CHAPTER II

METHODOLOGY

2.1. Scope and Limitation of the Study

The cross-seasonal data and information of rice production year 1993 from five subdistricts in the Red River Delta for Spring and Autumn rice crop are used in this study.

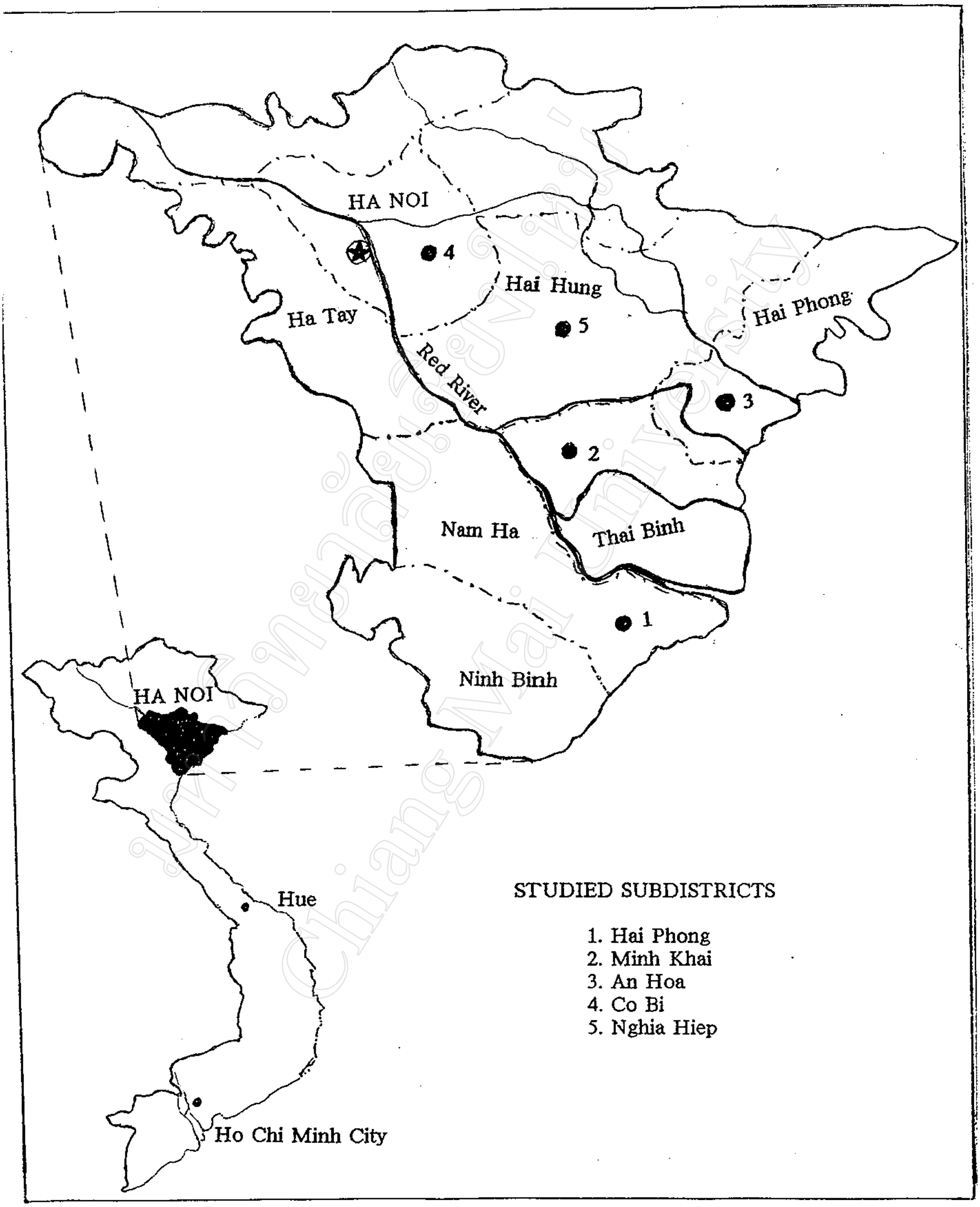
Descriptive method is employed to explain the production situation, input utilization, and statistical tests are used for the comparison between rice cultivation techniques and two rice varieties. Farm budgeting is used for cost, return and profitability study.

