CHAPTER 3

RESEARCH METHODS AND STUDY AREA

This chapter presents the conceptual framework of the study, study area, data gathering techniques, and method of analysis..

3.1 Conceptual Framework

This study used the general perspective of the system theory approach adopting the input-process-output model (Guerrero's, 1974; and Beghim, cited by Thanh, 2002) for analytical purposes and taking perspectives from economic techniques and theories. Inputs are fed into the system to work interrelatedly and interdependently in a manner called process to produce results called output of the system. These three components namely, inputs, process and output are necessary for the survival of the system. The input provides the system with its operating necessities, consisting of the farmer's socio-economic factor, the technical and biophysical factors supplying the major requisites for the existence and sustainability of rice production system.

The inputs feeding into the farming system are transformed into products through a process being a set of activities, which are related to the practices: namely, row seeding, broadcasting, policies, extension and decision marking. The outputs involve productivity and profitability information through changing of household income, perception of rice growers, and extension activities. The impacts of row seeding method in rice production system will be assessed through an evaluation of the effects of row-seeding. The impacts may either be positive or negative in term of socio-economic and environmental condition enhancing directly from the changes or indirectly as a result of the interaction of the inputs, process and output.

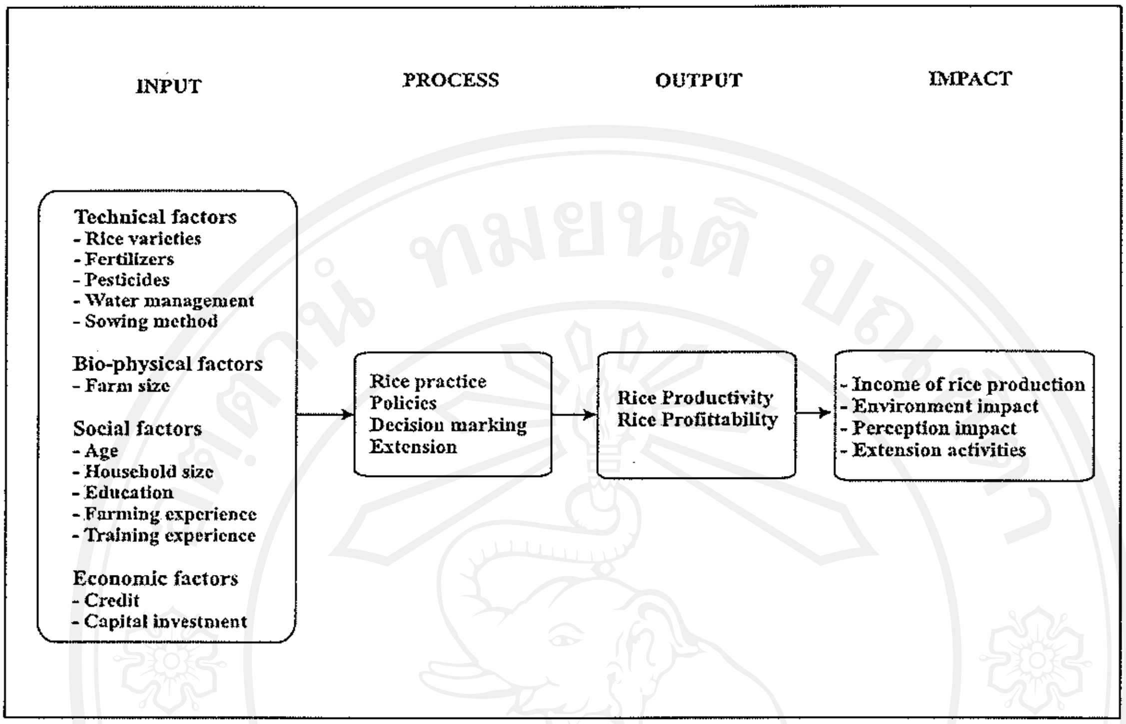

Figure 3. 1 Conceptual Framework.

3.2 Study Area

Can Tho province is one of 64 provinces of Vietnam, divided into seven agro-ecosystem zones, namely; the North Mountain Highland, the Red River Delta, the North Central Coast, the South Central Coast, the Central Highland, the North East South, and the Mekong River Delta (Figure 3.2).

