Determinants of Farm Decision to Enter Land Diversion: The Case of Upland Farmers in Northern Thailand

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Abstract

Mixed cropping has advantages to famers because it allows diversification for reducing risk, which is caused by unfavorable weather and market price variability. This research aims to analyze and determine factors that influence farmers' decision to transfer from growing traditional crops (a single crop such as corn and lychee) to diversified crops. The logit model was used to identify factors associated with the farmers' decision. Models based on a face-to-face survey of 185 respondents from six villages in Lampang Province belonging to the highland community of northern Thailand. The results showed that the farmers' decision to enter into land diversion was different in terms of socio-economic factors, such as the education level of the farmers and household debt responsibility. Government subsidy and technical assistance from agricultural extension services also significantly influenced the farmers' decision to accept the diversified crop method.

Key words: land diversion, upland farmer, logit model, co-cultivation

Thailand is comprised of four regions: North, Northeast, South, and Central. The landscape of northern Thailand is a highland area, along with the hillside, with three climate seasons: rainy, cool, and summer. In 2013, around 8.3% of Thailand's Gross Domestic Product (GDP) was contributed by an agricultural sector (Bank of Thailand, 2014). The value of the agricultural products represented approximately 20% of the Northern Gross Regional Product (GRP). The total area of harvested agricultural land of the Northern region is about 1.7 million rais. This accounted for 21% of the country's agricultural harvested land (Bank of Thailand, 2014). Rice, maize, sugarcane, lychee, and longan are major agricultural products of the Northern region (National statistical Office Thailand, 2013). Table 1 presents quantities and values of agricultural productions of the Northern region from years 2012-2013.

Table 1. The Quantities of Agricultural Products of the Northern Region from Years 2011-2013.

Agricultural Products	Production Year		
	2011	2012	2013
1. Crops			
1.1 Grains and Food			
Paddy			
Non-Glutinous paddy	21,790,916.49	24,509,421.25	23,025,440.21
Hommali paddy	7,359,409.48	7,296,565.83	7,072,640.67
Glutinous paddy	7,532,893.03	7,476,442.92	7,348,295.11
Sugarcane	107,678,112.00	101,622,731.00	104,618,528.00
Cassava	25,011,142.00	29,794,817.00	29,978,971.00
Maize	4,836,799.00	5,103,736.00	4,686,429.00
Mung bean	109,616.00	97,028.00	99,467.00

Table 1 (Contd.) The Quantities of Agricultural Products of the Northern Region from Years 2011-2013.

Agricultural Products	Production Year		
	2011	2012	2013
1. Crops			
1.2 Perennials			
Rubber, un-smoked sheet 3	3,783,509.00	4,098,110.00	4,375,320.00
Coffee	37,226.00	44,906.71	37,946.00
Peppercorn	4,395.00	2,241.00	1,332.00
1.3 Fruits			
Mango, Khiaw Sawei	2,793,640.00	2,985,530.00	3,141,950.00
Tangerine	214,898.00	185,084.00	155,772.00
Durain	509,424.00	524,469.00	569,313.00
Pineapple	2,593,207.00	2,400,187.00	2,067,907.00
Longan	780,580.00	877,176.00	854,616.00
Longkong	87,339.00	122,988.00	160,765.00
Rambutan	307,342.00	334,087.00	315,614.00
Mangosteen	146,538.00	210,481.00	279,263.00
Banana, Cavendish	230,480.00	233,200.00	234,220.00
Lychee	36,977.00	65,763.00	47,766.00
1.4 Vegetables			
Shallot	192,988.00	193,429.00	129,205.00
Garlic	75,642.00	85,325.00	79,398.00
Potato	136,603.00	134,593.00	103,462.00
Onion	50,707.67	51,159.00	39,719.00

Table 1 (Contd.) The Quantities of Agricultural Products of the Northern Region from Years 2011-2013.

