CHAPTER II

RESEARCH METHODS

Maize is planted in the all provinces and in many regions of Cambodia, from the highlands in the north and northeast areas to the lowland in the western and central areas surrounding the Tonlesap river and the Mekong river. Two most important provinces for maize production in Cambodia are Battambong and Kandal provinces. Battambang province covers 49 percent of the total maize areas. While Kandal province covers 16 percent of the total maize areas.

2.1 Site selection

The study was conducted during 2004. The selection of the study site was based on the area where both hybrid and local varieties of maize are being grown by farmers and the major maize growing area too. This study was undertaken in Kandal province where both hybrid and local maize varieties are grown. Choice of Kandal povince is the study area because it is the second largest maize producing province. Koh Thom District, within Kandal province, was selected as the study site. Rice, maize, mungbean, and soybean are the four major crops in the District, which is the lowland area along Bassac River.

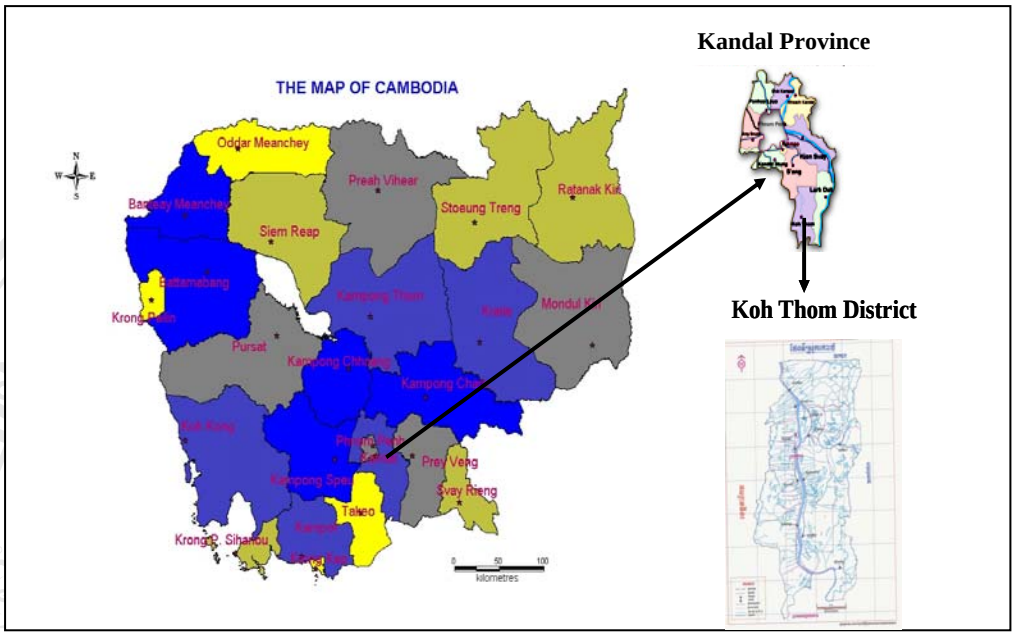

Figure 2.1 Map of Cambodia and location of study area

Source: Direction of Agriculture, Forestry, and Fisheries, Kandal Province

2.2 Sampling technique

A two-stage sampling procedure was used to select farmers for the study. One district where both hybrid and local varieties of maize were grown by farmers was selected. Four communes within the district were selected based on information on maize growing areas. Furthermore, two villages from each of the communes were selected purposively where different maize varieties were grown by the farmers. A total 80 farm households growing local and hybrid maize varieties were randomly selected from the target area for this study, 40 farmer households for local variety growers and other 40 for hybrid variety growers. Thirty-five households out of the 40 surveyed local maize growers grew yellow maize which was sold as dry grain and the other five households grew white maize sold as fresh ears. All of the local maize growers were in rainfed condition. Twenty households out of the 40 surveyed hybrid maize growers grew yellow maize sold as dry grain under rainfed condition, 15 households grew yellow maize sold as dry grain under irrigated condition, and the remaining 5 households grew white maize sold as fresh ears under irrigated condition. So, 75 per

cent of the total surveyed households were under rainfed conditions and 25 per cent under irrigated conditions.

2.3 Data collection

Data were collected from primary and secondary sources. Relevant information on maize-based farming system, cost and revenue of maize production, and factors affected adoption of hybrid maize varieties were gathered using methods as below:

2.3.1 Secondary Data

To have a better understanding of the existing situation of maize area, secondary data were collected from published and unpublished information about maize production in particular and the study area in general. This information was collected from Direction of Agriculture Forestry and Fisheries Kandal Province, Koh Thom District Agricultural Office, Department of Planning, Statistics and International Cooperation Ministry of Agriculture, Forestry and Fisheries, Cambodia Department Resource Institute, Seed Production Office of Department of Agronomy and Agricultural Land Improvement, and agro-chemical retailers.

