CHAPTER III

RESEARCH METHOD

Maize is cultivated mainly in Myanmar's Shan, Chin, Sagaing, Magway and Mandalay states and divisions, as a seasonal crop in monsoon and winter. Among them, Shan State is the major maize growing area covered with 38 percent (MOAI, 2009); and 44 percent of the total production comes from this State (CSO, 2006).

3.1 Site Selection

The selection of study area was based on the major maize area of both hybrid and local varieties being grown by farmers. This study was undertaken in Southern Shan State and reason for the selection of Taunggyi district in Southern Shan State as the study area is, it is the third largest State producing maize (17.1 percent of total maize production) in Myanmar. Within Taunggyi district, Yatsauk township and Pindaya township were selected as study sites (Figure 3.1). In this region, upland rice, maize and soybean are grown in rainy season and niger, wheat, groundnut, pigeon pea and other peas are grown in winter.

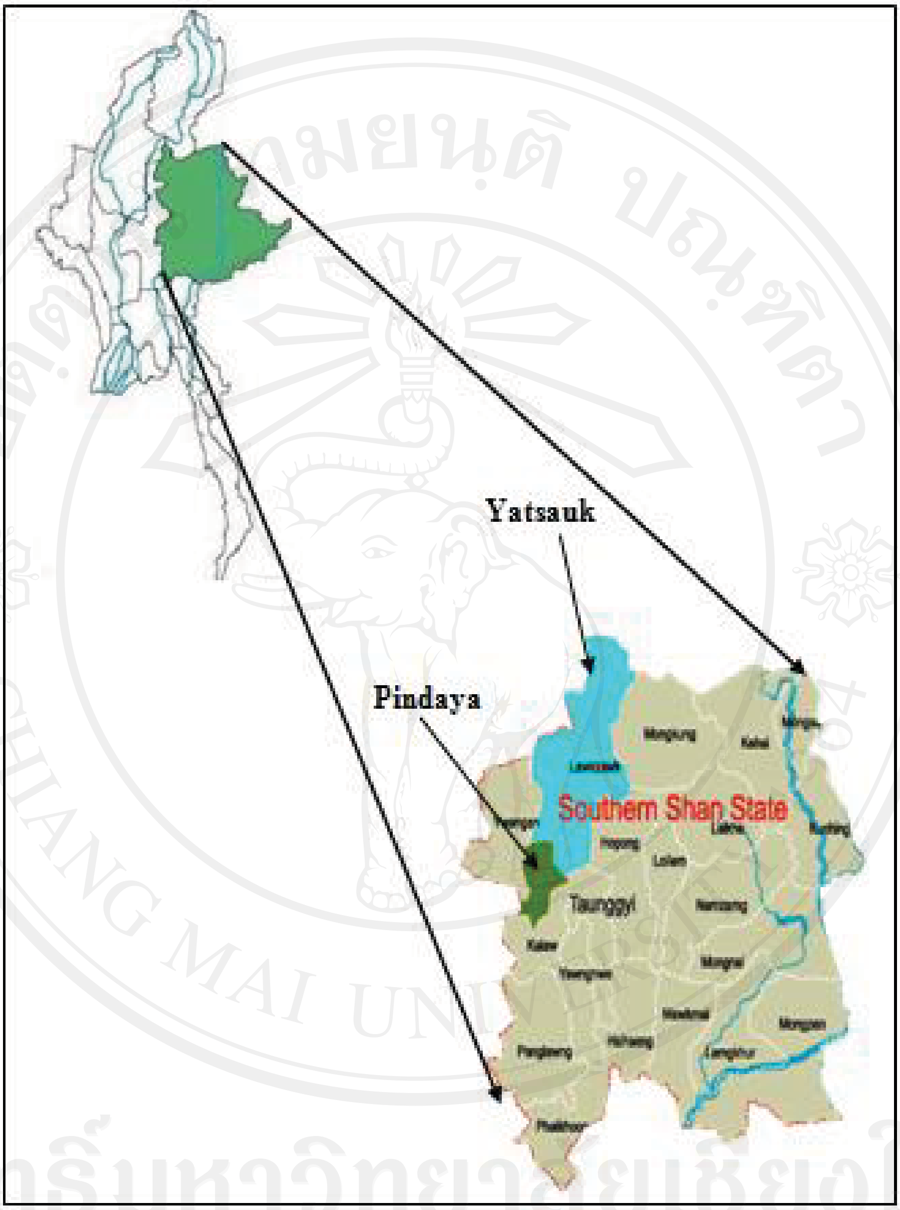

Figure 3.1 Location of study area, Taunggyi district, Myanmar

Source: Department of Agricultural Planning, Myanmar

3.2 Sampling technique

A two stage random sampling was used to select farmers for this study. Two townships where hybrid and local maize varieties were grown with chemical fertilizer use were selected. Moreover, two villages from each of these townships were selected purposively where farmers used chemical fertilizer in maize cropping system. Totally 167 farm households in maize cultivation were randomly selected from the target area for this study. There were 88 households in Yatsauk township and 79 households in Pindaya township were taken for my study. Thirty five out of 167 farm households did not use chemical fertilizers in the study area. In Yatsauk, three out of 88 farm households did not use chemical fertilizers and thirty-two out of 79 farm households did not use chemical fertilizers in Pindaya. Therefore, 79 percent used chemical fertilizers in maize cropping system in this study area.

3.3 Data collection

Data were collected from primary and secondary sources. Relevant information from maize based cropping system, profitability of maize cultivation and factors affecting the adoption of chemical fertilizers in maize were collected using the following methods as follows:

3.3.1 Secondary data

In order to get the most understanding of existing situation of maize, secondary data were gathered from published and unpublished information about maize in particular and the study area in general. This information was collected from Southern Shan State

