CHAPTER 3

METHODOLOGY

3.1 Conceptual framework for research

In the literature we found that the small financial groups commonly known as saving groups have important roles in the agricultural sector in three parts, namely the source of funds used in production, secondly, the market channel of agricultural products, and finally, a source of knowledge in production technology and financial management in the household. If the saving group operation is efficient, it affects the investment efficiency in the agricultural sector and the quality of life of farmers who are saving group members. This is the primary purpose of the saving group establishment.

In order to achieve results, the conceptual framework for this study is shown in Figure 3.1. The aspects of this study are as follows:

1) The role of saving for many agricultural investment aspects:

1.1) Production: comprising of the source of funds for production and input supply, including education and training in production techniques.

1.2) Processing and packaging: consisting of the source of funding for processing and packaging, and education and training in processing and packaging, including equipment rental services.

1.3) Marketing: being the middleman in public relations, distribution channels and product positioning, and in business negotiations between farmers and capitalists or companies, including education and market training.

2) Operational efficiency of the saving group affecting operational efficiency of agricultural households which are members of the saving group.

3) Operational efficiency of the saving group affecting the quality of life of farmer households by transmission of production efficiency of farmer households. This quality of life is considered in each aspect as follows:

3.1) Economy: income, savings, liabilities and total assets.

3.2) Food security: the adequacy of the amount of food from both production itself and buying for consumption of the household members.

3.3) Habitat: the ownership of housing space and stability of the house.

3.4) Education: the level of education classified as lower compulsory education, compulsory education and higher compulsory education.

3.2 Sample size

Sample size and sampling method are as follows:

Step 1: Farmer household selection

The sample size is calculated by the Yamane formula at a 90% confidence level. The total agricultural household samples are 400 and accounted for 0.43 percent of the farmer households which are members of all saving groups. Then, this ratio was used to calculate the sample size which is distinguished by region and type of savings groups shown in Table 3.1.

Step 2: 4 random samples of farmer households from each of the saving groups, which are separated into rice-only households, crop mix households, livestock only households, and crop and livestock households. Therefore, the 100 saving groups are shown in Table 3.1.

