CHAPTER VI
LOGISTIC REGRESSION ANALYSIS OF ADOPTION OF HYBRID MAIZE VARIETIES

This chapter investigates the factors influencing the adoption of hybrid maize varieties in Koh Thom district. The decision of whether to adopt hybrid maize or not is hypothesized to be a function of the combination of independent variables from an environment. A binary logistics regression was run using the twelve independent variables included in the hypothesis as described in Table 6.1. The binary logistic regression was used rather than a linear regression due to the dependent variable being dichotomous. The logistics model transforms the dependent variable into one that has linear relationships with a set of independent variables. This model estimates the linear determinants of the logged odds or logit rather than the nonlinear determinants of probabilities. The transformation is required in order to analyze the impact of these independent variables on the decision as to whether or not adopt hybrid maize varieties in Koh Thom district by the farmers.

6.1 Results

The effect of each of the individual independent variables on the decision to adopt hybrid maize are shown in Table 6.1. The constant variable is the intercept term in the equation and is not significant to the results in this model. The Table shows the values for Coefficient estimate (B) (a weighting value used in the equation) and Odds ratio (Exp (B)) used in interpreting the meaning of the regression coefficients. The final column, Statistical significance (Prob.) of Wald is also shown in the table.

The results of the logistic regression equation (Table 6.1) show that the four of the predictor variables show significance. The most significant predictor of the hybrid maize varieties is the dummy variable of tendency to follow their neighbor. The significance level of this independent variable is 0.000 with a coefficient (B) of

4.247. The Odds ratio score (Exp (B)) of 69.930 can be interpreted to mean that the decision of adoption of hybrid maize varieties is 69.930 times as likely to adopt hybrid maize varieties.

The other two most significant predictor variables are the cultivated maize area and the access to irrigation, both significant at the 0.05 level in the overall regression model. They both showed positive relationship with the adoption of hybrid maize with the coefficients of 2.880 and 2.532 and the odds ration score of 17.806 and 12.618, respectively. The odds ratio of existing maize area can be interpreted as if existing maize area is increased a unit, it leads to 17.806 times increase in the odds that the farmer will grow hybrid maize, assuming that the other variables are constant.

The last and fourth significant predictor variable is the distance to Vietnam border, which showed a negative relationship with the adoption of hybrid maize varieties. It has a coefficient of -0.146 with a significance of 0.071, and odds ratio of 0.864.

Other factors hypothesized to influence adoption did not have significant coefficient. They included age of household head, labor available in the family, education of household head, farm income, farm size, length of stay in the village, years of experience in growing maize, and soil fertility.

While another independent variable such as access to technical advice, access to input market, access to output market, access to credit, household maize objective, and land tenure of maize showed in Table 3.8 did not have any correlation to the model. So, they were not allowed to run the model and excluded.

Table 6.1 Logit regression analysis for adoption of hybrid maize varieties in the study area

Variable	Coefficient estimate (B)	Odds Ratio (Exp (B))	Prob.
Age of household head (years)	.152	1.165	0.282^{NS}
Labor available in the family (people)	.099	1.104	0.761^{NS}
Education of household head (years)	.259	1.296	0.204^{NS}
Farm income (Riel/year)	.000	1.000	0.821^{NS}
Farm size (ha/household)	-.964	.382	0.258^{NS}
Cultivated maize area (ha/household)	2.880	17.806	0.034**
Length of stay in the village (years)	-.044	.957	0.545^{NS}
Distance to Vietnam border (km)	-.146	.864	0.071*
Access to irrigation (1=yes, 0=no)	2.535	12.618	0.034**
Tendency to follow their neighbors (1=yes, 0=no)	4.247	69.930	0.000***
Years of experience in growing maize (years)	-.120	.887	0.301^{NS}
Soil fertility (1=good, 0=not so good)	-1.255	.285	0.474^{NS}
Constant	-2.889	.056	0.455^{NS}