Econometric models of profit functions are chosen for the analysis of efficiency of input utilization and output supply.

2.2. Sampling Methods

The multi-stage sampling method is used for selection of individual farm households from the Red River Delta:

First stage, five provinces: Hai Hung, Nam Ha, Thai Binh, Ha Noi, Hai Phong are selected on the basis of total rice cultivated area, rice yield, proximity to central markets from seven provinces in the Red River Delta.



Map of the Red River Delta showing the Study Area

Second, one of the main rice districts is chosen from each selected province.

Third, one of the main rice subdistricts is selected from each chosen district. And then 30 households in each subdistrict are randomly selected.

The result of this section is that 151 farm households from five subdistricts such as Hai Phong in Nam Ha province, Minh Khai in Thai Binh province, An Hoa in Hai Phong province, Co Bi in Ha Noi province and Nghia Hiep in Hai Hung province are selected to interview.

2.3. Data Collection

This study mainly focus on the rice production in two rice varieties (THQV and MHYV) in RCT Autumn rice crop and two rice cultivation techniques (RCT and MMCT) in MHYV Spring rice crop. The following information are collected:

Socio-Economic profile: farm size, farm income, off-farm income, factor endowments (labor, land, etc.), age, education and years in farming of household head, family size, number of dependents, etc.

Farm level input-output data: cultivated area, rice varieties, yield, inputs, prices of inputs and outputs, cropping patterns, etc.

2.4. Theoretical Model

The normalized restricted profit function developed by Lau and Yotopoulos (1971) is employed to derive variable input demands and product supply for rice production in the Red River Delta. The theoretical procedure of this method is as follows.

The production function with the usual neoclassical properties:

(1) $$V = F(X_1, \ldots, X_n; Z_1, \ldots, Z_m)$$

Where: V : output; X_i : variable inputs; and Z_i : fixed factors of production.

Profit (defined as current revenue less current total variable costs) can be written as:

(2) $$\Pi = P_y F(X_1, \ldots, X_n; Z_1, \ldots, Z_m) - \sum_{i=1}^{n} P_i X_i$$

Where Π is profit, P_y is the unit price of output, and P_i is the unit price of the ith variable input. The fixed costs are ignored since they do not affect the optimal combination of the variable inputs.

Assume that a firm maximizes profit given the levels of its technical efficiency and fixed inputs. The marginal productivity conditions for such a firm are:

(3) $$P_y \frac{\partial F(X; Z)}{\partial X_i} = P_i \qquad i = 1,\ldots,n$$

Defining $P_i^* \equiv \frac{P_i}{P_y}$ as the normalized price of the ith input, equation (3) can be written as:

(4) $$\frac{\partial F}{\partial X_i} = P_i^* \qquad i = 1,\ldots,n$$

By similar deflation by the price of output one can rewrite (2) as (5) where Π^* is defined as the Unit-Output-Price (UOP) profit or normalized profit:

(5) $$\Pi^* = \frac{\Pi}{P_y} = F(X_1, \ldots, X_n; Z_1, \ldots, Z_m) - \sum_{i=1}^{n} P_i^* X_i$$

Equation (4) may be solved for the optimal quantities of variable inputs, denoted $X_i^{*'}s$, as functions of the normalized prices of the variable inputs and of the quantities of the fixed inputs, that as:

(6) $$X_i^* = f_i(P^*, Z) \qquad i = 1,\ldots,n$$

Where P^* and Z are the vectors of normalized variable input prices and quantities of fixed inputs, respectively.

