CHAPTER III

RESEARCH METHODS

This chapter presents the description of study site, research area, methodologies used in data collection and analytical tools.

3.1 The study site

This study was conducted in Hambantota district, which is located in low country dry zone of Sri Lanka (Figure 3.1). It is one of the premier agricultural districts in south with more than 80% of people engaged in agriculture/livestock and agro-based industries. Among agricultural crops, paddy is the most dominant lowland crop occupying about 37,000 ha mainly under irrigated conditions fed by several major irrigation schemes; and it is one of the selected sites under the granary area programme. It was ranked as the third poorest district and the poorest coastal district of the island; recording 32% of its people as poor. The location of the district is, southeastern end of Sri Lanka between the latitudes 6^{o} 00' to 6^{o} 54' north and the longitudes 80^{o} 64' to 81^{o} 68' east. The total extent of the district is 2,609 sq Km; and it is 4% of the total land area of the island (Statistical Pocket Book, 2002).

The average annual rainfall shows somewhat skewed bimodal distribution pattern (October-January), with a distinct dry period of three to five months. Rainfall ranges between 1,000-1,200 mm, received mainly during maha season. District includes DL4 and DL5 agro-climatic regions, with some areas extending to the Intermediate Zone (1L2/1L3). The inland areas of the district are dominated by

reddish brown earth soil which is low in organic C content, which is one to two percent.

