KEY FACTORS INFLUENCING TREE PLANTING DECISIONS OF HOUSEHOLDS: A CASE STUDY IN HOA BINH PROVINCE

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SUMMARY

In coping with significant deforestation and forest degradation, currently in Kim Boi district, Hoa Binh province, and massive reforestation projects have been implemented. However, when remarkable attempts and investments have been made in reforestation, interaction of household characteristics and socio-economic factors with smallscale tree planting decision are still little understood. In this study, we survey 150 households (including 75 households with tree planting and 75 households without tree-planting) in Nuong Dam commune, Kim Boi district, Hoa Binh province. The results of stepwise binary logistic regression analysis indicate that the factors, including: Accessibility to Plantation Sites, Forestland Area, Investment Capital, and Knowledge on Silviculture have a significant effect on household's decision on tree planting in the study area. The study results may provide the basis for proposing solutions to strengthen tree planting of households in the study area.

Keywords: Households, influential factors, stepwise binary logistic regression, tree planting decision.

I. INTRODUCTION

Recent history reveals both that the large-scale reforestation projects of the 20th century have often been less successful than anticipated, and that tree growing by smallholders - as an alternative means to combat deforestation and promote sustainable land use - has received relatively little attention from the scientific and development communities (Snelder and Lasco, 2008). Related studies have shown that smallholder tree planting activity is influenced by socioeconomic characteristics such as access to land with secure land and tree tenure (Byron, 2001; Emtage and Suh, 2004; Sikor and Baggio, 2014; Tran Thi Mai Anh, 2015); suitable management skills, knowledge and labour force; interaction with peer farmers' through either social groups or cooperative organizations (Sikor and Baggio, 2014; Tran Thi Mai Anh, 2015); environmental factors (Summers et al., 2004; Jagger et al., 2005; Tran Thi Mai Anh, 2015); and access to markets (Akinnifesi et al., 2006; Tchoundjeu et al., 2006; Kallio et al., 2011; Tran Thi Mai Anh, 2015).

In Vietnam, 1.2 million households have been allocated 4.46 million ha, 70% of which is production forest land (Phuc and Nghi, 2014). Understanding the socioeconomic factors and perceptions of smallholders related to tree planting activities in Vietnam will be valuable for informing and supporting related policy interventions. The perceptions of local people examine their views on how they consider tree planting activity. If the incentives and disincentives to tree planting activities are understood, it will be easier to improve participation of smallholders and increase benefits from tree planting. In this paper, we analysed the key factors influencing tree planting decision from local people in the Nam Nuong commune, Kim Boi district, Hoa Binh province and provide suggestion in sustainable management of forest plantation in the study area.

II. REASEARCH METHODOLOGY

2.1. The study area

Hoa Binh Province is located in the North of Vietnam is the source of headwater and major tributaries that influence the lives of more than 808,200 people inside the province. It borders Son La and Phu Tho provinces to the northwest, Ha Noi city to the north and northeast, Ha Nam province to the southeast, Ninh Binh and Thanh Hoa provinces to the south. Hoa Binh is a mountainous province located on the entrance of the Northwest region and is proud to be famous with "Hoabinhian Culture" where human life is proven to existed here since 10,000 - 2,000 BCE. The topography is combined by mountains and narrow valleys results in the

climate of this district is representative for tropical monsoon, which is pretty cold and less rain in winter but hot and rainy in summer. The annual temperature varies between 15^0C to 29^0C, depending on season. Hoa Binh is in the region has a high poverty rate and a low standard of living of the population. The growth of GDP amounts to 11.8% during 2000 - 2010. The poverty rate was 31.31% in 2005, and was 14% in 2010, but in 2011 the rate of poverty has jumped again to 37.68%, according to the new rate of poverty (Mai Lan Phuong, 2011). They are a large variety of ethnic groups, which has 15 ethnic communities, and 63.4% is Muong ethnic group. The variety of both culture and environment leads to diverse land-use systems.

