

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary and conclusions

This study was an attempt to analyze farmers' strategies to achieve livelihood outcomes on post-monsoon cotton productivity and cotton-based cropping system of the selected areas under rainfed upland of Central Myanmar according to the sustainable livelihoods framework described by the U.K. Department for International Development (DFID) (1999). Accessibility of different five livelihood assets were major components of the framework along with their strategies and production constraints of cotton production was also determinant factors on yield of seed cotton. In this study, currently used management practices of cotton production were also investigated. The results of multiple regression to determine the effects of vital livelihood assets on seed cotton yield were also presented in this study.

The selection of the study area was based on the major post-monsoon cotton growing area of Central Myanmar and this study was conducted in Kyaukse, Myittha and Wundwin townships under Mandalay Division. Sample respondents were selected by using multistage random sampling technique. A total of 150 farmers, 50 household heads in one village of each township were interviewed individually through the structured questionnaire for primary data. In order to obtain secondary data, the relevant information from cotton-based cropping system was collected from different government agencies under the Ministry of Agriculture and Irrigation (MOAI).

Different types of descriptive statistical method were used to formulate percentage, frequency and average. This study used correlation matrix to investigate the multicollinearity of all independent variables and the relationship between the cotton yield and the key livelihood asset variables drawn from the results of correlation matrix was determined through the multiple regression analysis.

6.1.1 Production practices, constraints and livelihood assets

Based on the presented descriptive results, currently used production practices on post-monsoon cotton adopted by the respondents were mainly dependent on rainfall according to rainfed agriculture. Relatively resistant to bollworm cultivar (Ngwe Chi 6) mainly distributed by Cotton and Sericulture Department was used by the majority of farmers. Although all respondents in Kyaukse adopted recommended growing practices, 26% in Myittha and 30% in Wundwin did not adopt that practices according to their poor experience in cotton cultivation compared to Kyaukse. In fertility management, there was observed the differences among townships. A relatively small number of farmers (22% and 8%) applied both organic and inorganic fertilizers in Kyaukse according to their fertile soil condition compared to the other townships. About 60% and only 38% of respondents used FYM and chemical fertilizer in Myittha. Application of chemical fertilizer especially sidedressing of urea fertilizer was adopted by about 78% of respondents in Wundwin and only 32% of respondents applied FYM in cotton production. Pest is one of the most important problems in cotton and therefore, more than 50% of respondents in Myittha and Wundwin used seed treatment method to prevent early season sucking pests and there was observed only 28% of farmers in Kyaukse adopted this method. In prevention of

bollworms and late season sucking pests, 66% in Kyaukse, 90% in Myittha and 50% of farmers in Wundwin used the pesticide spraying within 2 to 5 times per growing season. Frequency of spraying was dependent on pest infestation and also availability of input especially financial support. Pest infestation was also dependent on the location and environmental conditions.

Regarding the surveyed results in terms of constraints of post-monsoon cotton production, the majority of farmers' faced problems were insufficient and lack of application of organic and inorganic fertilizers, sucking pests and bollworms infestation along the growing season, non appropriate rain water, insufficient labor at picking time, low seed cotton price and quality, limited financial and insufficient extension contacts. The average seed cotton yield was 947 kg ha^{-1} , 770 kg ha^{-1} and 891 kg ha^{-1} in Kyaukse, Myittha and Wundwin, respectively. Although 8% of farmers in Kyaukse, 4% of farmers in Myittha and 12% of farmers in Wundwin accepted seed cotton yield more than the national target yield of 1613 kg ha^{-1} , the rest of farmers' accepted yields were substantially below the national target yield because of the constraints factors described.

Five capital assets of the household such as human, natural, physical, social and financial assets are the heart of the framework. According to the availability of different livelihood assets, farmers' used strategies and outcomes are also different. Under the human capital assets, the average age of household head was about 53 years and family size was 5 people household⁻¹. All of the head of households attended at only primary level. There was highly significant among townships in household heads' cotton cultivation experience, the best experience was found in

Kyaukse with the average years of 27 and there were only 10 and 11 years in cotton production experience in Myittha and Wundwin.

Natural capital is the most important assets for rural households. Under natural capital, soil texture adopted by the respondents of the selected areas was loamy clay in Kyaukse, sandy loam and clay soil in Myittha and Wundwin and the average land holding was 4.62 ha across townships and there was significantly difference among townships. About 58.68% of total land holding was situated under cotton production in Kyaukse, 29.59% in Myittha and only 18.17% in Wundwin.