By substitution of (6) into (2) one can get the restricted profit function:

(7) $$\Pi = P_y [\, F(X_1^*, \ldots, X_n^*; Z_1, \ldots, Z_m) - \sum_{i=1}^{n} P_i^* X_i^* \,]$$

This restricted profit function gives the maximized value of the profit for each set of values $\{P_y, P^*, Z\}$. Observe that the term within square brackets on the right-hand side of (7) is a function only of P^* and Z. From that, one can write:

(8) $$\Pi = P_y G^*(P_1^*, \ldots, P_n^*; Z_1, \ldots, Z_m)$$

The normalized restricted profit function (the UOP profit function) is given by:

(9) $$\Pi^* = \frac{\Pi}{P_y} = G^*(P_1^*, \ldots, P_n^*; Z_1, \ldots, Z_m)$$

The UOP profit function Π^* is employed because it is easier to work with than Π. From UOP profit function, the firm's factor demand functions (10) and the firm's supply function (11) can be derived directly (Lau and Yotopoulos, 1971):

(10) $$X_i^* = -\frac{\partial \Pi^*(P^*, Z)}{\partial P_i^*} \qquad i = 1,\ldots,n$$

(11) $$V^* = \Pi^*(P^*, Z) - \sum_{i=1}^{n} \frac{\partial \Pi^*(P^*, Z)}{\partial P_i^*} P_i^*$$

2.5. Translog Profit Function and Variable Input Share Equations

The normalized restricted translog profit function was used by Sidhu and Baanante (1981) would have general advantages such as elasticities of input demand, output supply elasticities and present various opportunities for examining the economic decision making system of individual farmers.

The model of normalized restricted translog profit function that is applied for this study could be written as:

(12) $$Ln\Pi^* = \alpha_o + \sum_{i=1}^{n} \alpha_i LnP_i^* + \frac{1}{2}\sum_{i=1}^{n}\sum_{h=1}^{n} \gamma_{ih} LnP_i^* LnP_h^* + \sum_{k=1}^{m} \beta_k LnZ_k$$
$$+ \frac{1}{2}\sum_{k=1}^{m}\sum_{j=1}^{m} \phi_{kj} LnZ_k LnZ_j + \sum_{i=1}^{n}\sum_{k=1}^{m} \delta_{ik} LnP_i^* LnZ_k$$

Where: Π^* is the restricted profit (total revenue less total costs of variable inputs) normalized by P_y, the price of output; P_i^* is the price of variable input X_i, normalized by P_y; Z_k is the kth fixed inputs; $i = h = 1,2,...,n$ and $k = j = 1,2,...,m$; Ln is the natural logarithm; $\alpha_0, \alpha_i, \gamma_{ih}, \beta_k, \phi_{kj}$ and δ_{ik} are the parameters; $\gamma_{ih} = \gamma_{hi}$ for all h,i; and the function is homogenous of degree one in prices of all variable inputs and output.

One can define $S_i \equiv \dfrac{P_i^* X_i}{\Pi^*}$ as the ratio of variable expenditures for the ith input relative to normalized restricted profit. And $S_v \equiv \dfrac{V}{\Pi^*}$ would be ratio of output supply to normalized restricted profit. S_v is also equivalent to the ratio of the total value of output to restricted profit.

Differentiating the normalized restricted translog profit function (12) with respect to LnP_i^* and LnP_y gives a system of variable input/profit ratio functions and an output supply/profit ratio function. Because of the S_i and S_v sum to unity, the output supply equation can be ignored, and only the variable input equations and the normalized restricted translog profit equation need be used for econometric estimations. The variable input share equations can be derived as:

$$(13) \qquad S_i = \frac{P_i^* X_i}{\Pi^*} = -\frac{\partial Ln\Pi^*}{\partial LnP_i^*} = \alpha_i + \sum_{h=1}^{n} \gamma_{ih} LnP_h^* + \sum_{k=1}^{m} \delta_{ik} LnZ_k$$

Profit function and variable input share equations are estimated jointly. Under price-taking behavior of the farm households, the normalized prices of variable inputs and quantities (levels) of the of fixed factors are contemplated to be the exogenous variables. The Zellner's Seemingly Unrelated Regression Estimator (SURE) and the LIMDEP software are applied for these regression estimates.

