IMPACT OF GENDER ON RICE PRODUCTION ACTIVITIES AND RURAL LIVELIHOODS IN MAUBIN AND DAIK U TOWNSHIPS

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NOVEMBER 2017

IMPACT OF GENDER ON RICE PRODUCTION ACTIVITIES AND RURAL LIVELIHOODS IN MAUBIN AND DAIK U TOWNSHIPS

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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)

Department of Agricultural Economics
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NOVEMBER 2017

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

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DEDICATED TO MY BELOVED PARENTS,
U HTAIN WIN AND DAW OHM MYINT

ACKNOWLEDGEMENT

First of all, I sincerely wish to express my heartfelt thanks to Dr. MyoKywe, Rector, Dr. SoeSoe Thein, Pro-rector (Academic) and Dr. Nang HsengHom, Pro-rector (Administration), Yezin Agricultural University (YAU), for their kind permission, their review comments, invaluable suggestions and kind administrative support to this study.

I wish to extend my deep gratitude to U Naing Kyi Win, Director General, Department of Agricultural Research, Yezin, NayPyi Taw for his kind permission for my study leave.

Actually I cannot know even how to express my heartfelt thanks to supervisor and chairperson of the supervisory committee, Dr. Cho Cho San, Professor and Head, Department of Agricultural Economics, Yezin Agricultural University, for her kindness, inspiring encouragement, invaluable advice and guidance, generous help, helpful criticism, keen interest throughout my research work and offering me her enthusiastic benevolence in polishing this manuscript.

My sincere thanks also extend to Dr. TheingiMyint, Professor, Department of Agricultural Economics, Yezin Agricultural University, for her kind help, correction of my mistakes and valuable suggestions for in the whole thesis.

My sincere and profound thanks to the external examiner Dr. Thanda Kyi, Director, ASEAN Division, Department of Planning for her warm encouragement,valuable comments and suggestions.

Sincere appreciation and gratitude go to supervisor committee members, Dr.Soe Win, Professor, Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University, DawThida Than, Lecturer, Department of Agricultural Economics, Yezin Agricultural University, and DawKhaingKhaingHtwe, Research Officer, Agricultural Economics Research Section, Department of Agricultural Research, for their valuable suggestions, careful guidance, encouragement, generous helps and kindness, during the course of my study and for their critical reading and comments on this manuscript.

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

My special thanks go to sample farmers at Maubin and Daik U Townships for patiently answering my survey questionnaires. I am grateful to all of the staff from Department of Agriculture, Maubin and Daik U Townships for their help in obtaining the necessary primary and secondary data for this thesis.

I would like to express my graduate to all teaching staff from the Department of Agricultural Economics for their advice, suggestions and generous help throughout my study period.

I am also grateful to all my classmates, Ma Poe EiPhyu, Ma KhinSandar Linn, Ma Chan MyaeLwin, Ma San SanMyint, Ma Thuzar NaingOo and Ma ThadarHtwe for their cordially cooperation and understanding me throughout the study.

Last but not least, my deepest and greatest dedication is to my beloved parent, U Htain Win and Daw Ohm Myint, my little sister Ma HtetHtet Win for their understanding, encouragement, moral support, a lot of help and especially generous financial support whenever I need.

ABSTRACT

Marginal resource productivity and livelihoods by gender in rice production were studied in Maubin and Daik U Townships. Eighty-three male-headed households and fifty-five female-headed households were collected from Maubin and Daik U Townships by using purposive random sampling method. The results showed that 47% of male household heads was in the active age (35-50 years) while female household heads (40%) were in the older age group (51-65 year). About 91.6% of male household heads were still married whereas half of female household heads were widows and singles. It was found that the main income source of both types of households was crop income and the second was non-farm income. About 40% of female-headed households had earned above the average annual income whereas 33.7% of male-headed households generated income above the average income. Sin Thu Kha, HnanKar and Hmawbi-2 were the economically important rice varieties in monsoon rice production. The t-test showed that there were no significant differences between the benefit-cost ratios of Sin Thu Kha (1.18, 1.26), HnanKar (1.16, 1.12) and Hmawbi-2 (1.11, 1.13) respectively in both male and female-headed households in monsoon rice production. Results showed that the marginal productivity of sown areas, seed rate, fertilizer, family labor and hired labor for male-headed households were higher than those of female-headed households, while the marginal productivity of machinery used for female-headed households was higher than those of male-headed households. Institutional and cultural practices need to be allowed female households' heads to have equal access with productive resources and technological services to improve rural livelihoods. Adequate credit amounts should be made accessible for rice farming of both headed households through the creations of well-structured and functional rural agricultural microfinance institutions in the study areas.

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LIST OF ABBREVIATIONS

BCR	=	Benefit-Cost Ratio
CGIAR	=	Consultative Group of International Agricultural Research
CSO	=	Central Statistical Organization
DOA	=	Department of Agriculture
DOP	=	Department of Population
FAO	=	Food and Agriculture Organization
FYM	=	Farm Yard Manure
ha	=	Hectare
HHs	=	Households
IFDC	=	International Fertilizer Development Center
kg	=	Kilogram
MADB	=	Myanmar Agricultural Development Bank
md	=	Man day
MMK	=	Myanmar Kyat
MOALI	=	Ministry of Agriculture, Livestock and Irrigation
MT	=	Metric Ton

LIST OF CONVERSION FACTORS

1 basket of paddy	= 20.86 kilograms
1 hectare	= 2.471 acres
1 metric ton	= 1000 kilograms

CHAPTER IINTRODUCTION

1.1 Background of Myanmar Agriculture Sector

Myanmar is well-endowed with resources and known as a major exporter of rice in the past. It also increases its share of the global rice market. Its rich natural resources include lands ideally suited for rice cultivation and vast water resources for irrigation. Myanmar is an agricultural country. The agriculture sector is essential for providing food for increasing population and for earning foreign exchange.

Agriculture sector is the backbone of its economy.About 20.1% of gross domestic product (GDP) comes from the agricultural sector. Agriculture sector contributes 20% of total export earnings; and employs 61.2% of the labor force (MOALI2016). In addition, food security for the people and raw material production for domestic agro-based industries are heavily dependent on the agricultural sector.

1.2 Importance of Rice Production in Myanmar

Rice remains a strategic sector in terms of its significance in the country's socio-economic development. Myanmar paddy production was28,209,000 MT in which 54.3% of production was consumed, 7.9% was export and 37.8%was surplus (MOALI 2016). Rice, its main farm income source, generates livelihoods for over 50% of the population. People spend 61% of their income on food. Rice, a major staple accounts for 50% of their expenditures (World Bank 2015).To provide sufficient rice for domestic consumption in line with food security for increasing population and enhancing income by exporting of rice surplus, the successive Myanmar government generally has attempted to develop the country's rice economy.

The cultivated area of paddy was increasing from 6.36 million ha in 2000-2001 to 8.04 million ha in 2010-2011. Starting 2011-2012 from 2014-2015 the cultivated area was decreased again from 7.60 million ha to 7.17 million ha. The cultivated area was decreased mainly because farmers' aware of climate change and increasingly unreliable rainfall in the central dry zone and extensive flooding occasioned in the delta region.However, it increased again to 7.98 million ha in 2015-2016.

The yield of the paddy was increasing at a low rate from 3.38 MT/ha in 2000-2001 to 4.07 MT/ha in 2010-2011. Starting 2011-2012, the yield was decreasing at a low rate and then in 2015-2016 the yield was increasing. The production level was

also increasing from 20.97 million MT in 2000-2001 to 32.58 million MT in 2010-2011. But the production level decreased from 29.01 million MT in 2011-2012 to 28.209 million MT in 2015-2016 (Table 1.1).

1.3 Sown Area, Yield and Production of Paddy by States and Regions

Regarding the rice production, Ayeyawady, Bago Regions and Mon State are major rice producing and surplus areas at the lower part of Myanmar. Magway, and Mandalay Regions and Chin State are the rice deficit areas and Sagaing Region is the surplus area in central Myanmar.Table 1.2 shows Myanmar paddy area, yield and production by States and Regions. The agricultural sector of the delta region provides food for the community employs the majority of the regional population and contributes surplus for regional and national growth. The Ayeyawady and Bago Regions are the main-surplus rice producing areas where ecological environment is favorable for rice production and mainly supplies not only to the domestic but also to the international markets. The majority of rice production of Ayeyawady and Bago Regions contributed about 28.17% and 17.37% followed by Sagaing and Yangon Region provides 12.02% and 7.22%of total production. Ayeyawady Region is the largest rice producing area and Bago Region is the second largest rice producing area followed by Sagaing Region and Shan State (MOALI 2016).

1.4 Gender Composition and Agriculture

Myanmar population was about 52.22 million people which comprise 48% of male population and 52% of female population (MOALI 2016). Two thirds of Myanmar people live in rural area, depends on agriculture and the food sector as their main source of livelihood. Increasing agricultural productivity, availability of rural employment and sustainable rural livelihoods are keys to reducing poverty. Increasing the agricultural and labor productivity will raise incomes of the rural poor.

According to the census report, the household population is the highest in Ayeyawady Region and the second is Yangon Region which is followed by Mandalay Region, Shan State and Bago Region (Table 1.3). Of the total household population of Ayeyawady, male-headed households are about 80.7% and female-headed households are about 19.3%. In Bago region, about 76.8% of households are male-headed households and about 23.2% are female-headed households. Therefore, male-headed households are four time higher than female-headed households (DOP 2015).

Table 1.1 Sown area, yield and production of paddy in Myanmar (2000-2016)

Year	Sown area (million ha)	Yield per hectare (MT/ha)	Production ('000 MT)
2000-2001	6.36	3.38	20,970
2001-2002	6.46	3.42	21,570
2002-2003	6.49	3.42	21,460
2003-2004	6.55	3.54	22,770
2004-2005	6.86	3.63	24,330
2005-2006	7.58	3.74	28,730
2006-2007	8.13	3.84	30,980
2007-2008	8.09	3.81	31,450
2008-2009	8.10	3.91	32,573
2009-2010	8.07	3.93	32,681
2010-2011	8.04	4.07	32,579
2011-2012	7.60	3.72	29,010
2012-2013	7.24	3.84	27,704
2013-2014	7.28	3.90	28,322
2014-2015	7.17	3.94	28,250
2015-2016	7.98	3.97	28,209

Source: Department of Planning, Ministry of Agriculture, Livestock and Irrigation, 2016

Table 1.2 Myanmar paddy area, yield and production by States/ Regions

No.	States/Regions	Sown area ('000 hectare)	Harvested area ('000 hectare)	Yield (MT/ha)	Production ('000 MT)	% of Production
1	Ayeyawady	2,015	2,015	3.88	7,819	28.17
2	Bago	1,224	1,218	3.96	4,822	17.37
3	Sagaing	778	776	4.3	3,338	12.02
4	Yangon	561	561	3.57	2,004	7.22
5	Shan	549	549	3.94	2,163	7.79
6	Rakhine	454	448	3.51	1,571	5.66
7	Magway	351	350	4.38	1,532	5.52
8	Mon	291	291	3.39	988	3.56
9	Kayin	261	261	3.61	944	3.40
10	Mandalay	245	245	4.22	1,032	3.72
11	Kachin	180	181	3.4	615	2.21
12	Tanintharyi	107	107	3.56	380	1.37
13	Nay Pyi Taw	72	72	4.52	328	1.18
14	Kayah	40	40	3.42	137	0.49
15	Chin	38	38	2.33	88	0.32

Source: Ministry of Agriculture, Livestock and Irrigation (MOALI), 2016

Women produce over 50 percent of the world's food (FAO 2011) and comprise about 43 percent of the agricultural labor force globally and in developing countries (Doss 2014). The food supply of urbanconsumers will depend on the agriculturalproduction from the farming population, bothmen and women.The proportion ofeconomically active female to total femalepopulation ranged from 15-81% withinSoutheast Asia; 49 -98% in South Asia(FAO 2004). In Myanmar, the proportion of economically active female to total female population was 51.6% (CSO 2016).

Gender and Agriculture Research Network of the Consultative Group of International Agricultural Research (CGIAR) recommended two indicators (CGIAR 2014). The first is women's control over productive resources such as land, livestock, water, forests, common property, seeds, fertilizers, machinery, financial assets, and the income from sales of crop, livestock or forest products. The second is women's participation in making decisions over own labor, own income and the decisions made in groups or collective organization.

In rice farming, land preparation is mainly a task for men due to heavy labor requirement. Several women do clearing and maintenance of the bunds. Transplanting is commonly done in groups and those groups mostly consist of women. Men were involved in this task and assisted with pulling and distributing seedlings. Most women spend time on weeding during the growth phase of rice. Applying fertilizer and pesticides was considered men's job. Manual harvesting was done by female laborers (Rutsaert 2015). Women's decision making power in rice farming varies across and within countries. In Indonesia and Myanmar, men take a leading role in the field. Nonetheless, men listen to women's opinions and make decisions jointly (Akter 2017).

Table 1.3 Percentage and household population of male-headed households and female-headed households by States/Regions

No	States/Regions	Male-headed households		Female-headed households	
		Population	Percent	Population	Percent
1	Ayeyawady	1,201,958	80.7	287,025	19.3
2	Yangon	1,199,003	75.7	383,941	24.3
3	Mandalay	981,281	74.2	341,910	25.8
4	Shan	919,047	78.6	250,522	21.4
5	Bago	877,377	76.8	265,597	23.2
6	Sagaing	824,766	75.2	272,091	24.8
7	Magway	692,168	75.3	227,609	24.7
8	Rakhine	352,953	76.8	106,819	23.2
9	Mon	302,302	71.5	120,310	28.5
10	Kayin	228,868	74.3	79,173	25.7
11	NayPyi Taw	205,160	78.2	57,093	21.8
12	Tanintharyi	201,259	71.1	81,840	28.9
13	Kachin	195,808	72.7	73,557	27.3
14	Chin	70,291	77.1	20,830	22.9
15	Kayah	44,294	77.3	12,980	22.7

Source: Department of Population (DOP), 2015

1.5 Rationale of the Study

Myanmar's economy mainly relies on agriculture especially on rice farming which is very labor intensive, and both men and women actively participate in various forms of agricultural activities.Ayeyawady and Bago,the rice bowl of Myanmar, have high population density and they are and all of the farmers engaged in rice cultivation.More than 50 percent and nearly 50 percent of female population in Ayeyawady and Bago Regions performed in Agriculture sector (World Bank 2017). Ayeyawady contributes to 28.17 percent of the overall paddy production, followed by Bago at 17.37 percent. Poor rural women play important roles in rice cultivation as unpaid family workers, hired laborers, income earners, savers of expenditures and major caretakers of family health and nutrition. The gender-based differences between men and women in their livelihoods are invisible in the rural livelihood activities (Romero-Paris 2008). Despite their participation, women are at a disadvantage to men in some key ways. Access to land is an issue for women, which limits their ability to independently engage in rice production (IFDC 2015). Women are more constrained as compared to men in terms of access to inputs such as information and technology. (Rutsaert 2015)Furthermore, when being a land owner facilitates access to extension services and participation in training, women are likely to be overlooked.The insufficiency of information on resource productivity and their differentials by gender has limited for rice farmers. They are yet to realize their full potentials of resource used in rice production. It is needed to investigate profitability and marginal resource productivity of rice farmers by gender for household livelihoods in the study areas.

1.6 Objectives

The purpose of this study is to contribute to understand men' roles ofmen and women in rice farming systems of the study areas. The general objective of this study is to access the entrepreneurship of men and women in rice production in the study areas. The specific objectives of this study are

1) To study the socio-economic characteristics of the sample farmers in the study areas;
2) To investigate the major sources of income by gender;
3) To compare the profitability of rice production and production activities done by male-headed household and female-headed household;
4) To analyze resource productivity of rice farmers by gender in the study areas

CHAPTER II
LITERATURE REVIEW

2.1 Gender and Their Socio-Economic Characteristics

Gender roles are the socio-cultural constructs of roles in terms of responsibilities, characteristics, attitudes and beliefs among men and women, including the young and old (Njengaet al. 2011). These roles and relationships are learned, change over time, and vary widely within and between cultures. Gender as a social construct, link sex to expected characteristics and behavior, as such men are endowed by law and custom with property rights as well as the control of labor as women are sometimes viewed as tojmo weak or too emotional to have such control (Flora 2001).

According to Moock(1986), gender is fundamental to understanding social structures and expectations including decision-making processes and responsibilities, how risk-loving members of the society are and their rights to benefits due to technological improvement. The social relations of gender include all aspects of social activities with particular emphasis on the exercise of authority, access to and control of resources for production, distribution of income, and remuneration for work as well as cultural and religious activities.

Agriculture is becoming a predominantly female sector as a consequence of faster male out-migration (FAO 1998). Women constitute the majority of smallholder farmers, providing most of the labor and managing a large part of the farming activities on a daily basis(Saitoet al. 1994). Population pressure and off-farm employment opportunities for men have led to an increasing proportion of women becoming de facto farm managers. FAO(2004) pointed out that women in developing countries are the main stay of agricultural sectors, the farm labor force and food systems (and day to day family sustenance), the last to benefit from resources and in some cases have been negatively affected by prevailing economic growth and development process. Oyediran and Odusola (2006) classified household's leadership structure into two: male-headed and female-headed households. Female-headed households are further disaggregated into de jure and de facto female-headed households. The first arise in households headed by widows or unmarried, separated or divorced women. The latter occurs in households headed by females following

migration or illness of the male head. Widowed and single parent heads make all decisions on income generation and management affairs of the households.

Women become household heads as a result of death, divorce, separation, and increasing male migration, with the frequent result that more women participate in the labor force. The type and variety of farm tasks performed by women may also increase, as well as their role in decision-making (United Nation 1989).Staudt (1979) found that 40% of female headed farmers in two areas of western Kenya. In Kenya, about 86 percent of farmers are women, 44 percent of whom work in their own right and 42 percent of whom represent their husbands in their absence. As a result, a higher proportion of women than men are engaged in most phases of the production cycle for food, cash crops and livestock - in addition to their household work and small income-earning activities. Women are also engaged on a more regular basis than men in all farm activities and phases of the production cycle. They provide most of the labor and manage farms on a daily basis (Orivel 1995).

