CHAPTER VI

DISCUSSIONS

This chapter covers the discussions on the factors affecting the adoption of soil conservation measures applying crop residues, compost and growing green manure for soil conservation based on the information of survey and the results obtained from the three logistic regression models. According to the survey information, there were also discussions about the farmers' knowledge on soil conservation, soil degradation and soil erosion and the problems facing the use of organic materials such as crop residues, compost and green manure for soil conservation and fertility improvement.

6.1 Crop residues application

The results of logistic model revealed that age, knowledge and the amount of crop residues used as fodder were negatively related with the adoption of crop residues application for soil conservation. This means that farmers did not want to apply crop residues for soil conservation if they did not enough fodder to feed the cattle even though they got older and higher knowledge. Therefore, in this case where crop residues are more valuable as livestock feed than as soil fertility amendments, farmers are less likely to use crop residues for soil fertility management. The older heads of households have less adoption the crop residues application. Norris and Batie (1987) also proved that many equated short soil conservation practices that might not yield immediate benefits whereas younger farmers began more educated on the average and having longer planning horizons might be more likely to invest in soil

conservation. Similarly, Shiferaw and Holden (1998) indicated a negative relationship between age and adoption of improved soil conservation practices. Due to fodder scarcity, farmers kept their crop residues for summer duration. Farmers also had some knowledge of solutions; however, participation in soil conservation activities was minimal because of the immediate threat of food and fodder security. Generally farmers believe that all crops are good for soil because of their cover and crop residues. However, some crops are better than others to enhance the soil. The farmers noticed that all leguminous crops are the bests for soil enhancement because crops growing after leguminous crop are always profitable. Because of shortage of fuel wood and limitation of grazing land, they need to grow sesame and forage crops such as sorghum to get energy source and livestock feed. However, the model confirms total farm size was positively related with the adoption of crop residues application for soil conservation. This means that the farmers who owned more farms wanted to use crop residues. Because they could grow various kinds of crops on their farms and they may have enough crop residues not only for fodder but also for using soil conservation. Farm size is also an indicator of wealth and perhaps a proxy for social status and influence within a community. Marenya and Barrett (2007) proved that the probability of adopting each of the integrated natural resources management (INRM) and integrated soil fertility management (ISFM) practices was positively and statistically significantly influenced by the total farm size operated by a household. Moreover, farm income was positively related with the adoption of crop residues application for soil conservation. It can be described that farmers who got higher income wanted to use crop residues because the farmers can buy the supplement fodder such as sesame cake and groundnut cake as they get higher income.

Carlson *et al*. (1981) stated that a positive relationship had been found between gross income and the adoption of conservation practices. This relationship is expected, in part, because higher incomes could reduce financial constraints to adoption. Reij and Waters- Bayer (2001) stated that higher income farmers might be less risk averse, had more access to information, and had greater capacity to mobilize resources including information hence a high level of innovativeness could be expected from them. Sanchez *et al*. (2001), Reardon *et al*. (2001) and Barrett *et al*. (2002) stated that smallholder agriculture in much of the low income tropics was nonetheless characterized by widespread failure to make sufficient soil fertility replenishment and soil conservation investments in order to sustain the quality of farmland.

Besides, the model also showed that soil type was positively resulted with the application of crop residues application for soil conservation. It may be that farmers wanted to apply crop residues for soil improvement of their lands if their soil type were sandy because these sandy soils were very sensitive to wind as well as water erosion during the dry season. Ervin and Ervin (1982) stated that it was expected that farmers who faced most severe potential erosion problems were expenditures or acreage were greater than more likely to practice conservation. The natural potential of soil to erode was influenced by variables such as the type of soil, the conditions experienced, and the steepness of the land. It was found that farmers with the potentially more erodible land had greater levels of conservation effort.

Moreover, oil seed-legume cropping pattern was positively related with the adoption in model. This means that farmers growing oil seed-legume cropping pattern liked to apply crop residues because they may get enough fodder due to more growing

of legumes. Farmers believe that legumes crops are good for soil fertility improvement. However, the model revealed that oil seed-cereal cropping pattern was negatively related with the adoption of crop residues application. This may be that they cannot use crop residues for soil conservation if they grew more oil seed-cereal cropping pattern because most of the cereals were used for fodder and oil seed crop residues were burnt. Farmers have knowledge about the various technology options and their contribution to soil fertility and food security. Cropping systems that can enhance soil status are also perceived by the farmers in the study area. They believe that mixed and multiple cropping is the best cropping systems and crop rotation is the best crop management practice. This shows that farmers understand very well the role of cropping systems. However, adoption of these technologies is still low because of some limitation although they have some knowledge.

