# CHAPTER II

# RESEARCH METHODOLOGY

## 2.1 Scope of the Study

The research study was carried out in the Chom Thong Forest Land Reform Area in Chom Thong District, Chiang Mai Province. The farmers were interviewed for the socio-economic and agricultural production data of 1989/1990. These farmers were those holding and those not holding farm land outside the Chom Thong LRA. The study also focused on those LR farmers who occupied the land with legumes, tobacco, tomato, rice, roselle and mango as the components.

## 2.2 Theoretical Framework

The farmers in the Chom Thong LRA have grown tobacco, tomato, soybean and other cash crops mainly for market. Therefore, the concept of profit maximization under some physical and biological constraints should be an appropriate assumption for the production management of these farmers.

Two theoretical frameworks will be presented and employed for this research. First, is to evaluate efficiency of resource utilization for crop production. Second, is to select an optimal farm plan that maximizes net return which also efficiently uses given farm resources.

### 2.2.1 A Production Function

Mansfield (1982 : 145) defines a production function as "... is the relationship between the quantities of various inputs and per period of time and the maximum quantity of the commodity that can be produced per period of time. ....The production function summarizes the characteristics of existing technology at a given point in time, .....". A production function can take several forms : linear, or non-linear, for example, and it is suitable to use Cobb-Douglas function, quadratic or translog function. The Cobb-Douglas is often found suitable to describe input-output relationship in agricultural production. A typical Cobb-Douglas function is

$$Q = a\, x_1^b\, x_2^c\, e^u$$

or in the double log-form

$$\ln Q = \ln a + b \ln x_1 + c \ln x_2 + u \quad \ldots\ldots \quad (2.1)$$

Where $Q$ = output

$x_1$ and $x_2$ = physical amount of inputs.

a, b, c = parameters.

u = an error term

### 2.2.2 Elasticity of Inputs

Output elasticity of an input is percentage change of the output as one input changes by 1 percent given other input use constant. Mathematically, it is stated :-

$$E_{x_1} = \frac{\partial Q}{\partial x_1} \cdot \frac{x_1}{Q} \quad \ldots\ldots\ldots\ldots (2.2)$$

$$\text{or} = \frac{\partial \ln Q}{\partial \ln x_1} \quad \ldots\ldots\ldots\ldots (2.3)$$

From equation 2.1, the elasticity of input $x_1$ and $x_2$ is b and c respectively.

The elasticity of an input shows how the output responses to an input in a percentage term. In the case of Cobb-Douglas functional form, elasticity of an input is constant throughout the range of input use. That is b for $x_1$ and c for $x_2$.

For a profit maximizer, the optimal level of input use is where marginal value of the product (MVP) equal to unit input cost. The marginal value product is marginal product times output price, i.e.,

$$MVP = P(MP)$$
$$= P(\partial Q/\partial x_1)$$

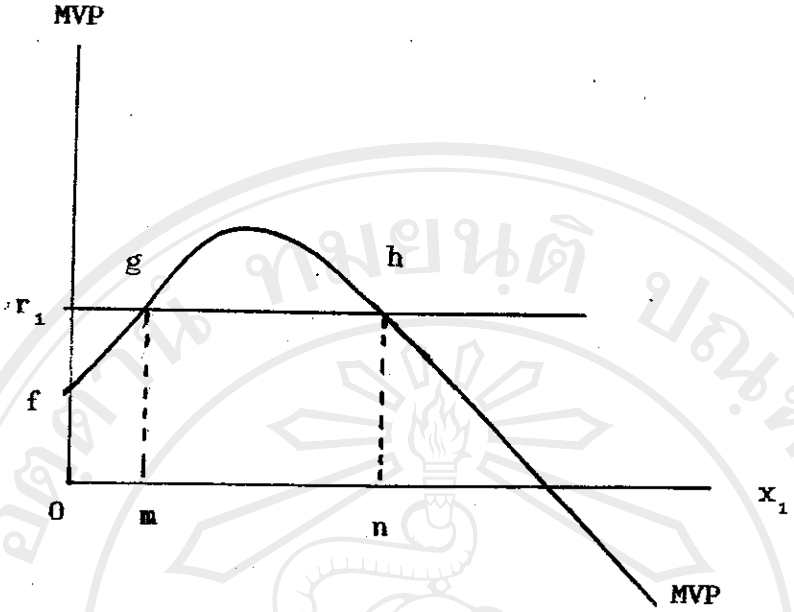


**Figure 2.1** The Optimal Level of Input Use.

In a competitive market, unit cost of input is in fact equal to its price. If the price of $x_1$ is $r_1$ , the producer should use $x_1$ at n instead of m in order to maximize profit from using $x_1$. At m, he will make loss by f g $r_1$ . At n, total cost of $x_1$ equals to o $r_1$ h n which is less than the total return, o f g h n (Figure 2.1). Profit will be reduced if the producer uses $x_1$ beyond n.