Bridget et al. (2015)studied gender differences and challenges in cassava production and processing in Nigeria. They indicated that majority of the respondents were married through greater population of the female (84%) where married than the male (70%) farmer and they are involved in farming in order to take care of their large household. This study revealed that both male and female farmers were actively involved in cassava production and processing, but female farmers dominated in most activities in terms of labor in production and processing. They had some similar constraints though the women had more constraints like labor intensiveness, land tenure problem and marketing problems.Most of women faced in labor shortages because of unending migration of able bodied youth from the rural to the urban areas creating labor shortage, especially at the peak period when labor is required for land preparation, planting, weeding, harvesting etc. They pointed out that both male and female farmers were actively involved in cassava production and processing, but female farmers dominated in most activities in terms of labor in production and processing. Therefore policies geared towards achievement of cassava production in the state should be gender based.

Keller(2000)hypothesized that married women in rural areas in Zambia gain access to land for farming through their husbands. In the event of divorce or widowhood, they may continue to use the land, but under customary law, they are prevented from inheriting the land. Most divorced or widowed rural women return to

their natal families, where they are dependent upon male kin for access to land. These situations come about because of gender roles that society defines for males and females.

In most developing countries, both men and women farmers do not have access to adequate resources; women's access is even more limited due to cultural, traditional and sociological factors. Accurate information about men's and women's relative access to, and control over, resources is critical in the development of food security strategies. Women access to economic resources and control of products of their labor has been worsened by the trends of globalizing economy, where by competing high, requiring quality and large scale productivity (Mbilinyi 2000). When women farmers can access the resources they need, their production increases, making it less likely that their families are hungry and malnourished(ICRW 2012).

FAO (2004) reported that extension is often biased towards cash crops that tend to be grown by men and large scale farmers in Asia. Most programmes targeted towards women tend to focus on home economics and nutrition rather than farm production and processing. Women are underrepresented and sometimes not represented at all among extension staff and trainer; therefore, there is need for an effective and efficient extension delivery system. Credit should be made available to small scale farmers especially women. As Desai and Mellor (1993) correctly noted farm level credit, when extended properly, not only for crop farming but for dairying and other directly related farm level economic activities encourages diversified agriculture which stabilizes and perhaps increases resources productivity, agricultural production, value added and net income of farmers.Handa(1996) studied expenditure behavior and children’s welfare in female headed households in Jamaica. He concluded that children from female headed households do not necessarily suffer from lower health and educational outcomes compared to male headed households. Because female are more efficient on use of inputs into the household production function.

Pandey(2010) studied the gender role in rice farming in the Philippines. They stated that gender roles and gender relations within households are strongly influenced by social, cultural, economic circumstances, family structure, and the degree of labor participation in the marketplace. They further stated that there is a high incidence of migration of women from rural to urban areas and overseas in the Philippines.

Tesfaye et al. (2001)looked at gender not as a means of categorizing household headship, but as a basic key to understanding structures and actions, including production relationships within and across households, goal setting and priorities, mobilization of resources, willingness to take risks, and the decision-making process to benefits derived from increased farm production. They studied to address the lack of concrete and statistical information on gender roles in agricultural production and decision-making in the household economy of Ethiopia, focused primarily on the role of gender in resource ownership and decision-making power in the mixed farming systems of Ethiopia. They indicated a range of similarities and differences among female-headed households (FHHs) and male-headed households (MHHs). The average size of MHHs was larger than FHHs and male heads of household were more educated than female heads of household.

2.2 Sources of Households' Incomes by Gender

Oladeebo (2012) studied rural women have less access to resources necessary to generate stable incomes and are frequently subject to laws that further compromise earning potential. He further noted that laws often prohibits women from owning property or signing financial contract without a husband’s signature, and women are typically ineligible for institutionally provided resources such as credit and training.

Grace (2004) indicated that the richer the household, the less the women work on land. If a family is poor, women work more on the land. She also reported that increasing labor shortage in the villages compelled women's entry into agriculture. If the men of the family do not own land or do not work as sharecroppers, it is highly unlikely that women will be working on agricultural land, sharing the work with their men.

Fernandez-Cornejo(2007) showed that off-farm income not only adds to household income but also improves the overall economic performance of the farm household. He further argued that increases in off-farm income were significantly and positively related to adoption of technologies that economize on management time. Quisumbing (1995) studied male and female differences in agricultural productivity on Burkina Faso. In this study, female-headed households on an averageearned were less on net income annually than male-headed households. Household income for and of female-headed households is negative and significance.Efficiency between male and female farmers found insignificant dummies for the sex of the farm manager or

household head. That is, female farmers are equally efficient as male farmers, once individual characteristics and input levels are controlled for. In this setting, women may be more constrained by cultural factors from having more active roles, and levels of education and technical development are lower. To the extent that better educated farmers are more likely to adopt modem inputs, these studies underestimate the consequences of underinvestment in women's education in rural societies.

Okwoche et al. (2013) studied compared gender off-farm activities and its implication on poverty reduction in Beneu State, Nigeria by using multi-stage stratified and purposive random sampling methods. The results revealed a significant difference in the number of off-farm activities carried out by male and female farmers. Furthermore, the results showed that a significant relationship between farmers off-farm activities and households poverty. This implies that farmers' participation in off-farm activities is capable of reducing households' poverty. They concluded that farmers in addition to their farm work can also engage in other non-farm activities to argument their income from farm, thereby alleviating poverty in rural areas. Off-farm employment should be emphasized among the rural community.

Osondu and Ijioma(2015) showed that women in farm households derived income from farming which accounted for more than half of annual total income. Crop farming was subsistence in nature and was by far the most important single source of income for women, providing about nearly one-third of total income of women in farm households. They concluded that women's access and control of resources affect their status in homes and their participation in control of households' earnings. Women are agents of economic and social change. Analysis of occupation and income diversification showed that land cultivation continued to constitute the major source of rural women livelihood.

2.3 Gender Differential in Crops Production

Ogato et al. (2009) indicated that there is a significant difference exists between the constraints of female farmers and those of male farmers in crop production and management practices. During the agriculture peak seasons, women work more than double the hours done by men. They argued that gender roles in household activities are socially constructed and not sexually determined. Gender roles are thus more responsive to changes in farming systems, economic pressure, cultural beliefs and practices.Females' contribution to crop production and

management in Ethiopia is significantly higher than that of males because they participate in almost all farming activities, domestic tasks and community development work. They found that gender roles in household activities are socially constructed and not sexually determined. Gender roles are thus more responsive to changes in farming systems, economic pressure, cultural beliefs and practices. The significant contribution of females in reproductive and productive works and community development should serve as a good guide for rural development interventionists

Udry et al. (1995)studied gender differentials in farm productivity in African households. They found that plots women controlled plots for all crops have significantly lower yields than men controlled plots within a same year and same cropping patterns. This is due to women have less access than men to productive resources and opportunities. Quisumbing(2014) stated that if women had the same access to productive resources as mean, they could increase farm yields by 20-30%. In spite of having major role of women in agricultural households, they got less power in the decision-making process.

Villabon(2012) examined gender characteristics and gender differences in agricultural productivity using a cross-sectional household survey data collected in Peru. Estimation of log linear models were aimed at explaining differences in female and male household heads, values of production per hectare, while controlling for socio-economic characteristics of the household heads, agricultural inputs and regional variations. The study found that there are no effects of sex of the household head itself as well as no effects of sex of the household individuals on plot yield. Furthermore, productivity differences were shown to be attributable to the several inputs male and female household heads used for their agricultural production, which appeared to be influenced by the different characteristics of the regions where the plots were located. Education and mother tongue were shown to be of high importance for agriculture in the Peruvian context. The study suggests that language skills and education become a policy priority for female household heads to increase their productivity.

Thapa(2008) studied productivity differentials between men and women in the peasant agriculture in Nepal. Both Cobb-Douglas and trans log production functions were estimated using data from the Nepal Living Standard Survey 2003/04. Male-managed farms produce more output per hectare with higher command in market

input use, obtaining credit, and receiving agricultural extension services than female managed farms. Sex of household head as proxy for farm manager did not show any difference between male and female managed farms. However, the coefficients of location and household characteristics show significant variations in farm output among ethnic and caste groups residing in different ecological belts of Nepal. The study found that, adult male labor contributed more in production process than adult female labour. Policy needs to focus on the reduction of caste or ethnic disparities as well as regional imbalance in order to minimize disparities in farm productivity between men and women as well as among ethnic and caste groups.

Aguilar et al. (2014)analyzed differences in agricultural productivity between male and female land managers in Ethiopia. Gender differentials are more pronounced at mid-levels of productivity and that the share of the gender gap explained by the endowment effect declines as productivity increases. Therefore, they indicated that at lower levels of productivity, returns to factors of production are similar for men and women and the gender gap is largely due to lower access to resources for women.

Oyakhilomen (2012) analyzed the influence of gender and other variables (farm size, level of education, membership of association, access to extension, amount of credit obtained, farming experience and irrigation) on the farm income of maize farming households by using multiple regression model in Nigeria. The result showed that gender was significant and had a positive influence on income of the maize farmers and this was attributed to the disparity in the access to production resources andsupportive services by the male and female maize farmers with men having more favorableaccess to production resources especially land and other supportive services than women.Based on this finding, it is recommended that gender inequality in the distribution ofresources, information and other farm inputs should be minimized so as to ensure thatwomen have access to resources for production just as men do thereby enhancing theirproductivity and income.

Adeleke (2008) calculated a Cobb-Douglas production function to estimate the coefficients and other parameter that affects the respondent's productivity. He analyzed the differences that exist in the basic socio-economic characteristics of male and female farmers that reflect a difference in the productivity levels of the sampled farmers in Nigeria. He showed that there is no difference in the average productivity of the sampled male and female farmers. Therefore, no barrier that can affect agricultural productivity especially of women. He found that majority of women were

farming on temporary land which only allows them to cultivate farm sizes smaller than those of their male counterparts. It can affect the generation of low income.

Koru and Holden (2008) explored possible factors that explain gender influences on maize productivity in Uganda. The study used matching estimators and econometric methods to analyze plot level data of households. The results from matching estimators demonstrated that productivity was significantly lower for female-headed households. A bivariate probit model indicated that the probability of adopting fertilizer was higher for male-headed households than female-headed households. Better market access by male-headed households was another factor explaining the productivity difference.

Ayoola et al. (2011) estimated that the parameters of the key inputs for rice production for men and women in Nigeria. He estimated factors and determinants of rice production for male and female farmers by using regression model of double log form and examined the performance of male and female farmers in rice farming with a view to determining the parameters for reducing gender imbalance in farmers' access to opportunities for improved livelihoods from rice production. The result showed that land, level of variable inputs (fertilizers, seeds, herbicides and labour), and farmers' experience were significant and implyed that these variables would likely influence productivity of rice among the male farmers in the area. Age would influence rice production negatively. This means that the older the rice farmers the less the vigor for farming.

Dadzie and Dasmani (2010) investigated the influence of gender in management on the level of efficiency of food crop farms in Ghana. The amount of both capital and labor inputs used in production by the male-managed farms was found to be relatively higher than their female counterparts. Consequently, male-managed farms achieved greater value of production than the female-managed farms. Both male-managed and female-managed farms were found to operate at low level of technical efficiencies. It is observed from estimates of the multiple regression models that technical efficiency scores were significantly influenced by dummy for sex of the farm entrepreneur, age, years of experience, household size, extension contacts, educational level, and access to credit. The estimates also confirmed the frontier results that, malemanaged farms, on the average, are less efficient than the female-managed farms.

Mukasa and Salami(2015)studied gender inequality in agricultural productivity, highlights its key determinants, and approximates the potential production, consumption, and poverty gains from reducing or closing the gender productivity gap. Using the estimated productivity differentials, they measured the potential benefits that each country could obtain from closing or gradually reducing these gaps. The decomposition of the sources of gender productivity differences indicates that in the three countries, endowment and structural disadvantages of female managers in land size, land quality, labor inputs, and household characteristics are the main drivers of gender gaps. They suggested that, in the three countries, female managers of agricultural lands have a clear endowment disadvantage in most factors generating agricultural productivity such as farm size and use or intensity of non-labor inputs. Furthermore, they found that on average female-managed agricultural lands are less productive than their male counterparts in Nigeria, Tanzania, and Uganda, respectively.

Saito et al. (1994) used Cobb-Douglas production functions with the gross value of maize, beans, and cowpeas per hectare to estimate at the plot level by gender of plot manager in Kenya. Capital (value of farm tools and equipment) is a positive and significant determinant of the gross value of output per hectare for male plots but is insignificant for female plots. While the effect of extension is positive and highly significant for male plots, it is insignificant for female plots. This may indicate better use of extension services by men.

Udry et al. (1995)studied gender differences in farm productivity in African. They indicated that the yield differentials between men and women controlled plots are due to significantly higher labor and fertilizer inputs per acre on plots controlled by men. These differences in input intensity between male- and female-managed plots persist even after land quality, measurement error, or risk management behavior are taken into account, and contradict the assumption of Pareto-efficient resource allocations within the household. They found that the value of household output could be increased by 10–15% by reallocating currently used factors of production across plots by using production function analysis.

Peterman et al.(2010)stated that gender inequalities resulting from gender definition of roles and the inadequate attention paid to this problem in agricultural development contributes to lower productivity among women in the developing countries. They reviewed focuses on four key areas: (1) technological resources, (2)

natural resources, (3) human resources, and (4) social and political capital. Across input areas, generally men have higher input measures than women; however, this finding was often sensitive to the use of models that control for other background factors, as well as the type of gender indicator implemented in the analysis.

Adesina and Djato(1997)showed that men farmers are able to gethigher prices for their rice than women, a situationthat may reflect the better organization of men farmersinto cooperatives. They found that the relative degree ofeconomic efficiency of women rice farmers is similarto that of men rice farmers in Africa. Results showed that women farmers have absoluteallocative efficiency in the use of the inputs at theirdisposal, although this did not translate into havinghigher economic efficiency due possibly to lack ofbetter technical options. Results from this paper suggest that there is noeconomic rationale for biasing rice developmentstrategies towards male farmers in the study area, asfemale farmers; when they have access to similarinputs, have equal levels of economic efficiency.

Offodile et al. (2010)used marginal productivity model to determine the functional form to analyzed resource inputs employed by male and female rice farmers. The result showed that male rice farmers use of labor input was more produced rice than female farmers per unit. A unit change in the use of labor, capital and land by male farmers produced more extra output with compared to female farmers but a unit change in the use of fertilizer and seed by female farmers produced more extra output as compared to male farmers.The marginal value product (MVP) of family labor is higher in male farmers and lower in female farmers, which indicated that male farmers could increase their productivity by using more family labor. Thus, female farmers could increase their productivity by cultivating more land. The MVP for inorganic fertilizer was higher than its factor cost for both male farmers and female farmers, which indicates that both types of household could increase their productivity by increasing the use of inorganic fertilizer.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Study Area

3.1.1 General description of Maubin Township

Maubin is a town of Ayeyawady Region, the rice bowl of the delta region. Geographically, it locates at 16˚ 30' N latitude and 95˚ 24' E longitude.In the study area, Maubin Township, there was 76 village tracts consisting of 442 villages and the total area is about 515.38 sq-miles. The area of Maubin Township was 133,540 hectares and the cultivated area was 86,538 hectares, 67.71 % of total area. The area of paddy land (Le) was about 57,348 hectares and dry land (Yar) was about 33,747 hectaresIts total population was about 314,093 with 152,940 (49%) male population and 161,153 (51%) of female population.

The selected villages from Maubin Township were Pann Pin Su, NgagyiGhayat, Tapart and Alang (Figure 3.1). The total population of Pann Pin Su village was 4,757 with 2,575 of male and 2,182 of female. In NgagyiGhayat village, the total population was 1,805 with 1,230 of male and 575 of female and in Tapart village 1,384 of total population with 816 of male and 568 of female. The total population of Alang village was 3,720 with 1,897 of male and 1,823 of female (DOA 2015)

3.1.2 General description of Daik U Township

Bago Region is the second largest rice cultivated area after Ayeyawady Region. Geographically, it stands at 87˚ 50' N latitude and 97˚ 48' E longitude.The area of Daik U Township was 90,236 hectares and the cultivated area was 80,820 hectares, 89.57 % of total area. The area of paddy land (Le) was about 77,984 hectares and dry land (Yar) was about 897 hectares.Its total population was about 139,232 with 64,435 (46%) male population and 74,797 (54%) of female population.

The selected villages from Daik U Township were KadokePhayarGyi, Pyin Ma-lwin, Pha-aungWae and Oat Shit Kone villages (Figure 3.2). The total population of village KadokePhayarGyi was 9,113 with 4,254 of male and 4,859 of female. In Pyin Ma-lwin village, the total population was 1,766 with 586 of male and 910 of female and in Pha-aungWae village, 12,290 of total population with 5,892 of male and 6,392 of female. The total population of Oat Shit Kone village was 5,916 with 2,456 of male and 2,460 of female(DOA 2015).

