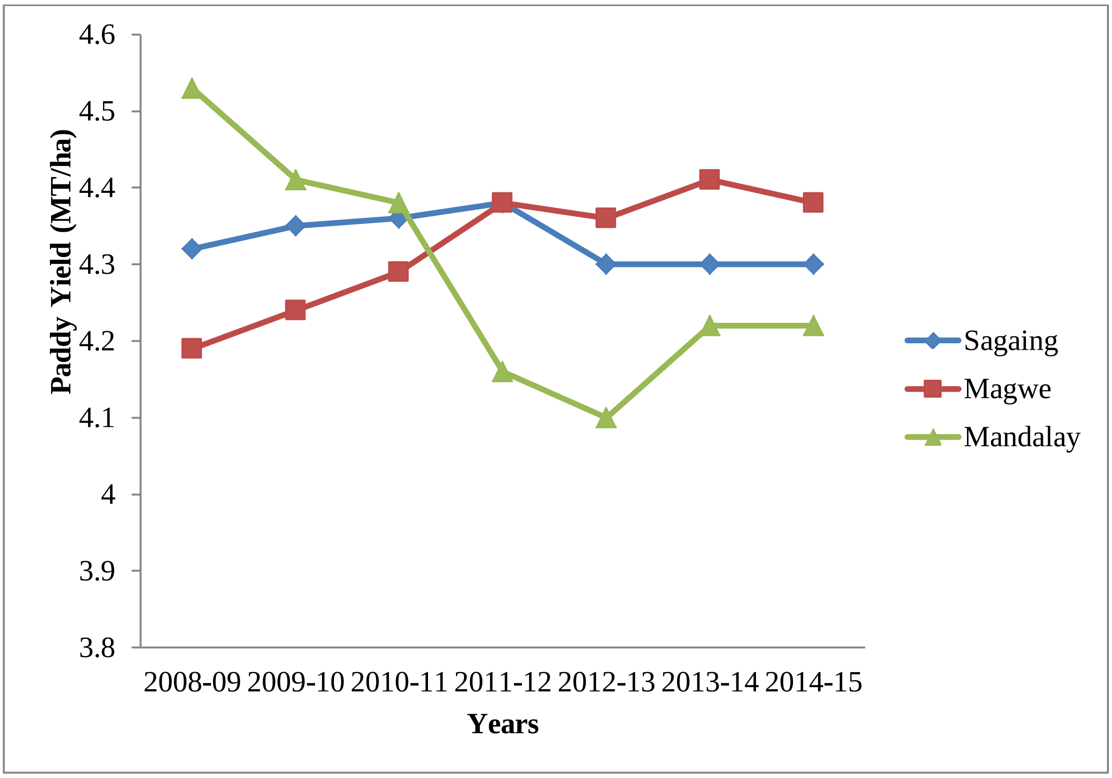

Figure 1.2 Paddy yield in Central Dry Zone

Source: MOALI 2016

According to Figure 1.2, paddy yield also decreased gradually. Paddy sown area in Thazi Township decreased significantly during 2007-2016 as shown in Figure 1.3. Paddy cultivated area was 28356 hectares in 2007-2008 but 16851 hectares in 2015-2016 (DoA 2016).

Due to flood and drought, farmers suffer crop loss or low yields. Area expansion and irrigation have already become a minimal source of output growth. So, rice production need to be increased in order to ensure food and income security through the adoption of improved rice production technology. Efforts to enhance productivity of rice are based on the development and dissemination of improved agricultural technologies such as improved cultivation practices, pest/disease resistant or hybrid rice varieties, etc.

1.3 Gender in Rice Production Technology Adoption in the World

Gender roles and responsibilities are dynamic. In particular, they are changing with new economic circumstances. Female share of economically active population in the world increased from 38.1 percent of total economically active population in 2008 to 40.5 percent in 2010 but agricultural share of economically active women decreased from 53.5 percent in 2008 to 42 percent in 2010 (Figure 1.4).

Therefore, the role of economically active women in agriculture needs to promote in several ways. Populations of rural woman labors vary in each region and women's participation is difficult to be clearly verified in agricultural activities. Gender-blind technology development can obstruct its efficiency and performance. Gender bias has been a problem for agricultural research centers and has been considered, among others, as a reason for the non-adoption of some agricultural technologies. Women play in the rural household as producers, but they have little control over decision making in adoption and implementation of agricultural technologies, and access to credit. Sometimes even with similar roles in agriculture, the women are uncertain to get equal opportunity and access to the resources available to men.

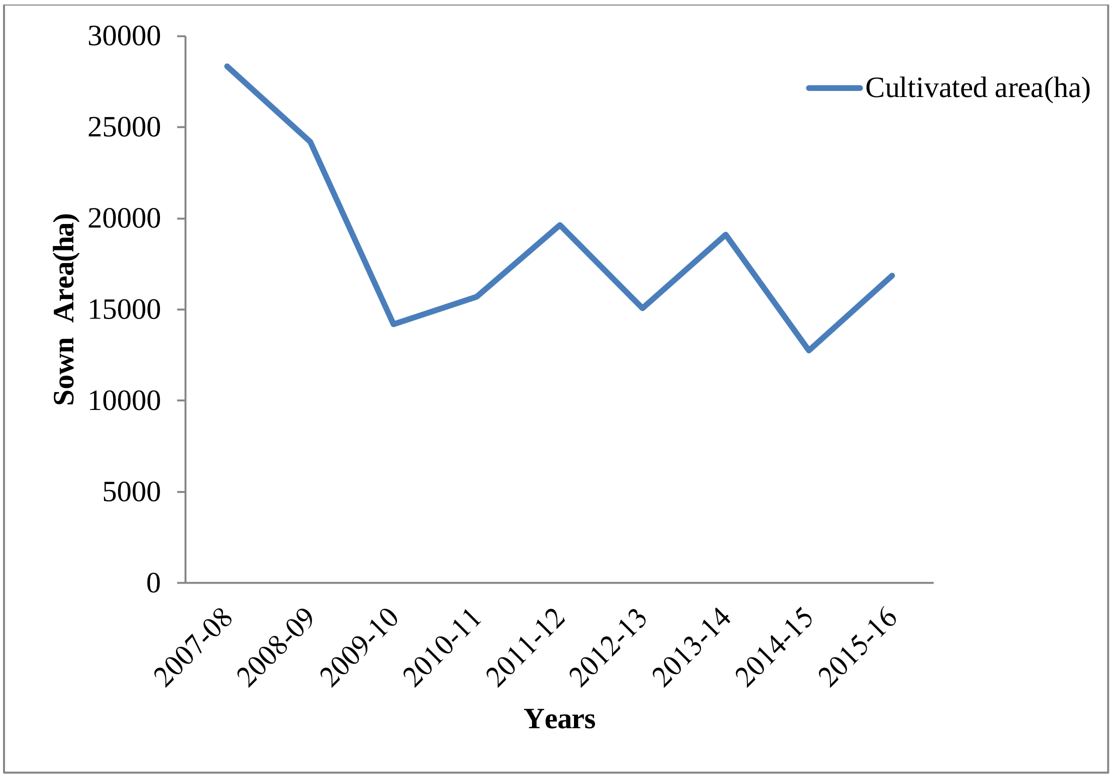

Figure 1.3 Paddy sown area in Thazi Township

Source: DoA 2016

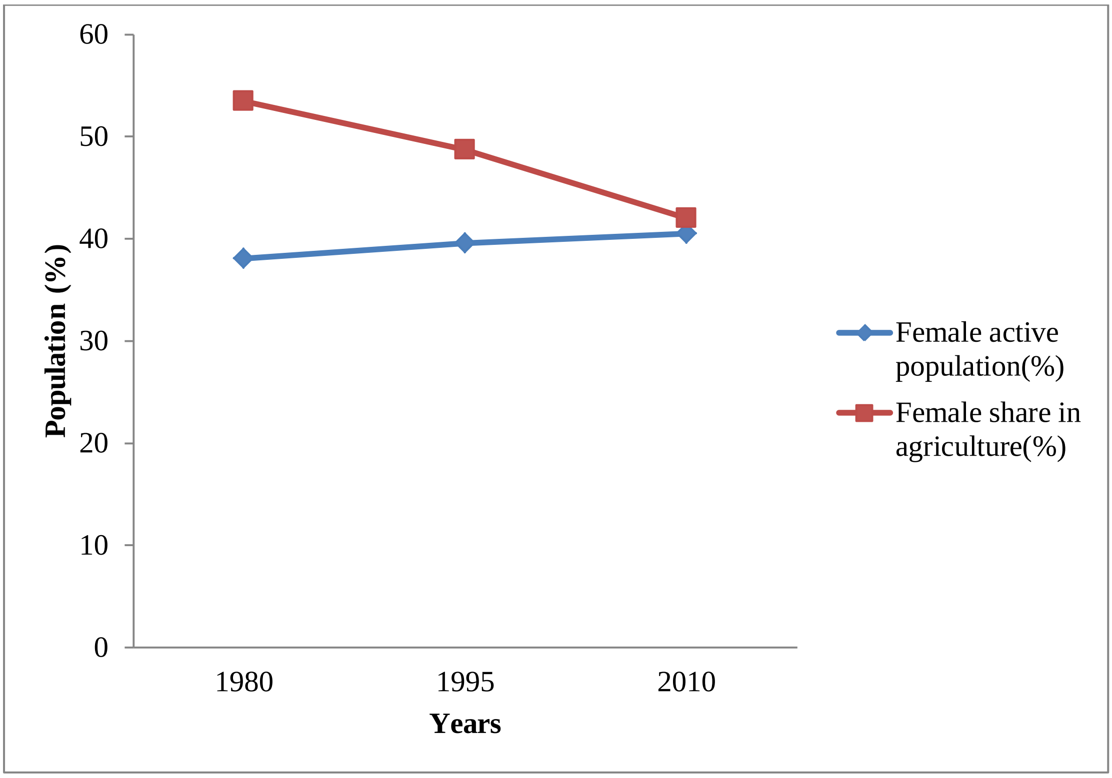

Figure 1.4 Female share of economically active population and agricultural share of active women in World

Source: FAO 2011

Woman workers in agriculture suffer from high illiteracy rate and drop-out of schools more than men. Promoting in women's technical knowledge and skills was required in the adoption of improved varieties and crop management techniques. The relative decision-making power of the wife increases significantly when the husband is a migrant. Differences in the decision-making power of women may also be based on age and status within the household. In African agriculture, the decision-making power within the household may affect decisions about adopting technologies. So, the adoption of technology may also shift the gender division of labors (Doss & Moris 1999).

1.4 Gender in Rice Production Technology Adoption in Myanmar

In Myanmar, above 70 percent of people lived in rural area and 51.66 percent of the population was female in 2014 (MOAI 2015). The proportion of female-headed households increased from 19 percent to 21 percent of total households between 2005 and 2010 (LIFT 2012). In Table 1.3, female population was 52.9 percent in urban area and 51.7 percent in rural area while female-headed household was 27.7 percent in urban and 22.2 percent in rural area. Both female population and female-headed household in urban and rural area were not many differences but slightly more in urban area (DoP 2015). The female-headed households' share of poverty is increased from 32 percent to 41 percent when household size adjustment was made. It is obvious that the female-headed households are more likely to be poor than the male-headed households with or without household size adjustment. Female-headed households receive lower average per capita income than male-headed households due to poor livelihood resources (land, cattle and capital). Female-headed household rely on low wage agricultural laborer as a major source of income (Dolly Kyaw & Routray 2006). In 2014, 92.6 percent of the male population and 86.9 percent of female population were literate. According to Census data, male was slightly more literate than female in Myanmar (DoP 2015).

The willingness to adopt new technology partly depends on the farmer's expectations for increased output from its use. A constraint is the lack of labor, including the gender division of labor, access to household labor, and access to hired labor. Different crop technologies may require concentrations of labor. Female-headed households may have a constraint to access labor because they have less male labor within the household and they may have less resource for hiring nonfamily labor. So, the gender of the farmer may affect the adoption of technology (Doss & Moris 1999). In Myanmar, women were extremely knowledgeable on rice production activities, besides their direct involvement in tasks of weeding and transplanting. Mostly, husband is considered as a household head and he makes all decisions about production. Farmer is also associated to be a man even though women are active in farming activities. Although men make most of decisions, both men and women involve in different farming activities. Husbands consult their wives in their decision making process. Women make decision while men are travelling or absent in their households, indicating that women's knowledge of rice production positions them to make independent decisions (IFDC 2015).

Table 1.3 Percentages of female population and female-headed households in urban and rural areas by States/Regions (2014)

No.	States/Regions	Female Population (%)		Female-Headed HH (%)	
		Urban	Rural	Urban	Rural
1	Nay Pyi Taw	51.3	51.3	24.7	20.5
2	Kachin	49.8	46.9	29.8	25.9
3	Kayah	50.7	49.8	27.5	21.0
4	Kayin	50.4	50.1	23.3	26.4
5	Chin	52.7	51.9	27.9	21.5
6	Sagaing	52.8	52.7	28.2	24.1
7	Tanintharyi	51.2	49.9	30.4	28.4
8	Bago	53.3	52.0	28.9	21.7
9	Magway	54.0	53.6	29.7	23.9
10	Mandalay	51.8	52.9	27.4	25.1
11	Mon	52.2	51.8	31.2	27.4
12	Rakhine	52.9	52.8	29.2	22.1
13	Yangon	52.7	51.1	26.7	19.1
14	Shan	50.4	49.9	29.7	18.8
15	Ayayarwady	52.7	51.1	25.6	18.3
	Union	52.9	51.7	27.7	22.2

Source: DoP 2015

1.5 Role of Agricultural Extension in Adoption of Rice Production Technology in Myanmar

One of the government policies was to conduct training and education activities for farmers and extension staff to get advanced agricultural techniques and MOAI is supporting and contributing to the transformation of conventional agricultural practices to improved production technology practices (MOAI 2014). Extension service is one of the most important institutional factors for diffusing technology and good practices, but for reaching female farmers, it requires careful consideration. A weak extension service will have a negative effect on adoption of improved rice production technology. The use of new technologies is often influenced by the farmer's contact with extension services.

In the technology generation and adoption process, preliminary and advanced trials are conducted as on-station trials which are finally followed by on-farm trials in cooperation with farmers. The final step at on-farm trials is still the weakest chain in the research-extension relationship. Thus the technology diffusion and adoption process in Myanmar were limited. DoA normally collaborates with contact farmers for improved rice production technology diffusion. Extension Division of DoA had been subjected to top-down approach oriented for over 40 years (San Thein 2015). Farmer Field School (FFS) and group meeting by DoA have proved to be a participatory and effective way of empowering and transferring knowledge to women farmers. They were easily accessible to women as well as to poor farmers and farmers with low literacy levels.

