Chapter 3

Research Methods

This chapter presents the conceptual framework used in the study, description of study site, methodologies used in data collection and analytical tools. There is an elaborate description of the methodologies used to collect data by mind mapping in informal survey.

3.1 Conceptual framework of the study

The problem identified for the research is the farmers adoption of soil conservation technologies in mid country steep lands of Sri Lanka. The study area consists of four highly degraded villages in mid country of Sri Lanka. Two main objectives were set in this study. The first objective is to find out the real picture about the soil erosion problem in study area and farmers perception on soil erosion problem. The second objective is to find out the factors affecting on farmers adoption of soil conservation. Informal interviews by mind mapping were done stratifying the farmers according to the slope and the soil conservation measures they adopted (Figure3.1).Combining the secondary information with the results of mind mapping made rich picture about the soil erosion problem and farmers perception. The factors affecting to the adoption were identified by formal interviews by structured questionnaires and analyzed by logit analysis using binary logistic analysis of SPSS and the results were discussed with combined the secondary information.

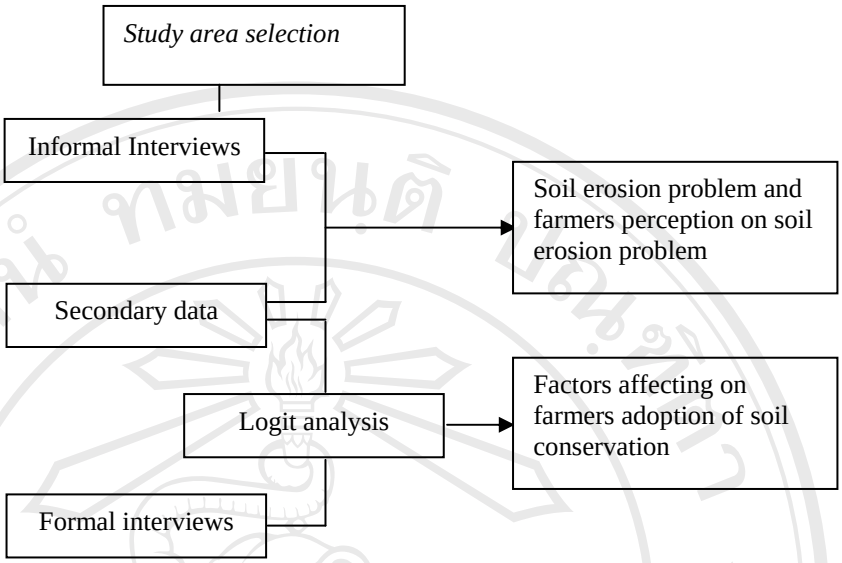

Figure 3.1 Conceptual Framework of the study

3.2 The study site

Four highly vulnerable degraded villages in the mid country intermediate zone of Sri Lanka were selected as the study sites (Figure 3.2). The prominent land use in this zone is short-term cultivations such as vegetables, tobacco and other field crops. The villages selected are Happugasyaya village belongs to Bowethene in Nalande AGA division (Matale District), Bopitiya village in Thalatuoya AGA division (Kandy District), Madugalle village belongs to Ududumbara AGA division (Kandy District) and Siyabhalakumbura village belongs to Walapane AGA division (Nuweraeliya District).