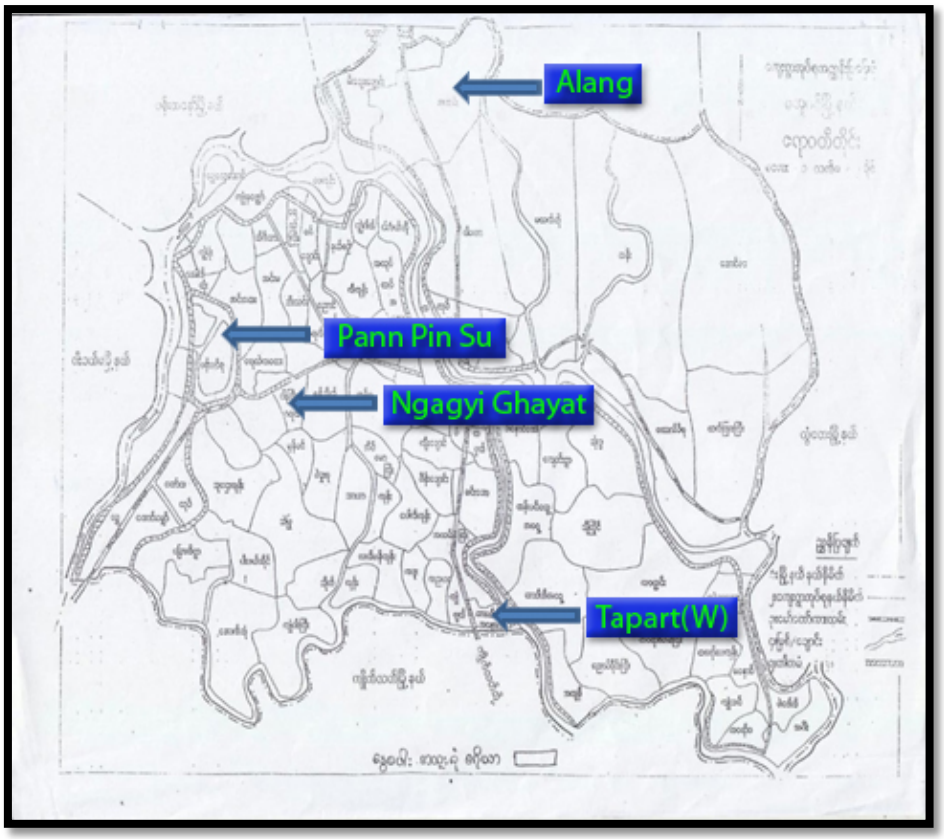

Figure 3.1 Map of Maubin Township, the study area

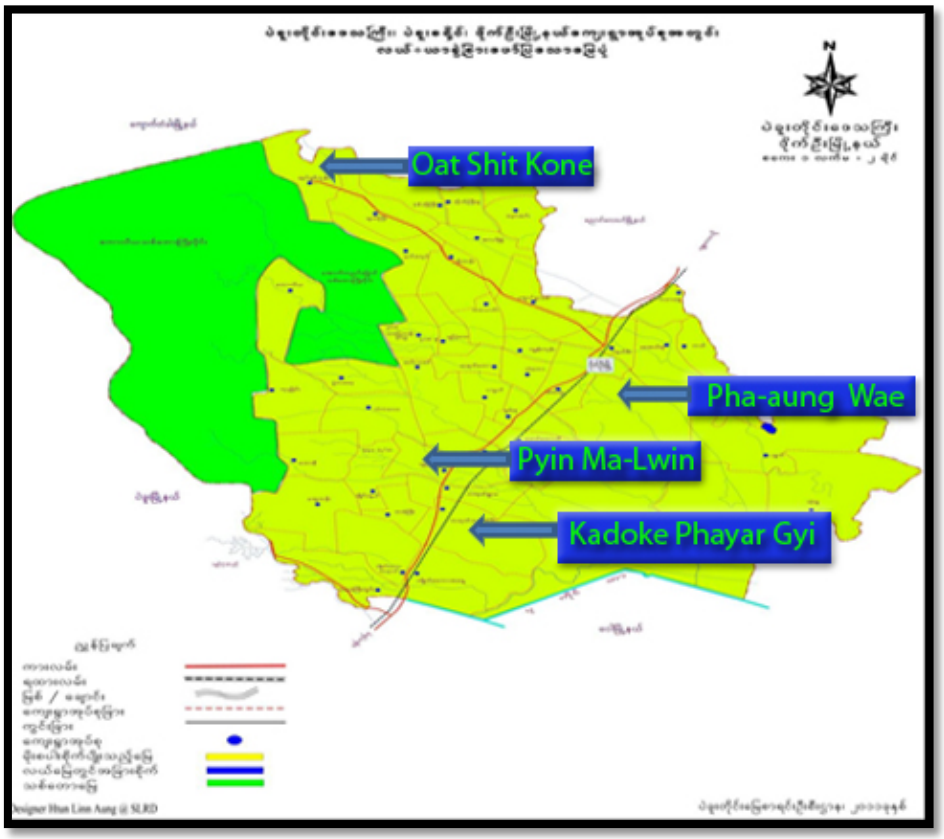

Figure 3.2 Map of Daik U Township, the study area

3.2 Data Collection and Sampling Method

Both primary and secondary data were used in this study. The primary information was collected by personal interview with a structured questionnaire. The survey was conducted during the period of October to November 2015. Purposive sampling method was used to select male-headed households and female-headed households in rice production. Total of 138 sampled farmers including 83 male-headed households and 55 female-headed households were interviewed in which 37 male-headed households and 29 female-headed households from Maubin Township and 46 male-headed households and 26 female-headed households from Daik U Township. The household level survey was carried out in each four villages in Maubin Township and Daik U Township.

Socio-economic characteristics of sample rice farmers such as marital status, age, education level, farming experience, family size, annual household income as well as crop income, off-farm income, non-farm income and livestock income, household assets and farm implements were collected. And also cultural practices of production such as rice production area, seed source, varieties used, seed rate per hectare, animal husbandry, utilization of fertilizer, seed, pesticide and herbicide were collected. Moreover, cost and returns of rice production of male and female-headed households were also composed in data collection.

The relevant secondary data was taken from official records of Ministry of Agriculture, Livestock and Irrigation (MOALI) and Department of Agriculture (DOA).

3.3 Analytical Methods

Both qualitative and quantitative data were firstly entered into the Microsoft Excel program. These data was analyzed by Statistical Packages for Social Science (SPSS) version 17.0 software. The analytical techniques used in this study were the descriptive analysis, the cost and return analysis and production function and marginal productivity model.

3.3.1 Descriptive analysis

Descriptive analysis was applied to describe and compare the socio-economic conditions, input use, yield, existing farming practices and income of male and female-headed households.

3.3.2 Cost and return analysis

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. It is important for decision making tool. It can help individual producers determine the most profitable crops to grow, develop marketing strategies, obtain financing necessary to implement production plans, and make other farm business decisions.

The concept of enterprise budget (Olson 2009) was used to evaluate the profitability of sesame production. In this analysis, variable costs were taken into account;

(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% for cropping period of 4 months.

The “return per unit of capital invested” was calculated by gross benefit per total variable cost.

$$\text{Return per unit of capital invested (BCR)} = \frac{\text{Total gross benefit}}{\text{Total variable cost}}$$

3.3.3 Multiple regression analysis

In order to determine marginal resource use efficiency, multiple regression analysis was being used. In this regression, the dependent variable was the total revenue of rice for male and female-headed households and independent variables were sown area, seed rate, fertilizer, family labor, hired labor and machinery cost.

$$\text{Ln } Y_i = \beta_0 + \beta_1 \text{Ln}X_{i1} + \beta_2 \text{Ln}X_{i2} + \beta_3 \text{Ln}X_{i3} + \beta_4 \text{Ln}X_{i4} + \beta_5 \text{Ln}X_{i5} + \beta_6 \text{Ln}X_{i6} + e_i$$

Where,

Ln	=	Natural logarithm
Y	=	Total revenue of rice (MMK/ha)
X_{i1}	=	Sown area (ha)
X_{i2}	=	Seed rate (kg/ha)
X_{i3}	=	Fertilizer amount(kg/ha)
X_{i4}	=	Family labor (man day/ha)
X_{i5}	=	Hired labor (man day/ha)
X_{i6}	=	Machinery cost (MMK/ha)
B_0	=	Constant
β_1 to β_6	=	Estimated coefficients
e_i	=	$\nu i - \mu i$ ($\mu i \geq 0$)
i	=	i^{th} male/female-headed households in sample

Marginal productivity of resource inputs employed by male and female-headed households was calculated by using the following formula.

$$MP_{x_i} = b_i \left(\frac{Y}{X_i} \right)$$

Where,

MP_{xi}	=	Marginal productivity of resource inputs employed by male/female-headed households
b_i	=	Regression coefficients for the resource inputs employed by male/female-headed households
Y	=	Value of rice output per male/female-headed households (MMK)
X_i	=	Amount of each resource input employed by male/female-headed households

Gender resource productivity differentials (GRPD) were estimated as the following formula;

$$GRPD = MP_{xim} - MP_{xif} = b_i(Y_m|X_{im}) - b_i(Y_f|X_{if})$$

m = male-headed households, f=female-headed households

Source: Offodile at al. 2010

CHAPTER IVRESULTS AND DISCUSSION

In this chapter, the results of the study are presented and discussed in detail to address the four objectives of the research. The chapter is divided into four sub-sections. These are description of households' socio-economic characteristics, sources of households' incomes, profitability of rice production and marginal resource used efficiency of male-headed households and female-headed households in the study areas.

4.1 Description of Household Socio-Economic Characteristics of Male-headed Households and Female-headed Households

Among the many socio-economic characteristics, age, marital status, educational level, farming experience, family size, family labor, dependency ratio, productive assets, household assets, livestock assets, access to credit and access to extension services are considered in this study.

4.1.1 Age distribution of male and female household heads

The age groups of male and female household heads were ranged from 21 to over 65 years. The age group of 36-50 years constituted the majority (47.0%) of the male household heads whereas the age group of female household heads 51-65 years was the majority (40%).The average age of household heads was 48.2 years and 51.4 years of male and female household heads respectively. There was a significant difference between the average age of male household heads and female household heads at 10% level (Table 4.1).

4.1.2 Farming experience of male and female household heads

Farming experience plays a significant role in agricultural production. It is expected that the higher in the farmers' experience in farming, the better will be the production capacity of the farmers. Farming experience in Table 4.1 was showed about 15.7% and 14.5% of male and female household heads had between 1-10 years of farming experience, 30.1% and 25.5% of male and female household heads had between 11-20 years of farming experience. More than 25% and 20% of households had 21-30 years and 31-40 years of farming experience. The average farming experience of female household heads (25.3 years) was higher than that of male household heads (23.5 years). There was no significant difference between the farming experience of male households' heads and female household heads.

4.1.3 Marital status of male and female household heads

About 91.6% of male household heads were married and 8.4% were singles and widowers. About 50.9% of female household heads were married and about half of female household heads were singles and widows. This is one reason to become household heads for female. There was a highly significant difference between the marital status of male household heads and female household heads at 1% level.

4.1.4 Educational level of male and female household heads

The educational status of male and female household heads in the study areas was mentioned in Table 4.2. The household heads' education level were divided into monastery education, primary level, secondary level, high school level, undergraduate or diploma and graduated school. In this categories, monastery education referred to informal schooling although they could read and write, primary level referred to formal education up to 5 years, middle level referred to formal schooling up to 9 years, high school level referred to formal schooling up to 11 years, diploma school referred to those who received a certificate from an Institute and graduated school referred to those who received a bachelor from university.

Education is one of the important variables, which increases farmer's ability to use agricultural related practices. With regard to education, the overall middle school level of male household heads (33.7%) was higher than 27.2% of female household heads. About 14.5% and 50% of female household heads had attended monastery and primary school level compared to 3.6% and 31.3% of male household heads. However, 25.3% of high school level of malehousehold heads was higher than female household heads (5.5%). In addition, 3.7% and 2.4% of male household heads had diploma certificate and graduate degree whereas only 1.8% of female household heads was graduated. In the educational status, the majority of male household heads had primary school level. Concerning with the educational status, the Pearson Chi-square test showed that the average educational status was highly significantly different between gender. This reveals that the male household heads were better educated than the female household heads.

4.1.5 Family size and dependency ratio of male and female-headed households

In this study, about 66.3% and 45.5% of male and female-headed households respectively had family members of 4-6 persons while more than 14% of male and female-headed households had family members of 7-9 persons. The average family size of male-headed and female-headed households was 4.8 and 4.4 persons. There was no significant difference between the average family size of male-headed households and female-headed households in the study areas. The average dependency ratios of male-headed and female-headed households were 52.3% and 58.4%, respectively. But the t-test showed that the dependency ratio between male and female-headed households was not significantly different. (Table 4.3).

4.1.6 Farm size owned by male and female-headed households

The data in table 4.3 shows the average farm size was 4.9 ha in male-headed households and 5.4 ha in female-headed households. The minimum and maximum farm sizes were 0.4 and 26.3 ha in male-headed households and 0.4 and 24.3 ha in female-headed households in the study areas. The results showed that there was no significant difference between the average farm size of male and female-headed households in the study areas.

Table 4.1 Socio-economic characteristics of male household heads and female household heads in Maubin and Daik U Townships

Items	Unit	Male-headed HHs (n=83)	Female-headed HHs (n=55)
Age group			
21-35	Year	12 (14.5)	6 (10.9)
36-50	Year	39 (47.0)	20 (36.7)
51-65	Year	26 (31.3)	22 (40.0)
Over 65	Year	6 (7.2)	7 (12.7)
Average HH head's age	Year	48.2	51.4
Range	Year	21 - 65	24 - 68
t-test		**t = -1.711***	
Farming experience			
1-10	Year	13 (15.7)	8 (14.5)
11-20	Year	25 (30.1)	14 (25.5)
21-30	Year	23 (27.7)	15 (27.3)
31-40	Year	17 (20.5)	16 (29.1)
Over 41	Year	5 (6.0)	2 (3.6)
Average	Year	23.5	25.3
t-test		**t = -0.891^{ns}**	
Marital status			
Single	Percent	6 (7.2)	10 (18.2)
Married	Percent	76 (91.6)	28 (50.9)
Widower or Widow	Percent	1 (1.2)	17 (30.9)
Pearson Chi-square		**P = 33.056*** **	

Note: The values in the parentheses represent percentage, HHs= households.* and *** are significant differences at 10% and 1% level, respectively and ns = not significant.

Table 4.2 Educationalstatus of male household heads and female household heads in the study areas

Items	Male-headed HHs (n=83)		Female-headed HHs (n=55)	
	Frequency	Percent	Frequency	Percent
Monastery	3	3.6	8	14.5
Primary	26	31.3	28	51.0
Middle school	28	33.7	15	27.2
High school	21	25.3	3	5.5
Diploma	3	3.7	0	0
Graduate	2	2.4	1	1.8
Pearson Chi-square	**P = 18.355****			

Note:** is significant differences at 5% level.

Table 4.3 Family size, dependency ratio and farm size of male-headed households and female-headed households in the study areas

Items	Unit	Male-headed HHs (n=83)	Female-headed HHs (n=55)	Significant test
Family size				
1-3	No.	16 (19.3)	22 (40.0)	
4-6	No.	55 (66.3)	25 (45.5)	
7-9	No.	12 (14.4)	8 (14.5)	
Average	No.	4.8	4.4	1.237a^{ns}
Range	No.	1-8	1-9	
Dependency ratio	Percent	52.3	58.4	-0.460b^{ns}
Farm size				
Average	ha	4.9	5.4	-0.673a^{ns}
Maximum	ha	26.3	24.3	
Minimum	ha	0.4	0.4	
SD		4.57	5.1	

Note: The values in the parentheses represent percentage,ns = not significant, a = t-test and b = Pearson Chi-square.

4.1.7 Ownership of productive assets of male and female-headed households

The ownership of the farming assets of male-headed household and female-headed household were presented in Table 4.4. More than half of the male-headed household possessed sprayer, plough, harrows and power tiller compared to 61.8%, 45.5%, 47.3% and 27.3% of female-headed household, respectively. More than 40% of households possessed water pump. About 42.2% and 39.8% of male-headed households possessed cattle and bullock cart while 27.3% and 38.2% of female-headed household possessed this farm equipment. About 19.3%, 14.5% and 2.4% of male-headed households had trawler jeep, thresher and tractor compared to 21.8%, 10.1% and 14.5% of female-headed households. The results showed male-headed households (6.0%) owned more combine harvester than female-headed households (3.6%). From these farm productive assets, male-headed household possessed both traditional farm implements and farm machinery more than female-headed household except trawler jeep and tractor. The results revealed that there were significantly differences between the ownership of productive assets except harrow, water pump, bullock cart, trawler jeep andcombine harvester.

4.1.8 Ownership of household assets of male and female-headed households

In the study areas, more than 50% of male-headed households and female-headed households possessed bicycle and about 53% and 43.6% of male-headed household and female-headed households possessed motor cycle. As regards to mobile phone, almost every household headed occupied mobile phone. They can easily communicate with family/friends, arrange with agricultural input sellers when they want to purchase seeds and pesticides from local dealers, governmental and nongovernmental extension agents. Moreover, they can get the information dealing with the market for their crops. More than half of male-headed households and female-headed households possessed both TV and EVD. But only 25.3% of male-headed households and 7.3% of female-headed households had Skynet. More than 28.9% and 25.3% of male-headed households possessed generator and solar panel compared to 7.3% and 12.7% of female-headed household. Only 3.6% and 1.8% of male and female-headed households possessed car. There were no significant differences in all items except of generator, sky net and solar panel between male-headed households and female-headed households (Table 4.5).

Table4.4 Productive assets of male and female-headed households

Assets	Male-headed HHs (n=83)		Female-headed HHs (n=55)		Pearson Chi-square
	Frequency	Percent	Frequency	Percent	
Sprayer	58	69.9	34	61.8	7.939*
Plough	52	62.7	25	45.5	8.271*
Harrow	52	62.7	26	47.3	5.534^{ns}
Power tiller	42	50.6	15	27.3	7.720**
Water pump	37	44.6	23	41.9	2.506^{ns}
Cattle	35	42.2	15	27.3	17.335**
Bullock cart	33	39.8	21	38.2	0.518^{ns}
Trawler Jeep	16	19.3	12	21.8	2.011^{ns}
Thresher	12	14.5	2	10.1	4.250**
Combine harvester	5	6.0	2	3.6	0.392^{ns}
Tractor	2	2.4	8	14.5	7.248***

Note: *, ** and *** are significant differences at 10%, 5% and 1% level respectively and ns = not significant.

Table 4.5 Household assets of male and female-headed households

Assets	Male-headed HHs (n=83)		Female-headed HHs (n=55)		Pearson Chi-square
	Frequency	Percent	Frequency	Percent	
Hand phone	78	94.0	52	94.5	3.875^{ns}
Bicycle	61	73.5	39	65.5	1.646^{ns}
TV	58	69.9	34	61.8	0.967^{ns}
Motor cycle	46	53.0	24	43.6	2.116^{ns}
EVD	46	53.0	33	60.0	0.655^{ns}
Generator	24	28.9	5	9.1	8.977*
Skynet	21	25.3	4	7.3	7.480**
Solar panel	21	25.3	7	12.7	3.234*
Car	3	3.6	1	1.8	0.379^{ns}

Note: * and ** are significant differences at 10% and 5% respectively and ns = not significant.

4.1.9 Livestock assets of male and female-headed households

Livestock are dependable cash sources for the households. The products of livestock are to satisfy immediate food needs of families or are sold for cash. Chickens are the most common livestock in the study areas, raised by nearly half of female-headed households and more than one-fourth of male-headed households. Duck are raised by more than 10% of both households. The second most common type of livestock in the study areas was pigs raised by nearly half of male-headed households and nearly one-fifth of female-headed households. The other category includes fish pond are present but not very common in the study areas. Livestock rearing in the study areas is done on a relatively small scale (Table 4.6).