The Mekong River Delta covers approximately four million ha of land areas. Based on agro-ecological such as rainfall, temperature, soil, topography, cropping system, and water resource, the delta can be divided into seven main agro-ecological zones (Xuan and Matsui, 1998). It consists Fresh-water alluvium, Plain of Reeds, Long Xuyen-Ha Tien Quadrangle, Trans-Bassac Depression, Coastal zone, and Ca Mau Peninsula (Table 3.1).

Can Tho belonging to the Mekong River Delta is situated in the southernmost of Vietnam.

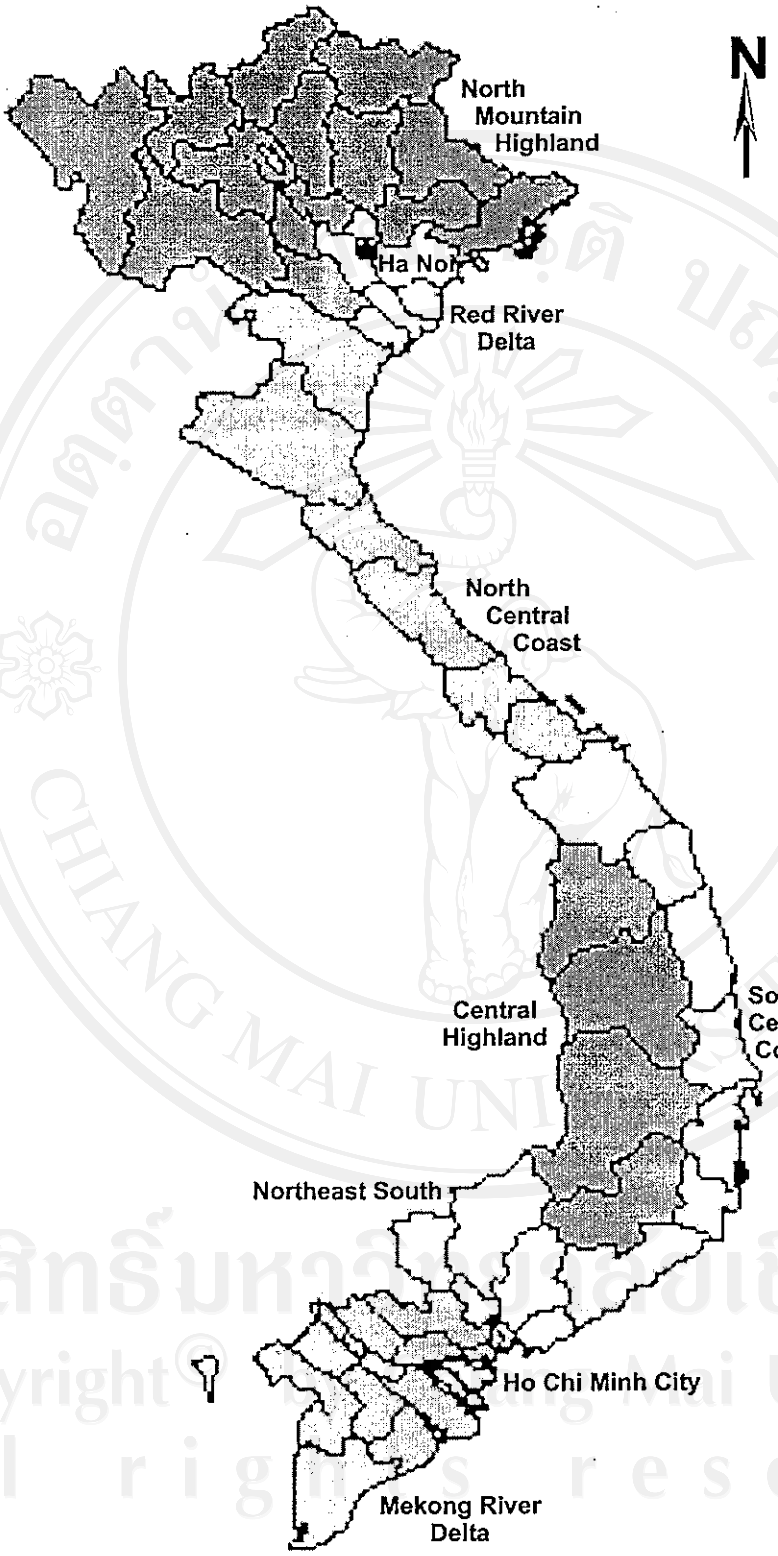

Figure 3. 2 Agro-ecological zone of Vietnam.