Physical capital is also the fundamental indicator of productivity and income of livelihoods. In cotton production, investment of inputs such as high quality seeds, both organic and inorganic fertilizers, appropriate application of pesticides, appropriate land preparation and weeding were mainly influenced on seed cotton yield. The average amount of only 7.82 and 846 kg ha⁻¹ of chemical fertilizer and FYM were applied in Kyaukse. The highest amount of FYM (2192 kg ha⁻¹) was observed in Myittha and the highest amount of inorganic fertilizer (91.62 kg ha⁻¹) was used in Wundwin. There was significantly difference in fertilizers application among townships. In pest management, the average amount of pesticide cost across townships was 39 thousand kyats ha⁻¹. Possession of farm tools for production smoothing and owing of cattle especially for animal power and FYM were also important in crop production.

Concerning the social capital, accessibility of labor network in each household solved the problem of labor shortage at important time of production especially picking time. The most important factor under social asset was availability of

extension officers' field visit during the growing season. Dissemination of improved technologies by extension staff was valuable thing in rural livelihoods.

Annual income, saving of money and accessibility of credit amount were vital financial assets for every household. The highest amount of yearly income (3,052,851 kyats which is equivalent to US\$ 3,053), saving (719,000 kyats which is equivalent to US\$ 719) and credit amount (218,640 which is equivalent to US\$ 219) were observed in Wundwin and there were significantly difference compared to the other townships. Credit availability is the vital factor in crop production to arrange input requirement if there was lack of saving amount.

6.1.2 Relationship between seed cotton yield and livelihood assets through multiple regression analysis

In the analysis of post-monsoon cotton production, seed cotton yield per hectare was used as the dependent variable and household size, education of household head, experience in cotton cultivation under human capital, cotton planted area under natural capital, seed rate used by respondents, chemical fertilizer and FYM amount added to the field, cost of pesticide, cost of land preparation and intercultivation and farm equipment value under physical capital, labor network and extension contacts under social capital and credit access of farmers under financial capital were used as independent variables for multiple regression.

For the respondents of Kyaukse, cotton planted area was significant with the negative algebraic sign of the estimated coefficient on seed cotton yield and the coefficient of pesticide cost and extension contacts were positively related with cotton yield and significant at 1% level.

In Myittha, only one independent variable (extension contacts) was significant with the positive coefficient on cotton yield. The rest of the independent variables showed positive impact on seed cotton yield except FYM amount and labor network in this area. However, these variables did not show statistically significant on yield of cotton.

Amount of pesticide cost and frequency of extension officers' field visits were positively significant on seed cotton yield at 1% level of significance and only accessibility of credit amount was significant on yield with a negative sign in Wundwin. Household size, experience in cotton cultivation, seed rate, amount of chemical fertilizer and FYM were positively impact on cotton yield but not statistically significant.

6.1.3 Farmers' livelihood strategies

The aim of livelihood strategies is to achieve livelihood outcomes. In terms of livelihood outcomes of this study, farmers' sustainable livelihood outcomes were increased seed cotton productivity and more annual income by sustainable use of natural resources. For all farmers in the selected areas, multiple livelihood strategies were carried out to sustain their livelihoods in both post-monsoon cotton production and cotton-based farming system.

Farmers' used strategies to accept more cotton production were mainly dependent on their inputs investment and management practices. According to the investment on sustainable production, farmers' used various kinds of strategies were growing of improved variety (relatively resistant to bollworms), using high quality seed for good germination, appropriate pesticides for both sucking pests and

bollworm complex, amount of fertilizers (inorganic and organic) according to soil condition and effective labor use. Regarding the management practices on sustainable production, appropriate plant protection practices such as seed treatment method for early season sucking pests and pesticide spraying according to types of pest infestation, appropriate fertilizer management practices such as basal and side dress application by using FYM and chemical fertilizer and crop rotation method in their field to prevent soil depletion and incidence of pests and diseases. Farmers also gave attention on the recommended growing practices for increased yield and extension officers' instruction to obtain advanced technologies of production system.

To achieve livelihood outcome in terms of more income, agriculture was the main livelihood strategy that impact directly or indirectly on other livelihood strategies such as off-farm and non-farm activities. There are 4 main types of livelihood strategies adopted by the respondents in all the study areas such as agriculture alone, the combination of agriculture and off-farm activity, the combination of agriculture and non-farm activity and the combination of agriculture, off-farm and non-farm activity. There are 3 sub categories under off-farm employment and 6 sub categories under non-farm employment. Off-farm activities carried by respondents were dairy farming, farm wage labor, hiring draught power and machinery power.