6.2 Compost application

On the other hand, the model showed that education, the amount of crop residues used as fodder, knowledge and times of extension visit were positively related with the adoption of compost application for soil conservation. This revealed that the farmers, who had higher education, higher knowledge and more times of extension visit, wanted to apply compost even if they did not have enough fodder. Because they can make compost by using alternative crop residues not relevant to feed cattle such as sesame based on their education level and knowledge getting from extension workers. Personal characteristics such as education indicated a strong positive relationship with investment decision on soil conservation. Formal education may be an effective variable to capture environmental awareness of farmers who are

basically literate. Exposure to education may increase the farmers' ability to obtain process and use information relevant to adoption of technology. Nkamleu (2007) also found farmer education had a positive and significant effect on the adoption of organic fertilizers and integrated soil nutrient management. Integrated soil nutrient management required greater management skills than those required for the application of inorganic fertilizers alone or organic fertilizers alone, since it required combination of two inputs in correct proportions. These results suggest that increased farmer education improved likelihood of using integrated soil nutrient management practices. The positive effect on the adoption of organic fertilizers suggested that educated farmers were better able to comprehend the benefits of biodegradable organic sources of nutrient management on their farms. Similarly, knowledge might increase their willingness to use organic materials such as compost for soil conservation and improvement. Malawi Government (2002) stated that farmers' knowledge of the usefulness of improving their soil fertility would enhance their willingness to substitute inorganic fertilizer, which was expensive, with low cost technologies. Knowledge would enhance farmers understanding of technology and change it attitude towards an innovation, hence farmers could exploit the potential benefits in using the technology. Agricultural extension services could also provide the major sources of agricultural information.

The model also resulted that cropping intensity and oil seed-legume cropping pattern were negatively related with the adoption of compost application. This may be that some farmers did not want to make compost although cropping intensity was higher. Because they grew sesame-cereal cropping pattern and they burnt most of the sesame crop residues and used all cereal crop residues for fodder. Even if the farmers

grew oil seed-legume cropping pattern, they did not want to make compost. Because they burnt their oil seed crops residues and used all legumes residues for cattle. On the other hand, some farmers believe that growing the legumes crops can improve soil fertility and they think that they do not need to use compost for soil improvement. Similarly, Chinangwa (2006) proved that common bean was intercropped with maize in the study area. Farmers believed that this improved soil fertility, and would give the same results as using compost. The residues from common bean were buried during land preparation to enhance soil fertility and yields for subsequent season, due to the incorporation of the organic matter. Therefore, increase in common bean growing would reduce use of compost manure significantly.

Besides, partial irrigation access was negatively related with the adoption of compost application for soil conservation. This might be that the farmers did not want to make compost unless they were enough water because of low biomass production. If they have access to good irrigation, they can grow the numbers of crops successfully and can get large amount of biomass and use them in different ways. In the dry lands, all forms of agriculture can be described as water-dependent land use, where water is often identified as the principal limiting factors in biomass production. Age was positively related with the adoption of compost application for soil conservation in this model. This may be that the older farmers wanted to make compost because they were rich in resources like experience, knowledge and training. These older farmers got compost technology and some training from UNDP organization in this area. Damisa and Igonoh (2007) proved that older farmers were more likely to try new technologies as they were rich with more resources than younger farmers. The model showed that numbers of cattle owned was negatively

related with the adoption of compost application. This might be that the farmers did not want to make compost although they owned a number of cattle. They wanted to apply only farm yard manure mixing with cow dung because compost making was laborious and time consumption. Moreover, there were some limitations such as labour consumption, and transportation problem to make compost. Similarly, Nkamleu (2007) stated that the possession of livestock had a significant negative effect on the utilization of organic inputs for soil fertility management. Purchased composts made from urban wastes and internally manufactured composts from household wastes (includes animal refuse) are substitutes for animal manure. Farmers using animal manure were less likely to adopt composts. It seemed that farmers preferred to use manure directly than making compost with.

6.3 Green manure growing

Regarding the green manuring, the model showed that total farm size, good irrigation access and times of extension workers visit were positively related with the adoption of green manure growing for soil conservation. This can be discussed that the farmers who possessed more farms with good irrigation and accessed more times of extension visit wanted to grow green manure because they got a lots of knowledge from extension workers. Nkamleu (2007) proved that contact with extension was positively and significantly related to farmers' adoption of organic fertilizers. Baidu-Forson (1999) stated that farmers who had participated in extension programs would be more knowledgeable about the effects of soil erosion and would therefore be more likely to perceive the erosion problem and adopt soil conservation. Besides, they can grow green manure as they have enough land and water. Similarly, Lasley and Nolan;

Baron; and Carlson *et al*. (1981) found a positive relationship between farm size and conservation. Operators of larger farms were likely to spend more on conservation because, in many cases, larger farm size was associated with greater wealth and increased availability of capital, which makes investment in conservation more feasible.

However, the model showed that farming experience, farm income and off-farm income were negatively related with the adoption of green manure growing for soil conservation. This may be that some farmers did not want to grow green manure even though they had good experience in farming and higher farm income and off-farm because of no monetary crops. Besides they can buy inorganic fertilizer as they have higher income. So, farmers did not want to grow green manure and give the space for this crop. Chinangwa (2006) stated that farmers with increased off-farm labour income were richer farmer and were capable of buying inorganic fertilizer. Therefore, use of inorganic fertilizer would be profitable as regard to time and labor allocation. Norris and Batie (1987) also proved that income and off-farm employment significantly and negatively affected conservation tillage acreage.