Source: Young et al (2002)

Table 3. 1 Agro-ecological zones in the Mekong River Delta.

Agro-ecological zones	Areas (ha)	Soil	Rice cropping system
Fresh-water alluvium zone	900,000	Alluvial soil	Double or triple modern rice variety
Plain of Reeds	500,000	Acid sulfate soil	Double modern rice variety
Long Xuyen-Ha Tien quadrangle	400,000	Moderate or severe acid sulfate soil	Double modern rice variety
Trans-Bassac depression	600,000	Moderate acid sulfate soil	Double modern rice variety
Coastal zone	800,000	Acid sulfate soil	One traditional rice variety or one modern rice variety
Ca Mau peninsula	800,000	Moderate acid sulfate soil	One traditional rice variety or one modern rice variety

Source: Xuan, 1998.

3.4.1 Location

Can Tho is bounded in the north by An Giang and Dong Thap provinces, in the south by Bac Lieu and Ca Mau provinces, and in the west by Kien Giang province, and in the east by Vinh Long province, and stretch from $9^{0}34'43''$ to $10^{0}19'25''$North latitude and $105^{0}19'51''$ to $105^{0}54'36''$ East longitude (Figure 3.3).

3.2.1 Climate

The average temperature is about $26.5^{0}C$. There is not much variation of annual temperature. The maximum daily temperature rarely exceeds $35^{0}C$, and the minimum temperature seldom falls below $19^{0}C$. The relative humidity remains high throughout the year, at 83 to 86%.