According to results, 38% of respondents in Kyaukse, 74% of respondents in Myittha and 58% of respondents in Wundwin performed agriculture alone for their livelihoods. In the study area of Kyaukse, the combined activity of agriculture and non-farm gave the highest income with the average amount of about 3,033,137 kyats (US\$ 3033). Also, the highest income was obtained by the combined use of

agriculture and non-farm with the average amount of 2,450,857 kyats (US\$ 2451) followed by agriculture only with the average amount of 1,729,682 kyats (US\$ 1730) in Myittha. There was about 4,178,085 kyats (US\$ 4178) of annual income from the strategy of the combined activities of agriculture, off-farm and non-farm from Wundwin. This was the highest income accepted by only 4% of respondents in this area.

Annual income is basically depended on agriculture for sustainable livelihoods by growing of different crops dominated by cotton, rice, chickpea, sorghum, chili, oilseed crops and pulses in all selected areas. Various kinds of cropping systems and cropping patterns (mono and double cropping) under diversified cropping were applied in all the study areas to sustain soil fertility and environmental pollution. Cotton is the principal economic crop in Kyaukse followed by sorghum and the major food crops are butter bean, mung bean, pigeon pea, sesame and groundnut. Cotton, chickpea, rice and oilseed crops are the major planted crops in the study area of Myittha township. Rice-based cropping systems with cotton or chili as a secondary crop were predominant in Wundwin area. By growing the various kinds of crops in a year, there was accepted not only comparatively high net return but also sustainable use of natural resources.

6.2 Recommendations

With regard to the results, majority of households in rural livelihoods basically depend on agriculture and hence the following recommendations are suggested to achieve livelihood outcomes according to livelihood assets along with the livelihood strategies of the cotton-based farming system of the study.

1) In order to improve the sustainable productivity and to mitigate the incidence of the constraint factors of cotton production in rainfed agriculture, production practices are an important tool to get the sustainable yield and more income. According to this, there should be an emphasis on appropriate land preparation, recommended spacing, appropriate sowing time, recommended seed rate, high quality seed and resistant variety. There also should give attention on appropriate usage of organic and inorganic fertilizers and right time application according to crop requirement. With regard to plant protection, there should be an emphasis on correct dosage, correct insecticide and right time application of pesticide to reduce pest occurrence. In addition, attention on extension officers' instructions to get improved technologies and emphasis on the quality control of product to accept high farm gate price for more income should be necessary to consider.

2) In post-monsoon cotton-based farming systems, households' access to five capital assets is essential for both cotton production and more income to sustain rural livelihoods. According to their different accessibility of assets, there were accepted different outcomes. Therefore, there should be maintained and emphasized to increase these capital assets and these capitals should be effectively used for more productivity and income to sustain their natural resources.

3) Regarding the livelihood strategies, the development of a combination of different strategies is essential to increase income for sustainable livelihoods. The farmers in the study areas mainly rely on rainfed agriculture activities and hence productivity of crops is not constant under the uncertainty of the rainfall. According to this condition,

farmers under rainfed areas have to find other livelihood strategies for income sources such as farm related or non-farm activities for additional income.

4) To reduce the risks of rainfed cotton-based farming system for long term productivity, the sustainable agriculture practices and strategies should be considered. To enhance soil fertility, there must be emphasized on balanced and integrated use of both organic and inorganic fertilizers, based on location-specific recommendations that contribute to long-term productivity and adequate economic returns. In addition, greater emphasis on crop rotation with leguminous crops is necessary. Integrated Pest Management (IPM) practices contribute to reduction of chemical pesticides and avoidance of environmental pollution should also be placed on attention. Consecutive growing of the same crop in the same field to avoid the build-up of pests and to avoid depletion of nutrients is the important fact to consider in agriculture. Diversification of crops is a useful means to increase crop yield under different situations and hence there is necessary to grow various crops in order to make increased income, judicious use of land, water and other resources.

5) Finally, this study recommends that there should be necessary to conduct field trials in farmers' plots, to provide sufficient research and training, to support adequate extension contacts, to carry out increased contract farming system, to provide adequate availability of input supplies such as improved variety, chemical fertilizer and pesticide and also to arrange adequate credit amount to solve the farmers' problems for sustainable livelihoods. The active involvements of private and public sectors are necessary to create new market for sustainably produced. Cotton research

should be focused on the cotton production with low-cost, low-risk and effective cotton cultivation practices.

6.3 Further research

According to the rainfed mode of agriculture, there is necessary for the dissemination of improved production technologies for the major crops in the study areas. This will be not only the receiving of annual income but also efficiently usage of capital assets for sustainable livelihoods.

There is a need for further research concerning about the Integrated Pest Management (IPM) with regarding the cotton is serious pesticide usage crop and also Integrated Nutrient Management (INM) practices to maintain soil fertility for sustainable development of livelihoods. There is also needed to emphasize the possible ways of income generating activities for improvement of rural livelihoods.