Kim Boi District, Hoa Binh Province was chosen to be a case study because of the following reasons. Kim Boi is considered as the district with the largest planted forest area in the province. The total natural area of Kim Boi district is 54,950 ha, of which 40,562 ha is forestry land (account for 73% of the district's natural area), and production forest area accounts for over 21,000 ha. On average, Kim Boi district has planted 1,000 - 2,000 ha of forest annually, mainly production forests and 100 - 200 ha of fruit trees. In 2014, the district has planted 2001 ha of forest increasing the forest cover to 49.3%. In 2018, Kim Boi district plans to plant 1,700 hectares of new forest, mainly production forests and allocate over 37,000 hectares of forests for people to manage and protect.

Nuong Dam is a commune with extremely difficult socio-economic conditions in Kim Boi district, Hoa Binh province. Nuong Dam commune lies in the tropical monsoon climate, with two distinct seasons: rainy and dry season, average temperature: 23°C, average humidity: 60%, the average rainfall: 1,800 mm. Land of Nuong Dam commune is typically with high fertility suitable for many crops. With hundreds of thousands of hectares of land including the adjoining plots, land in Nuong Dam commune can be used for various purposes, especially afforestation, industrial crops for the agro-forestry and industrial development. The Nuong Dam commune covers an area of 35.66 km² (in 2016), with a population of 3,381 people in 1999; 4,058 people in 2016, and a population density of 114 persons/km².

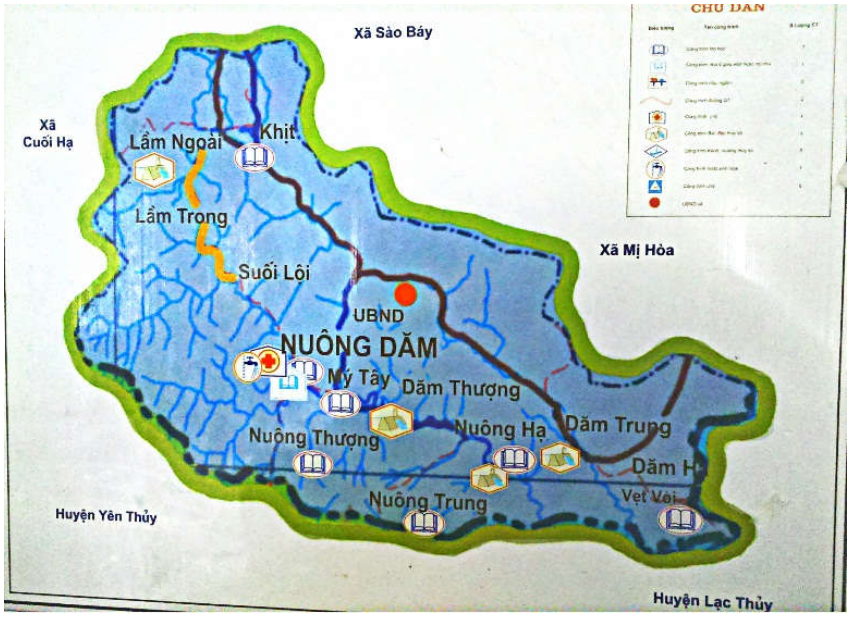

Figure 1. Map of Nuong Dam commune, Kim Boi district, Hoa Binh province

Source: People Committee of Nuong Dam commune, 2016

Nuong Dam commnue was chosen to be a case study because of the following reasons. Firstly, Nuong Dam commune is a large forested area of Kim Boi district which is representative for mountainous area, bounded with streams, rivers, valleys, and limestone mountains. Secondly, this area also is a focal point of planting for headwater which plays an important role for protecting water resource of whole regions.

2.2. Study method

In this study, we selected 150 households for survey according to the criteria in table 1. The attributes of the selected households are summarised in table 1. The survey was based on the conceptual model for assessing key factors affecting the tree planting decision of households (figure 2). The survey was conducted by using a questionnaire designed to collect data on general household characteristics, factors influencing tree planting decision of households. A copy of the questionnaire is available on request. The questionnaire was administered face-to-face, usually the head of households.