Agricultural Products	Production Year		
	2011	**2012**	**2013**
1. Crops			
1.5 Oilseeds			
Palm kernel (weight over 15 kg.)	10,759,772.00	11,353,067.00	12,374,489.00
Coconut	1,055,318.00	1,056,658.00	1,010,033.00
Soybean	129,655.00	91,076.00	61,613.00
Groundnut	48,674.00	47,979.00	46,122.00
1.6 Flowerers			
Orchids	47,670.00	37,542.00	47,812.00
2. Livestocks (Units)			
Swine (weight over 100 kg.)	11,886,122.00	12,828,363.00	13,071,563.00
Fowl	994,319,478.00	1,055,127,478.0	1,103,323,199.00
Egg, chicken**(Million units)**	10,024.43	10,998.33	11,148.50
Cattle	1,087,227.00	1,026,491.00	995,207.00
3. Fisheries			
Shrimp, Vannamei	649,186.00	576,417.00	277,574.00

Source: National statistical Office Thailand, 2013

The agricultural sector has created both income and employment to residents in the region. However, there is still a lack of knowledge and technical assistance for the farmers in remote areas, especially for those who live in the highland communities of northern Thailand. Low-productivity subsistence farming is still occurring in the upland area. Rural famers mostly grow only one crop (such as maize, rice, or lychee) and use traditional techniques. This improper management leads to low farm revenue and environmental resource degradation. Furthermore,

the standard of living of the households in the highland community is often low because of an insufficient income. The households have less opportunity to receive good health care, education, public services, and financial services. There were several local projects that tried to improve the well being of upland farmers, however, much of previous efforts have been very fragmented and less integrated with little cooperation of the famers. In addition, the upland farmers still have an entry barrier to the agricultural technique of crop diversion: knowledge from scientific information, the product market, and financial investments are crucial.

Previous research has determined the factors that impact the farmers' motivation and decision making process for his/her belief in Sustainable Agriculture System (SAS) adoption. Comer et al. (1999) have compared the socio-economic characteristics, attitude and beliefs of sustainable and conventional farmers by using the probit model. Researchers found that the use of Sustainable Agriculture System (SAS) is significantly different among the conventional and sustainable farmers. There were positive relationships between farmers' education and the use of SAS, as well as between a number of newly adopted farming practices and SAS. Further, the affiliations with different farming organizations do affect the farmers' perception toward SAS. There were 4.4 weighted averages of responses for the statement ''sustainable agriculture is better for society,'' compared to 3.43 for conventional farmers. This indicates a strong agreement by farmers to the belief that sustainable agriculture is better for society. Leiby et al. (2014) have identified factors that influence the adoption of Varroa Sensitive Hygiene (VSH) technology using a probit model. The VSH helps to clean the bee hives of infected pupae and associated Varroa mites. The technology was developed at the USDA-ARS Honey Bee Breeding, Genetics and Physiology Laboratory in Baton Rouge, Louisiana and released to commercial queen breeders and producers in 2001. The Apis cerana is a species of honey bee

that have been exposed to the Varroa mite for a greater number of generations. Researchers found that risk aversion, education and income are significantly influential factors to the adoption decision of the producers.

Increase in farm revenue and profitability help to reduce poverty and improve well-being of the households. For those farmers who have been farming for many years in the highland community of northern Thailand, the adoption levels of a mixed cropping system have not been wide-spread. This raises the research question "Why do many farmers not employ the mixed cropping practice?" The advantage of the diversification is to reduce risk of the market price variability and unfavorable weather. For those who are willing to employ the practice, what are their characteristics? Socioeconomic status (SES), social norms, and situational factors may link to the decision-making process of the farmer. Age, gender, educational attainment, household per capita income, and the debt holding amount of the household can enhance or hinder farmers' efforts to adopt the multiple-crop method. To promote further adoption of the crop diversification approach, the farmer's decision making process needs to be understood for future sustainable development.

A hypothesis in this study is that the socioeconomic status (SES), social norms, and situational factors may influence the farmers' decision to adopt the crop diversification process. The household economic status, age, and education of the farmer can positively impact the adopter's decision. Situational factors, such as the degree of farm, fit into a group of available agricultural extension services; if this information is communicated to the farmers, we propose that they will be more motivated to employ the practice of crop diversification. When the influencing factors are known, public outreach and agricultural extension services could be

developed to promote effective farm management. This could advance the economic status of households in remote areas.

Research Objectives

The aims of this research are to identify and compare characteristics of farmers associated with their motivation to adopt the mixed cropping practice. The specific objectives of this paper are to:

(1) determine factors influencing the farmers' decision to employ the new farming practice (i.e., co-cultivation); and

(2) identify characteristics of the farmer associated with his/her decision-making process.

