CHAPTER II

RESEARCH METHODS

This chapter will lay out research methods to achieve the study objectives, namely data collection, scope of the study, analysis, including model representation.

2.1 Data collection

This study used primary and secondary data. The primary data were obtained from surveys of farmers as well as interviews with merchants and the officers of the Bank for Agriculture and Agricultural Cooperatives (BAAC) in Phayao province. Information on patterns of crop production and market information was collected through informal and formal interview. Stratified random sampling was adopted for this study. Field surveys were conducted in irrigated lowlands and rainfed areas of Phayao province. 90 households were selected.

Secondary data were collected from many government offices, namely, the Center for Agricultural Statistics, Office of Agricultural Economic, Ministry of Agriculture and Cooperatives, Phayao Provincial Commercial Office, Phayao Department of Internal Trade, Phayao Provincial Agricultural Extension Office, and National Statistical Office. Some information was obtained from the research project entitled "Decision Support System for Agricultural and Resource Management in the Upper North, Phase II: Production, Risks and Farmers' Strategies" conducted by the Multiple Cropping Center, Chiang Mai University (Ekasingh *et al*, 2006)

2.2 Data Analysis

To achieve the first objective, to find variation in yields, and prices of different rice varieties in at least past five years in the study area. Coefficient of variation was used to approximate risk in yield, price, cost, and income in each rice variety. Rice varieties, namely Kao Dak Mali 105 (KDML105), RD15, and RD6 were studied. The yields and prices were for the year 2000/01 – 2005/06. The formulation of coefficient variation is below:

$$\text{Coefficient Variation (CV)} = (\text{Standard Deviation} / \bar{X})*100 \qquad .... (2.1)$$

Simple regression was used for trend analysis (Daniel and Gustavo, 1998; and Hafner, 2003). Trends of market prices of rice were for the year 1994/95-2007/08 and trends of government support prices that is covering the year 2000/01 – 2007/08. For yield, its trends were for the year 2000/01 – 2005/06 for each rice variety.

$$y = c + ab \qquad .... (2.2)$$

y = dependent variable (market prices, government support prices, or yields)

c= constant

a = coefficient

b = independent variable being trend variable

This study examines the effects of temporal variation in yields, and prices on the wet-season rice production.

For the second objective, MOTAD (Minimization of Total Absolute Deviation) model was used to find optimal farm plan for rice for farmers. Optimal rice production plans were generated with the risk aversion coefficient of farmer, Φ = 0.90 (Taksatipong, 1984). This study took into account rice production in rainy season with RD15, KDML105, and RD6. For each model, the area type in model was considered separately as rainfed area and irrigated area. Price also was separated into market prices and government support prices.

The modified linear programming named MOTAD (Minimization of Total Absolute Deviation) model is a technique used to find an optimal farm plan and to find the relationship between return and variation in yield, price on the rice production. Hazell and Norton, (1986) considered the Mean Absolute Deviation (MAD) as a measure of uncertainty.

$$\sigma \approx \left| \frac{T\pi}{2(T-1)} \right|^{0.5} MAD \qquad \text{……. (2.3)}$$

where

π = The mathematical constant or 3.14176

σ = Risk variable

T = Time

MAD = Mean Absolute Deviation

when MAD estimator is total absolute deviation (TAD) divided by number years (time)

$$MAD = \frac{TAD}{T} \qquad \text{……. (2.4)}$$

and TAD estimator is composed of positive total absolute deviation (TPD) and negative absolute deviation (TND). As the positive total absolute deviation is equal to the negative absolute deviation;

$$TAD = 2\,TND \qquad \text{……. (2.5)}$$

$$MAD = \frac{2TND}{T} \qquad \text{……. (2.6)}$$

Taking the MAD from (equation 2.6) into (equation 2.3), the estimated variance becomes

$$\sigma \approx \left| \frac{T\pi}{2(T-1)} \right|^{0.5} \frac{2TND}{T} \qquad \text{……. (2.7)}$$

$$\Theta = \frac{2s}{T} \quad and \quad s = \left(\frac{T\pi}{2(T-1)} \right)^{\frac{1}{2}} \qquad \text{……. (2.8)}$$

Since Θ is a constant for give farm problem, we can derive σ through by Θ to obtain

$\Theta TND - \sigma = 0$ ……. (2.9)

The model used in the analysis is shown below:

Objective function

Max $L(E,\sigma) = \sum_j E(c_{jt}) - \Phi\sigma(c_{jt})$ …... (2.10)