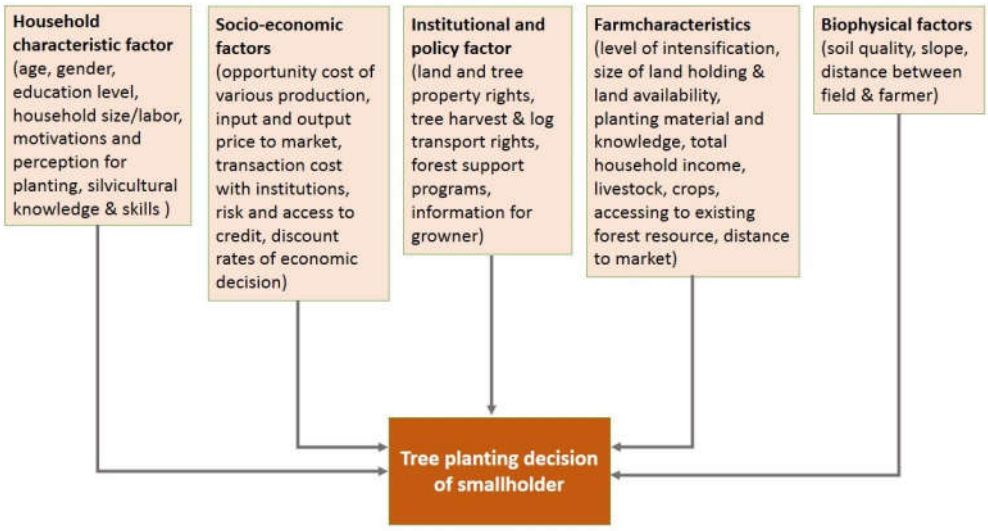

Figure 2. Factors influence tree planting decision of smallholder

Source: Tran, 2015

Kim Boi district has 27 communes and aninternal town with population of 114,000 people (GSO 2016). We conducted a household survey in one representative communes namely Nam Nuong commune, in which, 150 households including 75 households having decision of tree planting and 75 households without decision for tree planting. Within 75 tree planting households, we divided into 3 sub-group based on household wealth ranking including 25 rich households, 25 moderate households and 25 poor households. On the other hand, among 75 households not tree planting, 25 households are classified as rich, 25 households are classified as moderate, and 25 households are classified as poor. The interview design was followed by a stratified random sampling method to obtain representative strata by decision of tree planting and household wealth ranking.

Table 1. Number of survey households in the study area

		Households wealth ranking			
		Poor	**Moderate**	**Rich**	**Total**
Tree planting	Yes	25	25	25	75
	No	25	25	25	75
	Total	50	50	50	150

Personal interviews were conducted in the study area. This method allows researchers the opportunity to ask more questions, longer questions, more detailed questions, more open-ended questions, and more complicated or technical questions. Moreover, face-to-face surveys also offer advantages in terms of data quality (Manurung et al., 2008). The survey was conducted from 1st August 2017 to 20th August 2017.

IBM SPSS Statistics 23 was used for data analysis. Bivariate analysis was used to identify association between 'Tree planting decisions by households' (dependent variable) and factor (independent variable) (see Table 2 for a full list of variables included in the analysis). Factors found to be significantly associated with an independent variable in the bivariate analyses ($p < 0.05$) were considered as candidates in stepwise binary logistic regressions with independent variables.

Table 2. Description of variables

No	Variables	Description	States (range)
1	Ethnicity	Ethnicity of household	Muong = 1; Kinh = 2
2	Age	Age of household head	
3	Education of householdhead	Education level assigned for each level	
4	Forestland area (ha)	Forest land area of each household	
5	Investment capital	Sources of investment for tree planting	Forestry program = 1; Bank = 2; Self investment = 3
6	Length of rotation	Type of tree used for planting	Long time (> 5 years) = 1; Short time (1 - 5 years) = 2
7	Experience	An experience that tree planter has before	Yes = 1; No = 0
8	Accessibility to plantation site	Accessibility to the plantation site	Easy, accessible with car = 1; Medium, accessible by motorbike = 2; Difficult, have to walk = 3
9	Climate condition	Idea of tree planter about climate condition that influences to treeplanting	Suitable = 1; Unsuitable = 0
10	Knowledge on silviculture	Knowledge of tree planter on silviculture by applying fertilizers & pesticides, as well as practicing silvicultural plantation	Good = 1; Bad = 0
11	Knowledge about forestry program	Knowledge of tree planter about forestry program, and how to register forestry program	Yes = 1; No = 0
12	Land tenure	Land tenure of the household	Yes = 1; No = 0
13	Tree planting decision	Tree planting decision of the household	Yes = 1; No = 0