Note: Hosmer-Lemeshow Test: χ^2 = 10.63 df = 8 Sig. = 0.223

Omnibus Tests of Model Coefficients: χ^2 = 72.556 df = 12 Sig. 000

Percentage of Correct Predictions: 93.8%

1 ha = 6.25 rai

NS: Not significant level

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

According to the results in Table 6.1 logit model for adoption of hybrid maize varieties is

$$g(x_i) = \ln\left[\frac{p(x_i)}{1-p(x_i)}\right] = \beta_0 + \Sigma_{i=1}^{n}\beta_i x_i$$ = -2.889 + 2.880 Cultivated maize area – 0.146 Distance to Vietnam border + 2.535 Access to irrigation + 4.247 Tendency to follow their neighbors (4)

Where,

Cultivated maize area = Maize cultivated area owned by the farmer (ha)

Distance to Vietnam border = Distance from the farmer's house to the border (km)

Access to irrigation = Dummy variable (1 = access to irrigation, 0 = no access to irrigation)

Tendency to follow their neighbor = Dummy variable (1 = farmers grow hybrid or local maize by following their neighbor, 0 = farmers grow local or hybrid maize by their own idea).

From the equation above, the probability of combination of the important factors can be interpreted as shown in Table 6.2. The probability indicated the most important factor influencing the adoption of hybrid maize varieties and indicated how it is changed when the value of a factor was changed. Table 6.2 shows that if a farmer has cultivated maize area 0.57 ha, stay away from the border about 19.64 km, has tendency to follow their neighbors, and has access to irrigation, the probability of adoption hybrid maize varieties is 0.9356. It means that there is 94% of chance to adopt the hybrid maize varieties. But, the probability decline to 0.1722 when the farmer do not have tendency to follow their neighbor, to 0.5353 when the farmer do not have access to irrigation, and to 0.0162 when the farmer has neither access to irrigation nor tendency to follow their neighbors. So, it means that tendency to follow their neighbor is the most important factor. Moreover, the probability does not

change much when the cultivated maize area varied from 0.20-1.50 ha per household or distance to Vietnam border varied from 3.5-38 km.

Table 6.2 Probability of combination of the four important factors influencing the adoption of hybrid maize varieties

x_1	x_2	x_3	x_4	Probability
0.57	19.64	1	1	0.9356
0.57	19.64	1	0	0.5353
0.57	19.64	0	1	0.1722
0.57	19.64	0	0	0.0162
0.20	19.64	1	1	0.8323
1.50	19.64	1	1	0.9953
0.57	3.50	1	1	0.9935
0.57	38.00	1	1	0.8955

Note:

x_1: Cultivated maize area (at the average of 0.57 ha per household)

x_2: Distance to Vietnam border (at the average of 19.64 km far from the border)

x_3: Tendency to follow their neighbors (1 = yes, 0 = no)

x_4: Access to irrigation (1 = yes, 0 = no)

One of the outputs of a logistic regression model is the model of coefficients. The omnibus tests of model coefficients show whether or not all of the variables entered into the regression equation have a significant effect on predicting the dependent variable. The Chi-square value of 72.556 as shown in Table 6.3 is significant at 0.000 with the twelve variables in the regression equation. This indicates that of the twelve variables used in this analysis four are significant in predicting the adoption of hybrid maize varieties.

Table 6.3 Omnibus tests of model coefficients

		Chi-square	df	Sig.
Step 1	Step	72.556	12	0.000
	Block	72.556	12	0.000
	Model	72.556	12	0.000

In the logistic regression model, a Classification Table compares the predicted values for the dependent variable with the actual observed values in the data. As can be seen in the Classification Table shown as Table 6.4, the regression equation of twelve independent variables predicts the adoption or non-adoption of hybrid maize varieties correctly 93.8 per cent of the time. Specifically, 36 of the 40 adopters and 39 of the 40 non-adopters were predicted correctly. These results indicate that the twelve variables taken as a whole have a significant predictive capability on the decision by the farmers on whether or not to adopt hybrid maize varieties.