3.3 Research area

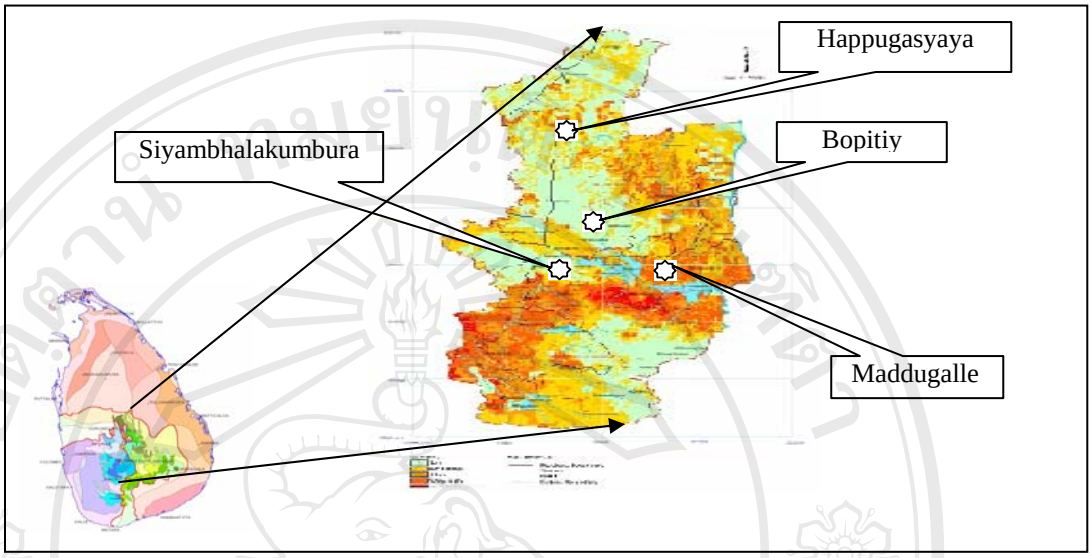

Figure 1.2 Research location of mid country intermediate zone and in Erosion Hazards Map of Central Province: Source NRMC (2002).

Happugasyaya village

Happugasyaya village is in Bowethene catchments in mid country intermediate Zone (IM3) agro ecological zone of Sri Lanka. This village is in Nalande AGA division of Matale district of central province. The village is above the Bowethene water reservoir. The steepness of these lands, and short-term cultivations during the rainy season of maha (October to December) experience the severe erosion and it directly affects the reservoir siltation. The farmers grow crops during the yala season during March to May because of the very limited rainfall. But in some cases they grow very little area of vegetables and other field crops where they can have the supplementary irrigation by wells.

Most of the lands near the reservoir are moderately steep around 5-12%. In some areas it is very steep slopes (about 25% or steeper). The moderate and flat lands are available where the farmers' houses locate. Reddish brown latosolitics is the most dominant soil group found in this village. According to Bandara (2001), Immature

Brown Loams (IBL), Mountain Regosols (MR), Low Humic Glay (LHG) and alluvial soils are also found in small extent.

The Happugasyaya village was under plantation crops in early nineties. The villagers are composed of mixed ethnic groups. Most of Tamil farmers now have their own land. The elders of this group have the skill to establish stone terraces and contour drains because earlier they worked as labors under the plantation sector. They can earn extra income by working on establishment of the stone terraces in others lands. When compare with the other three villages, this village has relatively good marketing facilities near by where wholesale market for the vegetables and other food items exist.

In the early and mid nineties the main crop grown in this area is rubber. There were large rubber and coconut plantations but they were changed to perennial crops especially export agriculture crops such as pepper, cocoa, coffee, and to the vegetables. Large extent of forest cover surround the hill tops of the catchments, but now was converted to short-term cultivations and over grazing of stray animals and also by the fires during dry seasons. About 60% of the farmers are landowners with the average land extent of about 0.25 ha per homestead. Very few were found to be the encroachers. Expansion of the land area for short-term cultivation is depending on the lease land area. Most of the landowners do not stay in the village and they do not normally concern about the land quality.