Agricultural Office, Yatsauk and Pindaya township Agricultural Office, Department of Agricultural Planning, Central Statistical Organization, Department of Agricultural Research, Land Use Division, and Myanmar Agriculture Service.

3.3.2 Primary data

Primary data were collected from small scale farmers in Southern Shan State in 2009, by using a structured questionnaire and through interviewing farmers who were growing maize. State managers, township managers, township extension agents, farmer groups and representative farmers for the maize cropping system were chosen for interview. The collected data included socio-economic, biophysical and institutional characteristics, farmers' use of maize variety, problems and potentials, inputs, labor used in maize production, other operating systems and machinery used. Moreover, off farm income was also recorded. For the analysis, data were entered in spreadsheets and read in SPSS 16 for data analysis.

3.4 Data analysis

The data from semi-structured interview, formal survey and interview were analyzed using descriptive statistics as percent, mean, standard deviation values and index to compare the different characteristics of all factors in the adoption of chemical fertilizers in maize cropping system in study area in order to overcome the first objective.

To achieve the second objective, this study utilized the logit model because the dependent variable is dichotomous (0, 1) for the groups of non adoption of chemical fertilizer (0) and the adoption of chemical fertilizer (1); and the model is computationally simpler. To focus on farmers' adoption of fertilizer, the empirical model for this technology is specified as follows:

Y = f (X_i, ε_j)…………………………………….. Eq (1)

Where;

Y = dependent variable: 0 = not adopt fertilizer

1 = adopt fertilizer

X_i = REGION, AGEHH, EDU, LAND, EXPMAZE, LABOR, OFFIN, BORCAP,

FPER, EXTVST, MEMHH, CROPROT, OX, LIVESTOCK, ACIDPROB, VARIETY

These X_i variables are defined in Table 3.1. In this study, socio-economic factors, institutional factors and physical factors were considered in the analysis of factors related with the adoption of chemical fertilizers in maize;

(1) Socio-economic factors: Age, education, households' purpose of production, off farm family income, total land, maize growing area, years of experience in growing maize, variety, yield, number of oxen, livestock, and availability of adult family labor.