Data and Methodology

Data

Two data sources were used in the study, namely administrative and survey data. The historical data population and agricultural land use were provided by the sub-district administrative organizations. The information helped to better understand the social and land structures of the upland community. In addition, a face-to-face survey was conducted to gather information on the farm structures, socio-economic factors, and characteristics of the farmers. The sample size was determined under the 95% confidence level. There were 204 samples from six villages in Lampang Province belonging to the highland community of northern Thailand. The six villages are located in three sub-districts (Tumbon) that are Tumbon Pongtoa, Nanga, and Baanrong. The household units of each village segment were sampled following a proportional stratified random sampling method. At the village level, household samples were

randomly selected based on the information from the village head and local government officers. The survey was taken during June 2014 to the beginning of January 2015. Data from 185 survey respondents out of 204 sample households were gathered and analyzed for this study.

TABLE 2. Distribution of Selected Farmers by Occupation, Age Groups, Education Level, Gender, and Numbers of Family Member.

Variables	Percentage		
	Male	**Female**	**Total**
Age (years)	**72.53**	**27.47**	**100**
0-20	0.00	0.55	0.55
21-40	20.88	10.44	31.32
41-60	37.36	14.84	52.20
61-80	14.29	1.65	15.93
Education	**72.53**	**27.47**	**100**
No formal schooling	37.36	14.84	52.20
Elementary	20.88	7.69	28.57
High school	12.09	4.40	16.48
Vocational	0.55	0.00	0.55
College or higher	1.65	0.55	2.20
Occupation	**69.90**	**30.10**	**100**
Farmer	68.82	26.88	95.70
Employee for farm labor	0.00	0.54	0.54
Employee of the private firm	0.54	1.60	2.14
Self-employed (handicraft)	0.00	1.08	1.08
Civil servant	0.00	0.00	0.00
Other	0.54	0.00	0.54

TABLE 3. Distribution of Household Economic Status, Annual (farm) Income, Expenses, and Debt.

Variables	Percentage
Average Household Income (baht/ year)	
< 60000	51.89
60001-120000	17.84
120001-180000	11.35
> 180001	18.92
Average Expenses (baht/year)	
<60000	38.38
60001-120000	48.65
120001-180000	8.65
> 180001	4.32
Debt Payment for the last three years (baht)	
>10000	10.30
10001-20000	24.24
20001-30000	11.52
30001-40000	11.52
40001-50000	9.09
50001-60000	6.67
60001-70000	2.42
70001-80000	4.24
80001-90000	0.61
90001-100000	12.12
>100000	7.27
Numbers of Household Member	
<5	41.08
6-10	55.68
>10	3.24

On average, there are 6 to 10 members in each household. Most of the households have annual incomes less than 60,000 bath/year and holding debt between 10,001-40,000 baht during the last three years. The borrowing sources are from relatives and the community monetary fund. Farm investments (e.g., input and seeding costs, and land preparation) are the major reason for households to create debt.

TABLE 4. Distribution of Farmland by Household and The Share of Agricultural Production Consumption.

Variables	Percentage
Average Farm Size (rai/household)	
<31	52.60
31-60	33.53
61-90	11.56
> 90	2.31
Share of Agricultural Production Consumption	
Crop (Grains and Food, Perennials, Fruits, Vegetables, and Oilseeds)	
Household Consumption	21.92
Marketed	78.08
Livestocks (Swine, Chicken, and Duck)	
Household Consumption	95.24
Marketed	4.76

The average farm size of the family is 31 rais while some families have owned 40 to 60 rais of farm land, 33.53 percent of the total number of household. Maize and lychee are major productions in the area, and 78% of the total output is sold to the market. The livestock (swine, chicken, and duck) are used for household consumption rather than marketed.

TABLE 5. Percentage of Mixed Farming Practice Adoption by the Household in Selected Villages of the Study Area.

Tumbon/ Villages	Percentage	
	Willing to Adopt	Not Willing to Adopt
Tumbon Pongtoa		
Baan Bo Srilium	82.86	17.14
Baan Bo Sramlium	92.91	7.09
Baan Huaynamtaun	58.33	41.67
Tumbon Nanga		
Baan Suntisuk	96.77	3.23
Tumbon Baanrong		
Baan Maekumla	100.00	0.00
Baan Kwankeereenonk	100.00	0.00

More than 80% of the famers from the three Tumbons are interested in changing their farming practices from the traditional method (single crop) to the inter-cropping system. Only those farmers who live in Baan Huaynamtaun, Tumbon Pongtoa are less interested in adopting this cropping system.

Factors Influencing Farmer's Decision to Adopt the Mixed Cropping System.