4.1.10 Access to credit of male and female household heads

Access to credit can relieve the financial constraints of both male and female household heads. Obtained credit could be used for either consumption or production purposes or both. Credit is used for production if obtained on time and raise chances of household to acquire productive resources (seeds, fertilizers, pesticides and others) which will help farmers to increase production and improve food situation of the households.In the study areas, it was found that 90% of male household heads and 85% female household borrowed credit from MADB.MADB borrowed money based on area. Since female household heads possessed more land than male household heads, they received more credit amount for crop production.About 11% of both maleand female household heads borrowed credit from cooperative. About 6% of male-headed households and 9% of female-headed households borrowed credit from money lender to purchase input for rice production. However, about 8% of male-headed households and 13% of female-headed households did not borrow credit from any credit sources. They used own capital to grow crops (Table 4.7).

Table 4.6 Livestock assets of male-headed households and female-headed households in the study areas

Assets	Male-headed HHs (n=83)		Female-headed HHs (n=55)		Pearson Chi-square
	Frequency	Percent	Frequency	Percent	
Pig	24	49.4	10	18.2	3.689^{ns}
Chicken	13	28.9	26	48.6	0.060^{ns}
Duck	11	13.3	6	10.9	3.154^{ns}
Fish pond	2	2.4	1	1.8	0.054^{ns}

Note: ns = not significant.

Table 4.7 Sources of credit from different sources by male household heads and female household heads in the study areas

Sources of credit	Male-headed households (n=83)		Female-headed households (n=55)	
	Frequency	Percent	Frequency	Percent
MADB	75	90	47	85
Cooperative	10	11	6	11
Money lenders	5	6	5	9

4.1.11 Access to agricultural extension services to male and female household heads

Agricultural extension services includes the provision of timely information, the linking of farmers with sources of farming inputs, credit facilities and the provision of training to farmers. The role of an agricultural extension agent is serving as technology transferred consultant, technician, and facilitator between agricultural institutions and the farm families, and advocate helping farmers to identify their problems and find their own solution. An agricultural extension agent helps farmers to increase the productivity of their farms and improve their standard of living. In this study, about 38% of male household heads and 76% of female household heads had no contact with the extension agents. About 9% of female household heads and 7% of male household heads participatedin the agricultural extension training above five times per season.Farmers preferred to work in the field and are not very interested in attending trainings or meetings because they faced the work load in this time. The attendance of extension training or meeting for male household heads was 23% for one time,16% for two to three times and 16% for four to five times while the contact time to extension agents for female household heads was 2% for one time, 7% for two to three times and 6% for four to five times. Mostly male household heads are more involved in agricultural extension training than female household heads. This suggests the need for frequent contact of agricultural extension agents with particular emphasis to female household heads (Figure 4.1).

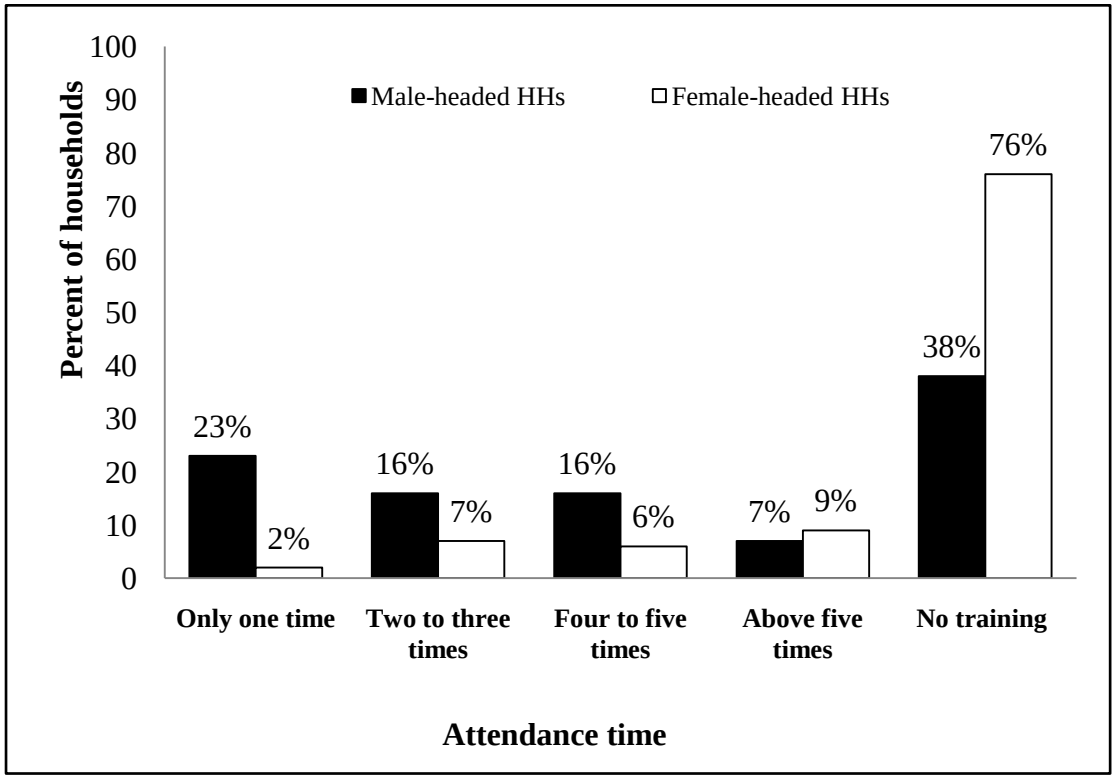

Figure 4.1 Training participated times by male and female household heads in the study areas

4.2 Household Income

In this study, the households' income was received from all sources such as crop income, off-farm income, nonfarm income, livestock income and remittance. Farm income was the sum of receipts from the sale of all crops. Nonfarm income was the income that received from small business, regular full time employment and regular part time employment. Off-farm income was the casual labor income in agriculture.Livestock income may be received by selling products from cow, pig, chicken or other large animals. Remittance income was computed by combining the income sent by those household members, currently staying outside of the house. Income of the household members, currently staying both in abroad and in district or capital town within the country, was considered as remittance income.

4.2.1 Income sources of male and female-headed households

The annual household income source of male-headed households and female-headed households was shown in Table 4.8. In this Table, all the male-headed and female-headed households, the main income source wascrop income, whereas 38.6% and 60.0% of male-headed and female-headed households received from non-farm income. Over 30% of both male-headed and female-headed households also had income from livestock production. Additional income sources were the same for both households indicating off-farm and remittance from migrant household members.

4.2.2 Income composition of male and female-headed households

The importance of different income sources in households' livelihood strategies among the male-headed households and female-headed householdswas presented in Figure 4.2. All male and female-headed households received incomes from farming. Crop production which was the most important single source of income provided about 80% for male-headed householdand 78% for female-headed household total incomes.

Non-farm activities provided about 8% to total male-headed household incomes and 11% to total female-headed household incomes. In the study areas, the results showed that remittance income in male-headed households provided about 8% to total household incomes. The remittance income share of female-headed households was about 9% of the total household incomes. Off-farm and livestock

Table 4.8 Percent of male-headed households and female-headed household income sources in the study

Items	Male-headed HHs (n=83)		Female-headed HHs (n=55)		Pearson Chi square
	No.	Percent	No.	Percent	
Crop income	83	100.0	55	100.0	129.657 ns
Non-farm income	31	38.6	33	60.0	34.469 ns
Livestock income	25	30.1	17	30.9	29.927 ns
Off-farm income	12	14.5	10	18.2	16.144 ns
Remittance	9	10.8	8	14.6	18.088 ns

Note: ns = not significant.

Table 4.9 Average annual household incomes of male-headed households and female-headed households

'000 MMK per year

Income sources	Male-headed HHs (n=83)			Female-headed HHs (n=55)		
	Average	Maximum	Minimum	Average	Maximum	Minimum
Crop income	5,390	28,760	245	5,550	20,075	555
Non-farm income	510	6,430	0	760	1,035	0
Livestock income	220	2,500	0	55	450	0
Off-farm income	80	4,000	0	60	1,035	0
Remittance	570	9,380	0	620	15,000	0

incomes in male-headed householdswere 1% and 3% of the total householdincomes. Both off-farm and livestock incomes provided 1% to the total households income.

Thehousehold members in male-headed households mainly worked as broker (22%), government staff (19%), tailor (16%), driver (13%) and restaurant (12%). Few percent of household members in male-headed households worked as carpenter and employed handicraft, beauty salon and motorcycle workshop. Among these non-farm activities, most of male-headed households were brokersand government staffs. In female-headed households, the non-farm activities were shopkeeper (21%),government staff (18%), driver (16%) and motorcycle carry (12%). They also engaged in company, beauty salon, broker, tailor and carpenter. Most of household members in female-headed households were shopkeepers and government staffs (Fig 4.3)

4.2.3 Average annual amount of income for sample households

Table 4.9 shows average amount of various annual incomes in male-headed households and female-headed households. The average annual total incomes were about 6.7 million kyats and 7.0 million kyats for male-headed households and female-headed households. The annual average crop income was not different between male-headed and female-headed households (5.3 and 5.5 million kyats). Crop income was the most important income source for rural households in the study areas. The average annual non-farm incomes and remittance of the female-headed households were better than those of male-headed households. Among the income sources, off-farm and livestock incomes were 0.08 million kyats and 0.2 million kyats respectively in male-headed households and 0.06 million kyats and 0.05 million kyats in female-headed households. Thus, the male-headed households received more incomes from off-farm and livestock production.

The result in Table 4.10 shows the comparison of male and female-headed households' average annual incomes. The average annual income was 6,900,000 MMK which was counted on the total household income (138). The results showed that about 66.3% and 60% of male and female-headed households respectively had an income less than the average. The results also show about 33.7% of male-headed households and 40% of female-headed households had above the average income in the study areas. It was found that most of the male and female-headed households had lower income than the average income.

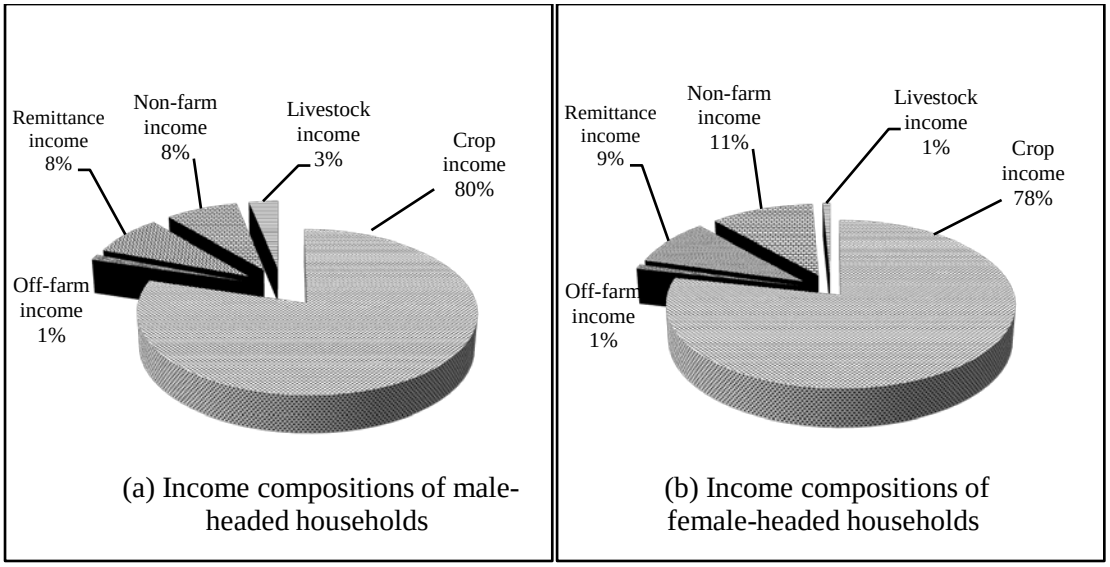

Figure 4.2 Income compositions of male-headed households (a) and female-headed households (b) in the study areas

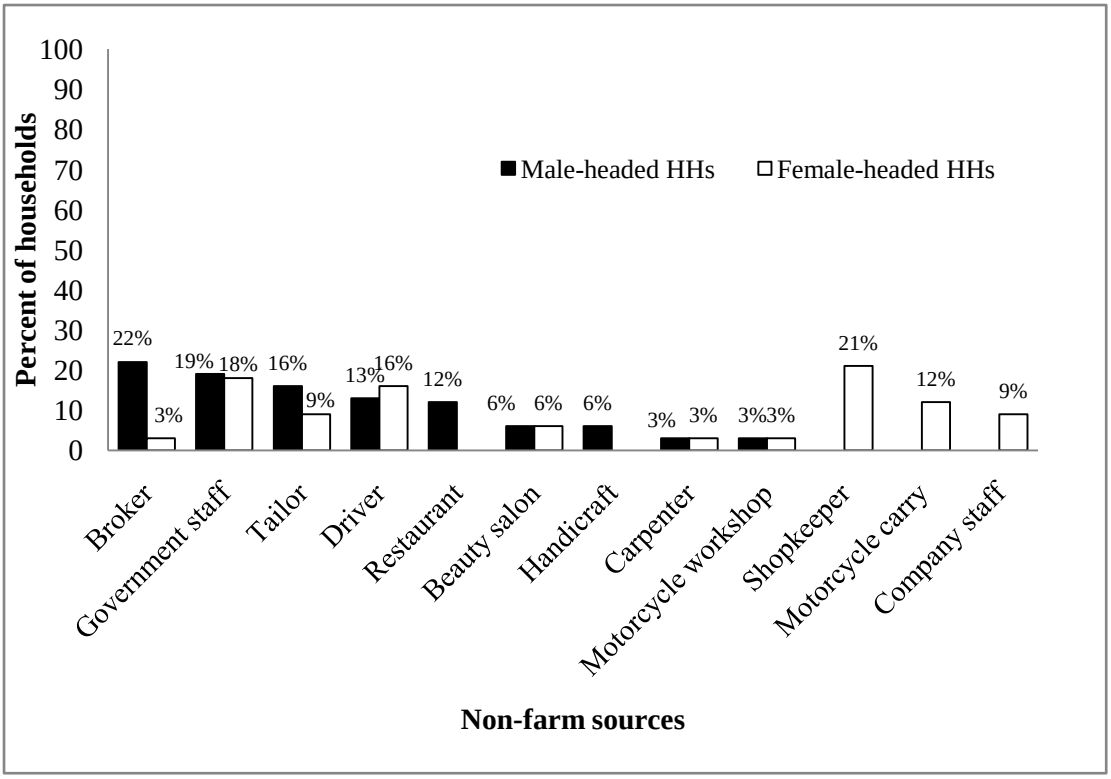

Figure 4.3 Non-farm income sources of household members in male and female-headed households in the study area

Table4.10Percent of male and female-headed household comparison based on average annual income of both households in the study areas

Items	Male-headed HHs (n=83)		Female-headed HHs (n=55)	
	Frequency	Percent	Frequency	Percent
< Average annual income	55	66.3	33	60.0
> Average annual income	28	33.7	22	40.0

Table4.11 Crop income amount and income shares of male and female-headed households

Income sources	Average ('000 MMK)	Maximum ('000 MMK)	Minimum ('000 MMK)	Income share (%)
Male-headed HHs (n=83)				
Rice	4,265	28,760	245	79
Pulses	950	14,700	0	18
Other crops	175	4,100	0	3
Feale-headed HHs (n=55)				
Rice	4,310	20,075	630	78
Pulses	1,175	80,000	0	21
Other crops	65	1,500	0	1

4.2.4 Crop incomes of male-headed households and female-headed households

Based on the study areas, the sample households cultivated rice, pulses and other crops such as betel, sesame, sunflower, black gram, green gram, perennial crop and vegetables. Rice is the most important and widely grown crop in the study areas. Almost all the study areas are covered by rice crop throughout the year. The average annual rice crop income 4.2 million kyats was received by male-headed households and 4.3 million kyats was received by female-headed households in the study areas. Male-headed households received lower the average annual income amount of 0.95 million kyats than female-headed households 1.175 million kyats from pulses production. The average annual income of other crops production of 0.18 million kyats and 0.065 million kyats respectively were received by male and female-headed households. The average annual crop income of female-headed households 5.55 million kyats was higher than that of male-headed households 5.39 million kyats. It was found that rice crop was the highest farm income source in the study areas. Rice is grown mainly twice, in a year and almost all farmers prefer to grow rice for assuring their food security and favorable climate conditions. Therefore, rice produces largest share of household farm income in the study areas (Table 4.11).

4.3 Inputs Used in Rice Production in the Study Areas

4.3.1 Rice varieties cultivated by sampled farmers

In the study areas, among 138 sample farmers, 41% of total male-headed householdsand 45% of total female-headed households grew Sin Thu Kha. About 25% of male-headed households and 29% of female-headed households grew Hmawbi-2 while HnanKar was grown by 25% of male-headed households and 15% of female-headed households. About 47% and 35% of total male and female-headed households cultivated summer rice. Among the summer rice growers, 41% of male-headed householdsand53% of female-headed households cultivated Thee Htat Yin and Sin Thu Kha which was cultivated by 28% of male-headed households and 21% of female-headed households.