6.4 Overall discussions

Under the Dry Zone conditions, a number of crop residues such as residues from sesame, various legume crops and other straw or dry grass can be used. Sesame residues can be applied at the surface of the soil (normal mulching) whilst legumes (grams, beans, peas, etc.) are better incorporated (stubble mulching) not to lose valuable nutrients (Nitrogen). In general, mulching and crop residues managements would be difficult under the Dry Zone conditions as these materials are badly needed

to supplement the short fodder feed supply during the dry season or use for cooking or sold for extra income. Since the application of organic fertilizers is laborious in nature, labor shortage has affected the adoption of all the organic fertilizers application. Due to the reduction of the woody biomass because of deforestation force, farmers use more of their crop residues for fuel. Other residues are used for livestock. Because livestock farming is mainly a complementary activity to all farming and cropping system in the Dry Zone areas. Ruminants not only provided main traction-power but also manure for improvement of soil condition and sustainable agriculture. It is clear that the introduction of biological measures such as dry mulching or stubble mulching is hampered by such constraints and thus of very limited or impossible application.

Therefore, among the sampled responds, 88 farmers are using crop residues, 62 farmers were adopted to use compost and 25 farmers were adopted to grow green manuring for soil conservation. The adopters of crop residues application for soil conservation are the highest among the three practices. This adopter percentage is over 50 per cent. However, their amount used is still low. But the adopters of compost making and green manuring growing were only 37.6 per cent and 15.1 per cent. The application of crop residues may be easier than the other two. The other two applications had some more limitation. Compost making is a labour intensive technology and is unlikely to be adopted by households with limited labour supply. The other limitation for using compost may be time consumption, lack of knowledge making the compost, no space to make this and laborious. The limitation for growing green manuring may be labour and time consuming and not giving particular good response in terms of yield increments under the Dry Zone conditions, especially

during the first year. Farmers may be reluctant to use legume produced biomass for manuring purposes instead for animal feed.

Therefore, fodder is very important in using crop residues for soil conservation. Extension activities are also vital role for the improvement of farmers' knowledge related on soil conservation practices using organic materials, especially compost and green manure. Total farm size is also an important factor for the use of organic materials for soil conservation. Suitable cropping patterns with irrigation systems are important leading to adoption of organic materials for soil conservation.

Among the three conservation practices, compost application is the most effective on crop yield. Crop residues application is the second most effectives and green manuring is at least. All of them cannot have the impact directly on crop yields because these practices tend to improve the soil fertility. If the crops are grown on the good fertility soil, the crops' yield will be increased. However, this impact on crop yields depend on the amount of usage, weather condition (rainy or summer), chemical contents of them, source of crop residues and other cultural practices. Therefore, it is difficult to tell the directly effect of them on crop yields. The advantages of these practices are stable yield, soil physical improvement and fertility improvement for long term sustainability. Moreover, the effect of these applications can not much have on the dry condition like the wet condition because the decomposition process is more difficult and slower effect to crops yields than that of submerged condition. Although these applications are not directly effect on the crop yields, farmers should follow these practices in order to improve the soil fertility, to maintain and improve the soil physical and chemical properties for long term sustainability. Table 6.1 summarizes effects on soil and yields of these three conservation practices.

Table 6.1 Summary of effects on soil and yield for three conservation practices

Conservation practices	Major Cropping systems		Effect on yield	Effect on soil	Contribution of social characteristics
Crop residues	Oil seed crops	Sesame	Low	- Increasing soil organic matter - Prevention from wind and water erosion - Maintaining and improvement of soil physical properties for long term	- Larger farm size - More sandy soil type - Higher farm income
		Groundnut	Medium		
	Legumes	Green gram	Medium		
		Pigeon pea	Low		
		Cow pea	Medium		
Compost	Oil seed crops	Sesame	Medium	- Maintaining soil organic matter - Good soil aeration - Increase water holing capacity - More sticky sandy soil - Adjust soil pH - Maintaining and improvement of soil physical properties for long term	- Older age - Higher education - Higher knowledge - More times of extension workers visit
		Groundnut	Medium		
	Legumes	Green gram	Medium		
		Pigeon pea	Medium		
		Cow pea	Medium		
	Cereal	Rice	Good		
Green manure	Oil seed crops	Sesame	Medium	- Increasing soil organic matter - Improvement of soil fertility - Suppression of weed - Reducing of soil drying - Maintaining and improvement of soil physical properties for long term	- Larger farm size - Good irrigation access - More times of extension workers visit
		Groundnut	Medium		
	Legumes	Green gram	Good		
		Pigeon pea	Medium		
		Cow pea	Good		

Source: Survey data (2010)