Factors were entered into the stepwise regressions if the significance of their relationship with an independent variable was $p < 0.05$ and removed from the stepwise regression if the significance of their relationship with an independent variable became $p \geq 0.10$. Factors were entered into the stepwise regressions in order of their correlation with a dependent variable, from most strongly (highest Pearson's correlation) to least strongly correlated (lowest Pearson's correlation) (Brace et al., 2006; Ho, 2006). A set of significant factors for a dependent variable was the result of the stepwise binary logistic regression. Stepwise regression is an appropriate analysis for this study because there are many variables (12 independent variables) in the binary logistic regression model and we are interested in identifying a useful subset of the predictors.

III. RESULTS AND DISCUSSION

3.1. Descriptive statistics on surveyed households

In general, almost all of households surveyed are Muong ethnicity (88%). The

results in table 4 show that approximate 60% of the respondents having good knowledge on silviculture and roughly 40% of total households admit that they have little or even no knowledge on this field. In addition, most of interviewees said an extension officer from government forestry program is very important in training and educating communities on tree planting practices. The more the farmers interact with them, the more likely it is for them to gain knowledge on silvilcuture. The fact that, 'Knowledge about forestry program' for those who did not have knowledge about forestry program was a quarter of who have 'Knowledge about forestry program'. And the accessibility from accommodation to forestland area is easy and moderate account for 12.7% and 49.3%, respective. The rest is a difficult accessibility accounted for 38%.

Table 3. Relationship between independent variables and tree planting decision of households

Independent variables		Tree planting			(%)
		No	Yes	Total	
Ethnicity	Muong	66	66	132	88
	Kinh	9	9	18	12
	Total	**75**	**75**	**150**	**100**
Investment capital	No investment	33	7	40	26.67
	Forestry program	7	7	14	9.3
	Bank	12	12	24	16
	Self-Investment	23	49	72	48
	Total	**75**	**75**	**150**	**100**
Length of rotation	Long time (> 5 years)	48	48	96	64
	Short time (1 ÷ 5 year)	27	27	54	36
	Total	**75**	**75**	**150**	**100**
Experience	No	30	10	40	26.67
	Yes	45	65	110	73.33
	Total	**75**	**75**	**150**	**100**
Accessibility to plantation sites	Easy, accessible with car	8	11	19	12.7
	Medium, accessible by motorbike	16	58	74	49.3
	Difficult, have to walk	51	6	57	38
	Total	**75**	**75**	**150**	**100**
Climate condition	Unsuitable	27	21	48	32
	Suitable	48	54	102	68
	Total	**75**	**75**	**150**	**100**
Knowledge on silviculture	Bad	42	19	61	40.67
	Good	33	56	89	59.33
	Total	**75**	**75**	**150**	**100**
Knowledge about forestry program	No	22	11	33	22
	Yes	53	64	117	78
	Total	**75**	**75**	**150**	**100**
Land Tenure	No	13	8	21	14
	Yes	62	67	129	86
	Total	**75**	**75**	**150**	**100**

Source: Household survey, 2017

Results from table 4 show that there are only significant differences at 5% level in 'Age of household head' and 'Forest land area' between households decided to planting trees and households decided not planting the trees.

Table 4. Descriptive statistics of quantitative variable

Parameter	Tree Planting Decision				Total		P value for t-test of Mean (2 tailed)
	No		Yes		Mean	Std. Dev.	
	Mean	Std. Dev.	Mean	Std. Dev.			
Age of household head	51.37	7.23	49.01	5.76	50.19	6.626	0.029
Forest land Area	0.53	0.40	2.28	2.92	1.40	2.259	0.000
Education	7.11	1.88	7.35	1.69	7.23	1.788	0.413

Source: Household survey, 2017

3.2. Key drivers influencing tree planting decision of surveyed household

Direct stepwise binary logistic regression was performed to assess the impact of a number of factors on the likelihood that households would report that they had a decision of planting trees or not. The model contained four independent variables (Forestland area, Investment Capital, Accessibility to Plantation Sites, and Knowledge on Silviculture). The full model containing all predictors was statistically significant, $\chi^2(4, N = 150) = 93.74$, $p < .001$, indicating that the model was able to distinguish between respondents who decided and did not decide tree planting. The model as a whole explained between 46.5% (Cox and Snell R squared) and 62.0% (Nagelkerke R squared) of the variance in the decision of tree planting, and correctly classified 86.0% of cases.