The government and non-government programs were launched in the village during the past ten years. For the flat areas they have recommended the earth bunds and the contour drains. Moderate and steep slopes were recommended to establish stone terraces and SALT. The most successful and popular measure is the stone terraces on steep slopes. Farm productivity in this village is not enough for the farmers for the whole year. Productivity depends very much on rainfall, if there is a dry spell during the rainy season, the consequence will be lower productivity and income from farm. Another problem is the price of the productions. During the December to April all the productions are reaching to the market. Sometimes they

cannot cover even the production cost. The quality of the production is not at the standard level. Poor quality of productions is the remarkable sign to show they grow in degraded lands. Due to the poor economic status the farmers' children are going for other jobs and some times they cannot continue their studies. The consequence is the unavailability of family labors for the constructions the conservation measures and the dependency of the off-farm income.

Another unavoidable situation is the drought. If there is the sudden drought during the October to December the income they expect from the farm fails. In this region they grow groundnut, chili, and all other dry zone vegetables as short-term crops. The distinct character of prominent soil group of Reddish Brown Latasolics is that it becomes very hard when soil moisture is low.

Bopitiya village

Bopitiya village belongs to the Talatuoya AGA division in Kandy district of central province. This is also a main vegetable growing area during the maha season. It is in IM1 agro ecological region and IM1*b* sub region. In most of the steep highlands farmers grow vegetables during the maha. The main vegetables grown are tomato, beans and cabbages, the major crop is tomato that is cultivated on 30-60% slops in maha rain. Most of the farmers are tenant farmers and they expand tomato-growing area but the adoption of soil conservation is very poor.

The hilltops are covered with pines forest. The farmers who live in Bopitiya village are not satisfactory with the pines plantation. Earlier the lands were covered with very dense forest with several kinds of indigenous species. There were non-wood forest products and many food species that provide support for the families. The rest of the area is under the short-term cultivations and during the off- seasons no crop can be grown.

The lands are on the moderate and steep slopes ranging from 10-60% covering with short-season crops. In valley bottoms paddy are grown during maha on the

terraced land. During the yala season farmers grow some vegetables where irrigation water is available. Their homes are confined to this valley bottoms and within the home gardens they have all kind of fruits, spices, coconut, vegetables and some forest trees. Prominent soil type is immature brown loam that is highly susceptible for the erosion. Landslides can occur during the rainy season. Stone terraces and the SALT are the most popular soil conservation measures. But during the off seasons SALT were easily destroyed by wild and stray animals and also die back of hedgerows due to the drought during the March to September. In this village land tenure is a main problem for adoption of soil conservation. More than 60% of farmers are leased holders.

The farmers are highly dependent on intensive farming, which require very high rate of chemical fertilizers. The pollution rate of the water streams near by cultivation area is in the unprecedented scale. Most of the farmers have livestock in their homesteads but the rate of application of organic manure is very low. This cultivation is almost commercial and very few cases of the traditional farming are found.

The farmers completely depend on the merchants who are dealing the vegetable market. Those merchants collect the products from the farmers in the village and sale in the wholesale vegetable markets. Farmers have to accept the amount they pay for the productions. Some of those merchants are the moneylenders who are providing informal credit facilities for the poor tenant farmers. Farmers settle the loans by providing the productions to the merchants.

The steep slope lands where farmers grow short-term vegetables are very sensitive to erosion and landslides. This condition is worsen by poor adoption of conservation measures, fires, practicing of clean weeding, up and down planting, application of high rates of artificial fertilizer and pesticides, and the poor maintenance of the soil cover. Whether they have perceived well the problem of soil erosion, they stated that practicing these because of the poor economic status. The remaining soils depth is only few inches and the quality become poorer each year.

The amount of fertilizers and chemicals use increase yearly and ultimate result is not only for the livelihoods in catchments but also for those who live down streams.

Maddugalle village

Maddugalle village locates in the mid country intermediate zone IM3 of the central hills of Sri Lanka. It is in Ududumbara AGA division in Kandy District of Central province. This village is also identified as a highly vulnerable region in mid country intermediate zone. Farmers' main income is growing tobacco and vegetables during maha season. Agriculture is mainly rain fed, most of the steep lands and hilltops are severely eroded by short-term cultivations and severely damaged by heavy run-off during maha. Another reason for soil erosion is no proper drainage system to drain out water during the heavy rain.