Table 4.12Cultivated monsoon rice varieties by male-headed households and female-headed households

No.	Name of variety	Male-headed HHs (n=83)		Female-headed HHs (n=55)	
		Frequency	Percent	Frequency	Percent
1.	Sin Thu Kha	34	41	25	45
2.	HnanKar	21	25	8	15
3.	Hmawbi 2	21	25	16	29
4.	ByautTun	14	17	6	11
5.	ManawThukha	7	8	2	4
6.	Sin ThweLatt	6	7	4	7
7.	Thee Htat Yin	6	7	2	4
8.	Begya	3	4	2	4
9.	Pyi Lone	3	4	1	2
10.	Pyitawyin	2	2	3	5
11.	Yadanar Toe	2	2	1	2
12.	Yeanelo 4	1	1	0	0
13.	Ayarmin	1	1	0	0
14.	SwanarSub-1	1	1	0	0
15.	TaungPyan	1	1	9	16
16.	Pale Thwe	1	1	0	0
17.	Thai Manaw	1	1	0	0
18.	KaukGyi	1	1	1	2
19.	Yadanar Aung	1	1	1	2
20.	Paw Hsan	1	1	0	0
21.	YarKyaw Bu	0	0	1	2
22.	Belgium	0	0	1	2

Table4.13 Cultivated summer rice varieties by male-headed households and female-headed households

No.	Name of variety	Male-headed HHs (n=39)		Female-headed HHs (n=19)	
		Frequency	**Percent**	**Frequency**	**Percent**
1.	Thee Htat Yin	16	41	10	53
2.	Sin Thu Kha	11	28	4	21
3.	Thai Manaw	8	21	1	5
4.	Hmawbi-2	3	8	2	11
5.	Yeanelo-4	3	8	0	0
6.	Vietnam	3	8	0	0
7.	ByautTun	1	3	0	0
8.	ManawThukha	1	3	0	0
9.	Pyitawyin	1	3	1	5
10.	Yadanar Toe	1	3	0	0
11.	Swanar Sub-1	1	3	0	0
12.	Pale Thwe	1	3	0	0
13.	KaukGyi	1	3	0	0
14.	Yatkoesee	1	3	0	0

4.3.2 Seed rate used by male and female-headed households

The amount of monsoon rice and summer rice seed used by male and female-headed householdswas shown in Table 4.14. In monsoon rice production, the average amount of Sin ThuKha seed used by male and female-headed households was 117.3 kg/ha and 127.3 kg/ha. The minimum and maximum Sin ThuKha seed ratesused was 52.2 kg/ha and 156.5 kg/ha for male-headed households and104.3 kg/ha and 182.5 kg/ha for female-headed households. The average HnanKar seed rates used of male and female-headed households were 104.3 kg/ha and 107.6 kg/ha. The minimum and maximum seed rate used was 52.2 Kg/ha and 182.5 kg/ha for male-headed households and 104.3 kg/ha and 208.6 kg/ha for female-headed households, respectively.In addition, the average Hmawbi-2 seed rate used by male and female-headed households were123.9 kg/haand 135.3 kg/ha, respectively. And then, the minimum and maximum seed rates used was 52.2 kg/ha and 156.5 kg/ha for male-headed households and 78.2 kg/ha and 156.5 kg/ha for female-headed households. All monsoon rice varieties, female-headed households used more seed rate than male-headed households. The t-test showed that there was no significant difference in the monsoon rice seed rate used.

For summer rice, the average seed rate used of Sin ThuKha variety of male and female-headed households was 125.6 kg/ha and 130.4 kg/ha. The minimum and maximum seed rates 104.3kg/ha and 130.4 kg/ha was used by male-headed householdsand 104.3 kg/ha and 156.5 kg/ha was used by female-headed households. The average Thee HtatYin seed rate used of male and female-headed households were 132.1 kg/ha and 146.0 kg/ha. The minimum and maximum seed rates 78.2 kg/ha and 156.5 kg/ha were used by male-headed households and 104.3 kg/ha and 182.5 kg/ha were used by female-headed households. For summer rice variety, there was no significant difference in the use of summer rice seed between male-headed households and female-headed households

4.3.3 Yield of monsoon rice and summer rice of male-headed households and female-headed households

In Table 4.15, the average yields of monsoon rice, Sin ThuKha, Han Karand Hmawbi-2 were3,920 kg/ha 2,821 kg/ha and 3,365 kg/ha respectively in male-headed households. Among then, they got high yield from Sin ThuKha variety, followed by Hmawbi-2 and HnanKar. For male-headed households, the minimum

yield of monsoon rice varieties were 1,565 kg/ha, 2,086 kg/ha and 2,086 kg/ha. The maximum yields were 5,737 kg/ha, 4,172 Kg/ha and 3,495 kg/ha for male-headed households, respectively. For female-headed households, the average yields were 3,724 kg/ha 2,797 kg/ha and 3,478 kg/ha. As like as male-headed households, female-headed households got the highest yield from Sin ThuKha variety, followed by Hmawbi-2 andHnanKar. The minimum yield of monsoon rice varieties for female-headed households were 2,608 kg/ha, 1,565 kg/ha and 1,565 kg/ha and the maximum yields were 5,319 kg/ha, 4,798kg/ha and 4,694 kg/ha and respectively. There was no significant difference among the monsoon rice yieldsbetween gender.

The average summer rice, Sin Thu Kha and Thee Htat Yin rice yields of male-headed households were 3,541 kg/ha and4,433kg/ha compared to 3,781 kg/ha and4,772 kg/ha of female-headed households. Therefore, they got the highest yield from Thee Htat Yin in summer rice production. The minimum summer rice (Sin Thu Kha and Thee Htat Yin) yields of male-headed households were 2,086 kg/ha and 4,694 kg/ha and the maximum yieldwas the same, 5,215 kg/ha. The minimum yields of female-headed households were 3,390 kg/ha and 2,608 kg/ha and the maximum yieldswere 4,172 kg/ha and5,215 kg/ha in Sin Thu Kha and Thee Htat Yin. There was no significant difference in summer rice yields between gender.

Table4.14 Amount of seed rate for monsoon rice and summer rice used by male and female-headed households

Items	Unit	Male-headed HHs	Female-headed HHs	t-test
Monsoon rice				
Sin Thu Kha		n = 34	n = 35	
Mean	kg/ha	117.3	127.3	-1.215^{ns}
Range	kg/ha	52.2 - 156.5	104.3 - 182.5	
HnanKar		n = 21	n = 8	
Mean	kg/ha	104.3	107.6	-0.329^{ns}
Range	kg/ha	52.2 -182.5	104.3 - 208.6	
Hmawbi-2		n = 20	n = 16	
Mean	kg/ha	123.9	135.3	-0.986^{ns}
Range	kg/ha	52.2 - 156.5	78.2 - 156.5	
Summer rice				
Sin ThuKha		n =11	n =4	
Mean	kg/ha	125.6	130.4	-0.241^{ns}
Range	kg/ha	104.3 - 130.4	104.3 - 156.5	
Thee Htat Yin		n =15	n =10	
Mean	kg/ha	132.1	146.0	-1.125^{ns}
Range	kg/ha	78.2 - 156.5	104.3 - 182.5	

Note: ns is not significant.

Table4.15 Yield of monsoon rice and summer rice of male-headed households and female-headed households

Items	Unit	Male-headed HHs	Female-headed HHs	t-test
Monsoon rice				
Sin Thu Kha				
Mean	kg/ha	3,920	3,724	0.099^{ns}
Range	kg/ha	1,565 - 5,737	2,608 - 5,319	
HnanKar				
Mean	kg/ha	2,821	2,797	0.093^{ns}
Range	kg/ha	2,086 - 4,172	1,565 - 4,798	
Hmawbi-2				
Mean	kg/ha	3,365	3,478	-0.986^{ns}
Range	kg/ha	2,086 - 3,494	1,565- 4,694	
Summer rice				
Sin Thu Kha				
Mean	kg/ha	3,541	3,781	-0.456^{ns}
Range	kg/ha	2,086 - 5,215	2,608 - 4,172	
Thee Htat Yin				
Mean	kg/ha	4,433	4,772	-0.894^{ns}
Range	kg/ha	4,694 - 5,215	3,390 - 5,215	

Note: ns is not significant.

4.3.4 FYM and different fertilizers application

The utilization of FYM and chemical fertilizer of sample households in rice production were described in Table 4.16, 4.17, Table 4.18 and Table 4.19. Among the sample households, 8% and 6.3% of female-headed households used FYM in Sin ThuKha and Hmawbi-2 rice production. About 76.5%, 52.9%, 26.57% and 17.6% of male-headed households usedurea, compound, T-super and potash in Sin ThuKha production while 88%, 32% 32% and 8% of female-headed households utilizedthese fertilizer. Moreover, about 2.9% of male-headed households and 12% of female-headed households utilized gypsum. There was no significant difference in using these fertilizers among gender in Sin ThuKha production.

In HnanKar, 71.2% and 75.0% of male and female-headed households used urea. About 10% of male-headed households used compound, potash and gypsum fertilizer and also about 33% used T-super fertilizer. About 37.5% of female-headed households used T-super and over 10% of female-headed households used potash and gypsum in monsoon rice production. There was significant different in compound and potash using between gender in HnanKar rice production. In Hmawbi-2, about 38.1% of male-headed households utilized urea and compound fertilizers, 9.5% of male-headed households and 28.6% of male-headed householdsutilized potash and T-super. About 87.5%, 43.8%, 6.3% and 43.8% of female-headed households applied urea, compound, potash and T-super, respectively. About 4.8% of male-headed households used gypsum in Hmawbi-2 rice production. The Pearson Chi-square showed that there were no significant differences in using these fertilizers among gender (Table 4.16).

Male-headed households applied the average amount of 80.3 kg/ha of urea, 52.2 kg/ha of compound, 11.6 kg/ha of potash 29.8 kg/ha of T-super in Sin ThuKha production. Female-headed households utilized 296.5 kg/ha of FYM, 108.8 kg/ha of urea, 30.9 kg/ha of compound and 38.8 kg/ha of T-super. In Sin ThuKha rice production, the t-test results showed that there were significant differences in FYM and T-super utilization among male-headed household and female-headed households. Furthermore, male-headed households utilized average amount of 55.8 kg/ha of urea, 7.7 kg/ha of compound, 4.4 kg/ha of potash, 22.4 kg/ha of T-super and 2.4 kg/ha of gypsum in HnanKar rice production. Female-headed households also utilized 51.7 kg/ha of urea, 30.9 kg/ha of potash, 34 kg/ha of T-super and 7.7 kg/ha of gypsum in HnanKar rice production. The t-test value showed that the utilization of T-

super was significant difference between gender in HnanKar production. In Hmawbi-2 production, male-headed households applied the average amount of fertilizer such as 94.8 kg/ha in urea, 34 kg/ha in compound, 9.3 kg/ha in potash, 17.9 kg/ha in T-super and only 2.2 kg/ha in gypsum. Female-headed households used 308.9 kg/ha of FYM, 127.6 kg/ha of urea, 39.8 kg/ha of compound and 62.6 kg/ha in T-super. Only 2.6 kg/ha of potash was used by female-headed households. The t-test results showed that the utilization of T-super was significant difference between gender in Hmawbi-2 production.

In summer rice Sin ThuKha production, all female headed households and half of female-headed households utilized urea, potash and T-super. About 81.8% and 63.4% of male-headed households used urea and compound fertilizer. In Thee Htat Yin production, 93.8% of male-headed households and 90.0% of female-headed households used urea fertilizer. The compound, potash and T-super fertilizers were used by 31.3%, 43.8% and 75.0% of male-headed households compared to 40.0%, and 50.0% of female-headed households used compound and T-super. The result showed that there was a significant differences in the utilization of potash between male and female-headed households (Table 4.18).

The average amount of 73.1 kg/ha of urea, 59.0 kg/ha of compound and 15.7 kg/ha of T-super were applied by male-headed households where as 123.6 kg/ha of urea, 61.8 kg/ha of compound and 92.7 kg/ha of T-super were used by female-headed households in Sin ThuKha production. Female-headed households used more these three fertilizers than male-headed households. The average amount of 2.8 kg/ha of potash was used by male-headed households. There was significant difference in urea and T-super fertilizer usage among male and female-headed households.

The average urea fertilizer rate of 189.4 kg/ha in male-headed householdsand170.9 kg/ha in female-headed household was used. Male-headed households used more urea fertilizer than female-headed households.Male-headed households and female-headed households utilized the average rate of 28.0 kg/ha and 55.6 kg/ha of compound fertilizer, 90.6 kg/ha and 74.1 kg/ha of T-super in Thee Htat Yin production. The average amount of 26.4 kg/ha of potash was used by male-headed households. The t-test shows that there was significant difference in the usage of compound, potash and T-super fertilizer among gender in Thee Htat Yin production (Table 4.19).

Table 4.16Number and percent of male-headed households and female-headed households using FYM and different fertilizers in monsoon rice production

Items	Male-headed HHs	Female-headed HHs	Pearson Chi-square
Sin Thu Kha			
FYM	0 (0.0)	2 (8.0)	2.815 ^{ns}
Urea	26 (76.5)	22 (88.0)	1.263 ^{ns}
Compound	18 (52.9)	8 (32.0)	2.563 ^{ns}
Potash	6 (17.6)	2 (8.0)	1.144 ^{ns}
T-super	9 (26.5)	8 (32.0)	0.215 ^{ns}
Gypsum	1 (2.9)	3 (12.0)	1.871 ^{ns}
HnanKar			
Urea	15 (71.2)	6 (75.0)	13.412 ^{ns}
Compound	5 (23.8)	0 (0.0)	0.037^{ns}
Potash	2 (10.0)	1 (12.5)	0.818^{ns}
T-super	7 (33.0)	3 (37.5)	0.045^{ns}
Gypsum	2 (10.0)	1 (12.5)	3.048 ^{ns}
Hmawbi-2			
FYM	0 (0.0)	1 (6.3)	2.647 ^{ns}
Urea	8 (38.1)	14 (87.5)	0.056 ^{ns}
Compound	8 (38.1)	7 (43.8)	0.286 ^{ns}
Potash	2 (9.5)	1 (6.3)	0.164 ^{ns}
T-super	6 (28.6)	7 (43.8)	1.406 ^{ns}
Gypsum	1 (4.8)	0 (0.0)	0.823 ^{ns}

Note:The values in the parentheses represent percentage and ns is not significant.

Table4.17 Amount of FYM and different fertilizers utilization for monsoon rice production by male and female-headed households

Items	Unit	Male-headed HHs		Female-headed HHs		t-test
		Mean	Range	Mean	Range	
Sin Thu Kha						
FYM	kg/ha	-	-	296.5	0 - 4,942	1.596***
Urea	kg/ha	80.3	0 - 247.1	108.8	0 - 370.7	-1.469^{ns}
Compound	kg/ha	52.2	0 - 123.6	30.9	0 - 274.1	1.414^{ns}
Potash	kg/ha	11.6	0 - 123.6	6.6	0 - 123.6	0.704^{ns}
T-super	kg/ha	29.8	0 - 123.6	38.8	0 - 247.1	-0.573^{ns}
Gypsum	kg/ha	0.9	0 - 30.9	6.2	0 - 61.8	-1.632***
HnanKar						
Urea	kg/ha	55.8	0 - 206.3	51.7	0 - 123.6	0.195^{ns}
Compound	kg/ha	7.7	0 - 123.6	-	-	1.321^{ns}
Potash	kg/ha	4.4	0 - 61.8	30.9	0 - 123.6	-0.624^{ns}
T-super	kg/ha	22.4	0 - 123.6	34.0	0 - 123.6	-0.999**
Gypsum	kg/ha	2.4	0 - 30.9	7.7	0 - 61.7	-0.679^{ns}
Hmawbi-2						
FYM	kg/ha	-	-	308.9	0 - 2,471	-1.162^{ns}
Urea	kg/ha	94.8	0 - 370.7	127.6	0 - 370.7	-0.260^{ns}
Compound	kg/ha	34.0	0 - 123.6	39.8	0 - 123.6	-0.328^{ns}
Potash	kg/ha	9.3	0 - 123.6	2.6	0 - 40.8	0.930^{ns}
T-super	kg/ha	17.9	0 - 247.1	62.6	0 - 247.1	-1.985*
Gypsum	kg/ha	2.2	0 - 43.2	-	-	1.00^{ns}

Note:*, ** and *** are significant differences at 10 %, 5% and 1% level and ns is not significant.

Table4.18 Number and percent of male and female-headed households using different fertilizers in summer rice production

Items	Male-headed HHs	Female-headed HHs	Pearson Chi-square
Sin Thu Kha			
Urea	9 (81.8)	4 (100)	0.839 ns
Compound	7 (63.4)	2 (50.0)	0.227 ns
Potash	1 (9.0)	0 (0.0)	0.390 ns
T-super	2 (18.2)	2 (50.0)	1.519 ns
Thee Htat Yin			
Urea	9 (93.8)	9 (90.0)	0.122ns
Compound	5 (31.3)	4 (40.0)	0.208 ns
Potash	7 (43.8)	0 (0.0)	5.987**
T-super	12 (75.0)	5 (50.0)	1.699 ns

Note:The values in the parentheses represent percentage, ** is significant difference at 5% level and ns is not significant.

Table4.19Amount of different fertilizers utilization for summer rice production by male and female-headed households

Items	Unit	Male-headed HHs		Female-headed HHs		t-test
		Mean	Range	Mean	Range	
Sin Thu Kha						
Urea	kg/ha	73.1	0 - 274.1	123.6	0 - 123.6	-1.333**
Compound	kg/ha	59.0	0 - 123.6	61.8	0 - 123.6	-0.084ns
Potash	kg/ha	2.8	0 - 30.9	-	-	0.589ns
T-super	kg/ha	15.7	0 - 123.6	92.7	0 - 274.1	-1.991***
Thee Htat Yin						
Urea	kg/ha	189.4	0 - 274.1	170.9	0 - 274.1	0.772ns
Compound	kg/ha	28.0	0 - 123.6	55.6	0 - 274.1	-1.163**
Potash	kg/ha	26.4	0 - 123.6	-	-	2.153 ***
T-super	kg/ha	90.6	0 - 123.6	74.1	0 - 247.1	0.670**

Note: *, ** and *** are significant difference at 10 %, 5% and 1% level and ns is not significant.

4.3.5 Pesticide and herbicide application in rice production

The percentage and average amount of pesticide and herbicide usage of male and female-headed households were presented in Table 4.20, 4.21, 4.22 and Table 4.23. Sample households in the study areas applied most pesticide when pests and diseases were found and herbicide to clean and control the weed. In Sin Thu Kha production, about 36.0% of female-headed households and 14.7% of male-headed households applied liquid form of pesticide. Pesticide powder and herbicide powder were applied by 5.9% of male-headed households. About 12.0% and 8.8% of female and male-headed households used pesticide liquid. There was a significant difference in the application of pesticide liquid between male and female-headed households in Sin Thu Kha production. Herbicide liquid was applied by 25.0% of female-headed households and herbicide powder was applied by 14.3% of male-headed households in HnanKar production. There was significant difference in the use of liquid form of herbicide between male and female-headed households. In Hmawbi-2 production, 28.6% and 68.8%, 19.1% and 37.5% of male-headed households and female-headed households applied pesticide liquid and powder. The Pearson Chi-square showed that there was significant difference in the liquid form of pesticide usage between male-headed households and female-headed households (Table 4.20).

In monsoon rice production, the average rates of 0.6 liter/ha and 0.4 liter/ha of pesticide liquid were applied by male and female-headed households. The average same rate of 0.1 liter/ha of herbicide liquid was applied by both gender. The average rates of 0.1liter/ha and 2.9 liter/ha of pesticide powder and herbicide liquid were applied by male-headed households in Sin ThuKha production. There were significant differences in the use of pesticide liquid, pesticide powder and herbicide powder between male-headed households and female-headed households in Sin ThuKha production.