Extension staffs make weekly meetings and group discussion with farmers in villages for education about improved agricultural practices and efforts to solve problems encountered in farmer's field through contact farmers as shown in Table 1.4. Therefore, it is possible for them not only to accelerate their extension activities but also to produce villagers' interactive learning by means of contact farmers. Head quarter of DoA allow the budget for Farmer's Field School annually. They are also supporting and contributing to the transformation of conventional agricultural practices to advanced technology practices and mechanized farming, and adopting special high yielding varieties by farmers.

FAO (2009) stated that extension services often appear as a "man-to-man" technology transfer in which men extension staff work with men farmers. Normally women are neglected, in sharing also information. Extension support should be given directly to rural women. The extension agents, in providing improved technology and information to farmers, should use a gender-sensitive approach. Women and men from poor households in rural area need close leadership from extension agents in adopting new rice farming technology and credit management to increase their welfare.

1.6 Role of Social Capital in Agricultural Production Technology Adoption

Various issues surrounding gendered access to and control over productive resources are sensitive. Farmers' decision to adopt a new technology depends upon the decisions of other farmers in their social network because they expect to share information, learn from each other's crop specific knowledge and experiences, and solve problems together. Njuki (2008) stated that the build-up of social capital was an important role in adoption of improved rice production technologies because of the ways in which social network and social relationships facilitated technology dissemination. It also raises collective action, cooperation, knowledge and risks sharing and adoption of improved technology and facilitates the relationship between farmers and markets- both input market and product market. Villages reporting percent of a village organization in Myanmar is described by Griffiths (2016) with Table 1.5.

According to this table, about half of all communities had a social organization and nearly one quarter of all communities reported their religious organization. In Myanmar, households in social organizations were less vulnerable than households without social organizations (27.6 percent and 28.8 percent respectively). The positive effect of social organization was seen mostly in the West, Southeast and Delta areas of Myanmar. In villages with social organizations, per-capita health and educational spending were higher, but levels of debt for healthcare and education costs were lower. The presence of village social organizations was also associated with lower degrees of income inequality, and a female-headed household or a household with a person with disabilities was lower in communities with social organizations, suggesting that the activities of these groups play a significant role in addressing vulnerabilities and inequalities in their communities.

Table 1.4 Extension activities by Department of Agriculture in 2015-2016

No.	States/Regions	Farmer Field School		Group Meeting	
		Times	Farmers	Times	Farmers
1	Nay Pyi Taw	111	2,935	238	8,271
2	Kachin	48	1,918	496	15,884
3	Kayah	12	360	503	25,480
4	Kayin	208	8,722	859	55,705
5	Chin	-	-	2,146	19,637
6	Sagaing	89	4,904	8,516	410,861
7	Tanintharyi	910	39,706	2,515	411,654
8	Bago	2,725	172,495	4,234	228,920
9	Magway	54	3,014	2,324	83,776
10	Mandalay	213	8,169	2,514	114,480
11	Mon	-	-	1,551	39,859
12	Rakhine	430	15,216	3,729	95,254
13	Yangon	-	-	2,272	163,509
14	Shan	137	5,114	727	29,298
15	Ayayarwady	5,286	447,163	5,765	481,403
	Union	10,223	709,716	38,389	2,183,791

Source: DoA 2016

Table 1.5 Village organizations in Myanmar (2015-2016)

No.	States/ Regions	Development Committee (%)	Social Organization (%)	Religious Organization (%)	Any Social or Religious (%)
1	Nay Pyi Taw	50.0	70.0	20.0	90.0
2	Kachin	72.3	55.6	38.9	68.6
3	Kayah	50.0	50.0	0.0	50.0
4	Kayin	58.6	20.7	34.5	55.6
5	Chin	25.0	18.7	18.8	37.5
6	Sagaing	69.1	68.1	28.8	76.3
7	Tanintharyi	83.4	94.4	55.5	94.4
8	Bago	69.4	47.0	36.8	64.6
9	Magway	63.7	62.5	25.0	65.3
10	Mandalay	65.6	42.5	17.3	51.2
11	Mon	28.6	71.4	35.7	78.6
12	Rakhine	55.4	47.3	27.1	57.5
13	Yangon	60.5	89.5	52.6	89.5
14	Shan	37.7	31.9	23.5	40.7
15	Ayayarwady	39.4	54.5	18.9	64.0
	Union	54.4	49.0	25.2	58.6

Source: Griffiths 2016

1.7 Rice Production Technology Recommendations by Department of Agriculture in Thazi Township

Many rice varieties are grown in Myanmar. Manawthukha, Sinthukha, Theedatyin, IR-747, Shwethweyin are mostly cultivated in Thazi Township. The choice of rice variety is determined by the farmer's objectives, the length of growing season, and the amount of rainfall at a given locality. Planting time is one of the crucial factors for high yield. The planting time in the study area is from July to November for monsoon rice and from March to July for summer rice but it depends on water availability. Two times of ploughing with 1-1.5 feet depth and one time of harrowing is recommended for land preparation in rice cultivation in Thazi Township.

The following rice production technology package was introduced since 2001-2002 by Department of Agriculture in Thazi Township (Table 1.6). The components of the recommended packages of improved rice production technologies in the study area are as follow:

(a) Seed Rate

The recommended seed rate for Thazi township is 51.55 – 77.32 kg/ha to be saved seed waste and cost.

(b) Spacing

Row spacing is important to get sufficient plant populations and good aeration. The recommended row spacing is 0.15 m× 0.15 m and 0.15 m× 0.2 m.

(c) Seedling Age

The recommended seedling age is 20-25 days after planting to be resistant weather condition.

(d) Planting System

Transplanting method is recommended to reduce seed rate and to withstand competition of weeds and plants. Inspection and Refilling of seedlings 7 to 10 days after planting to get sufficient plant populations.

(e)Fertilizer Application

Since Phosphorous is rich in soil of the study area, urea and compound fertilizer are mostly used. Fertilizer application is recommended at least 3 times of 123.5 kg/ha and 61.8 kg/ha of potash to support optimum growth and high yield.

(f) Weed Control

Weeds can seriously affect rice yield. So, summer fallowing is recommended to destroy weed seed production in last cultivated season and hand weeding is also recommended to do until 30 days after transplanting to improve soil aeration and to get more space for roots.

(g) Pest and Disease Control

Pest and disease also affects the rice yield and the best method is to use resistant varieties. Furadan 3G (14.83) kg per hectare is recommended to protect soil born pests and diseases. Insecticide and fungicide application rate are also recommended to be more effective and to support the plants to be healthy.

(h) Water Management

Water management practice is recommended to achieve uniform ripening condition and to ease rice harvesting.

(i) Harvesting

Suitable harvesting time is also recommended after 85 percent of tillers ripening to reduce harvest losses and to get filled grain.

Table 1.6 Rice production technologies package recommended by Department of Agriculture, Thazi Township

No.	Items	Recommended Technologies
1	Seed rate	51.55 – 77.32 kg/ha
2	Plant spacing	0.15m×0.15m (or) 0.15m×0.2m
3	Seedling age	20-25 days after sowing
4	Planting system	Transplanting method
5	Timely checking and refilling	Within 1 week after transplanting
6	Fertilizer application	At least 3 times with 123.5kg/ha and 61.8kg/ha of potash
7	Weed control	Hand weeding until 30 days after transplanting
8	Basal insecticide application	Furadan 3G (14.83) kg/ha
9	Water management	Drainage after 2 weeks of flowering
10	Harvesting	After 85% tiller ripening

Source: DoA 2016

1.8 Rationale of the Study

A primary constraint for Dry Zone communities of Myanmar is low income which creates food insecurity. Household debt is high and 35 percent of loans is used for food. So, paddy yield in Mandalay region is needed to promote for high income of paddy farmers. Thazi Township is located in Mandalay region. In rural area of Thazi Township, female population was 95943 and male population was 86,176. So, female population was higher than male in rural area (DoP 2015).

Climate change has numerous effects on rice production because it can affect rice growth and quality, and resistance to pests and diseases. Farmers in the Central Dry Zone has been facing changing rainfall patterns which delay planting time and affect the productivity of their crops. One critical challenge for the farmers is water shortage. So rainfall is very important for agricultural production. Paddy sown area of Mandalay region was the highest (459,647.8 hectare) at Central Dry Zone in 2008-09 but the lowest (245,550.2 hectare) in 2014-15. Paddy sown area in Thazi Township decreased significantly during 2007-2016 (DoA 2016). So, rice production in Thazi Township is needed to increase with limitation of cultivated area. However it is impossible to promote rice yield without adoption of improved rice production technologies. Poor adoption of improved rice production technologies would lead to high cost of production with corresponding low yield.

Two other important challenges for farmers in the study area are limitation to access agricultural inputs and training about improved rice production technologies. If farmers adopt and apply the improved techniques well, there will be increased rice productivity. The Department of Agriculture (DoA), from Thazi Township has been providing some trainings in group meeting method by extension staff. But farmers who access to training and improved agricultural techniques are low (Oxfam 2014).

In Myanmar, a quarter of households were headed by females. The majority of these 95 percent lack an adult male presence in the household. Household headed by women were less likely to own land than those headed by men (Edans 1999).

As labor supply exceeds labor demand, employment opportunities become more limited for women than men. More valuable productive assets are usually controlled by men because technology and equipment used by women are poor-quality. Gender power relations affect the realities of women’s engagement with economic actors and results in fewer opportunities for leadership in community structures and organizations (LIFT 2015).

Women's wages in the study area are 20 percent less per day than men even for the same work (Oxfam 2014). The build-up of social capital is also important for distribution of improved rice production technologies because social networks and social relationships facilitate technology dissemination and adoption. In the study area, women are active in village community groups but these groups are focused on non-farming cases such as weddings or roles like accountant or secretary rather than decision-making posts (Oxfam 2014).

Both female and male farmers should participate more actively in group activities as effective participation in association's decision making which facilitate to access and sharing of information, to increase employment opportunities and availability of productive resources like credit, seed and labor etc. Therefore, it is important to understand the role of social capital, constraints and factors influencing the role of gender in the adoption of rice production technologies according to gender perspectives in the study area to be able to build more effective strategies for improved rice production technology adoption.

1.9 Objectives

The purpose of this study is to achieve a greater understanding of women and men roles in technology adoption of rice production. The specific objectives of the study are as follows:

1) To analyze the gender perspective of decision making in adoption of improved rice production technologies recommended by DoA in Thazi Township,
2) To find out the constraints for rural women regarding adoption of the improved rice production technologies,
3) To identify the role of social capital with gender perspection in adoption of improved rice production technologies and
4) To examine factors influencing the role of gender in adoption of improved rice production technologies.

CHAPTER II
LITERATURE REVIEW

2.1 Gender Perspective in Decision Making of Improved Production Technology Adoption

2.1.1 Theoretical review

'Adoption' is a decision to make full use of a new idea as the best course of action available and 'adoption process' is the mental process through which an individual passes from first knowledge of an innovation to make a decision to adopt or reject and to later confirmation of this decision (Singh & Mishra 2007). Adoption process has five adoption steps which are of awareness, interest, evaluation, trial and adoption. The adoption rate will be different with different personal characteristics of the individual (Roger 1983). Adoption of technologies may be conceptualized at two different levels: aggregate and individual (farm-level) levels of adoption. Aggregate adoption is the adoption of an agricultural technology by a population within a region and farm level new technological adoption is defined as when an individual farmer adopts a new technology (Lopes 2010). According to Pannell (2006), adoption of innovations by landholders is a dynamic learning process. Adoption depends on a range of personal, social, cultural and economic factors, as well as on characteristics of the innovation itself. Innovations are more adopted if easy to test and learn about before adoption. Farm technology means agricultural knowledge and skills applied by the farmers to turn their resources into outputs. Technology adoption means the decision to acquire and use a new or improved invention or innovation (Juma 2009).

Based on farmers' behavior, farmers are classified into five adopter categories which are (1) innovators, (2) early adopters, (3) early majority, (4) later majority, and (5) laggards. The farmers who are the first person in a local to try out and adopt an innovation in their environment are innovators. They are willing to take risks and to take failure. If a new idea survive for a period of time and is accepted by more than first few and one can identify a second category of farmers, called early adopters. If the new idea is continue to spread many farmers who ultimately accept the new ides can be classified into early and late maturity depend on time. Laggards are accepted the new ideas very late. The concept of adopter categories is important to shows that all innovations go through a natural, predictable, and sometimes lengthy process before widely adopted within a population (Roger 1983).

Birthal (2012) stated that adoption models are usually based on the theory that farmers make decisions in order to maximize hand, farmers utility depends on optimizing the productivity and minimizing the cost of cultivation to get maximum profits. Adoption was also positively associated with experience, extension personnel should not only concentrate with more experienced farmers and should also work closely with new and less experienced farmers to stimulate more adoption of technologies.

Adopting a new technology requires taking on new risks. Not unpredictably, the adoption rate is high if the new technology is being offered with a package to mitigate the risks. Alternatively, social capital can apply a risk-mitigating effect (Edillon 2010). The critical factor of the firms' adoption behavior is uncertainty about the profitability of a new technology or the rate of technological progress. The expected post-adoption profit also depends on the belief that the adoption of new technology is profitable. The uncertainty may be reduced by observing the experience of other adopters which generates an incentive to wait until another firm moves first (Hoppe 2002).

Technology adoption is currently moving in three directions which are innovative econometric and modeling methodologies to understand adoption decisions, examinations of the process of learning and social networks in adoption decisions and micro-level studies based on local data collection intended to shed light on adoption decisions in particular contexts for policy purposes. Farmers do not adopt improved technologies with three reasons. The first reason, farmers have misunderstanding about the costs and benefits of the technologies. The second reason is unavailable of the technologies at need times. The third reason is that the technologies are not profitable due to incorrect allocation of their land and labor across agricultural and non-agricultural activities (Doss 2003).

Haito (2010) stated that a complicated relationship exists between agricultural technology adoption and farmers' well-being. The effect of technology on well-being had a diminishing impact over time. So agricultural technology innovations needed to be generated and promoted continuously to replace older technologies that have reached their saturation point.

Technology was the priority requirement for changing rural household agricultural production and market participation system. Availability of labor was also positively included for new technology adoption and market surplus crop production that confirm the labor intensive technologies which was appropriate for countries where there was surplus labor. Appropriate rural institutions require for respond effectively the changing agricultural technology adoption and market conditions (Melesse 2015).