Subject to

$\sum_j a_{ij} X_j \leq b_i$, for all i ……(2.11)

$\sum_j (c_{jt} - E[c_{jt}])X_j + d_t \geq 0$, for all t; t= 1,…,T ……(2.12)

$$\sum_t d_t - \frac{\sigma(c_{jt})}{\Theta} = 0$$ ……(2.13)

$X_j \geq 0;\ E(c_{jt}) \geq 0;\ \sigma(c_{jt}) \geq 0$ ……(2.14)

where

L (E, σ) = linear programming of the expected profit ($E(c_{jt})$) and mean absolute deviation ($\sigma(c_{jt})$)

X_j = the area in rice variety j^{th} (*rai*)

a_{ij} = respective input-output coefficients that capture the level of use of resource *i* in the production of rice variety j^{th}

b_i = the available resource endowment for factor i^{th}

c_{jt} = revenue of rice variety j^{th} in year *t* (*t*=1, 2,. . ., T)

$E(c_{jt})$ = sample mean revenue for the rice variety j^{th} across all of the T years

d_t = negative total absolute deviations

Θ = 2s/T is a constant

s = $(T\pi / 2(T-1))^{1/2}$ is the square root of the Fisher's constant (Hazell and Norton, 1986)

Φ = risk aversion parameter measuring the attitude of the farmer towards risk

$\sigma(c_{jt})$ = risk available based on the MAD (Mean Absolute Deviation) of the variance of profits from rice production over the T years and *j* rice variety

(Adesina, and Ouattara, 2000)

The software that was used to solve optimization problems with a well formulated model is LINDO (Linear Interactive Discrete Optimizer).

MOTAD was used to find optimal farm plans. Table 2.1 shows the structure of the model with objective function, activities (cross variable), and constraints (row variable). The following variables are used in model.

X01 = Area planted in RD15 in rainfed or irrigated condition
X02 = Area planted in KDML105 in rainfed or irrigated condition
X03 = Area planted in RD6 in rainfed or irrigated condition
X04 = Loan for farm production (baht)
X05 = Hired labor at the early of July (man-days)
X06 = Hired labor at the late of July (man-days)
X07 = Hired labor at the early of August (man-days)
X08 = Hired labor at the late of August (man-days)
X09 = Hired labor at the early of September (man-days)
X10 = Hired labor at the late of September (man-days)
X11 = Hired labor at the early of October (man-days)
X12 = Hired labor at the late of October (man-days)
X13 = Hired labor at the early of November (man-days)
X14 = Hired labor at the late of November (man-days)
X15 = Hired labor at the early of December (man-days)
X16 = Hired labor at the late of December (man-days)
X17 = absolute value of negative deviation in total revenue in crop year 2000/2001 (baht)

X18 = absolute value of negative deviation in total revenue in crop year 2001/2002(baht)

X19 = absolute value of negative deviation in total revenue in crop year 2002/2003(baht)

X20 = absolute value of negative deviation in total revenue in crop year 2003/2004(baht)

X21 = absolute value of negative deviation in total revenue in crop year 2004/2005(baht)

X22 = absolute value of negative deviation in total revenue in crop year 2005/2006(baht)

σ = Risk variable

Y01 = Total available rainfed or irrigated areas

Y02 = Available family or exchanged labor in Phayao at the early of July (man-days)

Y03 = Available family or exchanged labor in Phayao in the late July (man-days)

Y04 = Available family or exchanged labor in Phayao at the early of August (man-days)

Y05 = Available family or exchanged labor in Phayao in the late of August (man-days)

Y06 = Available family or exchanged labor in Phayao at the early of September (man-days)

Y07 = Available family or exchanged labor in Phayao in the late of September (man-days)

Y08 = Available family or exchanged labor in Phayao at the early of October (man-days)

Y09 = Available family or exchanged labor in Phayao in the late of October (man-days)

Y10 = Available family or exchanged labor in Phayao at the early of November (man-days)

Y11 = Available family or exchanged labor in Phayao in the late of November (man-days)

Y12 = Available family or exchanged labor in Phayao at the early of December (man- days)

Y13 = Available family or exchanged labor in Phayao in the late of December (man-days)

Y14 = Hired labor at the early of July to late of December (man-days)

Y15 = Total owned financial capital in farm production (baht)

Y16 = Total loan of money from bank (baht)

Y17 = Deviation in rice revenue in crop year 2000/2001(baht/*rai*)