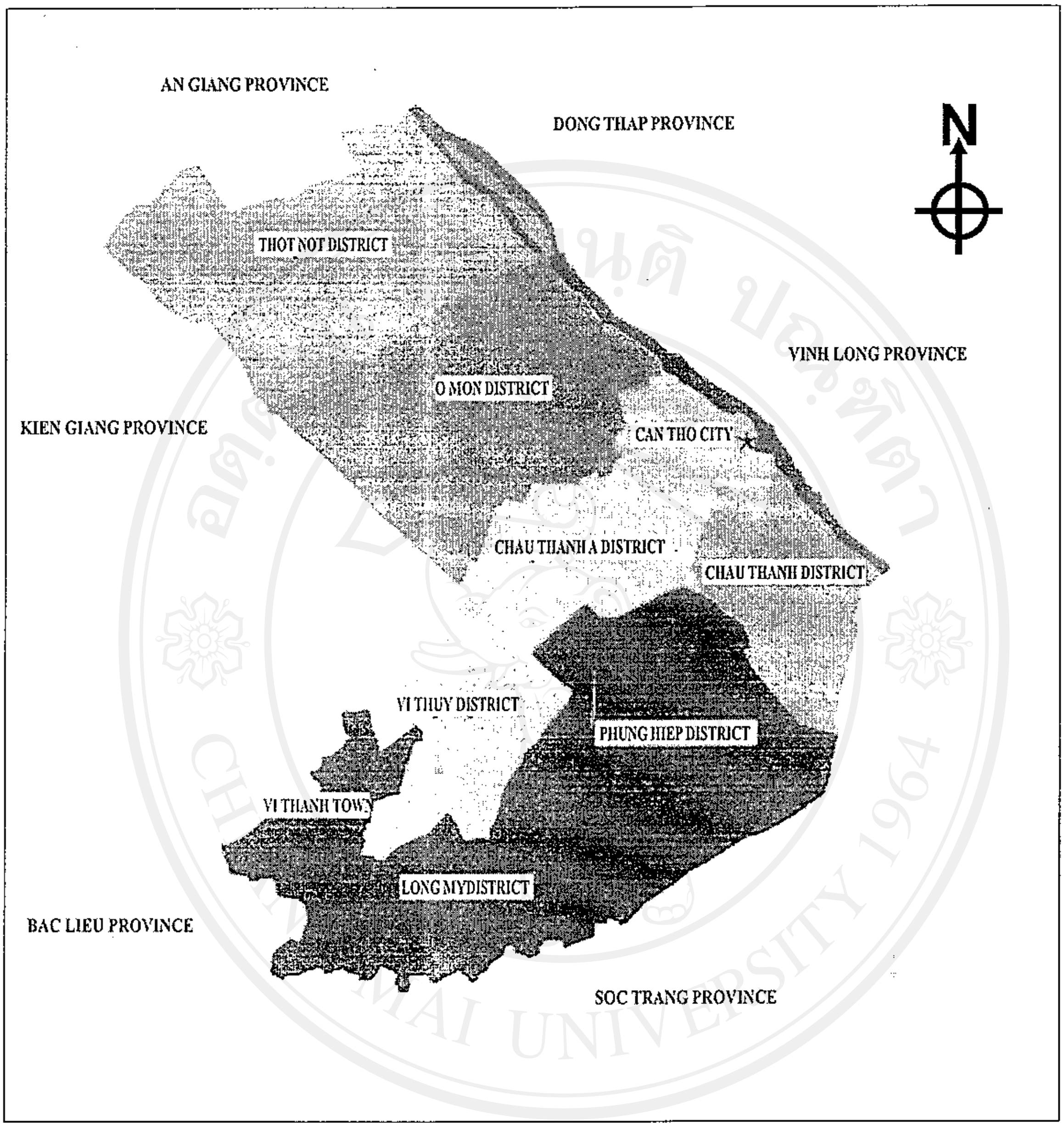

Figure 3. 3 Can Tho province administrative map.

Source: Can Tho Statistical Office (2003)

3.2.2 Hydrology

The rivers and canals systems in Can Tho province are influence by the semi-diurnal tidal regime of the south China Sea (the East Sea), however, some villages in west Vi Thanh are influenced by Cai Lon river systems which follow the daily tidal region of the Gulf of Thailand (the West Sea). The intermediate area is also the most depressed area, and flood water is therefore drained out so slowly that it can affect the timing of crop establishment.

Due to flood from upstream Mekong River since the end of July water levels in the rivers and canals systems begin to increase, and later submerge all the districts of province. Submergence usually lasts in three months, and will be more serious if there are local heavy rains.

Tide has great affect hydrology in the dry season because water discharge from upstream Mekong River is so weak in the dry season. Tide difference is quite large in rivers and canals systems. The region near Bassac river (a branch of Mekong River) can take advantage the daily tide to water rice field in the dry season, the rest of region must use pumping engines for growing rice in the dry season.

3.2.3 Rainfall

Can Tho gets rainfall during eight months of the year from May to December. The annual rainfall ranges between 1,500 to 1,900 mm.

3.2.4 Topography

In general, the elevation of the province is relatively flat, the elevation varies from the northern to the southern part of the province, and from near river to far from river. The average elevation of the province is about 1.6 meter in the northern, and 0.6 meter in the southern.

3.2.5 Soils

Can Tho province has three main groups consisting of fresh water alluvial soils, acid sulfate soils, and saline soils. Fresh water alluvial soils cover an area of 146,407 ha (49.3%), stretching along with Mekong River. It is fertile soils and abundant fresh water throughout the year. This is an irrigated lowland rice of the Mekong River Delta. Acid sulfate soils constitute 79,221 ha (26.7%), concentrating in Phung Hiep, Long My, and Vi Thanh district.

3.2.6 Population

The population of Can Tho province is about 1,878,226 inhabitants (Can Tho statistical yearbook, 2002), out of which the agriculture labor population is about 1.39 million. The population density is 629 persons per square kilometer.

3.2.7 Administrative Units

The total area of the province is about 2,962 square kilometer. The province has seven districts (Thot Not, O Mon, Chau Thanh, Chau Thanh A, Phung Hiep, Vi Thuy, and Long My), a town (Vi Thanh), and a city (Can Tho).