Personal factors (age, income, extension participation, knowledge, and local leadership), socioeconomic factors (education, social participation, socio economic status, and formal groups), psychological factors (risk orientation, economic motivation, attitudes) and other factors (culture, values, farm size, farm income, and farm power) were influenced to adoption of innovations (Chauhan 2007). Factors affecting farm-level adoption include off-farm economic constraint and opportunities that are communicated with off-farm input and output markets (Lopes 2010).

Factors effecting to the adoption of innovations are (1) relative advantages (2) compatibility with the farmer’s overall farming system (3) complexity (4) trial ability (5) absorbability (6) productivity (7) stability (8) sustainability (9) economic viability (10) operational feasibility (11) matching farmer’s needs and (12) marketability. The factors are not complete, but they are the most important factors, past researches indicate in contributing the adoption of innovations (Chauhan 2007).

According to Wiredu (2010), the use of improved agricultural technologies is expected to enhance performance through increased yields and incomes. The adoption rate varies by location. Adoption had positive impact on farmers’ rice yields. Experience, gender (male) and expectations about the yield and performance of improved technologies had positive effect on yield. Proper targeting of beneficiaries of interventions and effective training in good agricultural practices are expected to increase adoption rates and improve the level of performance. Hobbs J. (2003) stated that high rates of illiteracy, significant extension activities are required to facilitate the adoption and maintenance of improved technology among poorly educated farmers in developing countries.

FAO (2009) stated that farmer’s adoption was influenced by gender different. Income of women and their household bargaining power were improved by increasing rural wage employment to escape from poverty. Sharmin (2012) stated that most of the women were involved in homestead income generating activities. Yoris (2006) stated that decision for adoption depends on a firm’s expectations about the benefits and costs of the technology. Firms may have different levels of expectations about the value of the technology and different levels of willingness to pay. Potential adopters are willing and able to freely share information with each other at no cost because information sharing is essential for the alignment of expectations which, in turn, facilitates the adoption.

Technology offers women new opportunities to close the gender gap in physical strength but certain technologies often become biased towards one sex during project formulation and implementation in farming systems if plans are not gender sensitive. Technology development and transfer should purpose at equal opportunities for women and men to participate and profit. It is important to develop technologies with gender needs when designing and transferring agricultural technologies because men and women are physiologically different and their needs differ (Lubwama 1999). Birthal (2012) stated that male household-heads are better decision-makers than female-heads.

2.1.2 Empirical review

Gender and institutional dimensions of agricultural technology adoption of Brazil was studied in 2011 by Ragasa (2012) and stated that women were slower adopters of improved technologies, information about these technologies or inputs and services than men in priority-setting and decision making.

Ntsama and Epo (2009) studied real impact of adopting adequate innovation processes by women in the agricultural sector of Cameroon in 2007 and a two-step Heckman procedure was used to analysis the determinants of the choice for the modern maize variety. The procedure (1) estimates the determinants of innovative adoption, then (2) evaluates the effects of agricultural productivity, controlling, selection bias and potential endogeneity. They stated that the women in rural areas were the backbone of the households. Probability of adopting modern maize variety was higher for women than men and women played an important role in generating extra revenue and buffer food crisis in view of enhancing household welfare in rural areas.

Gender composition of labor use and factors determining demand and supply of female labor in crop production at Bangladesh were studied by Rahman (1999) in 1998. A multivariate regression analysis was used and stated that women labor use ranges was less in food-grain (rice and wheat) than in non-cereal (highest for vegetables) production. In Bangladesh, women's labor use was limited only to post-harvest processing sector and hiring female labor was less than two percent of total labor use.

Victoria (2007) studied effects of HYV adoption on time allocation and labor force participation of men and women in non-farm activities at Bangladesh in 1999 and mentioned that a larger farm size or land owned raises the non-farm labor supply of females. Higher HYV yields raised the supply of non-farm labor of women but higher local or traditional yields lower women's supply of non-farm labor.

Awotide (2012) studied the impact of improved rice varieties adoption on rice productivity and farming household's welfare of Nigeria in 2009. Logistic model was selected for this study and stated that improved agricultural technology adoption can lead to the much desired increase in productivity because there was a significant difference of 165.94 kg/ha in rice productivity between the adopters and non-adopters. The adoption of improved rice varieties significantly impacted rice productivity and total household expenditure significantly. The impact was much higher among the female headed households (445.46 kg/ha) than the male headed households (154.90 kg/ha).

Gilbert (2002) conducted gender analysis of cropping system trial survey at Malawi in 2000 and Descriptive statistics was used. They stated that financial constraints characterizing female-headed households would tend to support reduced adoption rates, even when exposed to new technology. It was not sufficient condition for adoption of new agricultural technologies. Male heads of household had significantly higher fertilizer use, cash crop area and total field area than female farmers, indicating higher levels of land, labor and cash available to the male farmers. When trial inputs were provided, there were no significant differences in grain yield between male and female farmers, indicating that the female farmers were equally productive.

Tin Cho Cho Myat (2004) studied the adoption of the improved sugarcane production technology in Pyinmana, Yedarshe, Taikkyi and Pyay of Myanmar in 2003 and the result showed that farmers' education, yield, distance from the field to collection center and amount of government credit received were significant factors influencing the adoption of the technology and the adoption of other technology packages was still weak in the study areas. Farmers' perception and adoption of new agricultural technology in Burkina Faso were analyzed by Adesina & Baidu-Forson (1995) in 1989-1990 and Tobit model was used. The result showed that farmers' perception of technological characteristics significantly affects their adoption decision.

Eerdewijk & Danielsen (2015) studied gender matters in farm power at Hawassa and Asella of Ethiopia, and Bungoma and Laikipia of Kenya in 2014. Descriptive statistics was used and mentioned that values and assumptions of women's work were invisible and unrecognized. Women no accessed to and control over a range of resources, including land, income, and extension services. Women's time poverty negatively affected their access to resources and information. Decision-making was mainly influenced by male because most women in male-headed households had limited opportunities to reduce their labor burden. Gender relations and intra-household relations were not static, but dynamic. Therefore gender dynamics not only affected technology adoption, but technology adoption affected labor allocation and control over benefits.

2.2 The Constraints for Rural Women Regarding the Improved Production Technology Adoption

2.2.1 Theoretical review

FAO (1998) stated that gender role is commonly recognized that women are the major producers of the world, with significant roles in management of farming resources. Worldwide, women produce more than 50 percent of the food that is grown. They do all this with constraints that conspire to increase their daily workload disproportionately, underestimate the economic contribution of their labors and hinder their participation in decision and policy-making.

The greatest challenge for rural women is low opportunities to manage their households, farms and to participate in extension and training programs dealing with rice technologies. They should be adequate and timely information; knowledge on new varieties and their associated crop and natural resource management practices and be involved as cooperators in participatory experiments conducted in environments which suffer from natural disasters and climate change. International and national agricultural research and extension institutions can contribute immensely to address the needs of women in agriculture (Romero 2004). Akpabio (2012) mentioned that the three highest ranking constraining factors for women farmers were high cost of inputs, low income level of women farmers and lack of regular contact with extension agents.

Male and female farmers are equally efficient farm managers, controlling for levels of inputs and human capital. Women may be more constrained by cultural factors from having more active roles, and levels of education and technical development are lower. Gender differences may lead to allocate efficiencies within the household, even if sex differences do not, for the most part, affect technical efficiency (Quisumbing 1996). Gender analysis provides an important framework for understanding adoption challenges. Women farmers have less access than men to productive assets and their preferences are less likely to be taken on board in priority-setting. Constraints for women are less access to adoption of land, credit, education or information and labor (Ley 2012).

Access to new technology is important in maintaining and developing agricultural productivity. Gender gaps exist for agricultural technologies, including machines and tools, improved plant varieties and animal breeds, fertilizers, pest control measures and management techniques. Various constraints, including the gender gaps, lead to gender inequalities in access to and adoption of new technologies, as well as in the application of inputs and existing technologies. Inputs application depend on the availability of complementary assets such as land, credit, education and labor, all of which more faced by female-headed households than male-headed households (FAO 2011).

Kumar (1994) stated that households headed by women can be among the technological innovators once they overcome resource constraints, and the majority of women farmer reside in households headed by men, in which both men and women together make decision for agricultural production. Both groups of households face adverse efficiency, equity and absolute welfare outcomes unless there are parallel improvements in the value of women's time with adoption of improved agricultural technologies. In farm and off-farm enterprise development, success will depend on the ability of women to obtain access to resources and technology along with skills and training.

World Bank (2010) stated that in many societies, the head of household, whether a man or a woman is still defined as the primary farmer and is perceived agricultural extension information. Many institutions maintain to operate with the perception that "women are not farmers". So, women are underserved as clients of extension services in their own right, often seen to be only helping. Colverson (1995) found that women described as helping their husbands in their agricultural activities. If information flows freely between men and women, targeting men is sufficient for relaying agricultural information, even when it concerns tasks for which women are responsible (Fong & Bhushan 1996).

Women access to technology is limited by several factors including their lack of cash income or credit to purchase technology and their lack of contact with extension service and cooperatives. New technologies are often inappropriate to women's needs because they have reduced poorer women's prospects for employment and cash income (Bavinic & Mehra 1990).

2.2.2 Empirical review

Ajibola et al., (2015) studied constraints faced by women vegetable farmers of Kwara state, Nigeria and its agricultural practices in 2012 and found that constraints facing women in vegetable farming according to their order of severity were availability of water, lack of credit facility, insufficient capital, health status, input supply, time, adequacy of transport, land availability and market for vegetable. Most (63.8 percent) of the respondent was achieved source for information through extension agents. A cooperative society also needed for easily access credit facilities and overcome unstable market price problem. Government and the private sector such as non-governmental organizations should construct dams for irrigation of vegetable farms.

Giné and Klonner (2006) analyzed credit constraints as a barrier to technology adoption by the poor persons in Tamil Nadu of India from 2002 to 2004 and mentioned that lack of wealth was a major constraint for delayed of technology adoption. Namwata (2010) analyzed adoption of improved agricultural technologies for Irish potatoes among farmers in Ilungu ward Mbeya Rural district, Tanzania. A multiple linear regression analysis was used for isolating factors influencing adoption of improved agricultural technologies and stated that female by a household head had been lessened adoption with limited resource special consideration for agricultural credits should be given to women.

Nyein Nyein Htwe (2000) studied the adoption behavior of farmers to recommended farm practices in Pyinmana Township in 1999 and found that the major constraints in rice cultivation were difficulty in control of hired transplanters (44 percent), unavailability of irrigation water in time (43.3 percent) and difficulty in obtaining farm yard manure (41 percent). High cost of NPK fertilizer led to partial adoption of recommended fertilizer application. The major problem was scarcity of labor for weeding in peak season (17.5 percent) and high labor cost (16.7 percent).

FAO (1998) stated that access to resources is essential to enhance agricultural productivity of both men and women but women generally less access to resource than men. Worldwide, women have insufficient access to land, membership in rural orgnization, credit, agricultural inputs and technology, training and extension, and marketing services. Land is usually required as collateral for loans. It is serious constraints to promote women's agricultural productivity, as women farmers are impossible to buy inputs like seeds, fertilizers and improved technologies or to hire labor.

Jazairy (1992) stated that, women farmers from Africa face many constraints in obtaining access to improved seeds, new crop varieties, knowledge about improved cropping systems and other forms of technology as a result of

1. Women poverty and the fact that most of their productive activities are not market- oriented;
2. Women's lack of legal right to land, which constraints for access credit and membership to farmers' organization, further limiting their access to input, credit and service
3. Women crop activities having achieved low attention from research and technology development programs
4. Project designers', credit officials', and extension staff's assumption that women cannot afford to purchase modern inputs, or to reimburse credit.

2.3 The Role of Social Capital with Gender Perspective in Adoption of Improved Production Technologies

2.3.1 Theoretical review

Type of social capital includes formal and informal clubs, groups, or associations established by farming communities in many villages. Social capital reduces the cost of information acquisition and uncertainty about the reliability of information. Kantungi (2006) stated that information that comes from trusted people is of higher value. It also facilitates the willingness and cooperation to share information. Building women's social capital can be an effective way to improve information exchange and resource distribution, and to ensure those women's voices in decision-making at all levels.

Social capital or social network is important for agricultural extension services to communicate with farmers because it is the most reliable source of information about new technologies (Yishay & Mobarak 2013). ‘Social capital’ refers to the ability of men and women farmers to develop and uses various kinds of social networks and voluntary action taken by a group to achieve common interests (Padmaja & Bantilan 2005).

Njuki (2008) stated that there are three types of social capital which are bonding social capital, bridging social capital and linking social capital. Bonding social capital is generally defined as closed networks of close friends and relatives or horizontal relationships among equals within a localized community. Bridging social capital links networks requiring collaboration and coordination with other external groups to achieve set goals; for example, it can be the link between two local groups from different villages. Linking social capital is the engagement of local groups or networks with institutions or agencies in higher influential positions.

Mehra and Rojas (2008) stated that women were lower tolerance of risk and slower adopter of new technologies than men because women faced difficulties to involve in rural organization and to access agricultural inputs and technologies. This barrier can cause reduced crop yields, delayed adoption of new technologies and crop varieties. Isham (2002) extends the model of Feder and Slade (1984) by incorporating social capital as a fixed input into the decision to adopt technologies. This extended model predicts that farmers with neighbors who adopt the technology, and those with higher levels of social capital, accumulate more information and adopt technology more rapidly.

2.3.2 Empirical review

Mwaura (2014) analyzed effect of farmer group membership on agricultural technology adoption of Uganda in 2008 and stated that membership to farmer groups did not necessarily lead to adoption of high yielding technologies and increased productivity. Adoption of groups by farmers could be applied to be at an early stage with only innovators and early adopters joining. Development agencies needed for farmer groups’ formation, leadership, organization, operation, dynamics, facilitations and sources of technology disseminated.

Bandiera and Rasul (2003) studied social networks and technology adoption of northern Mozambique in 2000 and stated that social networks were important determinants of technology adoption. The number of adopting households in the village represented to the village characteristics that determined the adoption decision of all farmers. Advantaged farmers were most likely to adopt irrespective of the choices of their family and friends. Poor farmers responded more to their network than do the rich. Rich farmers had a disproportionate influence on the adoption decisions of others.

Douthwaite (2001) studied the neglected role of user innovation during adoption at Nigeria in 1999. They stated that the adoption rate and impact of some new technologies depended upon the motivation and success of the people who directly benefit from an innovation (key stakeholders) in learning about the technology and their ability to make it cheaper and more profitable to replicate and use. It also depended upon researchers who had scientific knowledge of the technology and working in partnership with the key stakeholders to help impart scientific knowledge, learn more about the performance of the technology in real conditions themselves, and to make improvements of their own. The adoption rate depended on the amount of new knowledge that needed to be learnt by the researchers and key stakeholders.