2.6. Variable Input Demand Elasticities

From (13) the demand equation for the ith variable input could be written as:

(14) $$X_i = \frac{\prod}{P_i}\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(15) $$LnX_i = Ln\prod - LnP_i + Ln\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

From (15), the own-price elasticity of demand for variable input i, the cross-price elasticity of demand for variable input i with respect to price of the h variable input, the elasticity of demand for input i with respect to output price, and the elasticity of demand for variable input i with respect to the k fixed factor can be derived (Sidhu and Baanante, 1981):

2.6.1. Own-Price Elasticity of Demand

The own-price elasticity of demand (η_{ii}) for X_i then can be obtained:

(16) $$\eta_{ii} = \frac{\partial LnX_i}{\partial LnP_i} = \frac{\partial Ln\prod}{\partial LnP_i} - 1 + \frac{\partial Ln}{\partial LnP_i}\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(17) $$\eta_{ii} = -S_i^* - 1 - \frac{\gamma_{ii}}{S_i^*}$$

Where S_i^* is the simple average of S_i.

2.6.2. Cross-Price Elasticity of Demand

Similarly, from (15) the cross-price elasticity of demand (η_{ih}) for variable input *i* with respect to the price of the *h*th variable input becomes:

(18) $$\eta_{ih} = \frac{\partial LnX_i}{\partial LnP_h} = \frac{\partial Ln\prod}{\partial LnP_h} + \frac{\partial Ln}{\partial LnP_h}\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(19) $$\eta_{ih} = -S_h^* - \frac{\gamma_{ih}}{S_i^*}$$

Where $i \neq h$

2.6.3. Elasticity of Demand with Respect to Output Price

The elasticity of demand for input *i* (η_{iy}) with respect to output price, P_y, can be derived from (15):

(20) $$\eta_{iy} = \frac{\partial LnX_i}{\partial LnP_y} = \frac{\partial Ln\prod}{\partial LnP_y} - \frac{\partial LnP_i}{\partial LnP_y} + \frac{\partial Ln}{\partial LnP_y}\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(21) $$\eta_{iy} = \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i} \cdot \frac{\partial LnP_i}{\partial LnP_y} - (-1) - \sum_{h=1}^{n} \frac{\gamma_{ih}}{S_i^*}(-1)$$

Where $i = 1,...,n$ and $h = 1,...,n$

(22) $$\eta_{iy} = \sum_{i=1}^{n} S_i^* + 1 + \sum_{h=1}^{n} \frac{\gamma_{ih}}{S_i^*}$$

2.6.4. Elasticity of Demand with Respect to Fixed Factors

Finally, the elasticity of demand (η_{ik}) for input i with respect to the kth fixed factor Z_k is also gained from (15) as:

(23) $$\eta_{ik} = \frac{\partial LnX_i}{\partial LnZ_k} = \frac{\partial Ln\prod}{\partial LnZ_k} - \frac{\partial LnP_i}{\partial LnZ_k} + \frac{\partial Ln}{\partial LnZ_k}\left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(24) $$\eta_{ik} = \sum_{i=1}^{n} \delta_{ik} LnP_i + \beta_k - \frac{\delta_{ik}}{S_i^*}$$

2.7. Elasticities of Output Supply

Output supply elasticities with respect to output price, prices of variable inputs and quantities of fixed inputs, evaluated at averages of the S_i and at given levels of exogenous variables, could be expressed as linear function of parameters of the restricted profit function. From the duality theory (Lau and Yotopoulos, 1972) the equation for output supply could be written as:

(25) $$V = \prod + \sum_{i=1}^{n} P_i X_i$$

The various supply elasticity estimates can be derived from this equation. Rewrite (25) with the help of (14) one can get:

(26) $$V = \prod + \sum_{i=1}^{n} \prod \left(-\frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(27) $$V = \prod \left(1 - \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(28) $$LnV = Ln\prod + Ln\left(1 - \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i}\right)$$

From (28), the elasticity of output supply with respect to the i variable input, the own-price elasticity of output supply and the elasticity of output supply with respect to the fixed factor could be derived (Sidhu and Baanante, 1981)