Y18 = Deviation in rice revenue in crop year 2001/2002(baht/*rai*)

Y19 = Deviation in rice revenue in crop year 2002/2003(baht/*rai*)

Y20 = Deviation in rice revenue in crop year 2003/2004(baht/*rai*)

Y21 = Deviation in rice revenue in crop year 2004/2005(baht/*rai*)

Y22 = Deviation in rice revenue in crop year 2005/2006(baht/*rai*)

Y23 = Constraint equation dealing with risk (baht)

Y24 = RD6 household consumption 1,000 kg/household

C01 = RD15 gross margin (baht)

C02 = KDML105 gross margin (baht)

C03 = RD6 gross margin (baht)

D01 = RD15 cash cost (baht)

D02 = KDML105 cash cost (baht)

D03 = RD6 cash cost (baht)

F03 = coefficient of rice yield in rainfed area or irrigated area (kg/*rai*)

a_{ij} = Coefficient of labor use

b_i = Amount of restriction

T = 6 years

[R'] = $c_{jt} - E[c_j]$

Table 2.1 MOTAD model for analysis to find optimal rice production in Phayao province under risk situation

Restriction function		Activity					Sign.	RHS
		Production	Loan money (baht)	Hired labor (man-days)	Absolute of negative deviation in total revenue (baht)	Risk variable (baht)		
		X01…X03	X04	X05…X16	X17…X22	σ		
Objective function		C01…C03	-0.08	-150..…..-150		-0.90		
Paddy area(rainfed or irrigated)	Y01	1……….1					≤	b_{01}
Total family or exchange laborers (man-days)	Y02	a_{ij} …… a_{ij}		-1			≤	b_{02}
	:	: :		.			:	:
	Y13	a_{ij} …… a_{ij}		-1			≤	b_{13}
Total hired laborers (man-days)	Y14			1…………..1			≥	0
Own financial capital (baht)	Y15	D01…D03	-1	150………150			=	0
Loan money (baht)	Y16						≤	b_{16}
Deviation of revenue	Y17				1		≥	0
	:	[R']			.		:	0
	Y22				1		≥	0
Total deviation (baht)	Y23				1……………...……1	-2.17	=	0
Household Consumption (kg)	Y24	F03					≥	b_{24}

Equation explanations

Objective function

L(E, σ)= $C01X01 + C02X02 + C03X03 - 0.08X04 - 150X5 - 150X06 - 150X07 - 150X08 - 150X09 - 150X10 - 150X11 - 150X12 - 150X13 - 150X14 - 150X15 - 150X16 - 0.9\sigma$ ……(2.15)

Y01 = Total rainfed or irrigated area

$1X01 + 1X02 + 1X03 \leq b_{01}$ ……(2.16)

Y02 = Available family or exchanged labor at the early of July (man-days)

$a_{0201}X01 + a_{0202}X02 + a_{0203}X03 \leq b_{02}$ ……(2.17)

Y03 = Available family or exchanged labor in the late July (man-days)

$a_{0301}X01 + a_{0302}X02 + a_{0303}X03 \leq b_{03}$ ……(2.18)

Y04 = Available family or exchanged labor at the early of August (man-days)

$a_{0401}X01 + a_{0402}X02 + a_{0403}X03 \leq b_{04}$ ……(2.19)

Y05 = Available family or exchanged labor in the late of August (man-days)

$a_{0501}X01 + a_{0502}X02 + a_{0503}X03 \leq b_{05}$ ……(2.20)

Y06 = Available family or exchanged labor at the early of September (man-days)

$a_{0601}X01 + a_{0602}X02 + a_{0603}X03 \leq b_{06}$ ……(2.21)

Y07 = Available family or exchanged labor in the late of September (man-days)

$a_{0701}X01 + a_{0702}X02 + a_{0703}X03 \leq b_{07}$ ……(2.22)

Y08 = Available family or exchanged labor at the early of October (man-days)

$a_{0801}X01 + a_{0802}X02 + a_{0803}X03 \leq b_{08}$ ……(2.23)

Y09 = Available family or exchanged labor in the late of October (man-days)

$a_{0901}X01 + a_{0902}X02 + a_{0903}X03 \leq b_{09}$ ……(2.24)

Y10 = Available family or exchanged labor at the early of November (man-days)

$a_{1001}X01 + a_{1002}X02 + a_{1003}X03 \leq b_{10}$ ……(2.25)

Y11 = Available family or exchanged labor in the late of November (man-days)