Oladene (2005) studied the factors that affect farmers to discontinue the adoption of innovation at Southwestern Nigeria in 2002 and stated that change in attitude after adoption, extension visit to reinforce the technology, opportunity for expression of reactions to the technology, opportunity to market surplus yields and availability of required input to sustain adoption were important variables which stimulate to the farmers for discontinue adoption.

Factors affecting the adoption of modern yam storage technologies by farmers in the northern ecological zone of Edo State, Nigeria were analyzed by Okoedo-Okojie and Onemolease (2009) in 2006. They stated that major constraints for the farmers' adoption of these technologies were ignorance of technology existence (100 percent), non-availability (46.5 percent) and high cost (34.6 percent) of the some of the storage technologies. Farmers should be provided adequate capital and training with information.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Description of the Study Area

3.1.1 Location of the study area

Thazi Township, the study area, is located in Mandalay Region of the central dry zone of Myanmar at 21° 50′N 95° 39′E. Yangon-Mandalay railway passes through the study area as does the Meikhtila to Taunggyi highway, which is the main road to Shan state. Min Hla Lake provides formal irrigation system to south-west part of this township (Appendices 1).

3.1.2 Area, population and occupations of Thazi Township

According to the Department of Agriculture (2016), there are 81 village tracts. It has about 202680 populations in 2014 (DoP 2014). In 2016, farmer populations were 51049 in which 19428 populations were rice cultivated farmers in the area. Female agricultural labor was of 3500 populations and male was of 1500 populations in 2016. Rural laborers, as well as agricultural laborer, work as construction workers, timber workers, charcoals making, and there is also migration to other cities for better jobs in off-farm season (DoA 2016). Livestock and small ruminants are also raised as a part income in the area. But, the agricultural production is the major source of income.

3.1.3 Sown area and production of crops in Thazi Township

In 2015-2016, total rice cultivated area was 219761.60 ha and planned rice cultivated area for 2016-2017 was 307575.50 ha in Mandalay region as shown in Table 3.1. In 2015-2016, 9549.17 ha of monsoon paddy and about 0.8 ha of summer paddy were cultivated in Thazi Township (Table 3.2) (DoA 2016). The main cultivated crops in the study area are paddy, chili, chickpea, sesame and a few cultivated crops are sunflower and groundnut. Paddy production of the study area depends heavily on rainfall, and most soils are sandy and moderate fertility. Animal power and small hand tractors are commonly used in agricultural production.

Table 3.1 Rice cultivated area of Mandalay Region (ha)

No.	Districts	Cultivated area in 2015-2016	Planned area in 2016-2017
1	Mandalay	24,874.95	29,581.55
2	Pyin Oo Lwin	58,585.59	59,926.75
3	Kyaukse	58,163.50	92,961.55
4	Meikhtila	38,216.51	69,172.80
5	Myinghan	8,591.26	13,695.27
6	Nyaung U	7,925.54	9,291.79
7	Yamethin	23,404.29	32,945.77
	Total	219,761.64	307,575.48

Source: DoA 2016

Table 3.2 Rice cultivated area of Meikhtila District (ha) in 2015-2016

No.	Townships	Summer cultivated area	Monsoon cultivated area
1	Meikhtila	0.00	3,986.65
2	Mahlaing	0.00	2,380.82
3	Thazi	0.81	9,549.17
4	Wundwin	1347.33	22,299.88
	Total	1,348.14	38,216.52

Source: DoA 2016

3.2 Data Collection Methods and Selected Villages

3.2.1 Data collection and sampling procedure

Both primary and secondary sources of data were used in this study. The primary information was gathered by household interview technique. Data were collected from 180 respondents of the study area through personal interview using a set of structured questionnaires. The general descriptions of selected villages are shown in Table 3.3. A purposive random sampling method was used to select households for personal interview. Both female and male rice growers were selected. All sorts of technical and socio-economic data were collected. Information about gender role in adoption of rice production technology and their availability; technology characteristics; extent of farmers' adoption; institutions and support services; sources of income and other relevant demographic information have been collected. Detailed data on farmers' age, education level, family members, family labor, farm size, annual income, home assets, farm implements and gender role in extension access, credit availability, use of labor, use of fertilizer, paddy yield, social capital, participation in training and farming practices such as land preparation, use of seed rate, chemical fertilizer, spacing, time of sowing, transplanting and harvesting were gathered. Besides, the constraints faced by farmers in paddy production, costs and returns information were also collected.

3.2.2 Method of analysis

To analyze the data, Microsoft Excel was used for descriptive analysis and paired samples t-test Statistical Package for Social Science (SPSS) versions 17 Software was used for multiple regression.

3.2.3 Adoption score

The improved rice production technology package is composed of 10 main components for increasing yield. The marking system for the component adoption was considered on the basic of a total of 100 scores. This means that, if rice grower adopts one component, this grower will receive 10 score. The more the component adoption, the higher scores the farmer receives. Besides that if farmers obtain 60 score and above, they are classified as high-adopters; otherwise are as partial-adopters.

Table 3.3 Total sample size of the study

No.	Name of villages	Sample households (no.)		
		Male-headed HH	Female-headed HH	Total
1	Aung Thar	3	5	8
2	Bo Kone	5	3	8
3	Gway Kone (E)	12	12	24
4	Hnan Kan	11	8	19
6	Inn Kone	19	10	29
7	Kan Thit	9	10	19
8	Kyar Bet Kone	12	4	16
9	Ma Kyee Tha Myar	2	0	2
10	Nyaung Kone	17	11	28
11	Oke Pho	15	1	16
12	Sae Gyi	16	2	18
	Total	121	66	187

3.2.4 Cost and return analysis

Enterprise budgeting is the first tool used in the economic analyses. An enterprise budget is a physical and financial plan for raising and selling a particular crop or livestock commodity. It is a physical plan because it indicates the type and quantity of production inputs and the output or yield, per unit. It is also a financial plan because it assigns costs to all the inputs used in producing the commodity (Carkner 2000).

Enterprise budget enables to evaluate the cost and return of production process. Hired labor costs were valued by market wage rates and man days used in all farming practices. In order to estimate gross return for respective crops, average yield and average price were used. Benefit cost ratio was used as profitability measures for each crop enterprise computing total gross margin or return above variable cost and return above cash costs. Input quantities and values used in production process (costs) and output quantities and values (benefits) are the basic data required for budgets. The purpose of enterprise budgeting was to show the difference in net benefits under several resources situations in such a way as to help one make management decision (Olson 2009).

The cost and return analysis was used to assess the profitability of rice production in the study area on an average basis. In this analysis, the variable cost of the rice production was divided into four categories as follows:

(1) Material input cost,

(2) Hired labor cost,

(3) Family labor cost and

(4) Interest on cash cost.

The interest was normally charged on cash expense for early in the growing season. The counted interest rate was 10%. The first measurement was the difference between the total gross benefits or total returns and total variable cash costs; excluding on opportunity costs. This value was referred to as “return above variable cash cost”. The second measurement was deduction of the opportunity cost and total variable cash cost from gross benefit. This return was referred to as “return above variable cost” or “gross margin”. The “return per unit of capital invested” was calculated by gross benefit per total variable cost. The “return per unit of cash cost expensed” was calculated by gross benefit per total cash cost (Olson 2009).

These measurements could be expressed with equations as:

Measurement (1)

Return above variable cash cost = Total gross benefit – Total variable cash cost

Measurement (2)

Return above variable cost = Total gross benefit – Total variable cost (Gross margin)

Measurement (3)

Return per unit of capital invested = Total gross benefit/Total variable cost

Measurement (4)

Return per unit cash cost = Total gross benefit/Total cash cost

3.2.5 Weighted average

Each farmers was asked to indicate the extent of constraints faced by individual with the five responses such as, ‘extreme strong’, ‘very strong’, ‘strong’, ‘less’ and none weightage was assigned to these responses as 4, 3, 2, 1 and 0, respectively.

3.2.6 Regression analysis

Regression analysis is one of the most commonly used tool in econometric studies. Regression analysis is a statistical tool for the investigation of relationships between variables. Regression models are now a mainstay of statistical analysis in most fields because of its power and flexibility. Regression is a technique that allows additional factors to enter the analysis separately so that the effect of each can be estimated. It is valuable for quantifying the impact of various simultaneous influences upon a single dependent variable. The general purpose of regression analysis is to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. In the study, a regression model was used to find out the influencing factors on the dependent variables such as adoption of male and female rice farmer by using some selected socio-economic variables.

This model was as follow:

(1) Regression model for male rice farmers

$$Y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_7 X_{7i} + e_i$$

Where,

Y_i = Adoption score of male rice farmers

X_{1i} = Age (Yr.)

X_{2i} = Schooling year (Yr.)

X_{3i} =Total cultivated area (ha)

X_{4i} = Family labor (No.)

X_{5i} = Contact time with extension agent (No.)

X_{6i} = Training attendance time (No.)

X_{7i} = Total gross benefit (MMK/ha)

β_0 = Constant

e_i = Error term

(2) Regression model for female rice farmers

$$Y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_7 X_{7i} + e_i$$

Where,

Y_i = Adoption score of female rice farmers

X_{1i} = Age (Yr.)

X_{2i} = Schooling year (Yr.)

X_{3i} =Total cultivated area (ha)

X_{4i} = Family labor (No.)

X_{5i} = Contact time with extension agent (No.)

X_{6i} = Training attendance time (No.)

X_{7i} = Total gross benefit (MMK/ha)

β_0 = Constant

e_i = Error term

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Information on Improved Rice Production Technology Adoption of Sample Farmers

The distribution of farm households based on improved rice production technologies package adoption in the study area is shown in Table 4.1. About 1.7 % of male-headed households used recommended seed rate but female-headed households did not apply recommended seed rate in their rice production. Approximately 77% of male-headed households and 69.7% of female-headed households planted monsoon paddy with recommended plant spacing. About 23.1% of male-headed households and 19.7% of female-headed households transplanted seedling at the recommended seedling age. About 83.5% of male-headed households and 87.9% of female-headed households used transplanting method. In the timely checking and refilling, 0.8% of male-headed households and 1.5% of female-headed households followed the recommendation of DoA, Thazi Township. And it was also found that 19.8% of male-headed households and 28.8% of female-headed households used recommended application time and rate of fertilizer in rice production.

Moreover, the recommended basal insecticide application was followed by only 5% of male-headed households and 3% of female-headed households. Nearly fifteen percent of male-headed households and 37.9% of female-headed households practiced weed control system recommended by DoA. Adoption of weed control was higher in female-headed households compared with male-headed households. But there was obviously found that all sample farmers followed recommended water management. For the recommended harvesting time, the result revealed that 88.4% of male-headed households and 89.4% of female-headed households harvested rice in accordance with the recommendation of DoA. However, adoption of seed rate, time of checking and refilling, and basal insecticide application was still weak in both adopters' groups.

4.1.1 Analysis of adoption score of sample households in the study area

In the study area, high-adopter group was accounted for 9.1% of male-headed households and 16.7% of female-headed households. And then partial-adopter group was accounted for 90.9% and 83.3% of male-headed households and female-headed households respectively (Table 4.2).

4.2 Socioeconomic Characteristic of Sample Farmers

In this study, as shown in Table 4.3, the average age of high-adopters was 57.5 years old and that of partial-adopters was 52.8 years old. The high-adopters' experience in agriculture was an average of 29.4 years while the farming experience of partial-adopters was 26.3 years. The average years of schooling for high-adopters were 7 years while those of partial-adopters were 6.6 years. In the rice cultivated area, the average cultivated area of high-adopters was 4.9 hectares and that of partial-adopter was 7 hectares. The family size of high-adopters' farm households was 4.7 person whereas partial-adopters' farm households had 4.1 person. The average family labor of high-adopters' farm households was 2.4 person whereas partial adopter farm households had 1.6 person. In dependency ratio, high-adopters were 36% and that of partial-adopters was 31%. Age, family labor and dependency ratio of high-adopters group was significantly higher than partial-adopters groups at 10% and 1% level respectively.

Table 4.1 Distribution of farm households based on improved rice production technologies package adoption in the study area

No.	Items	Male-headed HH (n=121)		Female-headed HH (n=66)	
		no.	%	no.	%
1	Seed rate	2	1.7	0	0.0
2	Spacing	94	77.7	46	69.7
3	Seedling age	28	23.1	13	19.7
4	Planting system	101	83.5	58	87.9
5	Time of checking and refilling	1	0.8	1	1.5
6	Fertilizer application	24	19.8	19	28.8
7	Basal insecticide application	6	5.0	2	3.0
8	Weed control	18	14.9	25	37.9
9	Water management	121	100.0	66	100.0
10	Harvesting	107	88.4	59	89.4

Table 4.2 Grouping of sample households based on the adoption score in the study area

Adoption of recommended technologies	Marking score	Male-headed HH		Female-headed HH	
		no.	%	no.	%
One component	10	1	0.8	0	0.0
Two components	20	9	7.4	1	1.5
Three components	30	16	13.2	18	27.3
Four components	40	53	43.8	22	33.3
Five components	50	31	25.6	14	21.2
Partial-adopters	**≤ 50**	**110**	**90.9**	**55**	**83.3**
Six components	60	9	7.4	4	6.1
Seven components	70	2	1.7	6	9.1
Eight components	80	0	0.0	0	0.0
Nine components	90	0	0.0	1	1.5
Ten components	100	0	0.0	0	0.0
High-adopters	**≥60**	**11**	**9.1**	**11**	**16.7**
Total	**100**	**121**	**100.0**	**66**	**100.0**

Table 4.3 Socio-economic characteristics of sample household in the study area

Items	High-adopters (n=22)			Partial-adopters (n=165)			t-test & Pearson Chi-square
	Male-headed HH	Female-headed HH	Aver-age	Male-headed HH	Female-headed HH	Aver-age	
Number	11	11	22.0	121	55	165.0	
Age of household head (Year)	54	61	57.5	54	51	52.8	-1.80a*
Farming experience (Year)	28	31	29.4	28	24	26.3	-1.10a^{ns}
Schooling year (Year)	8	6	7.0	7	6	6.6	-0.58a ^{ns}
Cultivated area (ha)	3	7	4.9	8	6	7.0	1.52a ^{ns}
Family member (No.)	4	5	4.7	4	3	4.1	-1.44a ^{ns}
Family labor (No.)	1	4	2.4	2	1	1.6	-2.73a***
Dependency ratio (%)	36	38	36.0	45	17	31.0	47.05b***

Note: *** and * are significant at 1% and 10% level respectively and ns is not significant.
a=t-test, b=Perason Chi-square

4.2.1 Home assets of the sample households

The home assets such as hand phone, motorcycle, bicycle, television, EVD, solar panel, generator, Sky net TV receiver, sound box and battery are shown in Table 4.4. High-adopter group possessed hand phone (47.7%), motorcycle (40.9%), bicycle (27.3%), television (29.5%), EVD (22.7%), sound box (11.4%), solar panel for lighting (13.6%), sky net TV receiver, generator and battery (4.5%). Partial-adopter group possessed hand phone (43%), motorcycle (39.1%), bicycle (26.7%), television (22.7%), EVD (20.3%), sound box (5.2%), solar panel (23.9%), generator (4.5%), sky net TV receiver (3.3%), and battery (4.2%). Assets of sound box and solar panel were significantly different at 10% level between high and partial adopters.