From equation 2.1, the marginal product is

$$\frac{\partial \ln Q}{\partial \ln x_1} = \frac{\partial Q}{\partial x_1} \cdot \frac{x_1}{Q}$$

$$\frac{\partial Q}{\partial x_1} = \frac{\partial \ln Q}{\partial \ln x_1} \cdot \frac{Q}{x_1} \qquad \text{.......... (2.4)}$$

and $$MVP = P\,(\partial \ln Q/\partial \ln x_1 \cdot Q/x_1) \qquad \text{..... (2.5)}$$

### 2.2.3 Returns to Scale

Return to scale is defined as the changes of an output when there is an increase in all inputs by the same proportion (Henderson and Quandt, 1980).

For a production function :

$$Q = f(x_1, x_2)$$

and $x_1$, $x_2$ increases by the same proportion (t)

$$Q = f(tx_1, tx_2) \quad \ldots\ldots\ldots\ldots \quad (2.6)$$

$$= t^k f(x_1, x_2) \quad \ldots\ldots\ldots\ldots \quad (2.7)$$

The production exhibits constant, increasing or decreasing returns to scale if k equals to greater or less than 1.

For the Cobb-Douglas form, returns to scale are easily derived from the sum of elasticities. From equation 2.1, it is b+c. When a production function possesses an increasing returns to scale, the output increases more than the increase of all inputs. Thus, it suggests that the producer can raise output by increasing input. In this situation, unit cost of output is decreasing. On the other hand, producers should reduce all inputs if return to scale is decreasing.

**2.2.4 Optimal Output Combination**

Output combination is the framework for diversified farm planning. Diversification appeals especially to small farmers in developing countries as it helps to raise resource utilization and reduce risk due to crop failure and market fluctuations.

For limited resources and other production constraints, farmers can maximize household income by allocating their land, capital and labor for various farm enterprises and off-farm work.Assuming only 2 activities are in consideration, i.e., products Y1 and Y2 . With the available resource, one can draw an isoproduction cost curve between the two outputs which is called a "production possibility curve" or PPC. The PPC indicates how much of the product combination it is possible to produce under a given cost condition. It is also called isocost line in Figure 2.2.

Suppose that the prices of Y1 and Y2 are Py1 and Py2, the slope of isorevenue (DE) is Py1/Py2. The point B suggests the optimal combination of Y1 and Y2 to product such that the farmers can maximize revenue since he can not find any isorevenue line higher than this line (DE) for the prevailing prices of Y1 and Y2.

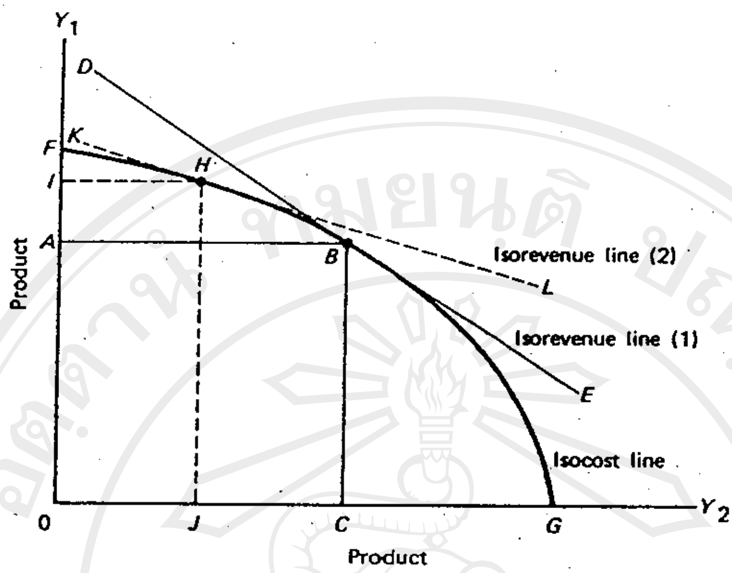


**Figure 2.2** The Optimum Combination of Two Enterprises under a Given Total-Cost Outlay and a Change in Product Price (Snodgrass and Wallace, 1975)