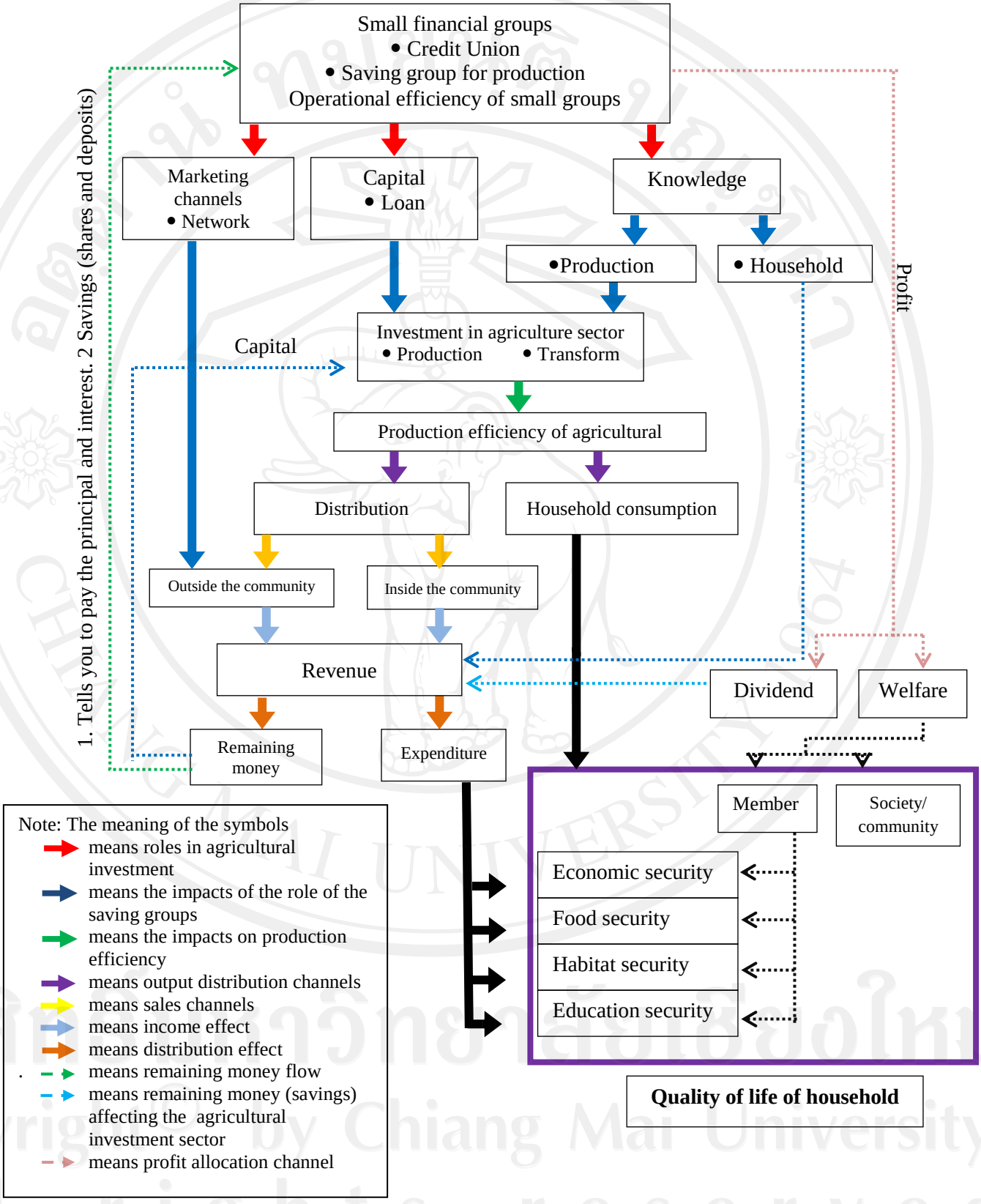

Figure 3.1 Research frameworks

Table 3.1 The number of farmer households and sample size shown by province and type of saving groups

Province	Production group		Credit union		Total	
	Household	Sample	Household	Sample	Household	Sample
Chiang Rai	47,250	196	9,785	48	57,035	244
Chiang Mai	17,322	76	16,526	80	33,848	156
Total	64,572	276	26,311	124	90,883	400

Source: Based on calculations.

Table 3.2 The number of farmer households randomized from selected saving groups.

Province	Production groups (group)	Credit union (group)	Total (group)
Chiang Rai	49	12	61
Chiang Mai	20	19	39
Total	69	31	100

Source: Based on calculations

3.3 Research Method

3.3.1 The Study of Saving Group Roles towards Investment of Agricultural Households

Data were analyzed using percentages and reported by Radar Graph. The roles of saving group towards investment of agricultural households comprise of production, processing and marketing. The criteria for dividing each role is displayed in Table 3.3 (Best & John, 1977).

Table 3.3 The criteria for dividing the saving group roles toward investment

The division	Average
Having the most role toward agricultural investment	4.50 - 5.00
Having much role toward agricultural investment	3.50 - 4.49
Having medium role toward agricultural investment	2.50 - 3.49
Having little role toward agricultural investment	1.50 - 2.49
Having the least role toward agricultural investment	0.50 - 1.49
having No role toward agricultural investment	0.00 - 0.49

3.3.2 The Efficiency Study of Saving Groups toward the Production Efficiency of Agricultural Households

The operational productivity of saving groups combines the role of saving groups toward agricultural investment and operational efficiency of saving groups including production efficiency of farmer households. The study of this part has three steps as follows:

Step 1: an analysis of productivity of farm households

Step 2: an analysis of operational efficiency of saving groups

Step 3: an analysis of factors affecting the production efficiency of households (having the operational efficiency of saving groups as a factor)

Step 1: Find the production efficiency scores of agricultural households (TE_F)

