ANALYSIS OF THE IMPACTS OF LIVELIHOOD ASSETS ON LIVELIHOOD OPTIONS OF FOREST-DEPENDENT HOUSEHOLDS IN TUYEN QUANG PROVINCE, UPLAND OF VIETNAM

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Abstract. This study assesses the current status of livelihood assets and their impact on the selection of livelihood options of forest-dependent households in Tuyen Quang province, upland of Vietnam. Research data were collected through a direct survey with 463 households living in forest districts of Yen Son and Son Duong, Tuyen Quang. Descriptive statistics, comparative methods, t-test and logit estimation model were used for analysis. Research results show that the level of dependence on forests of the surveyed households is still high. Households with substantial capital and high income tend to choose a strategy of low dependence on forests. In contrast, low-income households with limited capital often choose a highly forest-dependent strategy. In order to implement policies to limit access to forest capital to protect and maintain forest areas, the local government needs to find solutions to improve livelihood capital, especially human capital for the local households while improving their access to information and provide more technical support.
Keywords: *livelihood capital, local community, mountainous area, poor households, forest products, sustainable livelihoods*

Introduction

Forests play a vital role in the livelihoods of poor people in developing countries. The importance of forests is reflected in economic and social aspects (Luong, 2014; Le and Nguyen, 2019). Millions of people worldwide depend on forest capitals for their daily lives. Forests provide environmental products and services for production and life development, housing, employment, and stable livelihoods (Mahanta and Das, 2013; Mamo, 2015). Besides providing income for rural livelihoods, forests also contribute very positively to the green economy because they help to create a healthy and safe living environment for people and all living things on earth and serve as a sink of carbon dioxide. However, the degree of dependence on forests differs among household groups (Babulo et al., 2008). Forest-dependent livelihood strategies are mainly influenced by their livelihood capitals. For many years, the livelihood approach has been widely used in rural development issues for communities in general and forest-dependent households in particular (Le and Truong, 2019).

Livelihood capitals have an essential contribution to the interests of rural households. However, the livelihood capitals of households are heterogeneous (Mir et al., 2015; Megaze et al., 2017; Wang et al., 2021). People's dependence on a particular economic activity in general, and in particular on forest capitals, can vary and depends on the conditions of livelihood

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capitals and household demographic and economic characteristics. At the same time, it is also influenced by exogenous factors such as the market, price, and technology. Therefore, understanding the factors influencing change in the choice of activities of households and especially an understanding of the degree of dependence on forest capital is essential for conserving forest capital and maintaining and implementing development policies.

Livelihood capitals and livelihood outcomes are two critical components of the sustainable livelihoods approach. In which, income is considered an indispensable research indicator of livelihood results. Improving income for upland areas is one of the top national policies of the Party and the State. Tuyen Quang is a mountainous province with complex terrain, many high mountains, and divided rivers and streams. Here, the agro-forestry economy prevails, and the farm economic model combines agro-forestry. In the Provincial Competitiveness Index (PCI) of Vietnam in 2021, Tuyen Quang province ranked 56th out of 63 provinces (Hanh, 2021). The natural area is 5,867.3 square kilometers, of which the agricultural land area is 81,633 ha, accounting for 13.91%, the forestry land area is 446.641 ha, accounting for 76.12% (People's Committee of Tuyen Quang Province, 2021). The soil is fertile, suitable for many crops, and capable of forming concentrated commodity production areas such as tea, sugarcane, peanuts, soybeans, fruit trees, etc. (People's Committee of Tuyen Quang Province, 2021). In recent years, the agro-forestry sector has contributed more than one-third of the province's Gross Domestic Product (GDP); More than 75% of the province's employees are agricultural and forestry workers, of which forestry accounts for about 15%. Therefore, improving income for forest-dependent households in Tuyen Quang will contribute to the national poverty reduction and hunger eradication program and reduce the negative impacts on the maintenance and development of forest areas (Hanh, 2021).

