CHAPTER III

RESEARCH METHODS

In the central plains of Myanmar, gradual degradation of soil fertility through soil erosion is occurring. Moreover, Dry Zone farmers applied a very little amount of organic fertilizers and inorganic fertilizers into their fields for soil conservation and fertility improvement. This may also lead to favor soil erosion because the soils in this area are mainly sandy with low organic matter content. Due to natural erosion and with the declining inputs, organic and inorganic materials, it is subjected to severe soil degradation. Consequently, agricultural productivity is decreasing annually. Therefore, the Dry Zone farmers need to cope with soil fertility degradation by developing alternative strategies that include the use of organic residues, inorganic fertilizer, and crop rotation. However, the farmers rarely adopt organic materials for soil conservation. Therefore, this study was carried out with the main objective to determine factors affecting soil conservation measures using organic materials in the study area through the following research methods.

3.1 Site selection

Field survey was conducted in Magway division, Dry Zone area of central Myanmar. Because among the central plains of Myanmar, the worst soil degradation affected regions are Mandalay, Sagaing and Magway divisions. Among them, Magway division is a high level of erodibility because of sandy top soil there. The amount of crop residues used as fuel is also the highest in Magway division.

According to the high level of erodibility and high utilization amount of crop residues as fuel, soil conservation measures play vital role in Magway division. Besides, most of biophysical and socio-economic characteristics are typical and representative for the whole area of Dry Zone. It has an area of 9,592 sq km and is situated between north latitude 19° 36' and 20° 55' and between east longitude 94° 42' and 95° 50' with 402 m average altitude. There are six townships (sub-districts) namely; Magway, Yenanchaung, Chauk, Natmauk, Myothit and Taungdwingyi. Among six townships, Magway township, which has large cultivated crop area, was selected as the study area (Figure 3.1). The oil-seed crops mainly sesame and groundnut are cultivated in Magway township.

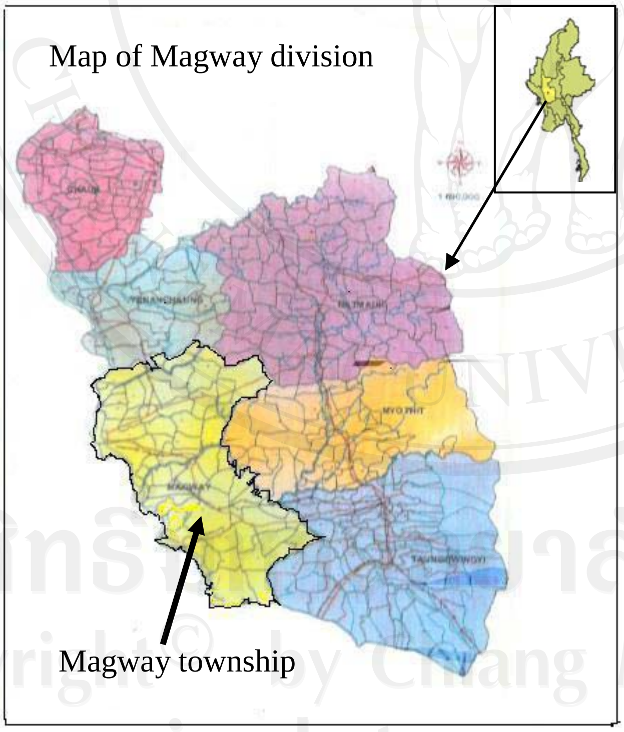

Figure 3.1 Location of study area, Magway township, Myanmar.

Source: Department of Myanmar Agriculture Service, Magway division (2010)

3.2 Sampling technique

Firstly, Magway division that represents the general situation of the Dry Zone area of Myanmar in terms of geographic and socioeconomic conditions as well as farming practices was selected through purposive sampling.

Secondly, Magway township from this division was selected according to the criteria for the selection of the study area. There are 214 villages. Among them, five villages were selected according to the cropping patterns such as oil seed-legume, oil seed-cereal and oil seed-vegetable cropping patterns.

Finally, a simple random sampling method was adopted to select farm household heads for the questionnaire survey. At least thirty household heads from each village were selected. A total of 165 farm household heads cultivating oil seed crops-based farming were randomly selected from the study area. Table 3.1 shows the distribution of sampled households by the cropping patterns. Note that a household could adopt more than one cropping pattern.

Most of the sampled farmers were growing the crops under rain fed condition. Among the sample farmers, 88 farmers used crop residues, 25 farmers used green manure and 62 farmers used compost for soil conservation.