The average herbicide liquid used by female-headed households was found 0.3liter/ha in HnanKar production. The average herbicide powder used by male-headed households was found 0.8 liter/ha. The results showed that there were significant differences in herbicide liquid and powder usage between male and female-headed households in HnanKar rice production. For Hmawbi-2 rice production, the average amounts of 0.2liter/ha and 1.1 liter/ha of pesticide liquid were applied by male-headed households and 0.2liter/ha and 0.3 liter/ha of pesticide

powder were applied by female-headed households. The t-test result showed that there was significant difference in the use of pesticide liquid in Hmawbi-2 rice production between male-headed households and female-headed households.

In the summer rice production, about 27.3% of male-headed households applied pesticide liquid and herbicide powder whereas 50.0% and 25% of female-headed households applied pesticide liquid and herbicide liquid in Sin Thu Kha production. About 37.5%, 25.0%, 25.0% and 56.3% of male headed households used pesticide liquid, pesticide powder, herbicide liquid and herbicide powder in the production of Thee Htat Yin. However, about 60.0%, 20.0%, and 50.0% of female-headed households used the pesticide liquid, pesticide powder and herbicide liquid in Thee Htat Yin production. The Pearson Chi-square showed that there was significant different in herbicide liquid used in Sin ThuKha production and herbicide powder in Thee Htat Yin production between male and female-headed households in the study areas (Table 4.22).

In Sin Thu Kha production, 0.1 liter/ha and 0.1 kg/ha of pesticide liquid and herbicide powder were applied by male-headed households. The average 0.4 liter/ha and 0.1 liter/ha of pesticide liquid and herbicide liquid were applied by female-headed households in Sin Thu Kha production. The t-test showed that there was significant differences in the use of pesticide liquid, herbicide liquid and powder between male and female-headed households in Sin Thu Kha production.The average rate of pesticide liquid, pesticide powder, herbicide liquid and herbicide powder was 0.4 liter/ha, 0.2 kg/ha, 0.5 liter/ha and 0.6 kg/ha were used by male-headed households in Thee Htat Yin production. The average rates of 0.8liter/ha, 0.1kg/ha and 0.6liter/ha of pesticide liquid, powder and herbicide liquid were used by female-headed households in Thee Htat Yin production. The t-test showed that there was a significant difference in the use ofherbicide powder in Thee Htat Yin production (Table 4.23).

Table4.20 Number and percentage of male and female-headed households using pesticide and herbicides in monsoon rice production

Items	Male-headed HHs	Female-headed HHs	Pearson Chi-square
Sin Thu Kha			
Pesticide liquid	5 (14.7)	9 (36.0)	3.610*
Pesticide powder	2 (5.9)	0 (0.0)	1.522^{ns}
Herbicide liquid	3 (8.8)	3 (12.0)	0.159^{ns}
Herbicide powder	2 (5.9)	0 (0.0)	2.324^{ns}
HnanKar			
Herbicide liquid	0 (0.0)	2 (25.0)	5.639**
Herbicide powder	3 (14.3)	0 (0.0)	1.275^{ns}
Hmawbi-2			
Pesticide liquid	6 (28.6)	11 (68.8)	5.355*
Pesticide powder	4 (19.1)	6 (37.5)	1.357^{ns}

Note:The values in the parentheses represent percentage. *and ** are significant differences at 10 % and 5% , and ns is not significant.

Table4.21 Amount of pesticide and herbicide utilization for monsoon rice production by male-headed households and female-headed households

Items	Unit	Male-headed HHs		Female-headed HHs		t-test
		Mean	Range	Mean	Range	
Sin Thu Kha						
Pesticide liquid	liter/ha	0.06	0 - 0.6	0.4	0 - 4.9	-2.110**
Pesticide powder	kg/ha	0.1	0 - 1.0	-	-	1.162**
Herbicide liquid	liter/ha	0.1	0 - 2.5	0.1	0 - 1.2	-0.032^{ns}
Herbicide powder	kg/ha	2.9	0 - 98.8	-	-	0.867*
HnanKar						
Herbicide liquid	liter/ha	-	-	0.3	0 - 0.6	-2.553***
Herbicide powder	kg/ha	0.8	0 - 1.0	-	-	0.965**
Hmawbi-2						
Pesticide liquid	liter/ha	0.2	0 - 1.2	1.1	0 - 4.9	-2.328**
Pesticide powder	kg/ha	0.2	0 - 1.2	0.3	0 - 1.6	-0.943^{ns}

Note: *, ** and *** are significant differences at 10 %, 5% and 1% level and ns is not significant.

Table4.22 Number and percentage of male-headed households and female-headed households using pesticide and herbicides in summer rice production

Items	Male-headed HHs	Female-headed HHs	Pearson Chi-square
Sin Thu Kha			
Pesticide liquid	3 (27.3)	2 (50.0)	0.682^{ns}
Herbicide liquid	0 (0.0)	1 (25.0)	2.946*
Herbicide powder	3 (27.3)	0 (0.0)	1.364^{ns}
Thee Htat Yin			
Pesticide liquid	6 (37.5)	6 (60.0)	1.254^{ns}
Pesticide powder	4 (25.0)	2 (20.0)	0.087^{ns}
Herbicide liquid	4 (25.0)	5 (50.0)	1.699^{ns}
Herbicide powder	9 (56.3)	0 (0.0)	8.603***

Note:The values in the parentheses represent percentage.*and *** are significant differences at 10 % and 1% level and ns is not significant.

Table4.23 Amount of pesticide and herbicide utilization for summer rice production by male-headed households and female-headed households

Items	Unit	Male-headed HHs		Female-headed HHs		t-test
		Mean	Range	Mean	Range	
Sin Thu Kha						
Pesticide liquid	liter/ha	0.1	0 - 0.7	0.40	0 - 1.2	-1.200**
Herbicide liquid	liter/ha	-	-	0.06	0 - 0.3	-.783***
Herbicide powder	kg/ha	0.1	0 - 0.3	-	-	1.140***
Thee Htat Yin						
Pesticide liquid	liter/ha	0.4	0 - 2.5	0.8	0 - 2.5	-1.258^{ns}
Pesticide powder	kg/ha	0.2	0 - 1.2	0.1	0 - 0.7	0.791^{ns}
Herbicide liquid	liter/ha	0.5	0 - 3.7	0.6	0 - 2.5	-0.165^{ns}
Herbicide powder	kg/ha	0.6	0 - 3.1	-	-	2.177***

Note: *, ** and *** are significant differences at 10 %, 5% and 1% level and ns is not significant.

4.3.6 Costs and returns of crops of production in study areas

Cost and return analysis can compare the profitability of rice production of male-headed households and female-headed households in study areas. In the study areas, most of male-headed households and female-headed households grew Sin Thu Kha, Hmawbi-2 and HnanKar in the monsoon season whereas Sin ThuKha and Thee Htat Yin in summer season. The economic return from these rice varieties productions are discussed in this section.

The costs and return analysis of male-headed households and female-headed households in rice production were shown in Table 24 and Table 25. The total gross benefit of Sin Thu Kha, HnanKar and Hmawbi-2 of male-headed households were 815,454 MMK/ha, 542,240 MMK/ha and 716,675 MMK/ha respectively. The yields of Sin Thu Kha, HnanKar and Hmawbi-2 for male-headed households were 3,920 kg/ha, 2,821 kg/ha and 3,365 kg/ha respectively. The total gross benefit of Sin Thu Kha, HnanKar and Hmawbi-2 of female-headed households were 819,172 MMK/ha, 524,520 MMK/ha and 861,728 MMK/ha respectively. The yields of Sin Thu Kha, HnanKar and Hmawbi-2 of female-headed households were 3,724 kg/ha, 2,797 kg/ha and 3,478 kg/ha respectively.The yields of male-headed households were higher than female-headed households, except Hmawbi-2. Male-headed households got the highest gross revenue from Sin Thu Kha and female-headed households got the highest gross revenue from Hmawbi-2. According to their BCRs, male-headed household got 1.18 MMK, 1.16 MMK and 1.11 MMK and female-headed households received 1.26 MMK, 1.12 MMK and 1.13 MMK respectively from Sin Thukha, HnanKar and Hmawbi-2 production in monsoon season for every one MMK spent in these varieties production. The t-test showed that there were no significant differences between the benefit-cost ratios of Sin Thu Kha (1.18, 1.26), HnanKar (1.16, 1.12) and Hmawbi-2 (1.11, 1.13) respectively in both male and female-headed households in monsoon rice production.

Costs and returns of summer rice, Sin Thukha and Thee Htat Yin productions, male-headed households received the total gross benefits of 691,438 MMK/ha and 849,336 MMK/ha from Sin Thu Kha and Thee Htat Yin and the yields were 3,541 kg/ha and 4,433 kg/ha respectively. The gross benefit of female-headed households from Sin Thu Kha and Thee Htat Yin were 802,031 MMK/ha and 882,975 MMK/ha respectively. They got the yields of 3,781 kg/ha and 4,772 kg/ha from Sin Thu

Khaand Thee Htat Yin. The gross revenues of female-headed households were higher than male-headed households in summer rice production. They received the benefit-cost ratios of 1.33 and 1.07 for male-headed households and 1.28 and 1.06 for female-headed households from Sin Thu Kha and Thee Htat Yin in summer rice production.According to the BCRs, male-headed households received 1.33 MMK and 1.07 MMK and female-headed households received 1.28 MMK and 1.06 MMK respectively from Sin Thu Kha and Thee Htat Yin production for every one MMK invested in these varieties in summer rice production. The t-test showed that there were no significant differences between the benefit-cost ratios of Sin Thu Kha (1.33, 1.28) and Thee Htat Yin (1.07, 1.06) respectively in both male and female-headed households in summer rice production.

Table4.24 Summarized data of yield, price, cost, revenue and benefit for monsoon rice production in the study areas

Crops	Items	Unit	Average	
			Male-headed HHs	Female-headed HHs
Sin Thu Kha	Yield	kg/ha	3,920	3,724
	Price	MMK/kg	175	185
	Total variable cost	MMK/ha	693,624	650,832
	Total revenue	MMK/ha	815,454	819,172
	Net revenue	MMK/ha	121,830	168,340
	BCR	-	1.18	1.26
	t-test (BCR)		$t = -0.039^{ns}$	
HnanKar	Yield	kg/ha	2,821	2,797
	Price	MMK/kg	192	188
	Total variable cost	MMK/ha	468,561	466,989
	Total revenue	MMK/ha	542,240	524,520
	Net revenue	MMK/ha	73,679	57,531
	BCR	-	1.16	1.12
	t –test (BCR)		$t = 1.054^{ns}$	
Hmawbi-2	Yield	kg/ha	3,365	3,478
	Price	MMK/kg	213	248
	Total variable cost	MMK/ha	644,165	764,441
	Total revenue	MMK/ha	716,675	861,728
	Net revenue	MMK/ha	72,510	97,287
	BCR	-	1.11	1.13
	t-test (BCR)		$t = 0.707^{ns}$	

Note: ns is not significant.

Table4.25Summarized data of yield, price, cost, revenue and benefit for summer rice production in the study areas

Crops	Items	Unit	Average	
			Male-headed HHs	Female-headed HHs
Sin Thu Kha	Yield	kg/ha	3,541	3,781
	Price	MMK/kg	195	212
	Total variable cost	MMK/ha	521,407	628,832
	Total revenue	MMK/ha	691,438	802,031
	Net revenue	MMK/ha	170,031	173,199
	BCR	-	1.33	1.28
	t-test (BCR)		$t = 0.136^{ns}$	
Thee Htat Yin	Yield	kg/ha	4,433	4,772
	Price	MMK/kg	192	185
	Total variable cost	MMK/ha	791,238	823,045
	Total revenue	MMK/ha	849,336	882,975
	Net revenue	MMK/ha	58,098	59,930
	BCR	-	1.07	1.06
	t-test (BCR)		$t = 0.094^{ns}$	

Note: ns is not significant.

4.3.7 Labor contribution of male and female-headed households in rice production activities

The percent of average labor contribution per hectare for male and female-headed households in rice production activities in the study areaswere shown in Table 4.26, 4.27, 4.28 and 4.29. In monsoon rice production, about 20% of family labors were applied by male-headed households in seedling establishment and land preparation. In addition, about 10% of family labors were used in weeding, fertilizer application, chemical application, harvesting and post-harvest activities. However about 20% of hired labors were applied in transplanting and harvesting. About 10% of hired labors were used in pulling and bundling, weeding and post-harvest activities. Male-headed households relied largely on family labors in seedling establishment and land preparation while most of hired labors were mainly used in transplanting and harvesting for rice production.

Female-headed households used about 20% of family labors in land preparation and harvesting, more than 10% in seedling establishment and weeding and about 7% in transplanting, fertilizer application, chemical application and postharvest activities. Most of hired labors were used in transplanting, harvesting and post-harvest activities and about 10% of hired labors were applied in land preparation, pulling and bundling and weeding. Female-headed households relied largely on family labors in land preparation and harvesting while hired labors were used in transplanting, harvesting and post-harvest activities for monsoon rice production.

In summer rice production, male-headed households used most of family labor in land preparation, irrigation and more than 10% of family labors in direct deeding, fertilizer application and post-harvest activities. Most of hired labors were mainly used in harvesting and more than 10% in land preparation and chemical application. About 10% of hired labors were used in weeding and fertilizer application. In female-headed households, most of family labors were used in land preparation and more than 10% were used in weeding, irrigation and harvesting. Most of hired labors were used in harvesting and more than 10% were used in land preparation and fertilizer application. Nearly 10% were used in the other production activities in rice production. Male and female-headed households relied largely on family labors in land preparation while hired labors in harvesting.

Table4.26 Percent of average labor contribution per hectare for male-headed households in monsoon rice production activitiesin the study areas

Activities	Family labor		Hired labor	
	Man day	Percent	Man day	Percent
Seedling establishment	4	19	4	7
Land preparation	5	24	5	8
Direct seeding	1	5	2	3
Pulling and bundling	1	5	6	10
Transplanting	0	0	13	22
Weeding	2	10	6	10
Fertilizer application	2	10	2	3
Herbicide/ pesticide application	2	10	2	3
Harvesting	2	10	12	20
Post-harvest activities	2	10	6	10
Total labor man day	21	100	58	100

Table4.27 Percent of average labor contribution per hectare for female-headed households in monsoon rice production activitiesin the study areas

Activities	Family labor		Hired labor	
	Man day	Percent	Man day	Percent
Seedling establishment	3	11	4	6
Land preparation	6	22	6	10
Direct seeding	1	4	2	3
Pulling and bundling	1	4	6	10
Transplanting	2	7	12	19
Weeding	3	11	6	10
Fertilizer application	2	7	4	6
Herbicide/ pesticide application	2	7	2	3
Harvesting	5	19	11	18
Post-harvest activities	2	7	9	15
Total labor man day	27	100	62	100

Table4.28 Percent of average labor contribution per hectare for male-headed households in summer rice production activities in the study areas

Activities	Family labor		Hired labor	
	Man day	Percent	Man day	Percent
Land preparation	7	27	6	14
Direct seeding	3	12	3	7
Weeding	2	8	4	10
Fertilizer application	3	12	4	10
Herbicide/ pesticide application	2	8	6	15
Irrigation	5	19	2	5
Harvesting	1	4	13	32
Post-harvest activities	3	12	3	7
Total labor man day	26	100	41	100

Table4.29Percent of average labor contribution per hectarefor female-headed households in summer rice production activitiesin the study areas

Activities	Family labor		Hired labor	
	Man day	Percent	Man day	Percent
Land preparation	6	21	5	15
Direct seeding	2	7	3	9
Weeding	4	14	3	9
Fertilizer application	3	11	4	12
Herbicide/ pesticide application	2	7	3	9
Irrigation	4	14	3	9
Harvesting	4	14	10	30
Post-harvest activities	3	11	3	9
Total labor man day	28	100	34	100

4.4 Regression Analysis for Rice Production in the Study Areas

4.4.1 Resources used by male-headed households and female-headed households

The factors which influenced the total revenues of rice in the study areawasmentionedin Table 4.30. Total revenues of rice were estimated by using log form of sown area, seed rate, fertilizer amount, total machine day, total animal labor and total man labor.To derive the productivity of resource inputs used by male and female-headed households, the average characteristics of resource inputs in the study areas were first calculated. The resources used were sown area, seed rate, fertilizer, family labor, hired labor and machinery cost. The average sown areas of male and female-headed households were 4.9 ha and 5.5 ha respectively. The average seed rate used by male-headed households was 115 kg per hectare which is lower than the seed rate used of female-headed households 123 kg per hectare. About 147 kg per hectare of chemical fertilizer were used by male-headed households and 176 kg per hectare were used by female-headed households. The average family labor and hired labor used of female-headed households (21 and 58 man days per hectare) were higher than that of male-headed households (27 and 62 man days per hectare). Male-headed households used more machinery cost 68,900 MMK per hectare for land preparation and harvesting in rice production than female-headed households, 62,400 MMK in the study areas. According to this result, female-headed households used more resources in rice production than male-headed households except machinery cost.

4.4.2 Total revenues of male-headed households and female-headed households

Total revenue was calculated by the multiplication of yield and price of rice. The average total revenues of rice for male-headed households and female-headed households were 736,900 MMK per hectare and 785,500 MMK per hectare (Table 4.30). Female-headed households returned more total revenue from rice production than male-headed households.

Table4.30Average characteristics of resource used by male-headed households and female-headed households in the study areas

Items	Units	Male-headed HHs (n=83)	Female-headed HHs (n=55)
Total revenue of rice	MMK/ha	736,900	785,500
Sown area	ha	4.9	5.4
Seed rate	kg/ha	115	123
Fertilizer	kg/ha	147	176
Family labor	md/ha	21	27
Hired labor	md/ha	58	62
Machinery cost	MMK/ha	68,900	62,400

Table4.31 Regression analysis showing male-headed households resource effects on rice production in the study areas

Independent Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
(Constant)	14.044***		31.756	0.000
Ln sown area	0.246***	0.593	6.670	0.000
Ln seed rate	-0.156*	-0.139	-1.818	0.073
Ln fertilizer amount	0.013^{ns}	0.074	0.980	0.330
Ln family labor	0.031^{ns}	0.086	1.084	0.282
Ln hired labor	-0.086***	-0.224	-2.679	0.009
Ln machinery cost	0.001^{ns}	0.020	0.250	0.803
R square	0.576			
Adjusted R square	0.542			
F-value	16.989***			

Note:Dependent variable = total revenue of rice for male-headed households.