The production efficiencies of farmer households are analyzed by the nonparametric approach based on DEA (Coelli et al., 1998). Because this study has four output variables, the model of production efficiency analysis of household is

$$\max_{\mu} Z = \sum_{r=1}^{s} \mu_r y_{rj} \quad (3.1)$$

restrictions

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} \nu_i x_{ij} \leq 0 \quad (3.2)$$

$$\sum_{r=1}^{s} \mu_r y_{rj} = 1 \quad (3.3)$$

$$\sum_{i=1}^{m} \nu_i x_{ij} = 1 \quad (3.4)$$

$$\mu_r, \nu_j \geq 0 \quad (3.5)$$

where Z is the total efficiency scores of farmer households *j*, y_{rj} is: output *r* of farmer household *j* and μ_r is the weighted value of the output *r*, *r* = 1, 2, ..., *s*: x_{ij} is the: inputs of type *I* of farm household *j* and ν_i is weighted inputs *i*, *i* = 1, 2, .., *m*. The variables used in this model are presented in Table 3.4.

Table 3.4 Variables used in the study of production efficiency of agricultural households

The output variables (y)	The input variables (x)
y_1= Net income from major crops (rice) (baht / year)	X_1= Amount of land used (RAI)
y_2= Net income from other crops (not rice) (baht / year)	X_2= Private investment (baht / year)
y_3= Non-agricultural income from processing products (baht / year)	X_3= Loans from saving group (baht / year)
y_4= Net income from non-agriculture (baht / year)	X_4= Loans from other financing sources (baht / year)
	X_5= Asset values invested in the production (baht / year)
	X_6= Household labors (working day: day)

From Table 3.4, these variables used in this study are important for the efficiency evaluation as follows:

1) Net income from major crops (rice) (y_1): Rice is the main crop which farmers grow for consumption and for sale.

2) Net income from other crops (y_2): Apart from rice, farmers plant other crops in the dry season. Livestock, such as fish and poultry, are also included in this variable

3) Non-agricultural income from processing products (y_3): For some agricultural products, farmers prefer to transform them into processed products in order to increase the value of the products such as the tilapia flesh being transformed pickled fish.

4) Net income from non-agriculture (y_4): Nowadays, the members of agricultural households (particularly descendants) prefer to work non-agricultural job which is one of the major sources of income of agricultural households.

5) Amount of land Used (X_1): This factor is very important in agricultural production. If there is a lot of farmland used, the expanded production opportunities are more. Then, the output and income increase.

6) Private investment (X_2): this is the agricultural household savings. If the agricultural households have a lot of savings, there is less loan dependency and interest expenditure, which affects net income.

7) Loans from saving group (X_3): This is one of the sources of funds for agricultural investment. If farmers lack capital, they cannot fully produce and thusly have low productivity. If farmers receive loans from a saving group, they can have

sufficient inputs for full production, and therefore receive higher output and farmer income.

8) Loans from other financing sources (X_4): Because of the limited capital of saving groups may be unable to provide enough funding to members, other financing sources such as village funds and Bank for Agriculture and gricultural cooperatives may be source of funds that makes up the difference. Consequently, the output and income of member households increase.

9) Asset values invested in the production (X_5): Production in the agricultural sector, land, capital and other assets such as machinery and equipment are also important. The use of machinery power results in faster production because there are fewer restrictions than using human or animal labor. In the same period, using machines gives more output than human or animal labor, so it affects output and cost of production which is directly related to farmer income.

10) Labor households (X_6): As mentioned in X_5, human labor is one of the most important factors, if a household has sufficient labor, the cost of production will decrease which will result in an increase of the net income of the household.

Step 2: Production efficiency analysis of saving group (TE_{MFI})

The operational efficiency analysis of a saving group uses the same method as production efficiency of a farmer household. There are four output variables, and the model is

$$\max_{\phi} \theta = \sum_{k=1}^{m} \phi_k O_{kp} \quad (3.6)$$

$$\text{Restrictions} \quad \sum_{k=1}^{n} \phi_k O_{kp} - \sum_{l=1}^{m} \gamma_l F_{lp} \leq 0 \quad (3.7)$$

$$\sum_{k=1}^{n} \phi_k O_{kp} = 1 \quad (3.8)$$

$$\sum_{l=1}^{m} \gamma_l F_{lp} = 1 \quad (3.9)$$

$$\phi_k, \gamma_l \geq 0 \quad (3.10)$$

where θ is the efficiency score of the total saving groups, O_{kp} is: output k of saving group p, ϕ_k is weighted of output k, k = 1,2 ..., n. F_{lp} is inputs l of the saving group p, and γ_l is the weighted of inputs l, l = 1,2 ..., m.