$a_{1101}X01 + a_{1102}X02 + a_{1103}X03 \leq b_{11}$ ……(2.26)

Y12 = Available family or exchanged labor at the early of December (man- days)

$a_{1201}X01 + a_{1202}X02 + a_{1203}X03 \leq b_{12}$ ……(2.27)

Y13 = Available family or exchanged labor in the late of December (man-days)

$a_{1301}X01 + a_{1302}X02 + a_{1303}X03 \leq b_{13}$ ……(2.28)

Y14 = Hired labor at the early of July to late of December (man-days)

$1X05 + 1X06 + 1X07 + 1X08 + 1X09 + 1X10 + 1X11 + 1X12 + 1X13 + 1X14 + 1X15 + 1X16 \geq 0$ ……(2.29)

Y15 = Total owned financial capital in farm production (baht)

$D01X01 + D02X02 + D03X03 - 1X04 + 150X5 + 150X06 + 150X07 + 150X08 + 150X09 + 150X10 + 150X11 + 150X12 + 150X13 + 150X14 + 150X15 + 150X16 = 0$ ……(2.30)

Y16 = Total loan of money from bank (baht)

$1X4 \leq b_{16}$

Y17 = Deviation in rice revenue in crop year 2000/2001(baht/*rai*)

$(c_{0101} - E[c_{01}])X01 + (c_{0102} - E[c_{02}])X02 + (c_{0103} - E[c_{03}])X03 + 1X17 \geq 0$ ……(2.31)

Y18 = Deviation in rice revenue in crop year 2001/2002(baht/*rai*)

$(c_{0201} - E[c_{01}])X01 + (c_{0202} - E[c_{02}])X02 + (c_{0203} - E[c_{03}])X03 + 1X18 \geq 0$ ……(2.32)

Y19 = Deviation in rice revenue in crop year 2002/2003(baht/*rai*)

$(c_{0301} - E[c_{01}])X01 + (c_{0302} - E[c_{02}])X02 + (c_{0303} - E[c_{03}])X03 + 1X19 \geq 0$ ……(2.33)

Y20 = Deviation in rice revenue in crop year 2003/2004(baht/*rai*)

$(c_{0401} - E[c_{01}])X01 + (c_{0402} - E[c_{02}])X02 + (c_{0403} - E[c_{03}])X03 + 1X20 \geq 0$ ……(2.34)

Y21 = Deviation in rice revenue in crop year 2004/2005(baht/*rai*)

$(c_{0501} - E[c_{01}])X01 + (c_{0502} - E[c_{02}])X02 + (c_{0503} - E[c_{03}])X03 + 1X21 \geq 0$ ……(2.35)

Y22 = Deviation in rice revenue in crop year 2005/2006(baht/*rai*)

$(c_{0601} - E[c_{01}])X01 + (c_{0602} - E[c_{02}])X02 + (c_{0603} - E[c_{03}])X03 + 1X22 \geq 0$ ……(2.36)

Y23 = Constraint equation dealing with risk (baht)

$1X17 + 1X18 + 1X19 + 1X20 + 1X21 + 1X22 - 2.18\sigma = 0$ ……(2.37)

Y24 = RD6 household consumption 1,000 kg/household

$F03X03 \geq 1,000$ ……(2.38)

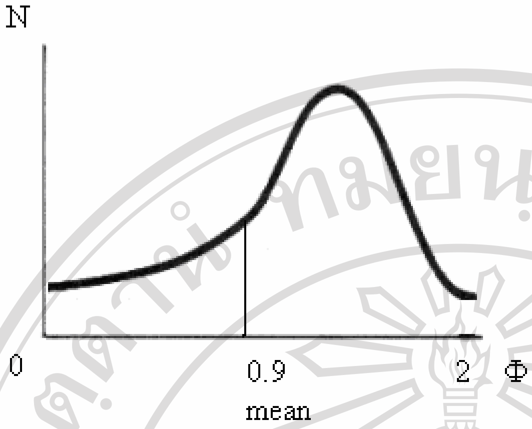

Figure 2.1 Farmer's risk aversions
Source: Taksatpong, 1984

Generlly, farmers are averse to risk. Taksatpong (1984) found that the coefficient for the average risk aversion of farmers is equal 0.90. Risk aversion range from 0.001 to 0.500 is for farmers who have low risk aversion or risk taking farmers. Risk aversion range from 0.51 to 1.25 is for farmer who have medium risk aversion or neutral farmers. Farmers who are risk averse farmer have risk aversion level more than 1.26.