3.2.8 Sub-Agro-Ecological Zones

Can Tho province is one of progressive province of the Mekong River Delta and known for its development activities. Based on natural and social conditions, Can Tho province is classified into four distinct sub-agro-ecological zones (Hien, 1998) as follows:

Zone 1: This zone covers Thot Not district and half of the northern of O Mon district. The predominant soils are alluvial and moderately present acid sulphate soils. This zone usually floods deeply in annual flooding (100-150 cm). There are three major cropping systems that are rice-rice, rice-rice-rice, and rice-upland crop-rice (Table 3.2).

Zone 2: This zone includes Can Tho city, the remainder part of O Mon District, Chau Thanh, and Chau Thanh A district with alluvial soil only. Rice-rice and rice-rice-rice are major cropping systems in this zone. Fruit tree has developed in this zone because annual flooding is shallow (less than 30 centimeter).

Zone 3: This zone consists of Phung Hiep district. Acid sulphate soils cover an area of 25,000 ha (46%), in which a half is slightly acid sulphate soils and the rest of them is moderately acid sulphate soils. Alluvial soils occupy 20,000 ha or 54 % of total area of this zone. Average depth of annual flooding is so high, from 60 to 100 centimeter. Rice-rice is dominant cropping system (52%), follow by rice-rice-rice (20%) and rice-sugar can or sugarcane monoculture (18%).

Zone 4: This zone includes Long My, Vi Thanh, and Vi Thuy district. Slightly and moderately acid sulphate soils constitute 43 percent (33,000 ha), and the remainder area is alluvial soil. Average depth of annual flooding is about from 0 to 60 centimeter. There are three main cropping systems here, rice-rice-rice, rice-rice, and rice-sugar cane or sugar cane monoculture.

Table 3. 2 Sub-agro-ecological zones of Can Tho province.

Zone	Agricultural area (ha)	Cropping system	Flooding depth (cm)
Zone 1	68,000	Rice-rice (89%), rice-rice-rice (4%), and rice-upland crop-rice (4%).	100-150
Zone 2	73,000	Rice-rice (45%), rice-rice-rice (43), and fruit tree.	Less than 30
Zone 3	43,000	Rice-rice (52%), rice-rice-rice (20%), and rice-sugar cane or sugarcane monoculture (18%).	60-100
Zone 4	65,000	Rice-rice-rice (46%), rice-rice (37%), sugar cane monoculture or rice-sugarcane (14%).	0-60 cm

3.2.9 Representative Research Area

Research area covers four hamlets of Tan Phu Thanh village, locating in the South of Chau Thanh A district, Can Tho province (Figure 3.4), neighbors in the North is Nhon Nghia village, in the East is Thanh Dong, in the Western-South is Thanh Xuan village. Total area is 2,557 ha, with 10 hamlets, including Thanh My, Thanh Phu, Phu Loi, Phu Thanh, Thanh Loi, Long An, Tan Thanh Tay, Tan Thanh Dong, Tan An, and Tan Phu (Figure 3.4).

Tan Phu Thanh Village belongs to Chau Thanh A district, Can Tho province, the climate conditions are similar to the condition of the district or province, which has distinct season, dry and rainy season. The dry season starts from January to May, while the rainy season starts from May to December.