2.7.1. Output Supply Elasticity with Respect to Variable Input Price

The elasticity of supply (ϵ_{vi}) with respect to the price of the *i*th variable input is given by:

(29) $$\epsilon_{vi} = \frac{\partial LnV}{\partial LnP_i} = \frac{\partial Ln\prod}{\partial LnP_i} + \frac{\partial Ln}{\partial LnP_i}\left(1 - \sum_{h=1}^{n} \frac{\partial Ln\prod}{\partial LnP_h}\right)$$

Where $i = h = 1,\ldots,n$

And for the translog profit function case this becomes:

(30) $$\epsilon_{vi} = -S_i^* - \frac{\sum_{h=1}^{n} \gamma_{hi}}{\left(1 + \sum_{h=1}^{n} S_h^*\right)}$$

2.7.2. Own-Price Elasticity of Supply

The own-price elasticity of supply (ϵ_{vv}) can be obtained:

(31) $$\epsilon_{vv} = \frac{\partial LnV}{\partial LnP_y} = \frac{\partial Ln\prod}{\partial LnP_y} + \frac{\partial Ln}{\partial LnP_y}\left(1 - \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i}\right)$$

(32) $$\epsilon_{vv} = \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i} \cdot \frac{\partial LnP_i}{\partial LnP_y} - \frac{\sum_{i=1}^{n}\sum_{h=1}^{n} \gamma_{ih}}{\left(1 + \sum_{h=1}^{n} S_h^*\right)}$$

(33) $$\epsilon_{vv} = \sum_{i=1}^{n} S_i^* - \frac{\sum_{i=1}^{n}\sum_{h=1}^{n} \gamma_{ih}}{\left(1 + \sum_{h=1}^{n} S_h^*\right)}$$

2.7.3. Elasticity of Output Supply with Respect to Fixed Inputs

And, finally, the elasticity of output supply (ϵ_{vk}) with respect to the fixed inputs Z_k could be derived as:

$$(34) \qquad \epsilon_{vk} = \frac{\partial LnV}{\partial LnZ_k} = \frac{\partial Ln\prod}{\partial LnZ_k} + \frac{\partial Ln}{\partial LnZ_k}\left(1 - \sum_{i=1}^{n} \frac{\partial Ln\prod}{\partial LnP_i} \right)$$

$$(35) \qquad \epsilon_{vk} = \sum_{i=1}^{n} \delta_{ik} LnC_i + \beta_k - \frac{\sum_{i=1}^{n} \delta_{ik}}{\left(1 + \sum_{h=1}^{n} S_h^{*} \right)}$$

2.8. Budgeting Analysis

The budgeting analysis of production in cost and return includes one set of items as follows:

Yield (per/sao)	=	Total production / Total area
Gross return	=	Total production in kg * Price per kg
Total cost	=	Material inputs
		+ Labor costs
		+ Hired machine and animal power costs
		+ Field protection service fee
		+ Imputed value of machine and animaL power supplied by household
		+ Tax of land use.
Material cost	=	Costs of seeds (own supply and purchased)
		+ Fertilizers (own supply and purchased)
		+ Insecticides
		+ Irrigation charges
Purchased cost	=	Material inputs
		- Own supply inputs of seeds and fertilizer
		+ Hired machine and animal power costs
		+ Hired labor
		+ Field protection service fee

Labor costs	=	Hired labor
		+ Imputed value of family and exchange labor
Net return	=	Gross return - Total cost
Gross margin	=	Gross return
		- (Purchased cost + Tax of land use)
Value added	=	Gross return - Material input costs
Return to labor	=	(Gross return - All costs except labor)/
		(Total cost of labor)
Return to material input	=	(Gross return - All costs except material input)/
		(Total material input costs)
Return/Cost Ratio	=	Gross return / Total costs
Net return/Gross return Ratio	=	Net return/Gross return.

Specific farm-gate prices is used to calculate cost, return, etc, of production. The currency used is Vietnamese Dong (D). At the survey period (April and May 1994), one US$ approximately equal to 10,700 Dong.