* and *** are significant differences at 10% and 1% level and ns = not significant.

Table4.32 Regression analysis showing female-headed households resource effects on rice production in the study areas

Independent Variables	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
(Constant)	16.654***		21.064	0.000
Ln sown area	0.050 ns	0.127	1.090	0.282
Ln seed rate	-0.576***	-0.419	-3.533	0.001
Ln fertilizer amount	0.007 ns	0.028	0.248	0.805
Ln family labor	0.023 ns	0.083	0.761	0.451
Ln hired labor	-0.166***	-0.424	-3.830	0.000
Ln machinery cost	0.013 ns	0.162	1.489	0.144
R square	0.494			
Adjusted R square	0.423			
F-value	6.990***			

Note: Dependent variable = total revenue of rice for female-headed households.

*** are significant differences at 1% level and ns = not significant.

Table4.33 Gender resource productivity differentials in rice production

Items	Unit	Male-headed HHs (n=83)	Female-headed HHs (n=55)	Differential
Land productivity	MMK/ha	39,678	7,220	32,459
Seed productivity	MMK/kg	-1,066	-3,678	-2,613
Fertilizer productivity	MMK/kg	69	31	38
Family labor productivity	MMK/md	1,160	669	490
Hired labor productivity	MMK/md	-1,165	-2,103	-938
Machinery productivity	-	0.01	0.16	(0.15)

Note: Bracket in the value means female-headed households use more efficient resources than male-headed households

Table 4.34 Gender impact on total revenue of rice

Independent Variables	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	Sig.
(Constant)	14.642***		38.060	0.000
Ln sown area	0.152***	0.378	5.238	0.000
Ln seed rate	-0.201**	-0.179	-2.591	0.011
Ln fertilizer amount	0.008^{ns}	0.044	0.636	0.526
Ln family labor	0.024^{ns}	0.078	1.139	0.257
Ln hired labor	-0.143***	-0.379	-5.319	0.000
Ln machinery cost	0.006^{ns}	0.086	1.232	0.220
Gender (Dummy)	-0.049^{ns}	-0.076	-1.108	0.270
R square	0.438			
Adjusted R square	0.407			
F-value	13.721***			

Note: Dependent variable = total revenue of rice. ** and *** are significant differences at 1% level and ns = not significant.

4.4.3 Determinants of total revenues of rice for male-headed households and female-headed households

The relationship between resources used and total revenues of rice for male-headed households and female-headed households in the study areaswere shown in Table 4.31 and 4.32. In the regression analysis, sown area, seed rate, fertilizer, family labor, hired labor and machinery cost were independent variables and the total revenue of rice was dependent variable for both male and female-headed households.

The total revenue of rice for male-headed households in the study areas was positively and significantly influenced by sown area at 1% level which implying that an increase in farm size would lead to an increase in the total revenue of rice in the study areas. The coefficient of sown areas was 0.25 which indicated that if 1% of sown area increased, total revenue of rice will be increased by 0.25%. The coefficient of seed rate (0.156) and hired labor (0.086) was found to be negative and significant at 10% and 1% level of probability. This implies that 1% increase in the seed rate used and hired labor, the total revenue of rice would be decreased by 0.16% and 0.09%.

The total revenue of rice for female-headed households in the study areas was negatively and significant influenced by seed rate and hired labor at 1% probability level. This implies that an increase in seed rate and hired labor would lead to decrease the total revenue of rice for female-headed households. The coefficient value of seed rate and hired labor were 0.576 and 0.166 respectively which means that if 1% of these resources used, 0.576% and 0.166% total revenues of rice would be decreased.

Multiple R square statistics in regression analysis measures the combined effects of all independent variables in a regression model. The closer R square is to one, the better the causal explanation provided by a set of independent variable. In this case, R square values of male and female-headed households were 0.576 and 0.494 respectively means that 57.6% and 49.4% of the variation in monsoon rice production is explained by independent variables used in the regression model in the study area.

4.4.4 Gender resource productivity differentials in rice production

The marginal resources used productivity of male and female-headed households in rice production in the study areas were described in Table 4.33. The marginal productivity of lands was 39,678 MMK for male-headed households and 7,220 MMK for female-headed households. This means that a unit increase in land input used in hectare will increase to an approximate change of 39,678 MMK for male-headed households and 7,220 MMK for female-headed households. Therefore, comparing land input used of male and female-headed households, male-headed households would produce more rice than female-headed households.

If a unit increase in seed rate input in kilogram will decrease 1,066 MMK and 3,678 MMK for male and female-headed households. Female-headed households use seed rate more than male-headed households in a loss efficient manner. Comparing the marginal seed productivity, seed rate input had more efficient on male-headed households than female-headed households.

The marginal products of fertilizer amountused were 69 and 31 respectively for male and female-headed households in the study areas. This means that a unit increase in fertilizer input used in kilogram will lead to increase an approximate change of 69 MMK and 31MMK of male and female-headed households in rice production. Thus, comparing the male and female-headed households use of fertilizer inputs, male-headed households would produce more output than female headed households.

The marginal product of family labor used in man day was 1,160 MMK for male-headed households and 669 MMK for female-headed households respectively. This implies that a unit increase in family labor use will result to increase 1,160 MMK and 669 MMK for male and female-headed households. As a consequence, family labor had more positive effect on the male-headed households than female-headed households.

Moreover, the marginal productivity of hired labor was -1,165 MMK and -2,103 MMK respectively for male and female-headed households. This suggests that a unit increase used of hired labor in man day will decrease 1,165 MMK and 2,103 MMK of male and female-headed households respectively. In addition, the marginal productivity of machinery cost for male-headed households was 0.01 which is smaller than 0.16 of female-headed households. If male and female-headed households

expensed 1 MMK for machinery, they got 0.01 MMK for male-headed households and 0.16MMK for female-headed households in rice production. Machinery cost had more positive effect on female-headed households than male-headed households. The marginal productivity differentials were 32459, -2613, 38, 490, -938 and (0.15) for land, seed rate, fertilizer amount, family labor, hired labor and machinery used. According to this result, male-headed households used resources more efficient in land, seed rate, fertilizer, family labor and hired labor than female-headed households while female-headed households used resources more efficient manner in machinery used than male-headed households.

4.4.5Gender impact on total revenue of rice

Gender impact on total revenue of rice was shown in Table 4.34. In the regression analysis, sown area, seed rate, fertilizer, family labor, hired labor, machinery cost and dummy of gender (male = 0 and female = 1) were independent variables and the total revenue of rice was dependent variable.

The total revenue of rice was positively and significantly influenced by sown area at 1% level which implying that an increase in farm size would lead to an increase in the total revenue of rice in the study areas. The coefficient of sown areas was 0.152 which indicated that if 1% of sown area increased, total revenue of rice will be increased by 0.152%. The coefficient of seed rate (0.201) and hired labor (0.143) was found to be negative and significant at 10% and 1% level of probability. This implies that 1% increase in the seed rate and hired laborusage, the total revenue of rice would be decreased by 0.201% and 0.143%. Gender was negatively and non-significant means there was no gender effects on total revenue of rice in the study areas

CHAPTER VCONCLUSION AND RECOMMENDATION

5.1 Summary and Conclusion

The study was an attempt to describe the socio-economic characteristics of rice production in the study areas, investigate the major sources of income by gender in the study areas, compare the profitability of rice production and its activities done by male-headed households and female-headed households in the study areas and analyze resources productivity of rice farmers by gender in the study areas.

A purposive sampling method was used to select 138 sample farmers in which 83 male-headed households and 55 female-headed households from Maubin and Daik U Townships. Descriptive statistics methods such as percentages, frequencies, means, and minimum, maximum were used in analyzing farmer's socio-economic characteristics and income sources. Enterprise budget was used to calculate the cost and return of rice production of male-headed households and female-headed households in the study areas.

The first objective was to examine the socio-economic characteristics of male and female-headed households. Gender differences were found in age, education and marital status of different gender headed households. The educational statuses of most of female household heads were higher than male household heads in monastery and primary education. However, male household heads were higher in middle and high school. Therefore, male household heads were more educated than female household heads in the study areas. This may be suggested that the low level of literacy among female household heads may negatively impact on their resource used effectively in the agricultural production than male household heads. When considering farm size, farming experience, female household heads possessed relatively larger farm size and experiences though they had small family labor for rice growing. Family labor is a cheap source of labor compared to hired labor. In male-headed households, larger family size might be strength of farm labor supply for farm work compared to female-headed households. Male household heads obtained more credit from MADB than female household heads. Female household heads borrowed money from money lenders with high interest rate than male household heads to invest in rice production. Although majority of male household heads participated in agricultural training or meeting,only two-third of female household heads did not participate in agricultural training or meeting.

In the study areas, all households had crop income source which contributed the largest income shares to the total households' income. More than one-third of male-headed households and half of female-headed households earned non-farm income sources which provided second largest income shares in both households. The non-farm incomes sources were brokers, government staffs and tailors sources male-headed households and shopkeepers, government staffs and car drivers. Although crop income was the main income source, non-farm and remittance were important income sources for both households. According to the results, female-headed households rear relatively smaller livestock than male-headed households except chicken. Livestock production seemed to be an opportunity for additional income. Therefore, livestock production should be encouraged especially for female-headed households. Almost all farmers cultivated rice as their major occupation for assuring their food security and favorable climate conditions in the study areas.

Comparing the highest BCR of Sin Thu Kha received by male and female-headed households in monsoon season, female-headed households received lower average yield. They got relatively higher price and expensed lower total variable cost and total variable cash cost. Therefore, female-headed households got higher BCR than male-headed households. ForHnanKar and Hmawbi-2 production, female-headed households also used more total material cost and opportunity cost; consequently they gained lower BCR compared with male-headed households. In summer rice production, female-headed households generally used more expenses in total material cost, opportunity cost, total variable cost and total variable cash cost. Their high input costs might be one reason of getting low BCR, though they could produce higher yield than male-headed households. Rice farming was the main source of income for both households. Therefore, agricultural policy measures should be taken towards provision of ready market with stable prices for rice output. Farmers should be encouraged for better management of input resources through technical training on production techniques/ practices that will improve their productivity.

Moreover, this study has revealed that a unit change in the resources used in rice production by male and female-headed households leads to an increase in rice output. Also, there were substantial differentials in resource productivity between male and female-headed households in the study areas. In resource productivity differential, male-headed households used sown area, seed rate, fertilizer, family labor and hired labor in a more efficient manner than female-headed households. Similarly,

female-headed households in the use of machinery have a more efficient manner than male-headed households.

5.2 Recommendation

Most of female household heads had low educational status and low participation in the agricultural extension training in the study areas. An adequate program on education and effective extension services should be extended for proper and effective resources-utilization.From the economic point of view, rice has a relatively low return because of low BCR in the study areas. Crop diversification plays one of the major roles in the agricultural sector from the sustainable point of view. Improving the current cropping systems to enhance their sustainability to the extent possible and shifting rice into other more profitable crops should be diversified. However, according to the land use policy, rice is compulsory for the land identified as "Le" in the current condition. If farmers have free of choice, it is needed to cultivate the high profitable crops or to shift crop diversification. Both male and female-headed households should be encouraged to use more fertilizer, family labor and machinery so as to increase productivity. Seed rate and hired labor should be used efficiently in rice production.Good quality seed and hired labor should be used to offer for greater efficiencies and for increased production in rice production. This could be done through provision of microfinance for rice farming of both households to enable the required inputs and hire labor for rice production process.

REFERENCES

Adeleke, O. A. 2008. Gender differentials in the productivity of cereal crop farmers: A case study of maize farmers in Oluyole Local Government Area of Oyo State. Agricultural Journal, Volume 3, Page 193-198.

Adesina, A. A. andK. K. Djato1997. Relative efficiency of women as farm managers: Profit function analysis. Agricultural Economics, Volume 69, Page 47-53.

Akter, S. 2017. Women's empowerment and gender equity in Agriculture. A different perspective from Southeast Asia. Food Policy. Volume 69, Page 270-297.

Aguilar, A., E. Carranza, M. Goldstein, T. Kilic, and G. Oseni (2014). Decomposition of gender differentials in agricultural productivity in Ethiopia. Policy Research Working Paper, No.6764, The World Bank.

Ayoola, Dangbegnon, B. C., Daudu, C. K., Mando, A., Kudi, T. M., Amapu, I. Y. and K. S. Ezuil 2011. Socio-economic factors influencing rice production among male and female farmers in Northern Guinea Savanna Nigeria: lessons for promoting gender equity in action research. Agriculture and Biology Journal of North America. Page 2151-7527

Bridget, E. A., Oghenekevwe, E. D., Alice, O. N. and O. C Chinelo. 2015. Gender differences and challenges in cassava. Academic Jornal, Volume 10, Page 2259-2267.

CGIAR. 2014, October 10. Common Gender and Empowerment IDO. Retrieved from CGIAR Gender and Agriculture Research Network. Montpellier: https://library.cgiar.org/handle/10947/317

CSO (Central Statistical Organization). 2016. Statistical Yearbook. Ministry of Planning and Economic Development.

Dadzie, S. N., and I. Dasmani (2010). Gender difference and farm level efficiency . Methafrontier production function approach. Journal of Development and Agricultural Economics, Volume 2, Page 441-451.

DOA (Department of Agriculture). 2015. Maubin Township. Bago Regions, Myanmar.

DOA (Department of Agriculture). 2015. Daik U Township. Ayeyawady Regions, Myanmar.

DOP (Department of Population). 2015. Ministry of Immigration and Population in Myanmar. Union Report.

Doss, C. 2014. If women hold up half the sky, How much of the world's foood do they produce? Gender in Agriculture. Working Paper 11-04.

FAO (Food and Agriculture Organization). 1998. Gender and development of action. Rural women and food security: current situation and perspectives.

FAO (Food and Agriculture Organization). 2004. Food Balance Sheet 1961-2002. Nigeria: http://www.faostat.org.

FAO (Food and Agriculture Organization). 2004. Learning Resources: Gender and Women in Agriculture and Rural Development in Asia.

FAO (Food and Agriculture Organization). 2011. Women in Agriculture: Closing the Gender Gap for Development. The State of Food and Agriculture, FAO, Rome, Italy.

Fernandez-Cornejo 2007. Off-farm income, farm economic performance, and technology adoption.Economic Research Report Number 36 ,Department of Agriculture.

Flora, C. B. 2001. Access and control of resources: lessons from the SANREMCRSP. Agriculture and Human Values, Volume 18, Page 41-48.

Grace. 2004. Gender Role in Agriculture: Case studies of five villages in Northern Afghanistan. Afghanistan research and evulation unit Working Paper Series (AREU), Kabul.

Handa, S. 1996. Expenditure behavior and children's welfare: An analysis of female headed households in Jamaica. Journal of Development Economics, Volume 90, Page 165-187.

ICRW (International Centre for Research on Women). 2012. Retrieved from http://www.icfs.org/ what we-do/ economic empowerment.

IFDC (International Fertilizer Development Center). 2015. USAID/Fertilizer sector improvement project, gender assessment.

Keller, B. 2000. Women's Access to Land in Zambia. Zambia: International Federation of Surveyors (FIG). Commission 7.

Koru, B. andS. Holden2008. Retireved on May 13. Retrieved from difference in maize productivity between male and female-headed households in Uganda:http://www.csae.ox.ax.uk/conferences/2011-EDiA/papers/122-Koru.pdf

Mbilinyi, M. 2000. Gender patterns in micro enterprises of Tanzanania In; . Conceptual and Methodological Issues (Edited by Maena, r. Harare) in SAPES Books, Page 31-70.Rome. Italy

MOALI. (Ministry of Agriculture, Livestock and Irrigation). 2016. Myanmar Agricultural at a Glance. Ministry of Agriculture, Livestock and Irrigation. Naypyitaw: MOALI

Moock, J.L., 1986. Understanding Africa‟s rural households and farming system. In S. Morgen (Eds.). Gender and Anthropology. Critical Reviews for Research and Teaching. American Anthropological Association, Washington, D.C.

Mukasa, A. N. and A. O. Salami (2015). Gender productivity differentials among smallholder farmers in Africa. A cross-country comparison. African Development Bank Group. Page 1-45.

Njenga, M., Karanja, N., Lee-Smith, G. and M. Pigeon 2011. Gender mainstreaming in organisational culture and agricultural research processes. Development in Practice, Page 379-391.

Offodile, P. O., Ohajianya, D. O., Echetama, J. A., Henri-Ukoha, A., Okereke-Ejiogu, N., Anyaoha, N. O., and U. C. Ibekwe 2010. Gender and Resource Productivity in Rice Production in Ebonyi State. Nigeria: Report and Opinion; Volume 2, http://www.sciencepub.net/report.

Ogato, G. S., Boon, E. K. and J. Subramani 2009. Gender roles in crop production and management practices: A case study of three rural communities in Ambo District, Ethiopia. J Hum Ecol, Volume 27, Page 1-20.

Okwoche, V. A., Asogwa, B. C. and T. D. Waya 2013. Comparative analysis of gender off-farm activities in zone b area of benue state: implication for rural poverty reduction in Benue State. Medwell Journals, The Social Sciences, Volume 8, Page 393-397.

Oladeebo, J. 2012. Technical efficiency and rural poverty among farmers in Nigeria: A gender perspective. Global journal of Science Frontier Research Agriculture and Veterinary Sciences, Volume 12, Page 1-8.

Orivel, A. F. 1995. Education primaire et croissance économique en Afrique sub-Saharienne. les conditions d'une relation efficace Revue d'Économie du Développement, 1.

Osondu, C. K., and J. C. Ijioma 2015. Status and participation of women farmers in farm household income generation and management in Isiala-Ngwa North Local Government Area of Abia State, Nigeria. 5th International Conference on Humanities. Indonesia: Economics and Social Sciences (ICHESS' 2015).

Oyakhilomen, O. 2012. Gender influence on the income of maize farmers in Giwal local government area of Kaduna State. Russian Journal of Agricultural and Socio-Economic Science, Volume 1.

Oyediran, K. A., and A. F. Odusola 2006. Poverty and the dynamics of women's participation.African Population Studies Supplement A, Volume 19, Page 115-139.

Pandey 2010. Rice in the global Economy. Strategic Research and Policy Issues for Food Security, IRRI, Page 477.

Peterman, A., Behrman, J. and, A. Quisumbing 2010.A review of empirical evidence on gender differences in non-land agricultural inputs, technology, and services in Developing Countries. International Food Policy Research Institute for Food and Agriculture Organization, ESA Working Paper No. 11-04.