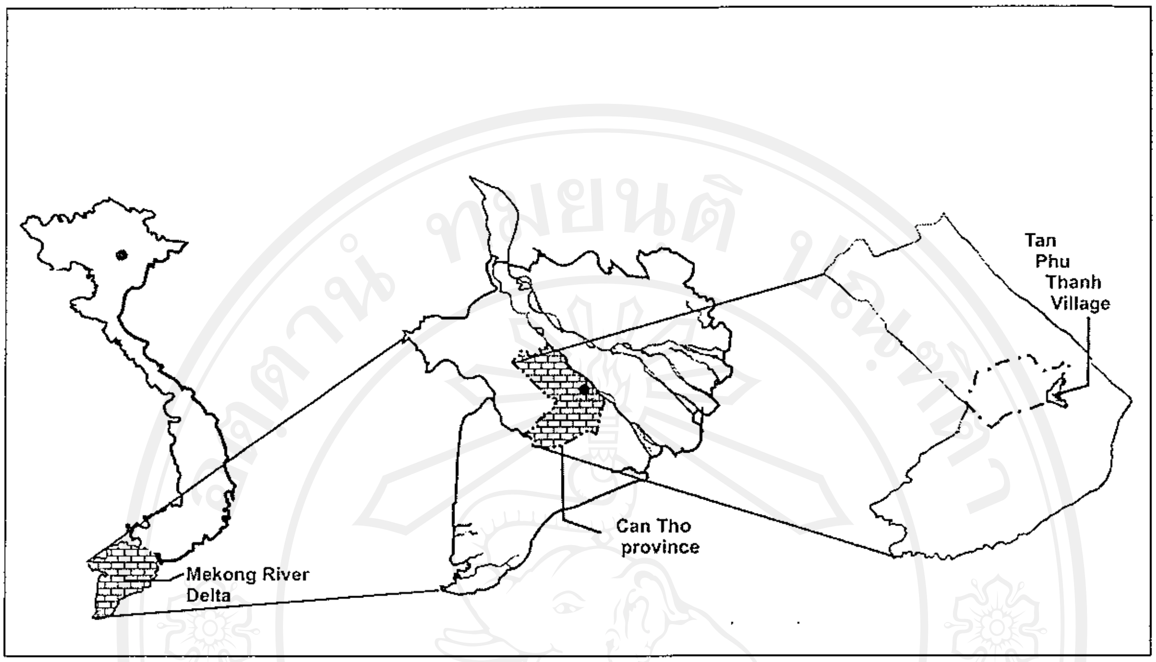

Figure 3. 4 Map of representative research site.

Total rainfall of the region about 1952 mm/year, however most of rainfall concentrates in rainy season, while there is no rain in February and March (Minh et al., 2002). Temperature of the village is nearly stable throughout the year, average temperature is about 27^0C, highest temperature is in May (29.6^0C), and lowest temperature is in December (25.3^0C). The village has high air humidity, especially in the rainy season, highest is in September (91%), and lowest in the dry season (79%).

The inundation depth influences the type of crops, cropping system, and the development of fishery. The inundation of Tan Phu Thanh village is affected by the tidal regime and receives water from Hau River, which is about 10 km from Tan Phu Thanh village. The maximum depth of inundation is high, ranging from 40 to 80 cm.

3.3 Data Gathering Procedure

3.3.1 Secondary Data

Data were collected including the area and yield of rice production, the area of row seeding application, socio-economic condition. Secondary data had been gathered from the provincial, district and village agricultural office and statistical yearbooks of General Statistical Office.

3.3.2 Primary Data

Primary data were gathered consisting of two parts namely Participatory Rural Appraisal (PRA) and household surveys.

Participatory Rural Appraisal (PRA) exercise consists of eight tools namely, (a) Wealth ranking, (b) Timelines and trendlines, (c) Calendar chart/Seasonal calendar, (d) Transect map, (e) SWOT (Strengths, Weaknesses, Opportunities, and Threats), (f) Problems and solution trees, (g) the open-ended questions, and (h) gender analysis. The objective of (a) wealth ranking is to identify and divide the wealth of all households within each village into three groups namely, poor, fair, and rich, ten farmers from each group. The researchers and the representative farmers (key informants) who have good knowledge about their hamlet were selected for discussion. The criteria of wealth were identified basing on the main factors (Table 3.3) such as land, house, household asset, and income.

Table 3. 3 Criteria for wealth ranking.

Criteria	Poor	Fair	Rich
Landsize	< 0.4 ha	From 0.5-0.9 ha	> 1 ha
Housing	Thatched house (Cottage)	Wooden house or a brick and roof tile house	Concrete house
Income (VND/person/month)	<VND 70,000	From VND 70,000-150,000	> VND150,000
Household asset	Bicycle	Black and white television	Tractor, color television

Results from wealth ranking exercise, the representative farmers can be divided into different three groups or stakeholders (SHs) namely, poor, fair, and rich in order to carry out further analysis by other tools because of their different responses in the same problem.