Table 3.1 Distribution of sampled households by the cropping patterns

Cropping patterns	Number of households
Sesame-sesame	4
Sesame-groundnut	100
Sesame-green gram	125
Sesame-sorghum	61
Sesame-cowpea	37
Sesame-onion	5
Groundnut-sesame	53
Groundnut-sunflower	5
Groundnut-niger	5
Groundnut-groundnut	6
Groundnut-green gram	40
Groundnut-sorghum	70
Groundnut-cowpea	28
Groundnut-onion	5
Groundnut-chili	5
Sorghum-groundnut	2
Rice-rice	74

Source: Survey data (2010)

3.3 Data collection

Both primary and secondary data were use in this study.

3.3.1 Primary data

The primary information was gathered through a household survey, focus group discussions, and interview with key informants. Data were collected from 165 respondents through personal interview using a set of structured questionnaires in Magway township on April to May 2010. State managers, township managers, township extension agents and representative farmers cultivating the oil-seed crops were chosen for interview. The data included the personal factors (age, education, experience and ethnic group), economic factors (farm income, off-farm income, farming status, land tenure and cattle owned), bio-physical factors (soil fertility, soil type, slope types, farm size, water scarcity, irrigation access, the amount of crop residues used as fodder, the amount of crop residues used as fuel and soil erosion), technological factors (farmers' knowledge, cropping intensity, extension visit, demonstration by extension workers and types of crop grown) and the problem and constraints faced by the farmers in using organic materials for soil conservation.

3.3.2 Secondary data

The relevant secondary data was collected from different government agencies such as Myanmar Agriculture Service (MAS) from Magway division, the statistical yearbook and documents provided by Ministry of Agriculture and Irrigation (MOAI) and other relevant organizations (including UNDP and others non government organizations).

3.4 Data analysis

3.4.1 Adoption model

The logistic regression was used to determine factors affecting adoption on soil conservation measures using organic materials because the dependent variable was dichotomous (0, 1) for each group of non-adoption of the soil conservation using organic materials (0); namely application of crop residues (CR), cultivation of green manure (GM), and application of compost (CP) and adoption of the soil conservation using organic materials (1). The model was estimated using the maximum likelihood method of SPSS 16 software. To focus on farmers' adoption of the soil conservation using organic materials, the empirical model for this technology is specified as follows:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n + e$$

$\ln\left(\frac{P_i}{1-P_i}\right)$ = the natural log of the probability of the applying each soil conservation measure (P_i) divided by the probability of not applying each soil conservation measure ($1- P_i$)

β_i = coefficient

X_i = independent variables (Table 3.2)

e = error term

There are three dependent variables as follows;

Y1 (Application of crop residues): If farmers adopt, Y1 = 1, if not adopt, Y1 = 0

Y2 (Application of compost): If farmers adopt, Y2 = 1, if not adopt, Y2 = 0

Y3 (Growing green manure): If farmers adopt, Y3 = 1, if not adopt, Y3 = 0

Each dependent variable was tested independently against the proposed explanatory variables (Table 3.2).

Table 3.2 The proposed explanatory variables and measurements

Explanatory Variables	Description	Hypothesized signs		
		CR	CP	GM
Personal characteristics				
AGE	Age of household head (year)	+/-	+/-	+/-
EDU	Education of household head (year)	+	+	+
FEXP	Farming experience of household head (year)	+	+	+
ETG	Ethnic groups (Native = 1, immigrant = 0)	+	+	+
Economic factors				
FARMIC	Farm income (Kyat / year)	+	+	+
OFFFARMIC	Off-farm income (Kyat / year)	+	+	+
FARMSTAT	Farming status (Full = 1, part = 0)	+/-	+/-	+/-
LTEN	Land tenure (Own = 1, tenant = 0)	+	+	+
CATTLE	Numbers of cattle (Numbers)	-	+	-
Bio-physical factors				
SOILF	Soil fertility (Good = 1, poor = 0)	-	-	-
SOILT	Soil type (Sandy = 1, no = 0)	+	+	+
Slope type (high slope as base)		+	+	+
SLOPE 1	Dummy 1 if 0-2% slope = 1, 0 otherwise	+	+	+
SLOPE 2	Dummy 2 if 2-5% slope = 1, 0 otherwise	+	+	+
TOTALFS	Total farm size (Acre)	+/-	+/-	+/-
WATERSC	Water scarcity (Scarcity = 1, no = 0)	-	-	-
Irrigation (no access as base)		+	+	+
GOODIRRI	Dummy 1 if good access = 1, 0 otherwise	+	+	+
PARTIALIRRI	Dummy 2 if partial access = 1, 0 otherwise	+	+	+
FODDERUSE	Amount of crop residues used as fodder (Ton / year)	-	-	-
FUELUSE	Amount of crop residues used as fuel (Ton / year)	-	-	-
Soil erosion		+	+	+