For the input and output data used in the study, the analysis approach is the output-oriented model. Because the bank is a producer with restricted operational capital, most of the capital is obtained from members and outside organizations providing funds without interest (Mohammad, 2003), and the saving group operation is composed of volunteers without compensation. The output (O1-O4) variables and input (F1-F4) of the saving group used in the model are shown in Table 3.5.

Table 3.5 Variables used in the operational efficiency analysis of saving groups

Output Variables (O)	Inputs variables (F)
O_1 = Loans (baht)	F_1 = Amount of capital (baht)
O_2 = Net profit (baht)	F_2 = Physical capital value or fixed asset value (baht)
O_3 = Investments in other assets (baht)	F_3 = Loans, savings deposits, and time deposit (baht)
O_4 = Welfare member fund (baht)	F_4 = Number of full-time employees (people)

In Table 3.5, these variables are important for the efficiency evaluation as follows:

1) Loans (O_1): The main goal of the savings group is to provide loans to members. so loans are a major output.

2) Net profit (O_2): Although the aim of saving groups is not focused on profits, there must be some profit for the operational costs. The rest of it is used to create welfare for their members.

3) Investments in other assets (O_3): Although the main goal of saving groups focuses on loan members, some capital is used to invest in other assets such as deposits with banks in order to have operational liquidity and have investment return.

4) Welfare member fund (O_4): This is an output, which measures the success of the operation of a saving group, particularly in regard to member care.

5) Capital (F_1): This is a source of funding for the operation of any saving group, and it has a higher percentage when compared with other sources of funds.

6) Fixed asset value (F_2): Fixed assets such as office buildings and equipment provide facilities for operation. The asset value is a proxy variable of service flow.

7) Loans (F_3): Operational capital borrowing from other financial institutions such as saving banks, or from members (both saving deposit and time deposit) are considered to be one source of operational capital.

8) Employees (F_4): This is an important factor for saving group operation. There are two types of staff employees who are hired to work and obtain salary, and volunteers who work for some time and obtain compensation.

Step 3: Analysis of factors affecting the production efficiency of the household and factors affecting the operational efficiency of saving groups

1) The calculated efficiency scores from Step 1 are used to create a model for analysis of factors affecting production efficiency of a farmer household using equation 3.11 which has variables as follows:

1.1) Characteristic variables of the household comprise of the number of household members (z_1), age of the householder (z_2), education of the householder (z_3) and farming experiences (z_4).

1.2) Variables related to inputs: the size of the farm land (z_5): the economy of scale, The farm characteristics (z_6), namely only rice cropping (z_{61}), rice with other cropping (z_{62}), only livestock (z_{63}) and rice cropping and livestock (z_7). These variables imply the transportation cost of input and output. The total loan (z_8) refers to the opportunity to expand production. The number of available loan resource (z_9) indicates the opportunity to access funding.

1.3) Other variables: market opportunities (z_{10}), loan from saving group (z_{11}); number of training times from group savings (z_{12}), and types of savings of the household member (D):

1.4) Operational efficiency score of saving group (TE_{MFI})

The model of factors affecting the production efficiency of the household is

$$TE_F = \alpha + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \beta_6 Z_6 + \beta_7 Z_7 + \beta_8 Z_8 + \beta_9 Z_9 + \beta_{10} Z_{10} + \beta_{11} Z_{11} + \beta_{12} Z_{12} + \beta_{13} D + \beta_{14} TE_{MFI} + \varepsilon_1 \quad (3.11)$$

where TE_F is the production efficiency of the household and ε_1 is the error term, $\varepsilon_1 \sim N(0, \sigma^2)$. In equations: (11), TE_F ranges from 0-1. The fitted model for this equation should be a two-limit Tobit model which is estimated by the maximum-likelihood method (Aree Wiboonpongse, 2006).