The area receives highest rainfall during the maha season by Northeast monsoon. The average rainfall is 1375 mm and the average day temperature is about 27 degrees centigrade. June to September period is very windy and dry. During the dry season they cannot grow short-term crops without irrigation facilities. Topography is steep and moderately steep with gentle sloping valleys as mix characteristics. Dominant slope is around 30-60%. At present very steep highlands are already degraded by tobacco and vegetable farming.

The available prominent soil types according to NRMC soil survey group are Immature Brown loams (IBL) and Reddish Brown Earths (RBE). Soil depth is limited to shallow to moderately deep. Surface soil texture is sandy clay loam and sub surface is gravelly sandy clay loam. Rock percentage is 0-10. Soil drainage is well drained. Home gardens in this village consist of mango, lime, banana, jackfruit, and oranges. This system is only confined to the homesteads. The forest which was covered with indigenous forest species but entirely destroyed by used for the fuel wood of tobacco barns. Few forest trees and fruit trees are available in the area where farmers grow vegetables and tobacco. The area with small shrubs was destroyed for the seasonal crops by burning of entire land. SALT system and stone terraces are the popular

conservation measures in steep slopes. Farmers prefer to establish contour drains in the moderate slopes. Before 1999 farmers raised the ridge and furrow system in up and down system. During the cultivation the temporary drains were established by keeping angle to the slope to drain out the excess water. This system was used for carrots and red onions. This practice caused large amount of soil erosion during the land preparation and harvesting. Farmers practice this system, in order to drain out water from the field to prevent root rot disease and yield loss by this problem.

National Agriculture Production Program of Department of Agriculture was started in 1999. The NRMC soil conservation unit was responsible for the productivity enhancement of degraded steep lands in mid country by introducing the suitable soil and water conservation measures from 1999-2001. Madugalle is one of the village NRMC selected to demonstrate the suitable soil conservation techniques using farmer participatory approach. Farmers were trained to establish ridges in contours and the excess water was drain off to the main drains. This system was introduced for carrots, red onions and groundnut. It was completely successful and during the periods of sudden droughts farmers were advised by technical officers to apply mulch between the ridges. After this introduction there was no more disease problem for the above crops. The required seeds, recommended dosage of fertilizers were provided as incentives for the farmers.

The farmers engaged with SALT hedgerow system for three years period of demonstration could realize the impact on conservation of the soil as well as the quality and quantity difference of the yield. Certain crop varieties being raised in the mulch of hedgerows expressed very good and healthy yield, eg: pumpkin, cucumber, corn and wing bean. The farm plots that have contour drain system nurturing by the Vetiver grass walls gave very good crop for the improved bean varieties introduced by the Horticulture Research Institute. During three years of demonstration period of NRMC, farmers realized that the introduction of proper soil conservation not only conserves the soil but also improves the quality of the productions and enhance the productivity of the land. The project provided the inputs which was necessary for farming as incentives for soil conservation.

There are about 120 Singhalease families living in Madugalle village. About 80% of them are farmers, and only 40% of them are landowners. The transport facilities and other facilities are limited with the long distance from the main road. Similar to Bopitiya village they have to depend on merchants for buying inputs and selling the productions. During the maha season they start this cropping by burning and clean weeding of the whole land areas as much as possible for growing crops to earn income that cover family expenses for the whole period of the year. Expansion of the area is limited by the land ownership, expenditure, destroy by the wild animals and labor problems.

The livelihoods in the village depend on income from farming. Eight years ago the main crop was tobacco, however, most farmers changed to vegetables due to poor land quality. At present few of them engaged in tobacco. The main problem in this village is the fluctuation of the prices of vegetables and difficulties during marketing of the productions. Most of the lands have been rehabilitated under the above program and soil conditions are improved.