(low erosion as base)				
SOILE 1	Dummy 1 if high erosion = 1, 0 otherwise	+	+	+
SOILE 2	Dummy 2 if medium erosion = 1, 0 otherwise	+	+	+
Technological factors				
KNOWLEDGE	Farmers' knowledge (Score)	+	+	+
CI	Cropping intensity (Index)	+	+	-
EXTVISIT	Times of extension visit (Time / year)	+	+	+
EXTDEMON	Extension demonstration (Yes = 1, no = 0)	+	+	+
Types of crop grown (oil seed-vegetable as base)		-	+	+
OILLEG	Dummy 1, if oil seed-legume = 1, 0 otherwise	+	+	+
OILCEREAL	Dummy 2, if oil seed-cereal = 1, 0 otherwise	-	+	+

The collected data (both qualitative and quantitative) were firstly entered into the Microsoft Excel program. Then, the data were re-entered into the Statistical Packages for Social Science (SPSS) 16 software. Actual farm data were analyzed by descriptive analysis and logistic regression model using Statistical Package for Social Sciences (SPSS) 16 software.

Descriptive analysis such as percent, mean, standard deviation value and index was applied to describe the socio-economic profile of farmers such as farmers' personal characteristic, economic characteristics, biophysical characteristics and present farming technology, existing farming practices of the sampled farmers cultivating oil seed crops in the study area.

To determine farmers' knowledge on soil conservation measures using organic materials in the study area, the farmers were asked and the farmers' knowledge were scored by asking about 13 questions relating to the soil conservation measures, soil degradation and erosion status. The score range on each question regarding knowledge of farmers was between the maximum score 11points score and the minimum 0 point score. Thirteen questions to determine farmers' knowledge on soil conservation, soil degradation and erosion status were as follows;

1. Do you know your field's soil condition? (total 5 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, how do you classify it?

□ Soil color □ Water holding capacity □ Ease of tilling

□ Stickiness or loose soil □ Soil type

2. Are you aware about the soil erosion in your field?

□ (Yes) 1 score □ (No) 0 score

3. Do you know which factors affect to lead soil erosion in your field? (total 2 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, which factors are they?

□ Wind □ Water

4. Have you ever seen any types of erosion form in your field? (total 3 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, which types are they?

□ Rill □ Sheet □ Gully

5. Do you think it is difficult to land preparation in severe soil erosion field? (total 2 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, why do you think it?

□ Loss of upper soil layer and appear hard bottom soil □ Stoniness

6. Do you know the effects of soil erosion? (total 4 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Low soil fertility □ Declining agricultural land productivity

□ Low crop yield □ Lead to food insecurity

7. Did you try to reduce the soil erosion problems in your field? (total 4 scores)

□ (Yes) 1 score one correct answer □ (No) 0 score

If yes, how did you do it?

□ Using crops residues □ Contour tillage

□ Growing cover crops □ Growing wind break

8. Do you know the causes of land degradation? (total 5 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Water erosion (run off) □ Water logging □ Wind erosion

□ Salinization □ Alkalinization

9. Do you know the advantages of the application of crop residues and green manuring ? (total 11 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Increase water infiltration rate □ Reducing of soil drying

□ Increase the total amount of nutrients added □ Maintain more moisture

□ Prevention from wind and water erosion □ Weed suppression

□ Increasing soil organic matter □ Good soil aeration

□ Reduction of soil temperature □ Maintenance & improvement

□ Increasing of microbial activity of soil physical properties

10. Do you know the advantages of the application of FYM and animal manure? (total 7 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Maintaining soil organic matter □ Good soil aeration

□ Supply nutrients, esp. N, P & K □ Increase water infiltration rate

□ Increase water holding capacity □ Decrease bulk density

□ Stimulate the activities of soil macro fauna & microorganisms in soil

11. Do you know the problems of post harvest plowing in sandy loan soil? (total 4 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Wind erosion □ Water erosion

□ Nutrient losses □ Soil drying

12. Do you know the advantages of legumes intercropping with other crops? (total 6 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Maintaining soil fertility through N_2fixation □ Weed suppressing

□ Reduce soil temperature □ Reduce soil & water erosion

□ Prevent the exhaustion of nutrients from the same root zone □ Maintain soil moisture

13. Do you know the advantages of rotation with legumes? (total 4 scores)

□ (Yes) 1 score for one correct answer □ (No) 0 score

If yes, what are they?