Table 6.4 Classification table (a)

Observed			Predicted		
			Hybrid Status = 1 for adoption		Percentage Correct
			0	1	
Step 1	Hybrid Status = 1 for adoption	0	39	1	97.5
		1	4	36	90.0
	Overall Percentage				93.8

a The cut value is .500

The results of the Model Summary in Table 6.5 show the -2 Log likelihood and the R Square for two different tests (Cox & Snell and Nagelkerke). These tests are used to indicate how well the model fits the data. Smaller -2 Log likelihood values indicate that the model fits the data better; a perfect model has a value of zero. The R Square indicates that between 59.6 per cent and 79.5 per cent of the dependent variable (adoption of hybrid maize varieties) can be accounted for by all the predictor

variables in the equation. The R square value is not high but is adequate for the evaluation in this regression model.

Table 6.5 Model summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	38.347(a)	0.596	0.795

a Estimation terminated at iteration number 7 because parameter estimates changed by less than 0.001.

When Hosmer- Lemenshaw test is significant, it means that the observed counts and those predicted by the model are not close, and the model does not describe the data well. When the Hosmer-Lemenshaw test is not significant it means that the observed and the predicted counts are close and the model describes the data well. The results of logistic regression model in Table 6.6 shows the Hosmer and Lemeshow test is not significant (0.223). So, it means that the observed and the predicted counts are close and the model describes the data well.

Table 6.6 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10.631	8	0.223

6.2 Discussion of results

Size of maize area owned by a farmer was supposed to positively affect the decision about hybrid maize growing. A farmer who has bigger size of cultivated maize area is more likely to grow high yield varieties than small size of cultivated area. Cost of hybrid maize production is significantly higher than local maize production as shown in Table 5.1 Besides; cost of maize production of small area may be higher than in big area comparing as per unit of cost. So, farmers may not get

benefit much from cultivating a small size of maize area. So, size of maize cultivated area determines their decision making.

Tendency to follow their neighbors was used as an indicator of farmers' decision making. For a long time, farmers generally grow crops by their experiences from their family. They will not change easily to a new technology or crop without seeing the results in their village because they rely heavily on their crops for their living, so they have to be careful to avoid risks. Moreover, it seems more complicated for them to follow extension workers than their neighbors. We can say that tendency of the farmers generally is to wait and see. Besides, farmers tend to follow each other; they will grow the same crop in their village. They will not grow any crop different from others because they are afraid of risks and of being criticized.

The distance of the border from homesteads can have a negative relationship with growing hybrid maize varieties because of poor extension service. It appears that maize growers who live near the border are more interested to grow hybrid maize than people who live far from the border because they see clearly the know how of growing maize and its yield (Vietnamese's farmers can produce maize 10 tons/ha) and it is also easier to learn how to grow the hybrid maize from Vietnamese's farmers. Moreover, it is easier to access to input and output markets than the area that far away from the border.

Access to irrigation can be a determinant in the adoption of hybrid maize varieties, though generally not a problem during the wet season, but it can be very important to the cropping system in the area because of flooded period from late August or early September to December. For the farmers who do not have access to irrigation, they will hesitate to grow hybrid maize if the rainfall starts late because of the high cost of hybrid maize production. If the farmers could not harvest in time, they would lose a lot of money. So, access to irrigation is one of the important factors that determine decision making of growing hybrid maize seed in such condition.

The age of household head suggests that the younger farmers will have greater access to information than the older one and would have feeling to take chance to grow hybrid maize. Whatever, the result of this model (Table 6.1) shows that it did not have any significant influence to the adoption. It appears that extension service of maize production in the area is poor; even if they have 100 per cent access to technical information. To what extent that the level of information that they got from their neighbor or ago-chemical retailers or somewhere else would be correctable, practicable and believable to make the farmers interested to grow hybrid maize or not, it is not known. Moreover, irrigation is an important factor that influences the adoption of hybrid maize as mentioned above. Ages of household head appear not affecting the adoption of hybrid maize.

Other factors such as farm income, labor available in the family, education of household head, farm size, length of stay in the village, years of experience in growing maize, and soil fertility hypothesized to influence adoption did not have significant coefficients.