2) The operational efficiency scores of saving groups obtained from Step 2 were used to model factors affecting the operational efficiency of saving groups using equation 3.12. The model for operational efficiency explanation is comprised of two groups of variables, namely economy variables (X_1 - X_5) and the administration performance (X_6 - X_9). This model also has the type of saving group variable (D) and the production efficiency variable (TE_F). Each variable has assumptions as follows:

2.1) Size of group measured by the number of group members (X_1): This variable reflects the economies of scale, while the efficiency of each group is comparative efficiency with the same size of production. However, there are other interested dimensions that compare efficiency between different scales. This variable has a direct relationship with efficiency.

2.2) Ratio of net profit/total assets (percentage) (X_2): This variable displays the ability of asset utilization for productivity. These are formed by two parts, namely the quality of the property according to workload, and the quality of management of the administration board. This factor is expected to positively correlate with the efficiency level.

2.3) Ratio of net profit/capital stock (percentage) (X_3): This factor shows the ability of financial administration. Although capital stock has no cost and can be allocated to members as a loan or spent without the lag time, it is the same as deposits which are held for account management. In addition, X_3 may have a positive effect on operational efficiency of the saving group.

2.4) The average loan per members (X_4): A high average loan per member represents the ability of financial management because the group that has financial restrictions usually determines the loan ceiling for members. Increasing the cost of a loan will decrease the cost per unit. Then the expected relationship between this variable and efficiency is positive.

2.5) The ratio of deposits from members/loans (X_5): Sources of operational capital of saving groups come from two parts, namely capital stocks and deposits from members. Deposit is capital that costs interest, so X_5 may negatively affect the operational efficiency of the group.

2.6) The administration of saving group: This variable is composed of qualitative variables measured at 6 levels, ranging from none (0) to the highest level (5). These variables are levels of the participation of members for board selection (X_6), the level of rule enforcement for administration (X_7), the level of financial management of the board (X_8), and the level of transparency in the management of the board (X_9).

2.7) Dummy variables (D): This dummy variable is a proxy of the different saving groups. If D =1, the credit union is supported by NGOs, and if D =0, it is a produced group supported by the government. The variables X_7 - X_9 and D should positively affect efficiency.

The models of factor affecting the operational efficiency of a saving group are presented as follows:

$$TE_{MFI} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} D + \beta_{11} TE_F + \varepsilon_2 \quad (3.12)$$

where TE_{MFI} is the operational efficiency of the saving group which is measured by Step 2, and ε_2 is the error variable, $\varepsilon_2 \sim N(0, \sigma^2)$. In the model as in equations (3.12) TE_F is ranged from 0-1. The reasonable model should be a two-limit Tobit model. The estimation is maximum likelihood (Aree Wiboonpongse, 2006)

The model selection is considered from

1) Akaike's Information Criterion (AIC): If the AIC of the model is small, the model is suitable for applications comparison with a model having high AIC.

2) Root Mean Square Error (RMSE): It is the square root of the mean squared error. The lowest RMSE represents the ability of forecasting that is higher than the model having a higher RMSE.

3.2.3 The quality of life study of agricultural households who are members of savings groups:

After obtaining the production efficiency score of farmer households, the next step is an analysis of whether production efficiency will affect the quality of life of an agricultural household.

Step 1: Determine the quality of life index of the agricultural household by using the composite index and quality of life indicators shown in Table 3.6.

The calculation method of the quality of life index is applied from the calculation method of Human Development Index (HDI) of the UNDP with the following steps:

Table 3.6 Composition and indicators of quality of life of farmers.