The farm assets owned by sample households in the study area are presented in Table 4.5. Most respondents own sprayer, and animal drawn plough, harrow and cart, thus they used traditional practices in their farming activities. In high-adopters, male-headed households possessed sprayer (81.8%), plough, harrow and cart (54.5%), power tiller and thresher (9.1%) while female-headed households possessed sprayer (63.6%), plough, harrow and cart (54.5%), power tiller (9.1%) and water pump (36.4%). In partial-adopters, male-headed households possessed sprayer (70%), plough and harrow (80.9%), cart (77.3%), power tiller (15.5%), thresher (0.9%), tractor (1.8%), hand-tractor (8.2%) and water-pump (29.1%) while female-headed households possessed sprayer (41.8%), plough (65.5%), harrow (63.6%), cart (58.2%), power tiller (10.9%) and water pump (12.7%). Male-headed households in both adopters group possess more farm asset.

Table 4.4 Home assets of sample households in the study area

No.	Home assets	High-adopters			Partial-adopters			Pearson Chi-square
		Male -headed HH	Female -headed HH	Average	Male -headed HH	Female -headed HH	Average	
1	Hand phone	11(100)	10(90.9)	11(47.7)	99(90.0)	43(78.2)	71(43.0)	0.53^{ns}
2	Motorcycle	8(72.7)	10(90.9)	9(40.9)	92(83.6)	37(67.3)	64.5(39.1)	0.35^{ns}
3	Bicycle	7(63.6)	5(45.5)	6(27.3)	60(54.5)	28(50.9)	44(26.7)	0.01^{ns}
4	Television	7(63.6)	6(54.5)	7(29.5)	41(37.3)	34(61.8)	37.5(22.7)	1.45^{ns}
5	EVD	5(45.5)	5(45.5)	5(22.7)	41(37.3)	26(47.3)	33.5(20.3)	0.19^{ns}
6	Sound box	3(27.3)	2(18.2)	3(11.4)	12(10.9)	5(9.1)	8.5(5.2)	2.89^{*}
7	Solar panel	2(18.2)	4(36.4)	3(13.6)	57(51.8)	22(40.0)	39.5(23.9)	3.32^{*}
8	Skynet TV receiver	2(18.2)	0(0.0)	1(4.5)	9(8.2)	2(3.6)	5.5(3.3)	0.18^{ns}
9	Generator	1(9.1)	1(9.1)	1(4.5)	10(9.1)	5(9.1)	7.5(4.5)	0.00^{ns}
10	Battery	0(0)	2(18.2)	1(4.5)	10(9.1)	4(7.3)	7(4.2)	0.01^{ns}
	Number	11	11		110	55		

Note: Figures in the parentheses present percentage.

*** is significant at 10% level and ns is not significant.**

Table 4.5 Farm assets of sample households in the study area

No.	Items	High-adopters				Partial-adopters			
		Male-headed HH		Female-headed HH		Male-headed HH		Female-headed HH	
		no.	%	no.	%	no.	%	no.	%
1	Sprayer	9	81.8	7	63.6	77	70.0	23	41.8
2	Plough	6	54.5	6	54.5	89	80.9	36	65.5
3	Harrow	6	54.5	6	54.5	89	80.9	35	63.6
4	Cart	6	54.5	6	54.5	85	77.3	32	58.2
5	Power Tiller	1	9.1	1	9.1	17	15.5	6	10.9
6	Thresher	1	9.1	0	0.0	1	0.9	0	0.0
7	Tractor	0	0.0	0	0.0	2	1.8	0	0.0
8	Hand-tractor	0	0.0	0	0.0	9	8.2	0	0.0
9	Water-pump	0	0.0	4	36.4	32	29.1	7	12.7
	Number	11	100.0	11	100.0	110	100.0	55	100.0

4.2.2 Mechanization operated by sample households in rice production activities

Mechanization operated by sample households in rice production activities in the study area are presented in Table 4.6. Some farmers used machine in threshing, ploughing and harrowing, and seedbed preparation. In high-adopters, all male-headed households and 81.8% of female-headed households used machine for threshing. Male-headed households (54.5%) and female-headed households (72.7%) used machine for ploughing and harrowing. In seedbed preparation, male-headed households (18.2%) and female-headed households (27.3%) used machine. Male-headed households (9.1%) and female-headed households (18.2%) used machines for leveling. Female-headed households (9.1%) harvested with machine.

In partial-adopters, male-headed households (84.5%) and female-headed households (87.3%) used machine for threshing. Male-headed households (67.3%) and female-headed households (80%) used machine for ploughing and harrowing. Male-headed households (16.4%) and female-headed households (14.5%) used machine for seedbed preparation. Male-headed households (5.5%) and female-headed households (9.1%) used machine for leveling. Male-headed households (0.9%) used in irrigation and (9.1%) used in harvesting while female-headed households (7.3%) used machine for irrigation and harvesting.

Male-headed households (18%) and female-headed households (9%) from high-adopters group and partial-adopters (20%) in each adopter group had male migration. Male-headed households (27%) and female-headed households (9%) from high-adopters group and male-headed households (15%) and female-headed households (9%) from partial-adopters had female migration (Table 4.7).

According to Table 4.8, male-headed households (45%) and female-headed households (18%) of high-adopters and male-headed households (28%) and female-headed households (18%) of partial-adopters migrated within the country. Male-headed households (6%) and female-headed households (9%) of partial-adopters migrated internationally. In high-adopters groups, female migration was observed in more internal migration.

Table 4.6 Mechanization operated by sample farmers in rice production activities in the study area

No.	Rice production activities	High-adopters				Partial-adopters			
		Male-headed HH		Female-headed HH		Male-Headed HH		Female-headed HH	
		no.	%	no.	%	no.	%	no.	%
1	Threshing	11	100.0	9	81.8	93	84.5	48	87.3
2	Ploughing and harrowing	6	54.5	8	72.7	74	67.3	44	80.0
3	Seedbed preparation	2	18.2	3	27.3	18	16.4	8	14.5
4	Leveling	1	9.1	2	18.2	6	5.5	5	9.1
5	Irrigation	0	0.0	0	0.0	1	0.9	4	7.3
6	Harvesting	0	0.0	1	9.1	10	9.1	4	7.3
	Number	11	100.0	11	100.0	110	100.0	55	100.0

Table 4.7 Migration of sample households by gender in the study area

Gender	High-adopters				Partial-adopters			
	Male-Headed HH (n=11)		Female-Headed HH (n=11)		Male-Headed HH (n=110)		Female-Headed HH (n=55)	
	no.	%	no.	%	no.	%	no.	%
Male	2	18	1	9	22	20	11	20
Female	3	27	1	9	16	15	5	9

Table 4.8 Type of migration of sample household in the study area

Type of migration	High-adopters				Partial-adopters			
	Male-headed HH (n=11)		Female-headed HH (n=11)		Male-headed HH (n=110)		Female-headed HH (n=55)	
	no.	%	no.	%	no.	%	no.	%
Internal migration	5	45	2	18	31	28	10	18
International migration	0	0	0	0	7	6	5	9

As shown in Table 4.9, male-headed households (27%) and female-headed households (9%) of high-adopters and male-headed households (26%) and female-headed households (18%) of partial-adopter migrated for more income earning. In high adopters, male-headed households (9%) migrated for better job opportunities and another (9%) also migrated because they are staff. For better job opportunities, male-headed households (18%) and female-headed households (4%) of partial-adopters migrated while male-headed households (36%) and female-headed households (5%) migrated because they are staff.

4.2.3 Cultivated rice varieties in the study area

The common cultivated rice varieties in the study area were 90 days Variety, Manaw Thu Kha, Thu Kha Tun, Yezin Thu Kha, Sin Thu Kha, Shwe Thwe Yin, Pale Thwe, Ayeyar Min, Byaut Tun, Shwe Poe, 182 BBB and Yay Anelo-4. As shown in Table 4.10, 90 days Variety, Manaw Thu Kha and Thu Kha Tun were the most common cultivated rice varieties as both adopter groups used in the study area.

4.2.4 Information about paddy production in the study area

Information about paddy production of high-adopters is shown in Appendices 2 by MMK and Appendices 4 by USD. As shown in Appendix 2, average total grown area of male-headed households was 1.49 hectare while female-headed households were 1.05 hectare. Average paddy yield of male-headed households was 3.60 ton per hectare while female-headed households were 2.66 ton per hectare. Average paddy price received by male-headed households was 279,545 MMK per ton while female-headed households received 265,909 MMK per ton.

Average total gross benefit received by male-headed households was 1,005,574 MMK per hectare but female-headed households earned 707,834 MMK per hectare. Average total material cost of male-headed households was 258,605 MMK per hectare but female-headed households was 191,525 MMK per hectare. Total family labor cost in male-headed households was 130,738 MMK per hectare but in female-headed households spent 134,557 MMK per hectare. Total hire labor cost in male-headed households was 327,183 MMK per hectare but in female-headed households its costs was 289,320 MMK per hectare. Total variable cost in male-headed households was 775,106 MMK per hectare but female-headed households used 663,487 MMK per hectare. Return per unit of capital was 1.30 for male-headed households and 1.07 for female-headed households.

Table 4.9 Reason of migration of sample households in the study area

Reason of migration	High-adopters				Partial-adopters			
	Male-headed HH (n=11)		Female-headed HH (n=11)		Male-headed HH (n=110)		Female-headed HH (n=55)	
	no.	%	no.	%	no.	%	no.	%
More income earning	3	27	1	9	29	26	10	18
Better job opportunities	1	9	0	0	2	18	2	4
Staff	1	9	0	0	4	36	3	5

Table 4.10 Cultivated rice varieties of sample farmers in the study area

No.	Rice varieties	High-adopters				Partial-adopters			
		Male-headed HH		Female-headed HH		Male-headed HH		Female-headed HH	
		no.	%	no.	%	no.	%	no.	%
1	90 days Variety	7	63.6	4	36.4	40	36.4	18	32.7
2	Manaw Thu Kha	6	54.5	5	45.5	48	43.6	26	47.3
3	Thu Kha Tun	0	0.0	2	18.2	16	14.5	8	14.5
4	Yezin Thu Kha	0	0.0	0	0.0	5	4.5	2	3.6
5	Shwe Pyi Htay	1	9.1	1	9.1	0	0.0	3	5.5
6	Shwe Manaw	0	0.0	0	0.0	0	0.0	1	1.8
7	Sin Thu Kha	0	0.0	0	0.0	1	0.9	1	1.8
8	Shwe Thwe Yin	0	0.0	1	9.1	2	1.8	2	3.6
9	Pale Thwe	0	0.0	0	0.0	3	2.7	0	0.0
10	Ayeyar Min	0	0.0	0	0.0	1	0.9	0	0.0
11	Byaut Tun	0	0.0	0	0.0	6	5.5	0	0.0
12	Shwe Poe	0	0.0	0	0.0	1	0.9	0	0.0
13	182 BBB	0	0.0	0	0.0	2	1.8	0	0.0
14	Yaenelo-4	0	0.0	0	0.0	2	1.8	0	0.0

Information about paddy production of partial-adopters is shown in Appendices 3 by MMK and Appendices 5 by USD. As shown in Appendix 3, in partial-adopters, average total grown area of male-headed households was 0.84 hectare while female-headed households were 1.05 hectare. Average paddy yield of male-headed households was 3.04 ton per hectare while yield of female-headed households was 3.17 ton per hectare. Average paddy price received by male-headed households was 251,045 MMK per ton while female-headed households were 252,091 MMK per ton.

Average total gross benefit received by male-headed households was 763,087 MMK per hectare but female-headed households earned 799,517 MMK per hectare. Average total material cost of male-headed households was 175,655 MMK per hectare but female-headed households spent 171,875 MMK per hectare. Total family labor cost in male-headed households was 121,661 MMK per hectare but female-headed households was 78,286 MMK per hectare. Total hire labor cost in male-headed households was 283,333 MMK per hectare but female-headed households was 336,082 MMK per hectare. Total variable cost in male-headed households was 626,548 MMK per hectare but female-headed households was 637,039 MMK per hectare. Return per unit of capital was 1.22 in both male-headed households and 1.26 in female-headed households.

Total gross benefit, total variable cost and net benefit on gross margin, and return per unit of capital and return per unit of cash cost of sample households are shown in Figure 4.1 and 4.2 respectively. Among these adopter groups, highly-adopted male-headed households were the highest in all items while highly-adopted female-headed households were the lowest except in total variable cost.