There have been many studies on factors affecting household income in the world and Vietnam, such as Vedeld et al. (2007), Scoones (2009), Ding et al. (2018), Bao et al. (2021), and Hieu (2022). Their research results show that livelihood capitals contribute significantly to household benefits and impact household income. They can improve their income by using rational use of livelihood capital. However, the livelihood capitals of households are not homogenous (Ding et al., 2018), and specific studies on improving the income of forest-dependent households are still lacking. Therefore, understanding the influence of livelihood capital on people's income, especially forest-dependent households, is necessary for conserving and implementing development policies toward forest development. This study aims to assess the current status of forest-dependent people's livelihood capitals in Tuyen Quang province, upland Vietnam, examine the relationship between livelihood capitals and people's livelihood strategies, and propose feasible solutions for sustainable livelihood development.

Materials and methods

Analytical approach

The study uses the approach according to the sustainable livelihoods framework (Chambers and Conway, 1992; DFID, 1999) to examine the impact of livelihood capital on the choice of a household's livelihood strategy (*Fig. 1*). The sustainable livelihoods approach examines the relationship between livelihood strategies and livelihood capital to build a capacity framework for households, including natural capital, human capital, financial capital, social capital, and physical capital (Khalilzadeh and Tasci, 2017; Kuang et al., 2019).
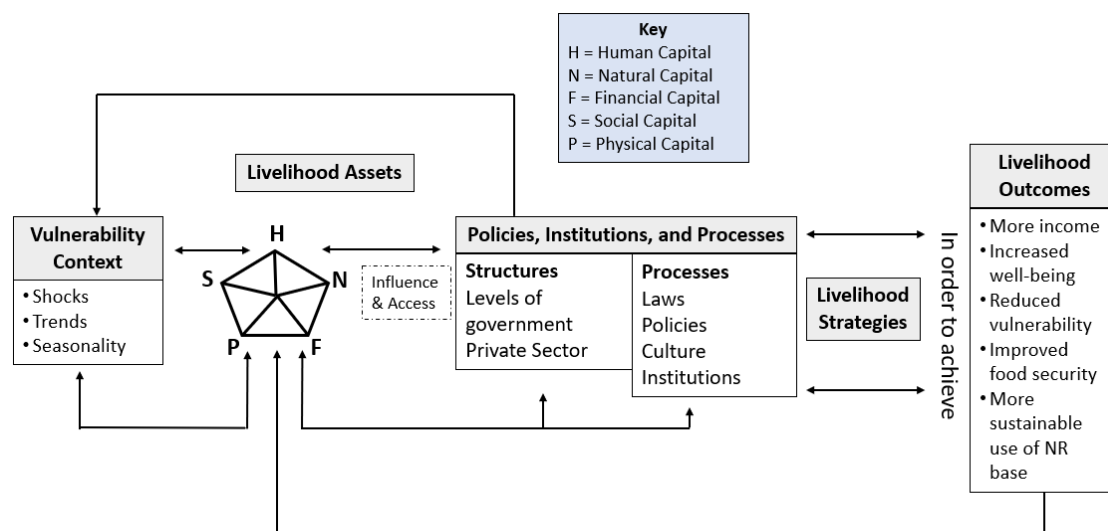
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***Figure 1.** Sustainable livelihoods framework. Source: DFID (1999)*

Based on a synthesis of related studies, combined with the characteristics of the study area, the initial system of livelihood resource indicators includes more than 30 indicators. However, after analyzing and applying the step-by-step method of eliminating variables, the livelihood resource indicator system has 16 remaining items shown in *Table 1*.