Quisumbing, A. R. 1995. Gender differences in agricultural productivity: A survey of empirical evidence. Education and Social Policy Discussion Paper 36, Washington, DC.

Quisumbing, A. R. 2014. Closing the knowledge gap on gender in agriculture. In Gender in Agriculture , Page 3-27.

Romero-Paris, T. 2008. Women's roles and needs in changing rural asia with emphasis on rice-based Agriculture. Social Science Division, International Rice Research Institute (IRRI).

Rutsaert, P. 2015. Women's empowerment and gender equity in agriculture. A Different Perspective from Southeast Asia.

Saito, K.A., H. Mekonnen, and D. Spurling. 1994. Raising the productivity of women farmers in sub-Saharan Africa. World Bank Discussion Paper 230. Washington D.C.: WorldBank.

Staudt, K.1979. Class and Sex in the Politics of Women Farmers. J. Politics Volume 41, Page 492-512.

Tesfaye, T., Tiruneh, A., Mwangi, W., and H. Verkuijl.2001. Gender differentials in agricultural production and decision-making among smallholders in Ada, Lume, and Gimbichu Woredas of the Central Highlands of Ethiopia.

Thapa, S. 2008. Gender differentials in agricultural productivity: Evidence from Nepalese Household Data. CIFREM Faculty of Economics, University of Trento, Italy, Munich Personal RePEc Archive Paper No. 13722.

Udry, C., Hoddinott, J., Alderman, H. and L. Haddad 1995. Gender differentials in farm productivity. Implications for household efficiency and agricultural policy, Food Policy, Volume 20, Page 407-423.

United Nations1989. Compendium of statistics and indicators on the situation of women. New York, New York. United Nation.

Villabon, C. C. 2012. Gender differences in Agricultural productivity. A cross-sectional households survey data collected in 2006 . An Unpublished Master Thesis for the Degree of Master of Philosopy in Environmental and Development Economics University.

World Bank. 2015. Myanmar rice price reduction and poverty reduction. World Bank Group.

World Bank. 2017. Strategic environmental assessment of the hydropower sector in Myanmar. Final social and livelihoods, International Finance Cooperation, Baseline assessment report, World Bank Group.

APPENDICES

Appendix 1 Enterprise budget for Sin Thu Kha monsoon rice production of male and female-headed households

Item	Unit	Average Value (MMK)	
		Male-headed HHs (n=34)	**Female-headed HHs (n= 25)**
Gross Benefit			
Average yield	kg/ha	3,920	3,724
Average producer price	MMK/kg	208	220
Gross benefit	MMK/ha	**815,454**	**819,172**
Variable Cost			
(a) Material cost			
Seed	MMK/ha	28,328	28,873
Fertilizer	MMK/ha	91,638	92,779
Pesticide	MMK/ha	4,381	6,168
Herbicide	MMK/ha	5,596	1,105
Fuel	MMK/ha	18,826	15,946
Total material cost (a)	MMK/ha	**148,769**	**144,870**
(b) Opportunity Cost			
(i) Family Labor Cost			
Seedbed preparation	MMK/ha	30,172	29,200
Land preparation with machinery	MMK/ha	26,647	22,272
Land preparation with draft animal	MMK/ha	22,975	9,587
Direct seeding	MMK/ha	2,834	2,347
Pulling and bundling	MMK/ha	2,584	3,084
Transplanting	MMK/ha	1,975	3,044
Weeding	MMK/ha	6,499	3,939
Fertilizer application	MMK/ha	14,961	18,093
Insecticide/ herbicide application	MMK/ha	3,314	3,321
Harvesting(manually)	MMK/ha	2,423	7,393
Harvesting(machine)	MMK/ha	2,289	6,780
Bundling	MMK/ha	4,419	297
Threshing	MMK/ha	5,031	5,592
Drying	MMK/ha		3,459
Item	**Unit**	**Average Value (MMK)**	
		Male-headed HHs (n=34)	**Female-headed HHs (n= 25)**
Transportation	MMK/ha	872	-

Total Family labor cost (i)	**MMK/ha**	**126,996**	118,409
(ii) Material Cost			
Seed	MMK/ha	9,020	11,275
Total Material cost (ii)	MMK/ha	9,020	11,275
Total Opportunity Cost (i+ii) (b)	MMK/ha	**136,017**	**129,684**
(c) Hired Labor Cost			
Seedbed preparation	MMK/ha	13,130	17,987
Land preparation with machinery	MMK/ha	19,245	11,358
Land preparation with draft animal	MMK/ha	15,117	16,792
Direct seeding	MMK/ha	1,781	2,059
Pulling and bundling	MMK/ha	33,569	27,758
Transplanting	MMK/ha	55,407	53,669
Weeding	MMK/ha	14,101	13,146
Fertilizer Application	MMK/ha	6,323	11,052
Insecticide/ herbicide application	MMK/ha	1,472	4,777
Irrigation	MMK/ha	-	-
Harvesting (manually)	MMK/ha	28,766	24,600
Harvesting by machine	MMK/ha	103,003	84,134
Bundling	MMK/ha	5,342	1,483
Threshing	MMK/ha	38,818	30,495
Drying	MMK/ha	-	4,448
Transportation	MMK/ha	22,075	25,142
Total hired labor cost (c)	MMK/ha	**358,147**	**328,900**
(d) Interest on cash cost			
Interest on Material Cost	MMK/ha	14,877	14,487
Interest on Hired Labor Cost	MMK/ha	35,815	32,890
Interest on total cash cost (d)	MMK/ha	**50,692**	**47,377**
Total variable cost (a+b+c+d)	MMK/ha	**693,624**	**650,832**
Total variable cash cost (a+c+d)	MMK/ha	**557,608**	**521,148**
Benefit and Cost ratio (BCR)		**1.18**	**1.26**

Appendix 2 Enterprise budget for HnanKar monsoon rice production of male- and female-headed households

Item	**Unit**	**Average Value (MMK)**	
		Male-headed HHs (n=21)	**Female-headed HHs (n=8)**

Gross Benefit			
Average yield	kg/ha	2,821	2,797
Average producer price	MMK/kg	192	188
Gross benefit	MMK/ha	**542,240**	**524,520**
Variable Cost			
(a) Material cost			
Seed	MMK/ha	16,396	19,479
Fertilizer	MMK/ha	41,365	61,209
Herbicide	MMK/ha	3,494	4,324
Fuel	MMK/ha	14,532	15,907
Total material cost (a)	MMK/ha	**75,787**	**100,919**
(b) Opportunity Cost			
(i) Family Labor Cost			
Seedbed preparation	MMK/ha	2,471	15,753
Land preparation with machinery	MMK/ha	36,040	33,359
Land preparation with draft animal	MMK/ha	706	4,942
Directing seeding		6,977	4,118
Pulling and bundling	MMK/ha	-	927
Transplanting	MMK/ha	-	927
Weeding	MMK/ha	6,315	772
Fertilizer Application	MMK/ha	10,487	7,645
Insecticide/ herbicide application	MMK/ha	1,490	927
Harvesting(manually)	MMK/ha	5,545	17,838
Bundling	MMK/ha	7,590	5,148
Threshing	MMK/ha	9,465	4,440
Transportation	MMK/ha	971	2,471
Total Family labor cost (b)(i)	MMK/ha	**88,056**	**99,265**

Item	**Unit**	**Average Value (MMK)**	
		Male-headed HHs (n=21)	**Female-headed HHs (n=8)**
(ii) Material Cost			
Seed	MMK/ha	**10,855**	4,633
Total material cost (a)	MMK/ha	**10,855**	**4,633**
Total Opportunity Cost (i+ii) (b)	MMK/ha	**98,911**	**103,898**
(c)Hired Labor Cost			

Seedbed preparation	MMK/ha	706	7,413
Land preparation with machinery	MMK/ha	26,638	24,710
Land preparation with draft animal	MMK/ha	2,353	10,811
Direct seeding		2196	1,853
Pulling and bundling	MMK/ha	2,059	12,355
Transplanting	MMK/ha	2,471	40,772
Weeding	MMK/ha	14,157	4,170
Fertilizer Application	MMK/ha	5,572	5,135
Insecticide/ herbicide application	MMK/ha	4,207	1,853
Harvesting (machine)		99,193	-
Harvesting (manually)	MMK/ha	64,246	72,939
Bundling	MMK/ha	5,043	5,405
Threshing	MMK/ha	12,296	30,455
Transportation	MMK/ha	19,121	15,506
Total hired labor cost (c)	MMK/ha	**260,258**	**233,376**
(d) Interest on cash cost			
Interest on Material Cost	MMK/ha	7,579	10,092
Interest on Hired Labor Cost	MMK/ha	26,026	23,338
Interest on total cash cost (d)	MMK/ha	**33,604**	**33,430**
Total variable cost (a+b+c+d)	MMK/ha	**468,561**	**466,989**
Total variable cash cost (a+c+d)	MMK/ha	**369,649**	**367,725**
Benefit and Cost ratio (BCR)		**1.16**	**1.12**

Appendix 3 Enterprise budget for Hmawbi-2 monsoon rice production of male and female-headed households

Item	Unit	Average Value (MMK)	
		Male-headed HHs (n=21)	Female-headed HHs (n=16)
Gross Benefit			
Average yield	kg/ha	3,365	3,478
Average producer price	MMK/kg	213	248
Gross benefit	MMK/ha	**716,675**	**861,728**
Variable Cost			
(a) Material cost			
Seed	MMK/ha	17,084	10,540
Fertilizer	MMK/ha	84,158	110,791
Herbicide	MMK/ha	2,295	4,396
Pesticide	MMK/ha	2,785	13,945
Fuel	MMK/ha	16,511	17,698
Total material cost (a)	MMK/ha	**122,832**	**157,370**
(b) Opportunity Cost			
(i) Family Labor Cost			
Seedbed preparation	MMK/ha	28,709	50,501
Land preparation with machinery	MMK/ha	19,274	37,290
Land preparation with draft animal	MMK/ha	22,445	8,432
Directing seeding	MMK/ha	1,059	1,544
Pulling and bundling	MMK/ha	883	4,818
Transplanting	MMK/ha	2,924	4,686
Weeding	MMK/ha	941	772
Fertilizer pplication	MMK/ha	12,817	14,742
Insecticide/ herbicide application	MMK/ha	6,256	8,185
Harvesting (machine)	MMK/ha	3,789	12,530
Harvesting(manually)	MMK/ha	1,977	2,224
Bundling	MMK/ha	2,746	-
Threshing	MMK/ha	2,795	772
Drying	MMK/ha	-	20,849
Transportation	MMK/ha	471	3,089
Item	**Unit**	**Average Value (MMK)**	
		Male-headed HHs	**Female-headed HHs**

		(n=21)	(n=16)
Total Family labor cost (b)(i)	MMK/ha	**107,084**	**170,435**
(ii) Material Cost			
Seed	MMK/ha	**16,511**	**30,640**
Total material cost (a)	MMK/ha	**16,511**	**30,640**
Total Opportunity Cost (i+ii) (b)	MMK/ha	**123,595**	**201,076**
(c)Hired Labor Cost			
Seedbed preparation	MMK/ha	23552	41,654
Land preparation with machinery	MMK/ha	27,769	30,623
Land preparation with draft animal	MMK/ha	7,295	15,003
Direct seeding	MMK/ha	2118	1,544
Pulling and bundling	MMK/ha	20,337	37,127
Transplanting	MMK/ha	61,524	70,300
Weeding	MMK/ha	5,648	9,708
Fertilizer Application	MMK/ha	10,845	30,623
Insecticide/ herbicide application	MMK/ha	4,448	16,415
Harvesting (machine)	MMK/ha	94,928	95,045
Harvesting (manually)	MMK/ha	29,955	3,883
Bundling	MMK/ha	5,030	15,885
Threshing	MMK/ha	30,226	2,295
Transportation	MMK/ha	26,740	12,532
Total hired labor cost (c)	MMK/ha	**350,414**	**382,634**
(d) Interest on cash cost			
Interest on Material Cost	MMK/ha	12,283	15,737
Interest on Hired Labor Cost	MMK/ha	35,041	38,263
Interest on total cash cost (d)	MMK/ha	**47,325**	**54,000**
Total variable cost (a+b+c+d)	MMK/ha	**644,165**	**764,441**
Total variable cash cost (a+c+d)	MMK/ha	**520,570**	**594,005**
Benefit and Cost ratio (BCR)		**1.11**	**1.13**

Appendix 4 Enterprise budget for Sin Thu Khasummer rice production of male-headed households and female-headed households in the study areas

Item	Unit	Average Value (MMK)	
		Male-headed HHs (n=11)	Female-headed HHs (n=4)
Gross Benefit			
Average yield	kg/ha	3,541	3,781
Average producer price	MMK/kg	195	212
Gross benefit	MMK/ha	**691,438**	**802,031**
Variable Cost			
(a) Material cost			
Seed	MMK/ha	28,641	7,413
Fertilizer	MMK/ha	76,280	122,006
Pesticide	MMK/ha	4,186	12,108
Herbicide	MMK/ha	5,167	1,730
Fuel	MMK/ha	19,459	18,055
Total material cost (a)	MMK/ha	**133,732**	**161,311**
(b) Opportunity Cost			
(i) Family Labor Cost			
Land preparation with machinery	MMK/ha	33,328	23,166
Land preparation with draft animal	MMK/ha	1,483	14,826
Direct seeding	MMK/ha	7,495	6,178
Weeding	MMK/ha	4,118	-
Fertilizer Application	MMK/ha	10,329	20,180
Chemical Application	MMK/ha	10,675	7,413
Irrigation	MMK/ha	9,060	-
Harvesting(machine)	MMK/ha	3,954	11,531
Total Family labor cost (i)	**MMK/ha**	**80,441**	83,293
(ii) Material Cost			
Seed	MMK/ha	4,493	30,146
Total Material cost (ii)	MMK/ha	4,493	30,146

Item	Unit	Average Value (MMK)	
		Male-headed HHs	Female-headed HHs

		(n=11)	(n=4)
Total Opportunity Cost (i+ii) (b)	MMK/ha	**84,934**	**113,439**
(c) Hired Labor Cost			
Land preparation with machinery	MMK/ha	31,929	19,459
Land preparation with draft animal	MMK/ha	5,436	15,444
Direct seeding	MMK/ha	9,390	12,355
Weeding	MMK/ha	13,838	-
Fertilizer application	MMK/ha	24,710	47,258
Insecticide/ herbicide application	MMK/ha	7,907	25,946
Irrigation	MMK/ha	3,707	9,266
Harvesting (manually)	MMK/ha	18,597	-
Harvesting by machine	MMK/ha	112,872	115,725
Bundling	MMK/ha	1,236	-
Threshing	MMK/ha	33,441	-
Transportation	MMK/ha	-	61,775
Total hired labor cost (c)	MMK/ha	**263,062**	**307,228**
(d) Interest on cash cost			
Interest on Material Cost	MMK/ha	13,373	16,131
Interest on Hired Labor Cost	MMK/ha	26,306	30,723
Interest on total cash cost (d)	MMK/ha	**39,679**	**46,854**
Total variable cost (a+b+c+d)	MMK/ha	**521,407**	**628,832**
Total variable cash cost (a+c+d)	MMK/ha	**436,473**	**515,393**
Benefit and Cost ratio (BCR)		**1.33**	**1.28**

Appendix 5 Enterprise budget for Thee Htat Yin summer rice production of male and female-headed households

Item	Unit	Average Value (MMK)	
		Male-headed HHs (n=16)	**Female-headedHHs (n=10)**
Gross Benefit			
Average yield	kg/ha	4,433	4,772
Average producer price	MMK/kg	192	185
Gross benefit	MMK/ha	**849,336**	**882,975**
Variable Cost			
(a) Material cost			
Seed	MMK/ha	22,413	27,655
Fertilizer	MMK/ha	147,826	145,931
Pesticide	MMK/ha	17,312	44,188
Herbicide	MMK/ha	23,075	8,649
Fuel	MMK/ha	59,505	72,870
Total material cost (a)	MMK/ha	**270,132**	**299,292**
(b) Opportunity Cost			
(i) Family Labor Cost			
Seedbed preparation	MMK/ha	1,544	-
Land preparation with machinery	MMK/ha	28,529	23,475
Land preparation with draft animal	MMK/ha	8,906	1,730
Direct seeding	MMK/ha	8,720	9,994
Weeding	MMK/ha	8,477	9,637
Fertilizer Application	MMK/ha	13,651	24,463
Chemical Application	MMK/ha	6,625	5,930
Irrigation	MMK/ha	34,609	68,076
Harvesting(manually)	MMK/ha	2,831	7,116
Bundling	MMK/ha	4,344	988
Threshing	MMK/ha	11,992	22,769
Transportation	MMK/ha	11,943	24,710
Total Family labor cost (i)	**MMK/ha**	**142,172**	198,888

Item	Unit	Average Value (MMK)	
		Male-headedHHs	**Female-headedHHs**

		(n=16)	(n=10)
(ii) Material Cost			
Seed	MMK/ha	17,838	18,347
Total Material cost (ii)	MMK/ha	17,838	18,347
Total Opportunity Cost (i+ii) (b)	MMK/ha	**160,009**	**217,235**
(c) Hired Labor Cost			
Seedbed preparation	MMK/ha	772	-
Land preparation with machinery	MMK/ha	25,559	32,617
Land preparation with draft animal	MMK/ha	6,499	6,178
Direct seeding	MMK/ha	2,239	3,089
Pulling and Bundling	MMK/ha	1,544	-
Transplanting	MMK/ha	4,633	-
Weeding	MMK/ha	7,883	1,483
Fertilizer Application	MMK/ha	10,618	4,448
Chemical Application	MMK/ha	3,583	5,930
Irrigation	MMK/ha	15,289	4,942
Harvesting (manually)	MMK/ha	60,540	44,190
Harvesting by machine	MMK/ha	119,149	104,606
Bundling	MMK/ha	9,096	6,721
Threshing	MMK/ha	36,308	37,242
Total hired labor cost (c)	MMK/ha	**303,712**	**251,444**
(d) Interest on cash cost			
Interest on Material Cost	MMK/ha	27,013	29,929
Interest on Hired Labor Cost	MMK/ha	30,371	25,144
Interest on total cash cost (d)	MMK/ha	**57,384**	**55,074**
Total variable cost (a+b+c+d)	MMK/ha	**791,238**	**823,045**
Total variable cash cost (a+c+d)	MMK/ha	**631,229**	**605,810**
Benefit and Cost ratio (BCR)		**1.07**	**1.06**