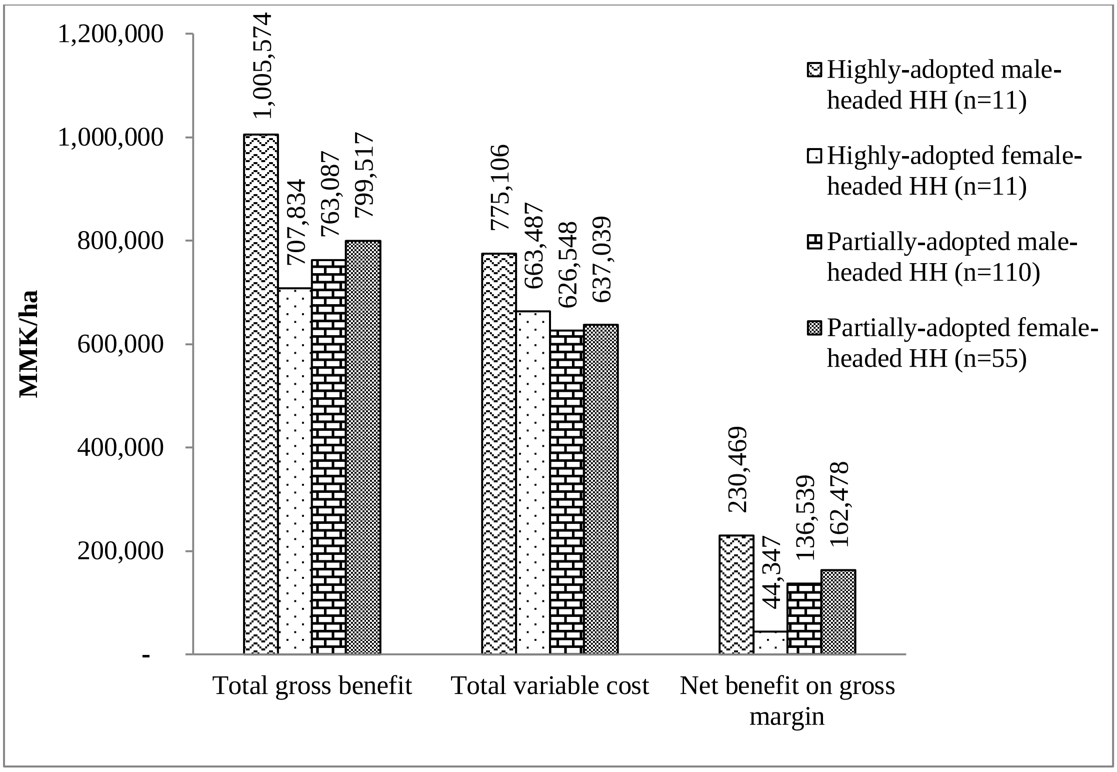

Figure 4.1 Total gross benefit, total variable cost and net benefit on gross margin of sample households

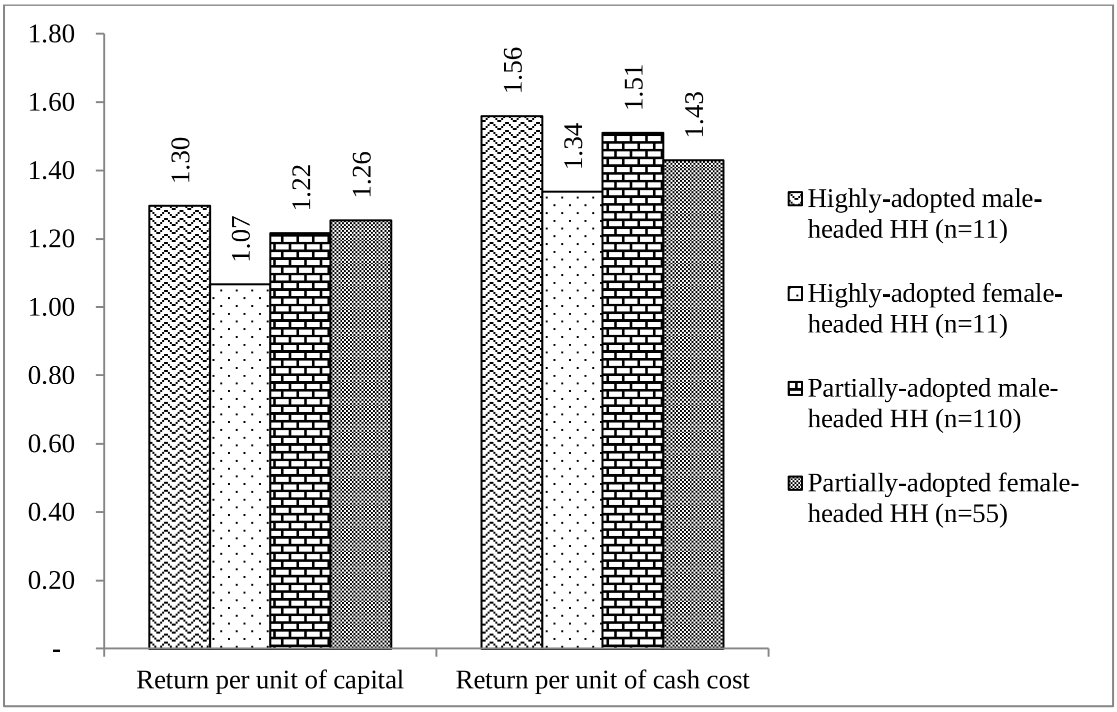

Figure 4.2 Return per unit of capital and return per unit of cash cost of sample households

4.2.5 Credit availability by sample households in the study area

In high-adopters, the sample households took credit from different sources as shown in Figure 4.3. There are 3 credit sources namely Myanmar Agricultural Development Bank (MADB), Microfinance cooperative and Evergreen village project. Among these 3 credit sources, MADB was the formal credit source. Male-headed households (73%) and female-headed households (64%) took the credit from MADB. Male-headed households (18%) and female-headed households (9%) accessed the credit from microfinance cooperative. Other male-headed households (9%) took credit from Evergreen village project. Thus majority of the households head had access to credit. Access to credit could enable farmers to purchase farm inputs and enjoy economies of scale.

In partial-adopters, the sample households took credit from different sources as shown in Figure 4.4. There are 4 credit sources namely Myanmar Agricultural Development Bank (MADB), Microfinance cooperative, Evergreen village project and Khitshae saung. Among these 4 credit sources, MADB was the formal credit source. Male-headed households (78%) and female-headed households (85%) could access the credit from MADB. Male-headed households (24%) and female-headed households (15%) took the credit from microfinance cooperative. Another male-headed households (7%) and female-headed households (4%) received credits from Evergreen village project. Only male-headed households (1%) took credit from Khitshae saung. Most of respondents used credit source from Myanmar Agricultural Development Bank (MADB) because they are rice growers.

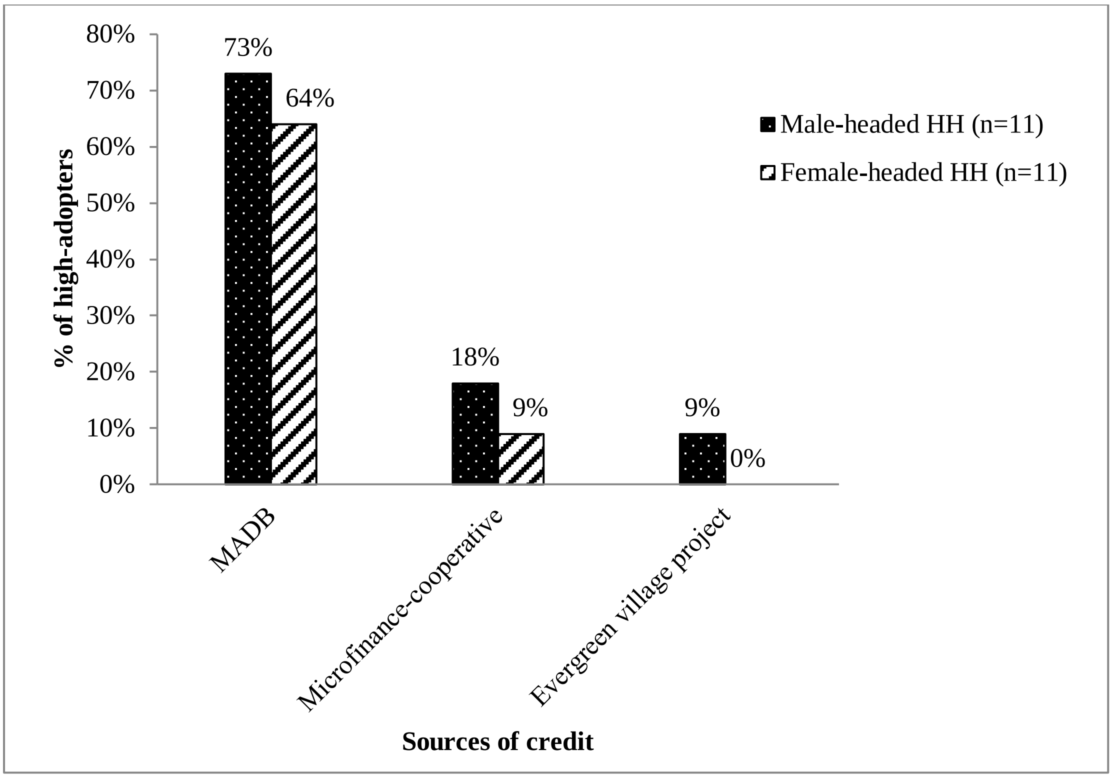

Figure 4.3 Credit availability of high-adopters in the study area

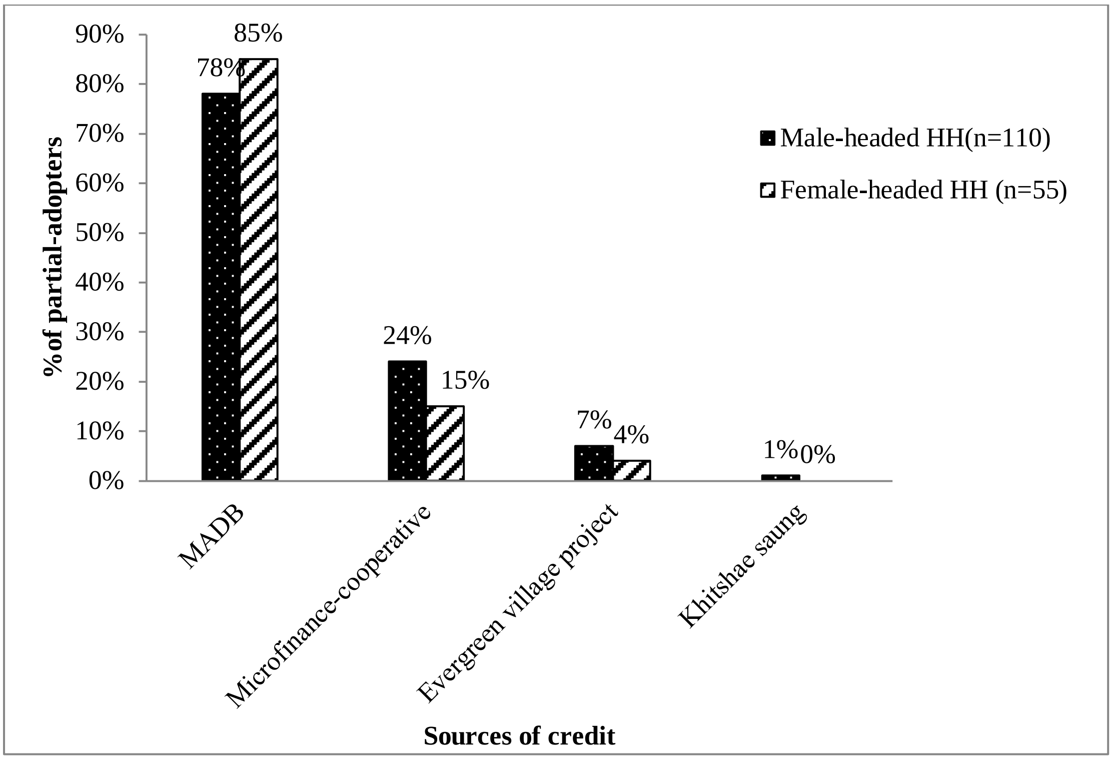

Figure 4.4 Credit availability of partial-adopters in the study area

4.3 Decision Making Participated in Rice Production Activities by Highly Adopted Male-Headed Households

According to the findings, male and female made joint decisions in all agricultural production activities but final decision maker was household's head in both types of households. In highly adopted male-headed households, women participated in decision making on rice production activities together with their husband. Only women in male-headed households (9.1%) influenced in decision making for assessing quality seed, fertilizer and insecticide (Table 4.11).

In highly adopted female-headed households, joint decision was made in all activities but final decision maker was female. In all activities, decision making was mainly influenced by female except in decision making for where to sell crops as (Table 4.12).

In partially adopted male-headed households, women also participated in decision making of rice production activities together with their husbands. Joint decision was made in all activities. In the male-headed households, very few women Joined in decision making for quality seed use and access of insecticide and pesticide (0.9%), quality seed and fertilizer access (4.5%), fertilizer buying (5.5%), and insecticide and pesticide buying (3.6%), income allocation for farm (17.3%), income allocation for household (23.6%), amount of loan (12.7%), price for sale (3.6%), to whom for sale and where to sell (2.7%) (Table 4.13).

In partially adopted female-headed households, men also participated in decision making on rice production activities together with household head. Joint decision was made in all activities. In the female-headed households, men participated in decision making only for mechanization used (1.8%) and market to sell (18.2%) (Table 4.14).

Table 4.11 Decision making in rice production activities by highly adopted male-headed households

No.	Activities	Jointly		Male		Female	
		no.	%	no.	%	no.	%
1	Production technology adoption	5	45.5	6	54.5	0	0.0
2	Quality seed use	5	45.5	6	54.5	0	0.0
3	Quality seed access	5	45.5	5	45.5	1	9.1
4	Fertilizer access	4	36.4	6	54.5	1	9.1
5	Fertilizer buying	4	36.4	6	54.5	1	9.1
6	Insecticide and pesticide access	5	45.5	6	54.5	0	0.0
7	Insecticide and pesticide buying	4	36.4	6	54.5	1	9.1
8	Mechanization used	5	45.5	6	54.5	0	0.0
9	Income allocation for farm	6	54.5	5	45.5	0	0.0
10	Income allocation for household	7	63.6	4	36.4	0	0.0
11	Amount of loan	6	54.5	5	45.5	0	0.0
12	For sale of paddy	7	63.6	4	36.4	0	0.0
13	To whom for sale	6	54.5	5	45.5	0	0.0
14	Where to sell	6	54.5	5	45.5	0	0.0
15	Price for sale	7	63.6	4	36.4	0	0.0

Table 4.12 Decision making in rice production activities by highly adopted female-headed households

No.	Activities	Jointly		Male		Female	
		no.	%	no.	%	no.	%
1	Production technology adoption	3	27.3	0	0.0	8	72.7
2	Quality seed use	3	27.3	0	0.0	8	72.7
3	Quality seed access	3	27.3	0	0.0	8	72.7
4	Fertilizer access	2	18.2	0	0.0	9	81.8
5	Fertilizer buying	2	18.2	0	0.0	9	81.8
6	Insecticide and pesticide access	2	18.2	0	0.0	9	81.8
7	Insecticide and pesticide buying	2	18.2	0	0.0	9	81.8
8	Mechanization used	2	18.2	0	0.0	9	81.8
9	Income allocation for farm	2	18.2	0	0.0	9	81.8
10	Income allocation for household	1	9.1	0	0.0	10	90.9
11	Amount of loan	1	9.1	0	0.0	10	90.9
12	For sale of paddy	1	9.1	0	0.0	10	90.9
13	To whom for sale	1	9.1	0	0.0	10	90.9
14	Where to sell	1	9.1	2	18.2	8	72.7
15	Price for sale	1	9.1	0	0.0	10	90.9

Table 4.13 Decision making in rice production activities by partially adopted male-headed households