□ Maintaining soil fertility through N_2fixation □ Recovery of deep nutrients

□ Addition of organic material to the soil □ Break the pests & diseases cycle

Upon their answers to the questions, the total score across 13 items is ranged from 0 to 58. The class interval was calculated by the class interval of Harshbarger (1977) as the following formula;

$$\text{Class} = \frac{\text{The highest score} - \text{the lowest score}}{\text{The number of levels}}$$

$$= \frac{58 - 0}{3}$$

$$= 19.3$$

The interval range of a high score level = 58-39

The interval range of a medium score level = 38-20

The interval range of a low score level = 19-0

The cropping intensity index (CII) was calculated by using the following formula (Menegay, 1975).

$$\text{CII} = \frac{\text{Total cultivated area of the number of crops}}{\text{Available cultivated land}} \times 100$$

3.4.2 Hypotheses

The explanatory variables can affect the adoption of the soil conservation using the organic materials. The hypotheses for the study are as follows:

The main hypothesis for farmers' decision to adopt or reject the soil conservation measures using organic materials is influenced by the combined effects of the personal characteristics, economic factors, bio-physical factors and technological factors. There are sub-hypotheses to affect the decision to adopt the soil conservation practices by application of organic materials.

a. Personal factors

1. As a farmer get older, it is reasonable to assume that he pays less attention to long-term investment and hence may be more interested in short-term agricultural activities. Younger farmers may be more educated and more involved with current innovation farming activities and thus more awareness of soil erosion problems and available solutions. On the other hand, the older farmers are more likely to try the beneficial technologies as they are rich with more resources than younger farmers.

   Hypothesis (1)

   Farmer's age is negatively or positively related to adopt all soil conservation practices.

2. Education is an important tool governing the decision-making process in soil conservation. Education is assumed to be associated with access to new information on consequences of soil erosion and conservation measures.

   Hypothesis (2)

   Farmer's education level is positively related to adopt all soil conservation practices.

3. Farmers who have been involved in agricultural activities in their own land for a long time period may know the productivity impact on soil erosion. Therefore, a positive relationship is assumed to exist between the adoption to apply soil conservation and the experience in agricultural activities.

   Hypothesis (3)

The farmer's experience in farming activities is positively related to adopt all soil conservation practices.

4. The farmers who are native can know about the soil erosion and their field conditions than the farmers who are immigrant.

   Hypothesis (4)

   Ethnic group is positively related to adopt all soil conservation practices.

b. Economic factors

A number of economic factors are considered in this study. These are farm income, off-farm income, farming status, land ownership and cattle owned.

1. If farm income is low, lower income farmers are usually more concerned with short term survival than with the long term benefits of soil conservation. Higher income farmers are usually more concerned for long term survival. Soil conservation practices by using organic materials are slow effect and long term benefit of soil conservation.

   Hypothesis (1)

   Farm income is positively related to adopt all soil conservation practices by using organic materials.

2. If the farmers with higher off-farm income are less likely to be financially constrained to adopt the organic soil conservation measures because they can get lesser yield than the yield using the chemical fertilizer. Unless they have the off-farm income, they do not want to adopt the organic materials in order to ensure that the yield may be high.

   Hypothesis (2)

Off-farm income is positively related to adopt all soil conservation practices.

3. Farming status will be expected to have a differential impact on adoption of soil erosion and conservation practices. Full-time farmers are expected to be more aware of the soil erosion problem than part-time farmers because they spent longer period on the farm. However, full-time farmers do not have a diversified income and therefore they may perceive a greater risk of investing in soil conservation practices.

   Hypothesis (3)

   Farming status may be either positively or negatively related to adopt all soil conservation practices.

4. Farmers who own their land are expected to be more likely to adopt soil conservation and expend more conservation effort than those who do not own their lands.

   Hypothesis (4)

   Land ownership is positively related to adopt all soil conservation practices.

5. If farmers own more cattle, they want to adopt the soil conservation by making compost using the farm yard and animals manure because they have enough the cattle manure. Unless they have cattle, they cannot use. On the other hand, farmers do not want to use crop residues and to grow green manure if they have a numbers of cattle because they want to use these crop residues for fodder.

   Hypothesis (5)

   The number of cattle owned is positively related to adopt the soil conservation practices applying compost but this is negatively related to adopt the two others soil conservation practices; crop residues and compost application.

c. Biophysical factors

Bio-physical factors relate to influence on the physical production process associated with farming. The variables chosen to represent bio-physical factors are soil fertility, soil type, slope types of farm land, farm size, water scarcity, irrigation access, amount of crop residues used as fodder, amount of crop residues used as fuel and status of soil erosion.