FG is the PPC of competitive relationship enterprises

DE is an isorevenue line, shows the amount of Y1 and Y2 to obtain the same total revenue

Py1/Py2 is the slope of DE

Py1 is price of product Y1

Py2 is price of product Y2

Px1 is price of input X1

Px2 is price of input X2



However, when the price of Y2 becomes cheaper relative to that of Y1, the optimal combination changes to H. That is producing less Y2 and more Y1. The concept can be applied for more than two products. The production combinations at point B and H are both optimal under different market situations. Both provide maximum revenue. And both use resources efficiently since the production is derived from the production efficient frontier (PPC).

## 2.3 Data Collection and Sampling Method

Data collection of this research composed of two steps which are :

### 2.3.1 Conducting Agroecosystem Analysis and RRA Survey

The agroecosystem analysis (Conway, 1986) and RRA were conducted in June-September 1988 and March 1989, respectively, to find out the general information and to identify problems in the project area. This information was the secondary data which included the natural resource endowment (i.e. soils, water supplies, climate, plots allocation, topography, land use pattern) and level of physical and social infrastructure. The findings of this step directed the research interests.



### 2.3.2 Conducting the Formal Survey with a Structured Questionnaire

A multi-visit interview was conducted. The data collected in the survey were the one-year data of 1989/1990 which include :

- Spatial location and plot numbers
- Dominant tenurial patterns
- Land use pattern
- Cropping intensity
- Profile of labour utilization and off-farm job opportunities
- Mechanization of farm production
- Application of inputs, levels of application
- Quantities and prices of inputs and outputs
- Family income and expenditures
- Family profile

### 2.3.3 Sampling Methods

First, the stratified sampling technique was used. The population was stratified into six groups in accordance with their major crop activities (as mentioned in 2.1). This was determined by utilizing the plot location map and land use patterns. Second, the crop activities were stratified again by using the land suitability classes for field crops. Finally, a random sampling technique was applied to select farm households.A sample size was 10 percent of each stratified group which totalled 303 households in all. The sampled households were expected to cover two groups of farmers i.e. those having and not having land outside the LRA.

## 2.4 Analytical Tools

### 2.4.1 Estimation of a Production Function.

A production function of a crop $i^{th}$ can be written as

$$\ln Q = \ln a + b\ln Lab + c\ln Fert + d\ln Cash + eG + fM + u \quad \ldots \quad (2.8)$$

Where

| | | |
|---|---|---|
| Q | = | output (kg/rai) |
| Lab | = | labor (mandays/rai) |
| Fert | = | chemical fertilizer (kg/rai) |
| Cash | = | cash expended for chemical and machine service for land preparation (baht/rai) |
| G | = | dummy variable stand for farmer group |
| M | = | dummy variable stand for cropping system |
| a,b,c,d,e and f | = | parameters |
| u | = | error term. |

Equation 2.8 is applied to estimate the production function of tobacco and soybean. The estimation technique employed here is Generalized Least Squares since varying variances of the error terms usually exist in cross-sectional data.

For the Cobb-Douglas production function, k is the sum of elasticities of all inputs. That is b + c in this particular example (equation 2.1)

### 2.4.2 Farm Planning Model

The model used in this study is multi-period programming. Optimal farm plans are to maximize the present value of net income from farm and non-farm activities. The multi-period programming is required because the farmers in the study area can incorporate annual crops and a perennial crop (mango)into their plans. The economic life of mango is over 20 years. The length of the planning horizon is 10 years although the model can be expanded to include as many years as necessary. This period is expected to be long enough to capture the impact of differences in returns of all enterprises. Once the mango is planted, the plan is self perpetuating. The total period is divided into a yearly intervals. This allows net income and savings generated in one year to be invested in the following year. Household consumption is modelled to differ from year to year according to income level. Details of the model, activities and constraints are presented in Chapter 5.

The procedure to work out a whole farm planning via programming consists of 3 steps

(1) estimate input factors required for cost, and net returns for a unit of output.

(2) explore resource endowment and farmers constraints.

(3) apply (1) and (2) in a programming model.

Partial budgeting was used for calculating costs and returns.