(2) Institutional factors: Extension officers' visit, field demonstration, membership of farmer organization and credit.

(3) Physical factors: REGION.

The vectors of explanatory independent variables are as follows:

Table 3.1: Definition of variables for adoption study

Variable	Description	Expected sign
REGION	Region (1 = Yatsauk, 0 = Pindaya)	+
AGEHH	Age of household head (years)	-
EDU	Education of household head (years)	+
LAND	Land area under maize cultivation (acres)	+
EXPMAZE	Years of experience in maize cultivation	+/-
LABOR	Availability of adult family labor (Members older than 14 years) (number/ hh)	+
OFFIN	Off farm family income (kyats/year)	+
BORCAP	Borrowed capital	-
FPER	Farmer's participation in field demonstrations (1= Yes, 0 = No)	+
EXTVST	Extension officers' field visit (1= Yes, 0 = No)	+
MEMHH	Membership of farmer organizations of HH (1 = Yes, 0 = No)	+
CROPROT	Crop rotation (1 = Yes, 0 = No)	-
OX	Oxen (1 = Yes, 0 = No)	-
LIVESTOCK	Livestock (1 = Yes, 0 =No)	+
ACIDPROB	Problems with the soil condition (acidity) (1 = Yes, 0 = No)	+
VARIETY	Variety (1 = Local, 0 = hybrids)	-

The above variables can affect the adoption of chemical fertilizers in maize and the hypotheses for the study are as follows:

(1) REGION: It is hypothesized that the region that has more accessibility, marketability and modernization will easily be adopted chemical fertilizers in maize production.

(2) Age of household head: It is hypothesized that, elder farmer will less likely to be adopted in chemical fertilizers. Younger farmers may have greater access to information and may have interest to take chance to use chemical fertilizers.

(3) Education of the household head: A higher level of education increases farmer's ability to obtain, process, and use adoption information of chemical fertilizers. Education thus increases the probability of adopting chemical fertilizers.

(4) Cultivated maize area: Farmers who possess larger areas planted to maize are better adopters of chemical fertilizer technologies.

(5) Years of experience in growing maize: The previous experience of farmers can be expected to either enhance or diminish their level of confidence. It is anticipated that with more experience, farmers could become risk-averse regarding the adoption of chemical fertilizers. Thus, this variable could have either a positive or a negative effect on farmers' decisions to adopt chemical fertilizers.

(6) Availability of adult family labor: It is hypothesized that the households who have large family labor can easily adopt chemical fertilizers in maize.

(7) Off farm family income: It can be hypothesized that there is a positive relationship between the adoption of chemical fertilizers and off farm family income.

(8) Borrowed capital: Farmers who borrow money are not likely to adopt chemical fertilizers. It is hypothesized that there is a negative relationship between the adoption of chemical fertilizers and borrowed capital.

(9) Farmer's participation in field demonstrations: If farmers participate in field demonstration, they will accept fertilizer adoption technologies, and it will be positively related with the probability of the adoption of chemical fertilizers in maize.

(10) Extension officers' field visit: Extension officers' field visit is a proxy to access to the technology (new skills) and; was expected to increase farmer's probability to the adoption of this technology.

(11) Households' membership of farmer organizations: Households' membership of farmer organizations was assumed to increase farmers' access to information on technologies and markets through interactions with other farmers within the community and in some cases; with the outside world, and therefore increase farmers' probability of adopting this technology.

(12) Crop rotation: It can be hypothesized that crop rotation is negatively related with chemical fertilizers adoption. Farmers who do not perform crop rotation may adopt this fertilizer application technology.

(13) Oxen: It is hypothesized that there is a negative relationship between chemical fertilizers adoption and oxen owned. Farmers who own oxen can apply manure by themselves to maize fields instead of chemical fertilizers.