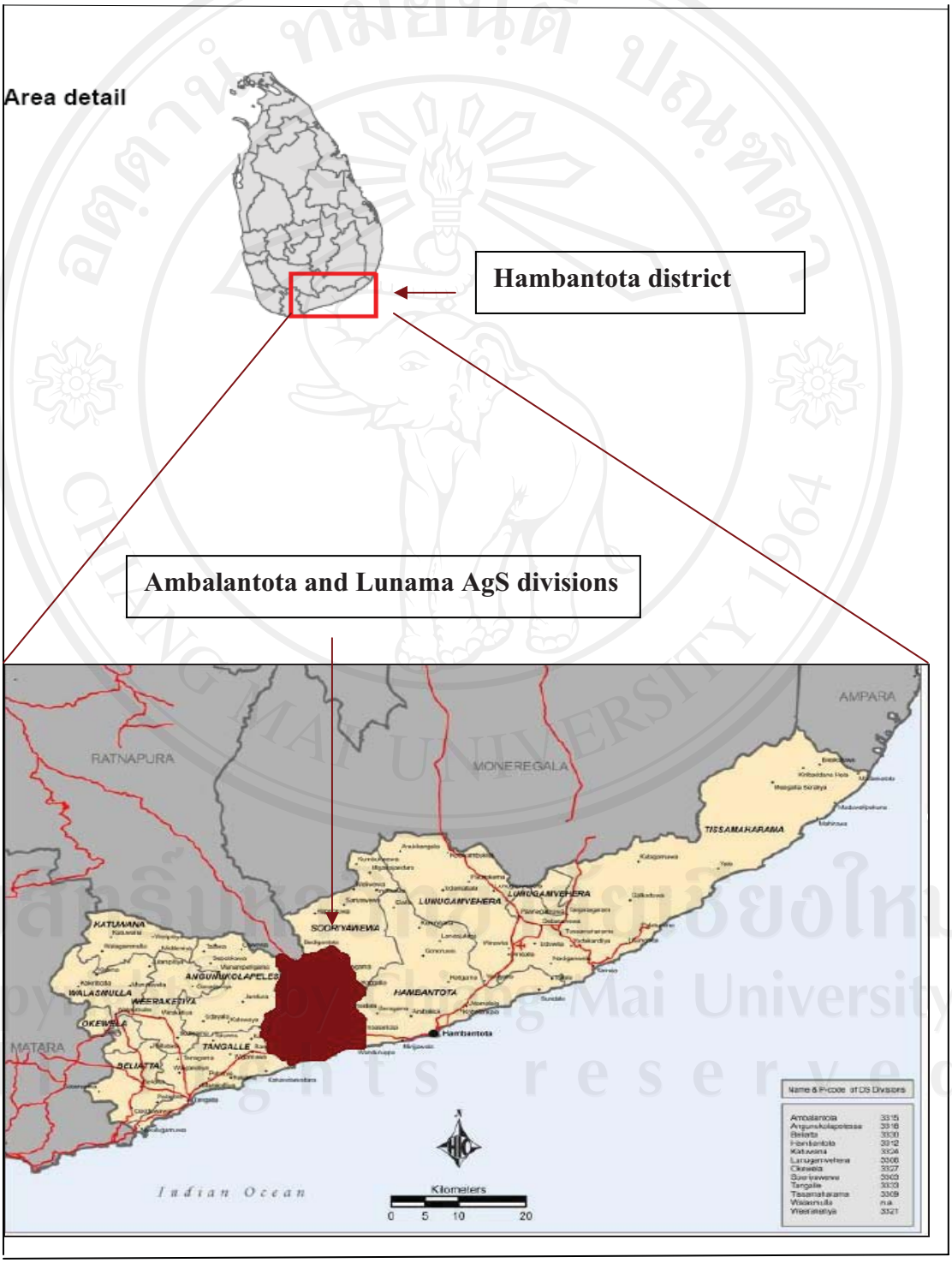

Figure 3.1: Location of the study site and research area

3.2 Research area

Following double stages random sampling technique; the study was conducted in two Agrarian service divisions (AgS divisions): Ambalantota and Lunama under major irrigation schemes of the inter-provincial area in Hambantota district. These two divisions are irrigated under Walawe irrigation scheme. Ambalantota AgS division, located at the left bank of Walawe River is irrigated through Ridiyagama reservoir; and Lunama AgS division located at the right bank is irrigated through the Liyangastota anicut. The AgS division Ambalantota is further divided into five agriculture instructors (AI) divisions namely Ambalantota, Beragama, Ridiyagama, Walawa and Koggalla; while the AgS division of Lunama is divided into Lunama, Mamadala, Deniya and Walawawatta AI divisions.

3.3 Data collection

Twelve respondents from each AI division in Ambalantota and fifteen respondents from each AI division in Lunama were selected randomly. Households were interviewed during May 2009 through a survey; using a semi structured questionnaire.

Primary data regarding farmers' adoption of nutrient management practices, costs and returns in paddy cultivation were collected from total number of selected 119 households. With reference to INM adoption; data were collected with regards to the application of rice straw, green manure, paddy husk charcoal and farm yard manure. Prices and quantity of inputs, labor and machinery costs, prices and quantity of the output with related to both 2008 yala and 2008/2009 maha seasons were collected for gross margin analysis.

Secondary data were collected from different sources such as government institutions, publications, reports, non governmental publications, research papers and also through key informant interviews.

3.4 Data analysis

Descriptive statistics, logit model and gross margin analysis were used to fulfill the first, second and the third objectives respectively. Statistical Package for Social Sciences (SPSS) and Microsoft Excel software were used for descriptive statistics and gross margin analysis. Independent t-test was performed for the comparison of two major categories of households. LIMDEP version 9 was used to estimate the parameters of logit model.

3.4.1 Descriptive statistics:

Descriptive statistics were used to summarize all of the variables to characterize nutrient management practices adopted by paddy cultivating households in two different AgS divisions and results were shown in tables and graphs.

3.4.2 Logit model:

The logit model was used to identify factors affecting to the adoption of INM practices. Following Zhou *et al*., (2008) the model will be defined as follows.

In deciding to adopt INM practices, it is assumed that households weigh the expected utility of wealth from adoption represented as U^*A (π), and the expected utility of wealth from non adoption represented as U^*N (π), where π represented wealth (net farm returns), and adoption occurs if U^*A (π) > U^*N (π), assuming that farmers are risk neutral.

The parameters of this decision are usually not observable, but can be represented by a latent variable

$U(\pi) = 1$ if $U^*A(\pi) > U^*N(\pi)$, and $U(\pi) = 0$ if $U^*A(\pi) < U^*N(\pi)$.

Dropping other subscripts for expositional purposes, utility of adoption $U(\pi)$ can be related to a set of explanatory variables X as:

$$U(\pi) = X_i \beta + \varepsilon_i \quad (1)$$

Where variables in X include characteristics of the household head, household, farm and off farm resource characteristics, trainings and extension contacts, β is a vector of parameters and ε is a random error term.

The probability of farmers' adoption of INM can be expressed as:

$$P(U=1|x) = P\_U^*A(\pi) > U^*N(\pi) \_ = P(\varepsilon_i > -X_i\beta) = 1 - F(-X_i\beta) = F(X_i\beta) \quad (2)$$

$$P(U = 1 \mid x) = F(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots\ldots\ldots + \beta_k x_k) \quad (3)$$

where F is the cumulative distribution function. Assumptions about the functional form of F result in different econometric models.

A logit model can be used to estimate the probability of households' adoption of INM practices.

The dependent variable U is binary: U takes value 1 if adoption occurred and value 0 if adoption did not occur. The logit model can be expressed as:

$$F(Z) = \frac{e^Z}{1 + e^Z} \tag{4}$$

The variable *z* is usually defined as

$$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k \tag{5}$$

Because the logit model is a nonlinear model, Equation (6) can be used to estimate the effect of one control variable on the probability of the response variable, where ΔP represented change in probability resulted by control variable x_1.

$$\Delta P = F\,[\beta_0 + \beta_1(x_1 + \Delta x_1) + \beta_2 x_2 + \ldots + \beta_k x_k] - F\,(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k) \tag{6}$$