Household survey was conducted at Tan Phu Thanh village of Chau Thanh district of Can Tho province. A Total of 70 households had been interviewed by structure questionnaire with 39 samples for row seeding and 31 samples for broadcasting. The samples in both row-seeding and broadcasting were divided in to three farmer groups (poor, fair, rich) with each group more than 10 samples. The process for gathering the primary data was described in Figure 3.5. The data gathered include four main parts: (1) general information, (2) rice production, (3) expenditure of household, (4) off-farm income. For rice production part, relevant information had been also collected namely: input and output of rice production.

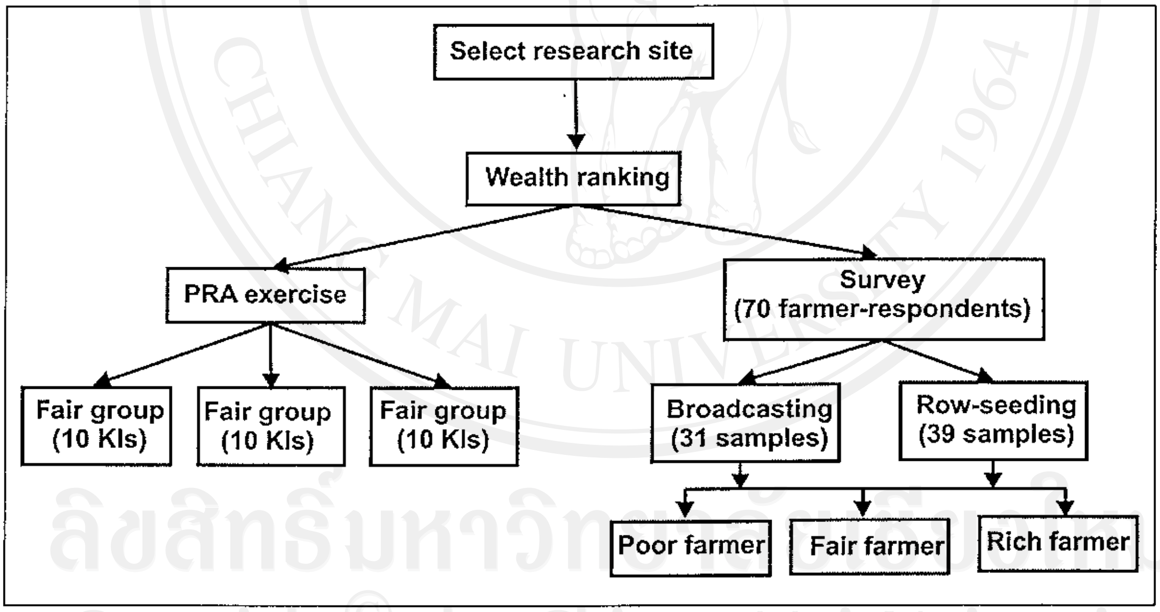

Figure 3. 5 Work-flow of the primary data gathering.

3.4 Method of Analysis

3.4.1 Basic Statistical Analysis

Besides descriptive statistics, other methods such as cross-tabulation with statistical test, mean-variance analysis and input-output ratios were used. The computation of input-output ratios was useful in analyzing resource utilization and efficiency.

3.4.2 Cost and Return Analysis

Costs and returns analysis (economic returns) is a common analytical tool to compare the relative economic return of alternative farming systems. By evaluating the costs and returns of a system, farmers may assess which system would be preferable based on their own interests.

In this study, the cost items included the costs of rice seeds, chemical fertilizers, pesticides, insecticides, herbicides, irrigation fee, machinery fee, as well as labor input, land tax, etc. The net return or the profit of rice is actually the return to land resource, the return to labor and the other farmer's cost input. In this study, the costs and returns were computed based on different rice planting techniques. The equation can be expressed as follows:

$$TC = \sum_{j}^{n}\sum_{i}^{m} P_i X_i \qquad \text{.................(3.1)}$$

$$GR = \sum_{j}^{n} Q_j P_j \qquad \text{.................(3.2)}$$

$$NR = GR - TC \qquad \text{.................(3.3)}$$

where:

TC = Total cost,

GR = Gross return (gross value of production),

NR = Net return,

Pi = the price of variable input i,

Xi = the quantity of variable input i used in system j,

Pj = the price of output system j, and

Qj = the output of system j.

$$Rate\ of\ return\ to\ input_i = \frac{(Gross\ Return - Variable\ Cost\ other\ than\ input_i)}{Cost\ of\ input_i} \quad (3.4)$$

$$Benefit - \cos t\ ratio = \frac{Gross\ Return}{Total\ Variable\ Cost} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

3.4.3 Cobb-Douglas Production Function Analysis

Cobb-Douglas production function analysis is a method to estimate the relationship of input-output of a production system. It represents a schedule or mathematical formulation expressing the relationships between inputs and outputs. It can provide information on the productivity of production process. Output (Y) is specified as a function of inputs (Xi) and disturbance (εi):

$$Y_i = f(X_{1i}, X_{2i}, ..., X_{ki}, \beta, \varepsilon_i) \quad (3.6)$$

Where:

Y_i : is output by farm i,

X_i : is input i,

β : is a vector of parameters

ε_i : is the disturbance term.

The production function can be derived from one of five functional forms as follows:

- Cobb-Douglas function
- CES function
- Linear function
- Quadratic function
- Translog production function.

A Cobb-Douglas production function is a suitable function form because it has the following advantages. (1) it can be used when a production function includes many input variable, (2) it gives a good statistical fit to data, (3) it provides computational feasibility, and becomes linear in logarithmic form, then, it is simple to estimate, (4) directly get output elasticities and returns to scale form regression coefficients.

The relationship between farm inputs and output was estimated by fitting a production function. The Cobb-Douglas production function was specified for each farming system by rice farming systems. The general form of Cobb-Douglas production function is defined as the following:

$$Y = A\prod_{i=1}^{k} Xi^{\beta i} e^{\sum yj\, Dj+\varepsilon} \qquad (3.7)$$

In logarithmic form:

$$\ln Y = \ln A + \sum_{i=1}^{k} \beta_i \ln X_i + \sum_{j=1}^{m} \gamma_j D_j + \varepsilon \qquad (3.8)$$

Where:

ln = Natural logarithm

Y = Dependent variable (rice yield—kg/ha)

X_i = i^{th} input variable

D_j = Dummy variable

β ,γ = Parameters to be estimated

ε = Disturbance term

X_1 = Total family + hired labor (manday/ha)

X_2 = Age of decision maker on rice production activities (years)

X_3 Farm size of household used for rice farming systems (ha)

X_4 = Total cash expenses for fertilizer, pesticides, and seeds (Dong/ha)

X_5 = Education of decision makers (years)

X_6 = Number of times the farmers participated in training courses

X_7 = Experience of decision makers on rice production (years)

D_1 = Application of tillage (“1” for tillage and “0” for No-tillage)

D_2 = Rice planting technology (“1” for row seeding and “0” others)

The most common functional form that is nonlinear in the variables (but still linear in the coefficients) is the double-log form (Studenmund, 1985). The double-log form is often used because a researcher has specified that, contrary to linear model, the elasticities rather than the slopes are constant.

The above equation (3.8) is the double-log functional form that is taken the log of both sides of the equation 3.7 to make it linear in the coefficients.

The way to interpret β_i in equation 3.8 is that if X_i changes by one percent while the other X_i are held constant, then Y will change by β_i percent.

Before using a double-log model, make sure that there are no negative or zero observations in the data-set. Because the log of a non-positive number is undefined, a regression cannot be run. Double-log models should be run only when all the variables take on positive values. Dummy variables, which can take on the value of zero, should not be logged even if they are in a double-log equation.

If it is necessary to take the log of a dummy variable, that variable needs to be transformed to avoid the possibility of taking the log of zero. The best way is to redefine the entire dummy variable so that, instead of taking on the values of zero and one, it takes on the values of one and e (the base of the natural logarithm). The log of this newly defined dummy then takes on the values of zero and one, and the interpretation of β remains the same as in a linear equation. Such a transformation changes the coefficient value but not the usefulness or theoretical validity of the dummy variable.