Selected households (farmers) were asked to indicate a number between 0 and 10 that best describes how factors in six dimensions have influenced their adoption decisions. Six statements were included in the survey to measure values of the six factors. Each factor has been measured by using a multiple-choice scale which ranges from "not influenced at all" to strongly

influenced." The number 0 represents "not influenced at all" and 10 stands for "strongly influenced."

A weighted average of the indicated numbers from the respondents was calculated for each factored statement.

Table 6. Means of Variables Influencing Farmers towards the Mixed Cropping System

Question Statements	Mean
1. Specialized skill of the family laborors for specific crop planting	7.10
2. Harvest period of the crop	6.92
3. The government policy (e.g., price support and input subsidy)	7.21
4. Farmer financial accessibility	5.39
5. The level of technical assistance and scientific information provided by agricultural extension services to the farmers	7.76
6. The consideration of sustainable agriculture and environment	7.47

The level of technical assistance and scientific information provided by agricultural extension services to the farmers, the revenue and profit of the new plant, and the degradation of the environment are all important factors that provide high motivation to the farmers to adopt the multi-crop planting method.

Economic Model

The logit model was used to identify factors associated with the farmer's decision. The model was estimated by using the Logit procedure in STATA. The model of the inter-cropping

adoption is specified as a functional relationship between the independent variables and the probability of the dependent variable. The dependent variable is the possibility of the farmer adopting the mixed cropping practice, which is the binary variable. The variable is equal to 1 if the farmer intends to adopt the multi-crop method, and 0 otherwise. The explanatory variables included in the model as repressors are:

1. The age of the respondent.
2. The gender of the respondent: The dummy variable has a value of 1 if the respondent is a male, and 0 otherwise.
3. The education level of the respondent.
4. The average monthly income of the household.
5. The number of household members.
6. The current responsibility of the household debt: the dummy variable has a value of 1 if the household is holding debt, and 0 otherwise.
7. Technical assistance and scientific information: the available knowledge and scientific information provided by agricultural extension services to the farmers. The factor scale ranges from "not influenced at all" to "strongly influenced." The number 0 stands for " not influenced at all" and 10 stands for "strongly influenced."
8. The government subsidy. This factor also has the scale ranges from "not influenced at all" to "strongly influenced." The number 0 stands for " not influenced at all" and 10 stands for "strongly influenced."
9. The environmental concern of the farmer.

The relationship model between the explanatory variables and the dependent variables can be defined as

$$MixC_i = f(A, G, Edu, I, M, D, Exs, P, Env) \quad (1)$$

$$i = (0,1)$$

where $MixC_i$ is the adoption of the mixed cropping practice (1 if the farmer is interested in adoption, 0 otherwise), *A* represents the age of the respondent (farmer), *G* is a gender of the respondent, *Edu* is the education level of the respondent, *I* is the average level of household income (baht/month), *M* represents the number of household members, and *D* is the debt payment responsibility of the household during the past 3 years. The scientist information and technical assistance provided by agricultural extension services is presented by *Exs, P is* the government subsidy, and *Env* represents the influence level of the farmer's environmental concern.

The dependent binary variable, *MixC*, indicates whether the farmer employs mixed farming practice or not. The questionnaire asked "Are you interested in employing co-cultivation agricultural practices (e.g., mixed cropping)?"

Assumptions of the Study and Hypotheses

The variable *A* represents the age of the respondent in years. We hypothesize that age significantly impacts the decision making process of the farmer. The variable *G* represents the gender. The male farmers are expected to adopt mixed cropping practice more than the female farmer because male farmers may have a different perception of risk than females.

The variable *Edu* represents the education level of the respondent which divided into two categories. The first category variable is the dummy variable for those respondents who have received a elementary school degree or below. The second dummy variable indicates whether the

respondent has obtained a high school degree or higher. We hypothesize that the education level significantly impacts the farmers' decision.

M represents the number of household members which also hypothesized that more members in the household will lead the farmer to change his/her farming practice.

The variable *D* is defined as the household debt, which hypothesized that the farmer who has carried less debt during the past 3 years is more willing to adopt the multi-crop planting technique because of the difference in economic status and risk perception.

The variable *Exs* defines the situational factors, i.e., the connection of the farmer to the agricultural extension services. Those farmers who have been provided information and technical knowledge by the agricultural extension services and outreach is hypothesized to be more motivated to employ the practice of crop diversification.