(14) Livestock: Livestock is a proxy for the adoption of chemical fertilizers and it can be hypothesized that it is positively related with adoption technologies; because if farmers possess livestock, they can sell the livestock and can purchase chemical fertilizer to apply in maize fields.

(15) Problems with soil condition: It is also hypothesized that problematic soil condition may be positively related with chemical fertilizers adoption. Farmers who face soil problems in maize cultivation will apply chemical fertilizers in their field.

(16) Variety: It is hypothesized that there was a negative relationship between the adoption of chemical fertilizers and variety. If farmers use local variety, they will not be interested in chemical fertilizers to apply in maize field.

Factors affecting the adoption of chemical fertilizers were analyzed by using binary logistic regression and multinomial logit model.

To identify factors affecting probability of the adoption of chemical fertilizer application technologies in study area, a multinomial logit model (Nkamleu and Coulibaly 2000; Cramer 1991; Madalla 1983) was applied in this analysis. The advantage of multinomial logit is that it permits the analysis of the adoption decisions across various soil fertility management alternatives – allowing the determination of choice probabilities for different categories of soil nutrient management practices.

Instead of having two dichotomous (0, 1) alternatives as in the multi variate logit or probit models, the multinomial logit has S possible states or categories that is S = 1, 2, 3 . . . , S., – which are disjunctive and exhaustive (Cramer 1991). In the analysis of the adoption of soil nutrient management systems in this study we considered three categories, namely, 1) farmer uses low level use of chemical fertilizer, 2) medium level use of chemical fertilizer, and 3) high level use of chemical fertilizer.

To quantify the probabilities of significant factors affecting the decision to adopt fertilizer, the empirical model is as follows:

Z = f (X_i, ε_j) ……………………………………………………………Eq (2)

Where,

Z = 1 for low use of fertilizer

Z = 2 for medium use of fertilizer

Z = 3 for high use of fertilizer

X_i = REGION, AGEHH, EDU, LAND, EXPMAZE, LABOR, OFFIN, BORCAP, FPER, EXTVST, MEMHH, CROPROT, OX, LIVESTOCK, ACIDPROB, VARIETY

These variables are defined in Table 3.1.

In this study, low level of chemical fertilizer used was defined as using less than 82 kg ha^{-1}, medium level was 82.1 to 123 kg ha^{-1} and high level was greater than 123 kg ha^{-1}. The intervals were determined by examining $\overline{X} \pm$ SD where $\overline{X}$ is equal to average use of chemical fertilizers among the sample and SD is equal to the associated standard deviation obtained from the data. Model (2) is used for the estimation of the multinomial soil nutrient management model.

To complete the third objective, data on cost and revenue of maize production were analyzed by using gross margin to determine the profitability of three levels of chemical fertilizers use. Costs and returns were analyzed based on variable costs, including costs of human labor, animal power, seed, fertilizers, pesticides and insecticides, compost, rent on machinery, threshers and interest of operating capital. Cost of inputs were computed on the basis of market prices whether they were supplied from home or purchased. Gross return was determined based on reported crop yield and farm gate price (Kay and Edwards, 1999).

Gross margin for an item is the sales revenue obtained from the item sold, minus the direct costs of producing and selling the item. Direct costs are the variable costs. Therefore gross margin is a good indication of how profitable an enterprise is initially although, finally, fixed costs should be deducted. Family labor is hereby treated as fixed costs.

In this study, gross margin of farm households was used to measure the profitability of maize production in two Townships with special reference to borrowed money, use of family labor and chemical fertilizers application technology as follows:

$$\mathbf{GM} = \mathbf{GR} - \mathbf{TVC}$$

$$\mathbf{GR} = \sum_{i}^{n} Q_i P_i$$

$$\mathbf{TVC} = \sum_{j}^{n} P_j X_j$$

Where:

GM = gross margin

GR = gross revenue

TVC = total variable cost

P_i = the price of output P_i

Q_i = the quantity of output

P_j = the price of variable input j, and

X_j = the quantity of variable input j