2.3.2 Primary Data

Primary data were collected from small-scale Koh Thom maize farmers in 2004 using a structured questionnaire and participatory rural appraisal (PRA) covering the study objectives. Discussions were held at the end of individual interview to note their practices in growing maize and comments. The data that were collected included socio-economic, biophysical and institutional characteristics, farmers' use of the maize, problems and potential of maize production, inputs of maize production applied (type, amount, cost), labor used in maize production (hired, family, age, hours, wage rate), for each operation, and machinery used (days, hours, cost). After harvest, the enumerator recorded the harvest and price that the farmers received at sale of his/her maize crop.

Moreover, another income from the maize production was also recorded: income from selling corncob and thinning plants. For the analysis, data were than entered into spreadsheet and read into SPSS 14 for data cleaning, organization and analysis.

2.4 Data Analysis

To fulfill Objective 1, information on biophysical environment, socio-economic characteristics, institutional development, and the agricultural sector in the study area were described. Information on the maize subsector, farmers' use of maize, problems and potential of maize production were also described.

To achieve Objective 2, data on cost and revenue of maize production were analyzed by using enterprise budgeting to know the profitability of each group. The farm record data were analyzed and average quantity and cost of various inputs (such as seed, fertilizer, herbicide and fungicide) used per ha was computed for each group of farmers for comparison and to be used for profitability analysis. Further more, labor use (man-days/ha) and its associated cost per ha by type of operation were analyzed and compared between local and hybrid maize farmers. Labor use and cost per hectare by operation was segregated into family and hired labor to gain a better understanding of the composition of labor and distribution of cost.

Revenue:

Gross Income (GI), is defined as the value of the total maize output produced. GI were computed by multiplying average yield by average price at farm gate level. GI included the output (yield of grain, corncob and thinned plants of maize crop) produced during the year, which may be sold, used for household consumption, used on the farm for seed, used for payments in kind for labor; or kept in store for future sale (ending stock). Non-market transactions were valued at their opportunity cost (average market price).

Costs:

Operating cost: Summing of material cost, land preparation cost (draught animals power or machine cost), hired machinery cost for irrigation, hired labor cost, opportunity cost of equity capital, and opportunity cost of family labor.

- Material cost - Value or expenses incurred on seeds, fertilizer, insecticides, fungicides, and herbicides. Non-purchased inputs cost, such as owned seeds were valued at their opportunity cost, i.e. market price.
- Land preparation cost - The opportunity cost or cost for hiring tractors or oxen for primary land tillage.
- Opportunity cost of equity capital is the amount that the farmer would otherwise be able to earn at the same risk level as investing on the maize production. It was computed at 6 per cent of cash/operating cost for 6 months.
- Opportunity cost of family labor was based on local wage rate (i.e. the cost paid for hired labor).

Total cost is generally divided into total variable cost and total fixed cost. However, in this analysis, total fixed cost was excluded since the fixed costs were minimal. The study did not assign price for the land, given the difficulty of estimating land values.

Returns:

(a) Enterprise gross margin (GM) is defined here as the difference between gross income and operating cost.

(b) Return to family land, labor and management (RFLLM) were computed by deducting operating cost from gross income and plus opportunity cost of family labor.

(C) Return to family land, labor and management per day (RFLLMD) was computed by dividing return to family land, labor and management by the number of family labor days used.

The results from enterprise budgets were used for sensitivity analysis to assess the degree by which the farmers' enterprise gross margin vary when alternative yields and prices were substituted for the actual average values used in the budgets.

The profitability and cost for each group were calculated and converted in standard unit per ha of land. The mean profit and cost of each group were calculated and compared. T-test was used to compare the two means.

To fulfill Objective 3, factors influencing farmers to use hybrid or local maize varieties were found using logistic regression model as follows: (Hosmer, and Lemeshow, 2000).

$$P(x) = \frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}} \qquad (1)$$

$P(x)$ is the probability that the farmers will adopt the hybrid maize varieties. The dependent variable = 1 if the farmer adopted the hybrid maize variety, 0 if they adopted local maize variety.

x is a vector of explanatory variables,

$\beta_0 and \beta_1$ are parameters of the model

e = Base of natural logarithms and approximately equal to 2.718

A transformation of $P(x)$ that is central to the study of logistic regression is the logit transformation. This transformation is defined, in terms of $P(x)$, as:

$$g(x_i) = \ln\left[\frac{P(x_i)}{1-P(x_i)}\right] \quad (2)$$

$$g(x_i) = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \quad (3)$$

A farmer's decision either to adopt or reject hybrid maize varieties is influenced by the combined effect of a number of factors related to farmers' objectives and constraints. In this study, three aspects were considered in the analysis of factors associated with the adoption of hybrid maize varieties:

1. Socio-economic factors: Education, age, family income, household objective, cultivated maize area, farm size, length of stay in the village, labor availability in the family, years of experience in growing maize, land tenure of maize, and tendency to follow neighbors.