The government support (*P*) such as agricultural output price support and input cost subsidy would encourage more farmers to adopt the co-cultivation technique. Also, the farmers' environmental concern (*Env*) would have positive impact on the farmers' decision.

Results and Discussion

Tables 7 presents results from the statistical analysis of the diversified cropping system survey data. The logit regression results for adoption of mixed cropping system for the farmers in the highland community of northern Thailand are based on only 181 observations (due to the missing data). The overall goodness of fit of the model is appropriate. The McFadden R-squared is 0.33. Our null hypothesis that all of the model regressors of zero have been rejected at the one-percent level (p-values < 0.05) based on the transformed log likelihood function (distributed chi-squared).

Table 7. Summary of Logit Regression Results

Variables	Statistic Value
Number of Observations	181
p-value for log likelihood function	0.000
McFadden R-Squared	0.333

Most of the coefficients are not statistically significant at 1- percent levels (shown in table 8). The coefficient of the government subsidy policy positively influenced the farmer's decision to adopt the co-cultivation agriculture technique at 5- percent level. This indicates that an increase in government support (e.g., output price support, and input cost subsidy) has a significant impact on the probability of the farmer's adoption of the multi-cropping practice. The effect of farmer education level in his/her decision-making process is significant at 1-percent level. The farmer who has an elementary school degree (or higher) is more likely to adopt the new practice (at 5-percent level).

The household debt payment responsibility is positive and significant at 10- percent level on the probability of employing co-cultivation practice. This relationship indicates the advantage of the multi-cropping system to the farmer. Those farmers who have carried debt for the past three years have higher probability to adopt the mixed cropping practice. On the other hand, the effect of variations in technical assistance and scientific information provided by the local agricultural extension services and outreach on the probability of adopting mixed cropping practice is negatively significant at 1- percent level.

Table 8. Logit Regression Results of Mixed Cropping System

Dependent Variable (The Adoption)	Estimated Parameters β_i	Changes in Probability,
Intercept	-0.30	
	(-0.2)	
Age of the respondent	-0.01	
	(0.018)	
Gender (male=1, and otherwise)	0.13	
	(0.592)	
Education Level	**(group *p*-value = 0.07)**	
Elementary	1.77**	0.041
	(0.817)	
High school	-0.001	
	(0.059)	
Average monthly income	**(group *p*-value = 0.295)**	
5,001-10,000	0.67	
	(0.723)	
10,001 -15,000	1.37	
	(1.293)	
greater than 15,000	1.435	
	(0.913)	
Numbers of Household Members	0.026	
	(0.100)	
Household Debt Holding	0.836*	0.011
	(0.540)	

Notes: 1. Standard errors are in the parentheses. 2. (*) Significant at ten-percent level, (**) Significant at five-percent level, and (***) Significant at one-percent level.

Table 8 (Contd). Logit Regression Results of Mixed Cropping System

Dependent Variable (The Adoption)	Estimated Parameters β_i	Changes in Probability,
Government Policy	0.570*** (0.124)	0.038
Agricultural Extension Services	-0.311** (0.121)	-0.021
Environmental Concern	-0.063 (0.112)	-0.004

Notes: 1. Standard errors are in the parentheses. 2. (*) Significant at ten-percent level, (**) Significant at five-percent level, and (***) Significant at one-percent level.

Table 9. Means of Variables for Logit Analysis

Variable	Mean	Std.Dev.
Farmer age	42.35	18.63
Gender dummy	0.71	0.45
Elementary School dummy	0.28	0.45
Highschool dummy	0.19	0.39
Numbers of family member	5.21	2.65
Household income dummy class 2 (5,001-10,000 baht/month)	0.18	0.38
Household income dummy class 3 (10,001-15,000 baht/month)	0.11	0.32
Household income dummy class 4 (> 15,001 baht/month)	0.19	0.39
Household debt holding dummy	0. 77	0.42
Government support policy	7.24	2.68
Available information from agricultural extension services	7.80	2.43
Environmental concern	7.51	2.68

Conclusion

The results show that farmers' decisions to enter into land diversion were different in terms of farmers' socio-economic status, such as the education attainment and household debt responsibility. Higher household debt could lead farmers to employ co-cultivation practice to risk increasing his/her family's economic status. Also, the government subsidy policy could encourage more farmers to enter the mixed-cropping technique. The mixed cropping system can help farmers to ensure their revenues to avoid crop failure from poor weather conditions and market price variability.

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