Siyambalakumbura village

The village is in wallapane AGA division in Nuwara-eliya district of Central province. The agro-ecological zone is IM1 and IM1*b* sub zone. Normally the maha rains starts in this area by end of September. It's very heavy during the November to December. The village is heavily degraded by tobacco cultivation during the last ten years period. Compare with other three villages the soils are badly eroded and the farmers are very poor.

The area receives rainfall during maha from the northeast monsoons. During this period they grow several kinds of short-term crops. For the last four years of period they could not get much rainfall during the yala season. The farmers cannot make the use of the rainfall because the soils have low water holding capacity.

The lands are very steep and moderately steep with the slope of 30-60%. Even the homesteads also locate in very steep lands. The lands are highly vulnerable for the erosion. The available soil types are Immature Brown loams (Eutroperts) and Reddish Brown Latasols. Reddish brown latasolic soils are highly permeable. Clean weeding and burning creates very serious erosion during the maha rains.

Home gardens are not well developed. The farmers are not allowed to grow trees in the lands where they grow tobacco and short term crops. The crops grown in this lands are bean, bringal, chili, pumpkin, bitter guard, cabbages, cucumber and lufa. The crops are not healthy due to low input used in the production. Stone terraces, SALT and bench terraces were observed but the adoption of SALT is better than others. Bench terracing and SALT are promoting for the short-term cultivation, however, adoption is very low. The main problems behind this are land tenure problems and the poverty.

The farmers in this village are depending more on short-term farming. They go outside for casual work during the off seasons. They have very good transport facilities compare with Maddugalle and Bopitiya. Water scarcity during the dry season is another problem. Land tenure and lack of information, no credit facilities and facilities to buy inputs are other problems. They especially mention about difficulties to buy the recommended improved varieties and problems on selling productions. The people in this village are very poor and they depend totally on the degraded steep lands. Landslides and problem of the wild elephants are the natural hazards. Farmers usually hurt by the wild elephants during the nighttime when try to protect crops from wild animals.

3.3 Data collection

The field survey includes both the review of secondary information and collection of primary data through structured questionnaires. Soft system approach was employed to gain the rich picture of soil erosion in the studied watershed and the perception of farmers on soil erosion problem. The informal group meetings with

farmers were made, and used as a participatory workshop for creating the mind mapping on problems of soil erosion, adoption and non -adoption of each of the soil conservation measure. These workshops were stratified into two groups of farmers where lands are on the steep and moderately steep lands.

The formal interview was used for data collection to obtain inside of the farmer activities and to identify factors affecting the probability of adoption the overall soil conservation measures and the adoption of Steep Land Agriculture Technology (SALT), stone terracing and the contour drains. Stratified sampling was employed to select 150 respondents, from both steep slopes and moderately sloping lands. Twenty-five adopters were selected from the farmers who successfully established each soil conservation technology, while the non-adopter (25) farmers for each measure) are the ones who fail to maintain or abandoned the conservation measures.

Collection of data regarding the skill on soil conservation establishments was achieved with the support from the technical officers who monitor soil conservation work in each village.

Attitude is another important factor and the collection of data regarding this is very important. If the farmer is a tenant farmer, and is willing to establish and maintain conservation measures in others land, he is considered to have good attitude. For the farmer who has own lands, and willingness to spend for establishment of soil conservation measures, he is rated as having good attitude.

Data on soil erodibility were collected by technical team on sites. Several indicators were used to collect this information such as soil surface texture, structure, and permeability.

3.4 Data analysis

Mind mapping, descriptive statistics and logistic regression model was used for data analysis of the informal meeting and formal interviews respectively.