***Table 1.** Indicator system of household's livelihood capital*

Indicator/Variable	Description
Human Capital	
Hhlabor	Households with stable-income laborers (1 = yes; 0 = no)
Hhage	Age of household head
Hhsize	Number of members of the household
Financial Capital	
Need	The household's income meets the minimum basic needs (1 = yes; 0 = no)
Saving	Household accumulation or saving (1 = yes; 0 = no)
incomesour	Number of income sources of the household (1 = household with more than three sources of income; 0 = household with no more than three sources of income)
Social capital	
Hamletmeeting	Household participating in village or hamlet meetings (1 = yes; 0 = no)
Forestpatrol	The household is a member of a forest protection organization/group (1 = yes; 0 = no)
Helpgetting	Households receive help when needed (1 = yes; 0 = no)
Trust	Household trust in the locals (1 = yes; 0 = no)
Natural capital	
Agriland	Agricultural land area (ha)
Forestland	Forest land area (ha)
Othersland	Other land areas (ha)
forestacces	Ease of access to forest resources (1 = yes; 0 = no)
Physical Capital	
Housing	The poor housing situation of the household (1 = yes; 0 = no)
Assets	Assets of households at the poverty level (1 = yes; 0 = no)

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For household livelihood strategies, previous studies used various methods to determine (Adam and El Tayeb, 2014; Ayuttacorn, 2019; Matsalabi et al., 2019). It is divided into agricultural and non-agricultural activities (Tabachnick and Fidell, 2014; Matsalabi et al., 2019). Some research groups use cluster analysis to identify livelihood strategies into three or four groups (Ayuttacorn, 2019). However, others define livelihood strategies based on household income structure. Since then, the household's livelihood strategy has been determined based on the degree of dependence on income sources from agriculture (Matsalabi et al., 2019), forests (Adam and El Tayeb, 2014), and livestock (Kuang et al., 2019). In this study, we use the forest-dependence approach. The proportion of income from forests is used to classify livelihood strategies into three groups: low dependency (LS1), medium dependence (LS2), and high dependency (LS3). Households' forest income includes income from timber and non-timber forest products, in which income from timber is calculated by the equal distribution method. Simultaneous application of the "income portfolio scoring" method shows the appropriateness of the ratio of income from forests to the assessment of the dependence on forests of households in the study site (*Table 2*).

Table 2. *Description of the household's livelihood strategy variables. (Source: Author's compilation, 2022)*

Variables	Description
LS1 - High dependency	The proportion of income from forests to total income is more than 40%
LS2 - Medium dependency	The proportion of income from forests to total income is more than 20% to 40%
LS3 - Low dependency	The proportion of income from forests to total income is less than or equal to 20%

At the same time, the study also uses the REDD + program approach (reduce emissions from deforestation and forest degradation) to provide solutions. There, the approach towards reduction of People's dependence on forests to reduce pressure on forest loss and degradation REDD + is being piloted in many localities across the country, especially in upland areas where there is a large area of protected forests, special-use forests, and protected forests.

Study site selection and data collecting

The survey to assess the possibility of choosing the quality of forest-dependent livelihoods was conducted in two representative districts of the midland region with large forest areas and forest cover of the province, Yen Son and Son Duong districts, Tuyen Quang Province, from July to September, 2022 (*Fig. 2*).

In each district, the study selected two target communes in the highlands with purpose, namely Chieu Yen and Phuc Ninh communes in Yen Son district and Son Nam and Phu Luong communes in Son Duong district. In each commune, the study was carried out in upland villages where households have the right to use forest land and the opportunity to access forest resources. According to Statistic Office of Tuyen Quang (2020), 5,891 households are living in study area. We use the following formula (Tabachnick, 2014) to estimate the samples:

$$n = \frac{N}{1 + N * e^2} \quad \text{(Eq.1)}$$

n is the sample size, N is total number of households in the population, e is errors.