2. Institutional factors: Access to technical advice, access to input market, access to out put market, access to irrigation, access to credit.

3. Physical factors: distance to Vietnam border and soil fertility.

The vector of explanatory variables (x) is as follows:

Table 2.1 Definition of variables for adoption study

Variable	Description	Expected Sign
AGE	Age of household head (years)	-
EDU	Education of household head (years)	+
INCOME	Family income (Riel/year)	+
FSIZE	Farm size (ha/household)	+
LTEN	Land tenure of maize (1=yes; 0=no)	-
CMA	Cultivated maize area (ha/household)	+
LSTAY	Length of stay in the village (years)	-
ATA	Access to technical advice (1=yes; 0=no)	+
AIM	Access to input market (1=yes; 0=no)	+
AOM	Access to output market (1=yes; 0=no)	+
AIRRI	Access to irrigation (1=yes; 0=no)	+
ACR	Access to credit (1=yes; 0=no)	+
LAF	Labor availability in the family (people)	+
TEN	Tendency to follow neighbors (1=yes; 0=no)	+
YEXP	Years of experience in growing maize (years)	-/+
SF	Soil fertility (1=good; 0=not so good)	+
OBJ	Household maize objective (1=for cash; 0=for home consumption)	+
DVB	Distance to Vietnam border (km)	-

The variables above affect decision making of the maize farmers. The working hypotheses for this study are:

- Age of household head: It is hypothesized that with increasing age a farmer will be less likely to be interested in new maize varieties. Younger farmers may have greater access to information and may have feeling to take chance to grow hybrid maize varieties.

- Educated household head: A higher level of education increases a farmer's ability to obtain, process, and use adoption information of hybrid maize variety. Education thus increases the probability of adopting hybrid maize variety.

- Family income: It is expected that higher income increase probability of adoption of hybrid maize varieties.

- Farm size: Farm size (ha) is an indicator of wealth and expected to be positively associated with the decision to adopt hybrid maize technologies.

- Land tenure of maize: Land tenure is hypothesized to affect adoption of hybrid maize. If farmers hire land from others they are more likely to grow hybrid maize and in other words farmers will not hire land to grow local maize.

- Cultivated maize area: Farmers with larger areas planted to maize are better adopters of improved maize technologies. Maize provides farmers with cash to buy inputs.

- Length of stay in the village: Length of stay in the village is hypothesized to be negatively correlated to the probability of adoption of hybrid maize because they are familiar to growing existing varieties in their area, so they will not change to other varieties easily.

- Access to technical advice: Technical advice provide by extension agencies, neighbors, or agro-chemical retailers. Contact with them is hypothesized to increase probability of adopting hybrid maize variety.

- Access to input market: Access to input market is hypothesized to be positively related to the probability of adoption of hybrid maize varieties.

- Access to output market: Access to output market is expected to increase the probability of adopting hybrid maize varieties.

- Access to irrigation: Access to irrigation increases the probability of adopting hybrid maize varieties. This is a dummy variable (1=access to irrigation, 0=no irrigation).

- Access to credit: Access to credit can ease farmers' financial constraints. In this study, access to credit was expected to increase the probability of adopting hybrid maize varieties.

- Labor availability in the family: It is hypothesized that there is a positive relationship between adoption of hybrid maize varieties and labor availability in the family.

- Tendency to follow neighbors: Tendency to follow neighbors is hypothesized to be related to the probability of adoption of hybrid maize varieties because farmers' habit is to wait and see.

- Years of experience in growing maize: The previous experience of farmers can be expected to either enhance or diminish their level of confidence. It is anticipated that with more experience, farmers could become risk-averse regarding the adoption of specific maize varieties. Thus, this variable could have either a positive or a negative effect on farmers' decisions to adopt specific maize varieties.

- Soil fertility: It is believed that the better soil fertility they have, the more likely they are to adopt hybrid maize varieties.

- Household maize objective: Household maize objective is hypothesized to be positively related to adoption of hybrid maize varieties. It is assumed that the probability of adopting hybrid maize varieties will be increased if farmers grow maize for cash.

- Distance to Vietnam border: Distance to Vietnam border is hypothesized to be related to the probability of adoption of hybrid maize varieties. Households near Vietnam border tend to have easier technical access and tend to follow Vietnam farmers also to dispose of their production.

Factors influencing the adoption of hybrid maize were analyzed using maximum likelihood estimation of a logistic regression model and estimated odd ratios.