Table 5. Model summary for key drivers affecting tree planting decision of surveyed households

Independent variables	B	S.E.	Exp(B)	Sig
(Constant)	2.341	1.307	10.392	0.073*
Forestland area	1.117	0.344	3.056	0.001***
Investment capital	0.678	0.193	1.970	0.000***
Accessibility to plantation sites	-1.613	0.377	0.199	0.000***
Knowledge on silviculture	1.239	0.509	3.452	0.015**
Dependent variable: Tree planting decision by households				
Number of Observations			150	
Omnibus Tests of Model Coefficients:				
· Chi-square			93.74	
· df			4	
· Sig.			0.000	
Model summary:				
· -2 Log likelihood			114.205***	
· Cox & Snell R Square			0.465	
· Nagelkerke R Square			0.620	
· Predicted Percentage Correct (%)			86.0	

Note: *** p < 0.01, ** p < 0.05, * p < 0.10, NS Not significance (two-tailed tests).

Source: Household survey, 2017

As shown in table 6, four independent variables (Forestland Area, Investment Capital, Accessibility to Plantation Sites, and Knowledge on Silviculture) were statistically significant in distinguishing between households decide or did not decide to plant trees. The odds of households decide or did not decide to plant trees were improved by about 5.025 times if Accessibility to Plantation Sites of household decrease one level from "difficult level" to "easy level", by about 3.452 times if household has 'Knowledge on Silviculture', by about 1.970 times if Investment Capital increases one level (table 6).

Table 6. Determining importance of variables in the multiple linear regression model

Dependents	B	Exp(B)	$Exp(B)_{adjusted}$	Ranking
Forestland area	1.117	3.056	3.056	3
Investment capital	0.678	1.970	1.970	4
Accessibility to plantation sites	-1.613	0.199	5.025	1
Knowledge on silviculture	1.239	3.452	3.452	2

Note: Ranking with 1: highest, 4 smallest; if B > 0 then $Exp(B)_{adjusted}$ = Exp(B); and if B < 0, then $Exp(B)_{adjusted}$ = 1/Exp(B).

Source: Household survey, 2017

$Exp(B)_{adjusted}$ in table 6 shows that 'Knowledge on Silviculture', 'Forestland Area', 'Investment Capital' variables have a positive influence on the tree planting decision of local households, and 'Accessibility to Plantation Sites' variable is negatively influenced on tree planting decision of local households in the study area. Ordinal influential factors are represented as following: (1) Accessibility to Plantation Sites; (2) Knowledge on Silviculture; (3) Forestland Area; and (4) Investment Capital.

3.3. Discussions and Policy Implication

3.3.1. Accessibility to plantation site

Accessibility to plantation site was found to be significantly and negatively related to tree planting decision of households. Dupuy and Mille (1993) indicated that accessibility of the planted area is a parameter that cannot be overlooked, for it is important only in reforestation per se, but also in the follow-up (tending, thinning, and wildfire protection, etc.) and in taking out harvested products. Therefore, the improvement of infrastructure, such as roads, as part of forest plantation programs is important to success, particular where plantation sites are isolated and the improved infrastructure can assist communities to reliably access tree planting inputs and product markets. Infrastructure development is very expensive and not all projects are able to fulfil fund it, therefore lower-cost options for infrastructure improvement are vital.

3.3.2. Forestland area

Result of this study indicated that forestland area was found to be significantly and positively related to tree planting decision of households. Byron (2001), Kallio (2013) and Tran Thi Mai Anh (2015) found that tree planters were generally with more land, higher value of total assets and more active participation in tree planting than non-tree planters.