3.4.1 Mind mapping of the participatory work shop

The mind mapping is a very important soft system methodology we can use for problem identification. It is also called Fish bone diagrams and Ishikawa diagrams. The approach combines brainstorming with use of a type of concept map. The results of the mind mapping were constructed as diagrams to capture key components and linkages among key factors gathered. These workshops were stratified in two groups, farmers who cultivate on the steep and moderately steep lands. Brain storming was done among the groups of the farmers and within the groups in order to get good pictures. Most of the problems identified behind the situations were not expected. In some problems we allowed the farmers to link the problems in the board and they were arguing each other to finalize the answers. The results of these activities were drawn as mind maps for specific conditions regarding the adoption of conservation measures which will be elaborated in the next chapter.

3.4.2 Analysis of the formal survey data

Descriptive statistics was used to summarize all variables gathered to frame quantitative view of the farmers and their farm characteristics. Own tabulation of some variables was made to capture their relationships and presented as tables.

Binary logistic regression models were used to assess the factors affecting on adoption of soil conservation measures.

The logit model is based on the cumulative logistic probability function (Pindyck and Rubinfeld, 2001) and is specified as

$$P_i = f(\alpha+\beta x_i) = 1/(1+e^{-(\alpha+\beta xi)}) \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where

P_i = is probability that an individual will make a certain choice given x_i, ranging from 0 (non-adopter) to 1.0 (adopter)

e = is the base of natural logarithms and approximately equal to 2.718.

x_i = is a vector of explanatory variables, α and β are parameters of the model.

Explanatory variables include:

x_1 = Age: Age of the farmer respondent (Years),

x_2 = Family size: Family size of the farm household,

x_3 = Education: Number of years farmer studied in school,

x_4 = Stay: Length of stay in the village (Years).

x_5 = Skilled or not(Skill dummy):If the farmer has skill in establishment in conservation measures the dummy variable is1,and otherwise it is 0.

x_6 = Labor availability in the family: Number of labor units available.

x_7 = Tenure status (Tenure status dummy): If the farmer who operates farm has belonged the dummy variable is 1, otherwise it is 0.

x_8 = Incentives : How much money farmer receives as incentives for one meter of the soil conservation work.

x_9 = Technical Assistance :How often the technical officer come and give the advices.

x_{10} = Good marketing facilities (Marketing facilities dummy):If the farmer has good marketing facilities the dummy variable is 1, otherwise 0.

x_{11} = Area: total operated farm area (ha).

x_{12} = Average slope: Average slope of the farm lot (percent).

x_{13} = Erodibility 1:Dummy variable is 1 for low erodible soil and otherwise 0.

x_{14} = Erodibility 2: Dummy variable is1when the soil is moderately erodible and otherwise 0.

x_{15} = Road Access : Distance from the road (meters).

x_{16} = Soil fertility 1: Dummy variable is 1 for the fertile soil, and otherwise 0

x_{17} = Soil fertility 2:Dummy variable is 1 for the moderately fertile soil and otherwise 0.

x_{18} = Total annual farm income is total annual income from the farm.

x_{19} = Off- farm income is total annual income from off farm activities.

x_{20} = Availability of Credit: How much credits the farmer can obtain.

x_{21} = Framer's attitude toward soil conservation dummy: The dummy variable is 1 if his attitude is satisfactory and otherwise

The factors hypothesized to influence the decision of farmers on soil conservation were analyzed using a logit model. The model has the following functional form (Maddala, 1992):

$$Log\left(\frac{p_i}{(1-p_i)}\right) = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \qquad \text{--------} \quad \textbf{(2)}$$

Where, $Log\left(\frac{p_i}{(1-p_i)}\right)$ = Log-odds ratio (ratio for the probability for the adoption)

β_0 = Constant

β_I = Coefficients

p_i = Probability of adoption

$(1-p_i)$ = Probability of non-adoption

x_i = Independent variables

The dependent variable (log-odds ratio) in the model for identifying the factors determining application of the soil conservation measures to a specific field is the natural logarithm of the probability that the farmer applies soil conservation measures to field i (p_i) to the probability that the farmer will not apply soil conservation to his field ($_{1-}p_i$).