No.	Activities	Jointly		Male		Female	
		no.	%	no.	%	no.	%
1	Production technology adoption	61	55.5	49.0	44.5	0	0.0
2	Quality seed use	60	54.5	49.0	44.5	1	0.9
3	Quality seed access	56	50.9	49.0	44.5	5	4.5
4	Fertilizer access	47	42.7	58.0	52.7	5	4.5
5	Fertilizer buying	44	40.0	60.0	54.5	6	5.5
6	Insecticide and pesticide access	47	42.7	62.0	56.4	1	0.9
7	Insecticide and pesticide buying	42	38.2	64.0	58.2	4	3.6
8	Mechanization used	49	44.5	61.0	55.5	0	0.0
9	Income allocation for farm	54	49.1	37.0	33.6	19	17.3
10	Income allocation for household	54	49.1	30.0	27.3	26	23.6
11	Amount of loan	55	50.0	41.0	37.3	14	12.7
12	For sale of paddy	59	53.6	47.0	42.7	4	3.6
13	To whom for sale	55	50.0	52.0	47.3	3	2.7
14	Where to sell	54	49.1	53.0	48.2	3	2.7
15	Price for sale	58	52.7	48.0	43.6	4	3.6

Table 4.14 Decision making in rice production activities by partially adopted female-headed households

No.	Activities	Jointly		Male		Female	
		no.	%	no.	%	no.	%
1	Production technology adoption	20	36.4	0	0.0	35	63.6
2	Quality seed use	21	38.2	0	0.0	34	61.8
3	Quality seed access	21	38.2	0	0.0	34	61.8
4	Fertilizer access	21	38.2	0	0.0	34	61.8
5	Fertilizer buying	19	34.5	0	0.0	36	65.5
6	Insecticide and pesticide access	18	32.7	0	0.0	37	67.3
7	Insecticide and pesticide buying	18	32.7	0	0.0	37	67.3
8	Mechanization used	17	30.9	1	1.8	37	67.3
9	Income allocation for farm	11	20.0	0	0.0	44	80.0
10	Income allocation for household	10	18.2	0	0.0	45	81.8
11	Amount of loan	10	18.2	0	0.0	45	81.8
12	For sale of paddy	11	20.0	0	0.0	44	80.0
13	To whom for sale	13	23.6	0	0.0	42	76.4
14	Where to sell	12	21.8	10	18.2	33	60.0
15	Price for sale	13	23.6	0	0.0	42	76.4

4.4 Common Constraints Faced by Sample Farmers

Common constraints faced by sample households in rice production were presented by Table 4.15 and 4.16. Most of sample households in the study areas faced many constraints in monsoon paddy production in 2016. On the overall average, it was obvious that the most constraints faced by male-headed households in Thazi Township were water scarcity (97.73%), labor scarcity (87.27%), quality seed unavailability (70%), high seed price (75%), high fertilizer price (61.82%), high insecticide and pesticide price (60.45%), farm machine unavailability (57.27%),low paddy quality (59.55%), high interest rate for credit (52.27%), high machine hire price (42.27%), credit unavailability (40%) and lack of market information (45.91%).

Female-headed households faced constraints in water scarcity (100%), labor scarcity (90%), credit unavailability (39.09%), high seed price (60.91%), high machine hire price (33.64%), quality seed unavailability (40.91%), lack of market information (32.73%), high fertilizer price (30%), farm machine unavailability (19.09%), high interest rate for credit (7.27%), low paddy quality (9.09%) and high insecticide and pesticide price (5.45%). These common problems caused to reduce yield and low income. It is one of the important factors that farmers did not highly adopt the improved rice production technologies.

Distribution of percentage of constraints that were faced by high-adopter in rice production is shown in Table 4.17. The weighted average indicated that water scarcity (2.77), labor scarcity (1.82), high seed price (1.55), high interest rate for credit (1.09), quality seed unavailability, farm machine unavailability and lack of market information (0.82), high fertilizer price and machine hire price (0.77), credit unavailability (0.59), low paddy quality (0.45), and high insecticide and pesticide price (0.36) facilities posed very strong constraints to high adopters in their efforts. These constraints were ranked 1st to 9th from serious to mild. The 1st constraints was water scarcity, the 2nd constraints was labor scarcity and then high seed price. The lowest one was high insecticide and pesticide price.

Distribution of percentage of constraints that were faced by partial-adopter in rice production was shown in Table 4.18. The weighted average indicated that water scarcity (3.48), labor scarcity (2.93), high seed price (2.83), quality seed unavailability (1.90), high interest rate for credit (1.69), lack of market information (1.66), high fertilizer price (1.47), high mechanization hired price (1.45), farm machine availability (1.43), high insecticide and pesticide price (1.02), low paddy quality (0.84), credit unavailability (0.75) facilities posed very strong constraints to partial adopters in their efforts. These constraints were ranked 1st to 12th from serious to mild. The 1st constraint was water scarcity; the 2nd constraint was labor scarcity and then high seed price. Credit unavailability had the lowest constraint rank.

Although the same constraints were faced by both types of households in two adopters groups, highly-adopted households noticed more about constraints in their rice production compared with partially-adopted households.

Table 4.15 Male-headed households who faced constraints in rice production

No.	Constraints	High-adopters	Partial-adopters	Total
1	Water availability	100.00	95.45	97.73
2	Labor scarcity	81.82	92.73	87.27
3	Quality seed availability	63.64	76.36	70.00
4	High seed price	63.64	86.36	75.00
5	High fertilizer price	54.55	69.09	61.82
6	High insecticide and pesticide price	54.55	66.36	60.45
7	Farm machine availability	54.55	60.00	57.27
8	Low paddy quality	54.55	64.55	59.55
9	High interest rate for credit	45.45	59.09	52.27
10	Mechanization hired price	27.27	57.27	42.27
11	Credit unavailability	27.27	52.73	40.00
12	Lack of market information	27.27	64.55	45.91
	Number	11.00	110.00	121.00

Table 4.16 Female-headed households who faced constraints in rice production

No.	Constraints	High-adopters	Partial-adopters	Total
1	Water availability	100.00	100.00	100.00
2	Labor scarcity	81.82	98.18	90.00
3	Credit unavailability	54.55	23.64	39.09
4	High seed price	45.45	76.36	60.91
5	Mechanization hired price	45.45	21.82	33.64
6	Quality seed availability	36.36	45.45	40.91
7	Lack of market information	36.36	29.09	32.73
8	High fertilizer price	27.27	32.73	30.00
9	Farm machine availability	27.27	10.91	19.09
10	High interest rate for credit	9.09	5.45	7.27
11	Low paddy quality	9.09	9.09	9.09
12	High insecticide and pesticide price	0.00	10.91	5.45
	Number	11.00	55.00	66.00

Table 4.17 Distribution of percentage of constraints faced by high-adopters in rice production

No.	Constraints	Never 0		A few 1		Fair 2		Strong 3		Very strong 4		Weighted average	Ranks
		no.	%	no.	%	no.	%	no.	%	no.	%		
1	Water availability	0	0.00	7	31.82	1	4.55	4	18.18	10	45.45	2.77	1st
2	Labor scarcity	4	18.18	6	27.27	6	27.27	2	9.09	4	18.18	1.82	2nd
3	High seed price	10	45.45	3	13.64	1	4.55	3	13.64	5	22.73	1.55	3rd
4	High interest rate for credit	16	72.73	0	0.00	0	0.00	0	0.00	6	27.27	1.09	4th
5	Quality seed availability	11	50.00	7	31.82	2	9.09	1	4.55	1	4.55	0.82	5th
6	Farm machine availability	13	59.09	2	9.09	0	0.00	0	0.00	4	18.18	0.82	5th
7	Lack of market information	15	68.18	1	4.55	1	4.55	5	22.73	0	0.00	0.82	5th
8	High fertilizer price	13	59.09	5	22.73	1	4.55	2	9.09	1	4.55	0.77	6th
9	Mechanization hired price	14	63.64	2	9.09	2	9.09	1	4.55	2	9.09	0.77	6th
10	Credit availability	13	59.09	2	9.09	1	4.55	3	13.64	0	0.00	0.59	7th
11	Low paddy quality	15	68.18	6	27.27	0	0.00	0	0.00	1	4.55	0.45	8th
12	High insecticide and pesticide price	16	72.73	5	22.73	0	0.00	1	4.55	0	0.00	0.36	9th

Table 4.18 Distribution of percentage of constraints faced by partial-adopters in rice production

No.	Constraints	Never 0		A few 1		Fair 2		Strong 3		Very strong 4		Weighted average	Ranks
		no.	%	no.	%	no.	%	no.	%	no.	%		
1	Water availability	5	3.03	45	27.27	26	15.76	32	19.39	57	34.55	3.48	1st
2	Labor scarcity	9	5.45	55	33.33	32	19.39	41	24.85	28	16.97	2.93	2nd
3	High seed price	28	16.97	29	17.58	45	27.27	29	17.58	34	20.61	2.83	3th
4	Quality seed availability	56	33.94	36	21.82	41	24.85	16	9.70	16	9.70	1.90	4th
5	High interest rate for credit	97	58.79	20	12.12	3	1.82	1	0.61	44	26.67	1.69	5th
6	Lack of market information	78	47.27	22	13.33	19	11.52	43	26.06	3	1.82	1.66	6th
7	High fertilizer price	71	43.03	43	26.06	28	16.97	13	7.88	10	6.06	1.47	7th
8	Mechanization hired price	90	54.55	25	15.15	18	10.91	5	3.03	25	15.15	1.45	8th
9	Farm machine availability	93	56.36	27	16.36	13	7.88	0	0.00	30	18.18	1.43	9th
10	High insecticide and pesticide price	86	52.12	48	29.09	23	13.94	2	1.21	6	3.64	1.02	10th
11	Low paddy quality	89	53.94	58	35.15	13	7.88	2	1.21	3	1.82	0.84	11th
12	Credit availability	94	56.97	53	32.12	7	4.24	4	2.42	3	1.82	0.75	12th

4.5 Role of Social Capital with Gender Perspective in Adoption

4.5.1 Participation in trainings offered by various organizations

Training in extension programs is one of the most important components in the rural development strategies to increase the livelihoods of the rural people. In the study area, there were many kinds of trainings for different purposes with many development aspects. It is good for the village development in the long run. Table 4.19 demonstrates that the sample households' participation in trainings offered by various organizations. These trainings were offered by Department of Agriculture, private company and non-government organization.

In high-adopter group, the results for participation in training indicated that 54.5% of male-headed households and 45.5% of female-headed households respectively attended trainings offered by the DoA. Only 45.5% of male-headed households participated in trainings offered by private company. The same percentage (9.1%) of male-headed households and female-headed households participated in trainings offered by non-government organization. However, 18.2% of male-headed households and 54.5% of female-headed households were never attendended any training.

In partial-adopter group, 53.6% of male-headed households and 27.3% of female-headed households respectively attended trainings offered by the DoA. Only 9.1% of male-headed households participated in trainings offered by private company. 6.4% of male-headed households and 5.5% of female-headed households participated in trainings offered by non-government organization. However, 39.1% of male-headed households and 72.7% of female-headed households were never attendended any training.

4.5.2 The experiences of sample households attending in rice production trainings

It was found that high-adopters (18.2%) in attendended more than 5 training times than partial-adopters (7.3%). Generally, attendance percentage of high adopters was relatively higher than partial-adopters in all levels of trainings times. Regarding the specific adopters group, male-headed households in high-adopters group were more comparatively experienced than female-headed households in all levels of training times. Moreover, 45.5% of female-headed households had never attendended any training whereas only 18.2% of male-headed households did not attend training.

In partial-adopter group, male-headed households' attendances were relatively higher than female-headed households at all levels of training numbers. The female-headed households (74.5%) and male-headed households (39.1%) never attended any training at all. In overall, it can be said that high-adopter group more involved in training attend and male-headed households in both groups were comparatively more active in attending trainings (Table 4.20).

Some respondents shared extension advice and technologies from farmers to other farmers by means of farmers to farmers about production technology (Table 4.21). Some of the respondents did not give extension advice and technologies to other farmers. High-adopters (41%) and partial-adopters (37%) offered extension advice and technologies to other farmers but high-adopters (59%) and partial-adopters (63%) were not offered.

High-adopters comparatively more participated in agricultural trainings and shared extension advice and technologies to other farmers than partial-adopters groups. Female heads were comparatively low participated in trainings in terms of training type and frequency.

Table 4.19 Participation of sample households offered trainings in various organizations

Organizations offered trainings	High-adopters				Partial-adopters			
	Male-Headed HH(n=11)		Female-headed HH(n=11)		Male-headed HH(n=110)		Female-headed HH(n=55)	
	no.	%	no.	%	no.	%	no.	%
Department of agriculture	6	54.5	5	45.5	59	53.6	15	27.3
Private company	5	45.5	0	0.0	10	9.1	0	0.0
Non-government organization	1	9.1	1	9.1	7	6.4	3	5.5
Nil	2	18.2	6	54.5	43	39.1	40	72.7

Table 4.20 Attendance of rice production trainings by sample households

Training attendance (time/season)	High-adopters				Partial-adopters			
	Male-Headed HH (n=11)		Female-Headed HH (n=11)		Male-Headed HH (n=110)		Female-Headed HH (n=55)	
	no.	%	no.	%	no.	%	no.	%
Above 5 times	2	18.2	2	18.2	8	7.3	0	0.0
4-5 times	3	27.3	0	0.0	13	11.8	2	3.6
2-3 times	1	9.1	3	27.3	34	30.9	11	20.0
Only 1 time	3	27.3	1	9.1	12	10.9	1	1.8
Nil	2	18.2	5	45.5	43	39.1	41	74.5

Table 4.21 Sharing extension advices and technologies to other farmers by sample households

Items	High-adopters (n=22)		Partial-adopters (n=165)	
	no.	%	no.	%
Sharing knowledge	9	41	61	37
No	13	59	104	63

4.5.3 Participation in rural community and organizations

Participation in rural organizations play an important role to improve rice production technology adoption. Communities at village level are relatively socially cohesive and have strong capacities for collective problem solving and decision-making due to lack of development resources from higher levels, which highlights the importance of working together at the community level. Communities' affairs are the different interventions in the society which are very crucial to exchange information and to increase the exposure of women to the outside environment.

High-adopters group participated in Oxfam (27.3%), microfinance cooperative and Khitshae saung (18.2%), rural welfare association (22.7%), evergreen village project and rural youth organization (4.5%) as shown in Table 4.22. Partial-adopters group participated in microfinance cooperative (30.9%), rural welfare association (23.6%), Oxfam (13.9%), evergreen village project (6.7%), rural youth organization and Chan Myae Myittar (4.8%), and village administive board (2.4%), china finance cooperative (1.8%), farmer's group (1.2%) and Khitshae saung (0.6%) as shown in Table 4.23 respectively. The main reason of participation in their rural communities and association by respondents was to achieve credit. Thus, sample households mostly participated in credit providing communities such as Oxfam, microfinance cooperative and Khitshae saung.