1. If the soil fertility is good, the farmers do not care the conservation practices. If the soil fertility is poor, the farmers concern on the soil conservation practices in order to improve their soil fertility status.

   Hypothesis (1)

   Soil fertility is negatively related to the adoption of all soil conservation practices.

2. If the soil type is sandy, farmers want to do some soil conservation practices in order to improve their soil structure improvement and in order to prevent soil erosion from wind.

   Hypothesis (2)

   Soil type is positively related to the adoption of all soil conservation measures.

3. There are three slope types: 0-2 %, 2-5% and > 5% slope. Slope type (1): 0-2% slope is fairly flat and suitable for farming of many different types of crops and generally requires no improvement. Slope type (2): 2-5% slope has a flat to gentle slope. Slope type (3): > 5% slope, is quite steep and

classified as marginal land. It is assumed here that these three classes are directly related to the soil erosion potential of a given piece of land. Therefore, if the farmers are more likely to perceive the soil erosion and undertake soil conservation measures effort the steeper is the slope of their land.

Hypothesis (3)

The slope percent is expected to be positively related to adopt all soil conservation practices.

4. Farmers with less farm size may be expected to have greater levels and increased quality of management, which implies that they are more likely to perceive the problem and take conservation action. On the other hand, if they own enough lands, they can grow different kinds of crops and they can use their crop residues in different ways.

   Hypothesis (4)

   The area cultivated will have a positively or negatively effect on perception of soil erosion problem and conservation adoption.

5. If the water is scare in the field, farmers do not want to adopt the soil conservation by using the organic materials because water is needed to decompose the organic materials and to grow the crops, especially the green manure.

   Hypothesis (5)

   Water scarcity is negatively related to adopt all soil conservation practices.

6. If farmers can access irrigation, the farmers want to adopt the soil conservation practices by using organic material because water is needed to

decompose the organic materials and to grow the crops, especially the green manure.

Hypothesis (6)

Irrigation access is positively related to adopt all soil conservation practices.

7. If the fodder is scare, farmers do not want to adopt the soil conservation practices by using the crop residues because they want to use crop residues for fodder of cattle.

   Hypothesis (7)

   Amount of crop residues used as fodder is negatively correlated to adopt all soil conservation practices.

8. If the fuel is scare for cooking, farmers do not want to adopt the soil conservation practices by using crop residues because they want to use the crop residues for burning to cook.

   Hypothesis (8)

   Amount of crop residues used as fuel is negatively related to adopt all soil conservation by using the crop residues.

9. If the farmers are aware the extent of soil erosion problem in their fields, they will be to adopt the soil conservation practices.

   Hypothesis (9)

   The extent of soil erosion problem in the fields is positively related to adopt all soil conservation practices.

d. Farmers' knowledge

1. If farmers can gain some knowledge about the soil erosion condition and soil conservation practices by using organic materials and technologies from the

extension workers and other sources, they may have more knowledge about this and they can know the advantages of the organic materials for their fields. If they have more knowledge, they want to adopt the conservation practices by using organic materials.

Hypothesis (1)

Farmer's knowledge is positively related to adopt all soil conservation practices by using organic materials.

e. Cropping intensity and types of crop grown

1. If cropping intensity is high, the farmers want to adopt some conservation practices by using crop residues because they may have a lot of crop residues as they grow more crops and they can use for diversify purposes. However, there is less chance to grow green manure if cropping intensity is high.

   Hypothesis (1)

   Cropping intensity is positively related to adopt some soil conservation practices such as crop residues and compost application but negatively related with green manuring.

2. Conservation decisions are closely linked with crop diversity. Depend on the types of crop grown; the farmer's opinion for adoption of using organic materials in soil conservation may be different.

   Hypothesis (2)

   Types of crop grown may be positively or negatively related with soil conservation using organic materials.

f. Extension Activities

1. Extension agents' field visit is a proxy to access the new technology and skill. So, if extension agents often visit to field, the farmers get the new and good technologies to improve their farming status and they want to adopt the new and good technologies.

   Hypothesis (1)

   The time of extension agents' field visit is positively related to adopt the technology.

2. Field demonstrations are akin to "prototyping" a technology or process. The field trial objectively demonstrated the appropriateness of the technology, process, or innovation. If the field trial and demonstration are conducted by extension agents, the farmers will understand the benefit of technology and know what modifications and adaptation are likely to be needed for implementation the innovation to their own environmental problems and trials will help to achieve this.

   Hypothesis (2)

   Demonstration the technology is positively related to adopt the new and good technologies.