Elements	Indicators
Economic security	●Revenue ●Savings ●Value of the property ●Value of liabilities
Food security	● Sufficient food for household consumption (from producing and buying)
Education security	● Number of people in households receiving compulsory education ● Number of people in households receiving higher compulsory education
Habitat security	● Have their own habitat● Permanent stability of habitat ● Having sufficient living space per household member

1) The index calculation for each of the indicators:

The index is computed by the difference between the values obtained from each indicator and the minimum indicator's score, then divided by the difference between the maximum and the minimum score of that indicator. For example, if the household debt is 100,000 baht, the maximum debt of household is 500,000 baht, the minimum household's debt is 50,000 baht: The formula for calculating the value of the index is:

$$I_n = \frac{S_n - S^{\min}}{S^{\max} - S^{\min}} \qquad (3.13)$$

where I_n Index of indicator n

S_n Score of indicator n

$S^{\min}$ Minimum score

$S^{\max}$ Maximum score

then,

$$0.11 = \frac{100{,}00 - 50{,}000}{500{,}000 - 50{,}000}$$

Therefore, the total score is 1, the debt ratio indicator of this example is 0.11:

2) The overall index calculation for each indicator:

Because each indicator has a different basic concept and database, these cause variance in the data. Therefore, the overall index calculation for each indicator cannot use the sum and averages. In this study, the calculation method for Human Poverty Index (HPI) of UNDP has been applied. The index value of each indicator is raised to the power 3 in order to reduce the variability of the data. Then, the value of each indicator is added together and the cube root is taken

$$C_m = \left[\frac{\sum_{n=1}^{N} I_n^3}{n} \right]^{\frac{1}{3}}$$

where C_m Overall index value of indicator *m*:

I_n Index value of indicator *n*:

n Number of index of indicator *m*.

For example: The economic security component, income indicator is 0.25, saving indicator is 0.50, and debt indicator is 0.11, so

$$0.28 = \left[\frac{0.25^3 + 0.50^3 + 0.11^3}{3} \right]^{\frac{1}{3}}$$

3) The overall index calculation for the quality of life

In order to calculate the overall index of the quality of life, the same method of the overall index calculation is used for each indicator:

$$QLI = \left[\frac{\sum_{m=1}^{M} C_m^3}{m} \right]^{\frac{1}{3}}$$

By: QLI Overall quality of life index

C_m Overall index value of indicator m:

m Number of overall index of all indicators

For example: Overall quality of life index composes of the economy, food and education indicators are 0.33, 0.54 and 0.74, respectively, so

$$0.53 = \left[\frac{0.33^3 + 0.54^3 + 0.74^3}{3} \right]^{\frac{1}{3}}$$

4) The criteria for quality of life:

After we obtained the overall index of each component and the overall index of quality of life which are divided into three levels, low, medium and high. The criteria used to grade the quality of life is,

$\bar{x} - S.D. >$ Indices Low quality of life:

$\bar{x} - S.D. <$ Indices $< \bar{x} + S.D.$ Medium quality of life:

Indices $> \bar{x} + S.D.$ High quality of life:

$\bar{x}$ is mean and $S.D.$ is standard deviation:

Step 2: An analysis of the relationship between the level of production efficiency and quality of life of farmer households. Because the quality of life has three levels ranged from low, to high, the relationship is estimated by the ordered probit model. The vector of dependent variables, quality of life index of farmer household (y^*), is determined to have a linear relationship with explanatory variables which affect quality of life, namely the production efficiency score of farmer

households (TE) and operational efficiency of the saving group (TE_{MFI}), these variables should have a positive effect on the quality of life of farmer households:

SEX and AGE and farming experience (FAREXP) of the householder, these variables should have a positive impact on quality of life:

The household account (HAC) variable which reflects the household resource management will result in a positive effect on households being credit union group members because these groups are not intervened with by the government.

Vector of error terms has standard normal distribution with $\varepsilon_i \sim iidN(0,1)$.

$$y^* = x'\beta + \varepsilon \tag{3.16}$$

When: Y^* = Vector of quality of life:

By: Y= 0 Low quality of life:

Y=1 Medium quality of life:

Y=2 High quality of life:

$X^{'}$ = Vector of dependent variables:

ε = Vector of error term:

The estimation of ordered probit model is the maximum likelihood method.