Table 4.22 Participation of high-adopters in rural community and organizations

No.	Rural community and Organizations	Male-headed HH (n=11)		Female-headed HH (n=11)		Total (n=22)	
		no.	%	no.	%	no.	%
1	Oxfam	3	27.3	3	27.3	6	27.3
2	Microfinance cooperative	2	18.2	2	18.2	4	18.2
3	Khitshae saung	2	18.2	2	18.2	4	18.2
4	Rural welfare association	2	18.2	3	27.3	5	22.7
5	Evergreen village project	1	9.1	0	0.0	1	4.5
6	Rural youth organization	1	9.1	0	0.00	1	4.5

Table 4.23 Participation of partial-adopters in rural community and organizations

No.	Rural community and Organizations	Male-headed HH (n=110)		Female-headed HH (n=55)		Total (n=165)	
		no.	%	no.	%	no.	%
1	Microfinance cooperative	31	28.2	20	36.4	51	30.9
2	Rural welfare association	29	26.4	10	18.2	39	23.6
3	Oxfam	14	12.7	9	16.4	23	13.9
4	Evergreen village project	9	8.2	2	3.6	11	6.7
5	Rural youth organization	7	6.4	1	1.8	8	4.8
6	Chan myae myittar	5	4.5	3	5.5	8	4.8
7	Village administive board	3	2.7	1	1.8	4	2.4
8	China finance cooperative	1	0.9	2	3.6	3	1.8
9	Farmer's group	1	0.9	1	1.8	2	1.2
10	Khitshae saung	0	0.0	1	1.8	1	0.6

4.6 Descriptive Statistics of Dependent and Independent Variables in Adoption Score of Male-headed Household Farmers in the Study Area

The dependent variable was an adoption score (41.49). The independent variable for adoption rate were age (53.69) years, schooling year (7.12) years, total cultivated area (2.88) hectares, the number family labor (1.79) persons, contact time of extension agent (2.11) times, attendance in DoA (1.50) times and total gross benefit (788,317) MMK/ha (Table 4.24).

According to the regression results, age, schooling year, family labor used, and total gross benefit were positively correlated with adoption rate of male rice farmers in the study area. Among them, family labor used and total gross benefit were significant at 10% and 5% level respectively. If family labor increased 1 person, adoption score will increase 1.282 score. If total gross benefit is increased by 1 MMK/ha, adoption score will increase 7.514E-6 score. Total cultivated area, contact time of extension agent and attendance time to training in rice production were negatively correlated with adoption rate. Among them, total cultivated area was significant at 1% level. If total cultivated area is increased by 1 hectare, the adoption rate of improved rice production technologies will decrease by 1.628 score. The F value shows that the selected model was significant at 1% level. The R squared points out that the model is significant and it can explain on the variation in adoption score by 20 % in Table 4.25.

Table 4.24 Descriptive statistics of dependent and independent variables in adoption score of male rice farmers in study area

Variables	Unit	Mean	Max.	Min.
Dependent Variable				
Adoption Score		41.49	70.00	10.00
Independent Variables				
Age	Year	53.69	81	26
Scholing year	Year	7.12	14	0
Total cultivate area	ha	2.88	12.95	0.28
Family labor	No.	1.79	8	0
Contact time with extension agent	No.	2.11	9	0
Training attandence time	No.	1.50	9	0
Total gross benefit	MMK/ha	788,317	1,482,600	67,953

Table 4.25 Factor affecting the adoption of male rice farmers in the study area

Independent Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
Constant	36.492***		6.058	0.000
Age	0.014ns	0.015	0.166	0.869
Schooling year	0.286ns	0.077	0.842	0.402
Total cultivate area	-1.628***	-0.382	-3.930	0.000
Family labor used	1.282*	0.169	1.736	0.085
Contact time with extension agent	-0.165ns	-0.027	-0.244	0.808
Training attandence time	-0.667ns	-0.109	-1.052	0.295
Total gross benefit	7.514E-6**	0.224	2.597	0.011

Note: Dependent Variable: Adoption Score of Male Farmer

R= (0.448), R^2= (0.201), F= (4.052)***

***, ** and * are significant level at 1%, 5% and 10%, ns= not significant

4.7 Descriptive Statistics of Dependent and Independent Variables in Adoption Score of Female-headed household Farmers in the Study Area

The dependent variable was an adoption score (43.79). The independent variable for adoption rate were age (52.83) years, schooling year (5.74) years, total cultivated area (2.44) hectare, the number family labor (1.41) persons, contact time of extension agent of DoA (2.65) times, attendance in DoA (0.74) times and total gross benefit (789,750) MMK/ha (Table 4.26).

The regression results are shown in Table 4.27. According to the results, age, schooling year, contact time with extension agent, attendance time to training in rice production and total gross benefit were positively correlated with adoption rate but not significant. Only family labor used on farm was positively correlated and significance at 1% level. It mean that, if family labor number is increased by 1 number, adoption score will increase by 6.989 score. Total cultivated area was negatively correlated with adoption but non-significance. The F value shows that the selected model was significant at 1% level. The R squared points out that the model is significant and it can explain on the variation in adoption score by 41 %.

Table 4.26 Descriptive statistics of dependent and independent variables in adoption score of female rice farmer in the study area

Variables	Unit	Mean	Max.	Min.
Dependent Variable				
Adoption Score		43.79	90.00	20.00
Independent Variables				
Age	Year	52.83	78	27
Schooling year	Year	5.74	14	0
Total cultivate area	ha	2.44	12.95	0.40
Family labor used	Number	1.41	6	0
Contact time with extension agent	Number	2.65	7	0
Training attandence time	Number	0.74	7	0
Total gross benefit	MMK/ha	789,750	1,698,813	123,550

Table 4.27 Factor affecting the adoption of female rice farmers in the study area

Independent Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
Constant	26.085***		3.054	0.003
Age	0.037ns	0.031	0.247	0.806
Schooling year	0.565ns	0.138	1.200	0.235
Total cultivate area	-1.045ns	-0.168	-1.554	0.126
Family labor used	6.989***	0.659	5.593	0.000
Contact time with extension agent	0.048ns	0.004	0.038	0.969
Training attandence time	0.459ns	0.045	0.391	0.698
Total gross benefit	6.015E-6ns	0.154	1.338	0.186

Note: Dependent Variable: Adoption Score of Female Farmer

R= (0.641), R^2= (0.411), F= (5.780)***

***, ** and * are significant level at 1%, 5% and 10%, ns= not significant

CHAPTER V
CONCLUSION

5.1 Conclusions

In examining adoption of rice production technology package, high-adopters group adopted 6 to 10 components and partial-adopters group could practice 1 t0 5 components of package. According to the results, the adoption percent of recommended plant spacing, planting system, water management and harvesting were high but seed rate, seedling age, timely checking and refilling the plant, fertilizer application, basal insecticide application and weed control were still weak in the study area.

Among the sample farmers, the ratio of high-adopters and partial-adopters was approximately found as 1:10 in male-headed households and 1:5 in female-headed households respectively. According to the adoption score, more female-headed households were found to be participating in high-adopters' groups because higher number of family labor of female-headed households was found in high-adopters' group and family labor number was positively related to adoption rate.

In this study, farming experience, education, family number and cultivated area were not different between high-adopters and partial-adopters group, though age, family labor and dependency ratio were significantly varied between them. Male headed households had more credit assessment in both adopters groups. Majority of female headed households could only access to MADB.

Regarding the decision making in rice production activities, whether high or patrial-adopters group, depending on types of gender headed households; decision making was made jointly and influenced by household head. Although total gross benefit and total variable cost were the highest in highly-adopted male headed households. Net benefit, return per unit of cash cost and return per unit of capital were the lowest in highly-adopted female headed households

According to the results of the survey, water scarcity was one of the most important factors for increasing the yield of monsoon paddy. And then labor scarcity and high seed price were also serious constraints. Although the same constraints were faced by both faced types of households in two adopters groups, highly-adopted households more noticed about constraints in their rice production compare with partially-adopted households. These constraints lead to large variations in yield and represent major barriers for farmers to adopt recommended input application and systematic management of rice filed.

Regarding the participation in training, male-headed households from both adopters groups highly participated in various rice production trainings. However, female-headed households in high-adopters group more participated only in rice production training offered by DoA. None participation in various rice production trainings and attendance frequency per season were high in partial-adopters group than high-adopters group for both male and female-headed households. And then, high-adopters group made sharing of extension advices and technologies to other farmers than partial-adopters groups. Therefore, social capital was a considerable factor to promote adoption rate.

5.2 Recommendation

This finding indicates that extension institution needs more emphasis on participation of male as well as female farmers to increase adoption rate of technologies. To solve the problem of labor scarcity, mechanization should be transformed. To reduce high seed price and constraint in quality seed availability, quality seed production program would be set up by the Department of Agriculture in collaboration with private sector and NGO.

Seed technology training and education program at farmer level also needed moreover. The availability of insecticide and fertilizers with reasonable price and availability of credit with low interest rate are required to overcome farmer's constraints. Water saving technologies and would be disseminated to reduce water scarcity.

According to the results, market price of rice would be key for decision making of technology adoption. Income earning of crop production would be the main incentive for technology adoption and it should be noticed by extension institution for the technology dissemination.

Elder male and female farmers had more adoption as found in this study area. This factor should be taken into account for improving adoption of young farmers by Department of Agriculture. Total cultivated area is negatively correlated with adoption in both gender groups. Thus, large farmers who owned large cultivated areas were needed to encourage for technology adoption. Adoption would be depended on the return of the crop cultivated, thus total revenue of crop is the incentive for adoption. Adoption rate of male and female headed household were relied on availability of family labor. Internal migration of female was higher than male in high-adopters groups while male migration was high in partial adopter group. Therefore, it is important to consider migration status as a challenge to farm labor in the study area. Extension contacts and trainings attendance were important factors for adoption although these factors didn’t significantly influence on adoption of both households in the study area. Extension agents should be more emphasized on participation of young and active male and female farmers to increase adoption rate.

Therefore, market-led approach extension would be implemented for high technological adoption and increase income earning of the farmers.

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APPENDICES

Appendix 1 Map of Myanmar and location of Thazi Township

Appendix 2 Information about paddy production of high-adopters in the study area (MMK)

Items	Unit	Male-headed HH				Female-headed HH			
		Mean	Max.	Min.	SD	Mean	Max.	Min.	SD
Total grown area	ha	1.49	2.02	0.40	0.56	1.05	4.05	0.40	0.99
Yield	t/ha	3.60	4.94	1.98	0.99	2.66	4.12	0.74	1.02
Price	MMK/t	279,545	375,000	200,000	64,049	265,909	375,000	225,000	45,101
Total gross benefit	MMK/ha	1,005,574	1,482,600	411,833	356,559	707,834	1,482,600	185,325	368,751
Total material cost	MMK/ha	258,605	391,654	113,666	74,448	191,525	352,118	54,362	100,330
Total family labor cost	MMK/ha	130,738	198,916	24,710	50,108	134,557	290,343	30,888	69,045
Total hire labor cost	MMK/ha	327,183	459,606	256,984	56,505	289,320	404,009	139,612	80,349
Total variable cost	MMK/ha	775,106	913,838	576,509	99,846	663,487	944,046	400,426	181,058
Return per unit of capital		1.30	2.57	0.50	0.62	1.07	1.96	0.44	0.46

Appendix 3 Information about paddy production of partial-adopters in the study area (MMK)

Items	Unit	Male-headed HH				Female-headed HH			
		Mean	Max.	Min.	SD	Mean	Max.	Min.	SD
Total grown area	ha	0.84	12.14	0.20	1.44	1.05	3.24	0.24	0.76
Yield	t/ha	3.04	5.44	0.25	1.19	3.17	6.42	0.62	1.29
Price	MMK/t	251,045	375,000	200,000	32,532	252,091	375,000	200,000	35,936
Total gross benefit	MMK/ha	763,087	1,449,653	2,133,862	314,567	799,517	1,698,813	123,550	349,508
Total material cost	MMK/ha	175,655	474,432	774,909	85,696	171,875	377,075	46,949	72,855
Total family labor cost	MMK/ha	121,661	247,100	16,062	51,808	78,286	227,332	0	47,371
Total hire labor cost	MMK/ha	283,333	459,606	0	84,958	336,082	478,139	145,789	87,876
Total variable cost	MMK/ha	626,548	1,014,716	265,138	134,863	637,039	907,314	379,546	135,836
Return per unit of capital		1.22	2.45	0.12	0.46	1.26	2.71	0.39	0.57

Appendix 4 Information about paddy production of high-adopters in the study area (USD)

Items	Unit	Male-headed HH				Female-headed HH			
		Mean	Max.	Min.	SD	Mean	Max.	Min.	SD
Total grown area	ha	1.49	2.02	0.40	0.56	1.05	4.05	0.40	0.99
Yield	t/ha	3.60	4.94	1.98	0.99	2.66	4.12	0.74	1.02
Price	USD/t	233	313	167	53	222	313	188	38
Total gross benefit	USD/ha	838	1236	343	297	590	1236	154	307
Total material cost	USD/ha	216	326	95	62	160	294	45	84
Total family labor cost	USD/ha	109	166	21	42	112	242	26	58
Total hire labor cost	USD/ha	273	383	214	47	241	337	116	67
Total variable cost	USD/ha	646	762	481	83	553	787	334	151
Return per unit of capital		1.30	2.57	0.50	0.62	1.07	1.96	0.44	0.46

(Exchange rate-for monsoon rice- 1199.7MMK/USD (as of 2016 third quarter average from CBM website))

Appendix 5 Information about paddy production of partial-adopters in the study area (USD)

Items	Unit	Male-headed HH				Female-headed HH			
		Mean	Max.	Min.	SD	Mean	Max.	Min.	SD
Total grown area	ha	0.84	12.14	0.20	1.44	1.05	4.05	0.40	0.99
Yield	t/ha	3.04	5.44	0.25	1.19	3.17	4.12	0.74	1.02
Price	USD/t	209	313	167	27	210	313	167	30
Total gross benefit	USD/ha	636	1208	57	262	666	1416	103	291
Total material cost	USD/ha	146	395	34	71	143	314	39	61
Total family labor cost	USD/ha	101	206	13	43	65	189	0	39
Total hire labor cost	USD/ha	236	383	0	71	280	399	122	73
Total variable cost	USD/ha	522	846	221	112	531	756	316	113
Return per unit of capital		1.22	2.45	0.12	0.46	1.26	2.44	0.29	0.51

(Exchange rate-for monsoon rice- 1199.7MMK/USD (as of 2016 third quarter average from CBM website))