Explanatory variables (*x*) including in logit model are presented in Table 3.1

Table 3.1: List of explanatory variables included in logit model

Variable	Description	Codes/Value
LAND	Total cultivated land extent	Acres (4000 m^2)
LD_OWN1	Type of land ownership	Dummy 1=tenant/leased 0=otherwise
LD_OWN2	Type of land ownership	Dummy 1=own+tenant/leased 0=otherwise
AGE	Age of the household head	Years
EDU	Education level of the household head (HH)	Years
MEMSP	HH membership in a farmer organization	Dummy 1=Yes 0=otherwise
TRAIN	Number of trainings participated by HH	No: of trainings/2years
LABOR	Household labor availability	Number of members (14-80 years)
INCOME	Household Income from other sources	Rupees/ month/ season
EXTEN	Number of extension contacts by HH	Number/season
MTD_H	Method of harvesting	Dummy 1=Mechanical 0=otherwise
PERCP	HH perception on organic fertilizer application (Need to apply for better results)	Dummy 1=Yes 0=otherwise
AGS_D	Agrarian Service Division	Dummy 1=Ambalantota 0=otherwise

Working hypotheses for this study with related to above variables are as follows,

- **Land extent:**

This represents the total land area under paddy cultivation of each surveyed household. In literature, it can be noticed that it affects the total cultivated land extent on technology adoption in two ways; either positively or negatively. So there was no agreement on the sign of this variable on technology adoption; and was included in the model to get a clear idea on its affection on the adoption of different nutrient management practices.

- **Type of land ownership**:

It was hypothesized that household ownership of the land stimulates paddy cultivating households' perception to follow INM technologies.

- **Age of the household head:**

The effect of age of the household head on technology adoption remains somewhat controversial in literature. So here it was included in the model to get a clear picture of the affection of age of the household head on nutrient management practices.

- **Education level of the household head**:

Education level was considered as an indicator of information that shapes management skills or simply human capital. It was hypothesized that with the amount of formal education, it increases farmers' ability to collect information and thereby to improve his / her knowledge on new technologies. Education was thus thought to increase the probability of the adoption of INM practices.

- **Household head's membership in a farmer organization:**

Farmers who have membership in a farmer organization may have a better access to information. Therefore it was expected to have a positive relationship with the adoption of INM practices.

- **Number of trainings participated by the household head:**

As a way of the access to technical training, number of trainings participated by the household head on organic fertilizer application within two years; was hypothesized to have a positive relationship with the adoption.

- **Household labor availability:**

With increased number of family labor, it was expected to encourage the probability of adopting INM practices.

- **Household Income from other sources:**

It was expected that farmers who were access to income from other sources were likely to invest on organic fertilizer application as well as chemical fertilizers.

- **Number of extension contacts of the household head:**

Technical advice provided by extension services is the major source to provide important technologies to farmers. Therefore number of extension contacts kept by the household head within a season was hypothesized to have an increased likelihood of adopting INM.

- **Method of harvesting:**

It was hypothesized that with mechanical harvesting with combine harvesters, it may promote the adoption of INM through easily spreading of rice straw in their fields.

- **Household head's perception on organic fertilizer application:**

It was hypothesized that paddy farmers' perception on the need of organic fertilizers for better performance; as a positive perception of the household head and it may lead to the adoption of INM technologies.

- **Agrarian Service Division**:

This variable was included in the model in order to identify the adoption differences in two studied divisions.

3.4.3 Gross margin analysis:

The "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 after variable costs have been deducted.

In this study, gross margin of farm households was used to measure the profitability of paddy production in two different AgS divisions with especial reference to the land ownership, use of family labor and nutrient management practices.

Profit over variable cost = GR – TVC

GR = Gross revenue,

TVC = Total variable cost

GR = Q P , P = the price of the unit of output, Q = the quantity of the output

TVC = $\sum PjXj$

Pj = the price of variable input j

Xj = the quantity of variable input j

Data were collected for all relevant cost and return items. Price was considered as the “farm gate” price; as almost all of the households in both AgS divisions were used to sell their paddy to the middlemen who visit their fields to buy the product. Gross revenue was computed multiplying the price of a unit of output by total amount of the output.

Cost of adding variable inputs to the production process were incurred only if they were used (such as: seed, fertilizer, machinery used, hired labor, opportunity cost of capital and opportunity cost of family labor etc.) (Kay and Edwards, 1999). Operating cost was computed by adding costs for the above variable inputs and the cost of hired labor and machinery. Total variable cost was computed by adding the above operating cost with the interest of working capital; it was taken as 5.5% annual interest for about four months period of a production cycle.

Farmers were found applying chemical fertilizers according to the recommendations of DOA and accordingly, they apply 125, 45, 35 Kg of urea, TSP and MOP respectively for one acre of paddy cultivation. This costs 1,435 rupees per acre. Gross margin also calculated under non subsidized condition, using market prices of the above chemical fertilizers under the above rate of recommendations.