3.3.3. Investment capital

Funding from self-investment was found to be significantly and positively related to tree planting decision of households. Byron (2001), Sikor and Baggio (2014), and Tran Thi Mai Anh (2015) found that better-off households are more likely to possess forestland, grow trees, and invest in plantations than poor ones. In addition, land plantations, and investment tend to be larger for the better-off than the poor. Better-off households are in a better position to engage in tree plantations due to, among other factors, the institutional mechanisms differentiating household access to land and finance. Sandewall et al. (2010) revealed that many poor farmers had received forest land through the Forest Land Allocation (FLA), but their possibility to benefit from plantations was limited. They had usually received land late in the process of FLA, as they initially declined to become involved; their plantations were small and far away, which complicated management and protection; they had to harvest prematurely to secure the necessary cash flow, and they did not have the necessary finances to maintain the plantations. There were very limited credit facilities. Therefore, the forest administration

such as the Department of Forestry Development and the Forest Protection Stations at District level, mainly had regulatory, supervisory and monitoring tasks.

3.3.4. Knowledge of household head about silviculture

Knowledge on silviculture had significantly positive effects on tree planting decision of households. Salam et al. (2000) and Tran Thi Mai Anh (2015) indicated clearly that farmers' awareness of forestry extension programs is slight, and the contribution of forestry workers to motivate farmers to plant trees has been negligible. To maximize the potential of homestead forestry, forestry professionals and extension workers should broaden their activities and work more closely with local farmers. They should disseminate technical information to tree growers, supply quality seedlings suitable for the area, provide effective institutional support, and arrange for efficient marketing facilities of the farm forest products so that poor farmers can come forward to enhance tree production and get proper returns from production. Therefore, reforestation education, information or awareness building campaigns also provide market information, and marketing support for timber and other forest products that can help to increase the cash income of farmers, which in turn can lead to better site management and protection, and reduced erosion and landslide risk (Le et al., 2014).

IV. CONCLUSION

A number of biophysical, socio-economic, institutional and management factors influence tree planting decision of household in Kim Boi district, Hoa Binh province. Based on our analysis we found that 'Accessibility to Plantation Sites', 'Knowledge on Silviculture', 'Forestland Area', and 'Investment Capital' were among the most highly connected factors influencing tree planting decision of households in the study area. Therefore focusing on performance indicators alone will not improve our understanding of why households decide to plant or not plant trees. Therefore, it is essential to develop infrastructure that can help farmers to easily access of plantation sites, better access to credit, provide farmers with more agroforestry extension activities.

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CÁC NHÂN TỐ ẢNH HƯỞNG ĐÁNG KỂ ĐẾN QUYẾT ĐỊNH TRỒNG RỪNG CỦA CÁC HỘ GIA ĐÌNH: NGHIÊN CỨU ĐIỂM TẠI TỈNH HÒA BÌNH

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TÓM TẮT

Để ứng phó với sự mất rừng và suy giảm tài nguyên rừng nghiêm trọng, đã có nhiều dự án khôi phục rừng đã được triển khai trên địa bàn huyện Kim Bôi, tỉnh Hòa Bình. Tuy nhiên, khi mà những nỗ lực và đầu tư đáng kể vào khôi phục rừng, thì sự tương tác giữa đặc điểm của hộ gia đình và các yếu tố kinh tế xã hội có liên quan đến trồng rừng qui mô hộ gia đình còn được biết đến một cách hạn chế. Trong nghiên cứu này chúng tôi khảo sát 150 hộ gia đình (bao gồm 75 hộ trồng rừng và 75 hộ không trồng rừng) trên địa bàn xã Nuông Dăm, huyện Kim Bôi, tỉnh Hòa Bình. Kết quả phân tích ứng dụng mô hình hồi qui Stepwise Binary Logistic Regression đã xác định được 4 yếu ảnh hưởng đáng kể đến quyết định trồng rừng của hộ gia đình trên địa bàn nghiên cứu, bao gồm: khả năng tiếp cận rừng trồng, diện tích đất lâm nghiệp, vốn đầu tư và kiến thức về kỹ thuật lâm sinh. Kết quả nghiên cứu có thể làm cơ sở cho việc đề xuất các giải pháp làm tăng cường và mở rộng trồng rừng qui mô hộ gia đình trên địa bàn nghiên cứu.

Từ khóa: Hộ gia đình, mô hình hồi qui logit chọn từng bước (stepwise binary logistic regresion), nhân tố ảnh hưởng, quyết định trồng rừng.

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