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With e = 0.05, the estimated number of samples to ensure reliability is 463. Hence, the study conducted a survey with 463 households in Tuyen Quang province. The questionnaire was collected by direct interview with households. First, we collected the household list of each commune from the District People's Committees. The households were then randomly selected from the list to be interviewed. Interviews were conducted in the evening so that the head of the household could be met. If one household is absent, the next household will be selected instead. After collecting data, there were 17 incomplete questionnaires, so 446 households were summarized and processed. The survey content focuses on the indicators of livelihood capital and the level of dependence on the forest of the household.
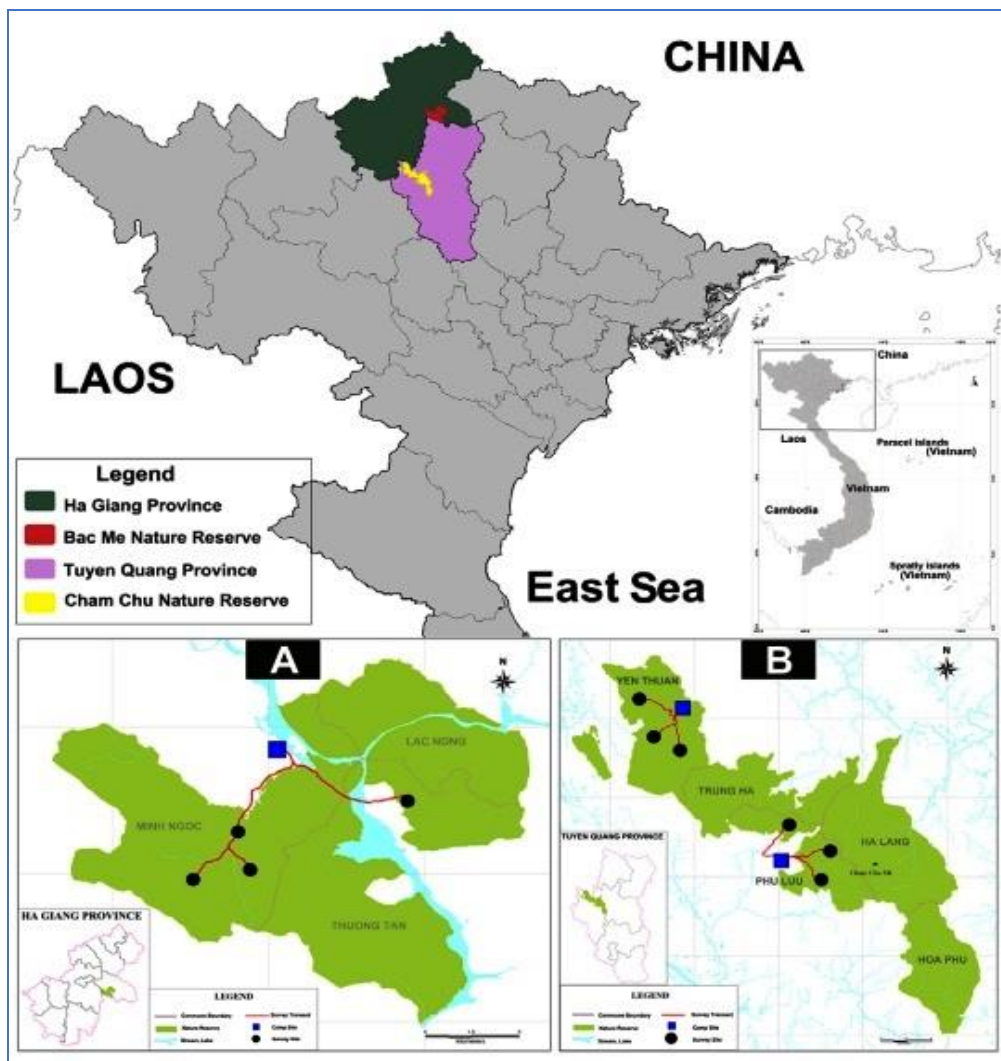

Figure 2. *Study area, Tuyen Quang province, upland of Vietnam*

Analysis methods

Descriptive statistical method is employed to describe livelihood capitals and the quality of household's life. The study also uses comparative methods and statistical T-tests to evaluate the difference between the average of each indicator in the five groups of livelihood resources of the local people. We also use the hierarchical Logit model to

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evaluate the people's intention to select livelihood options and influencing factors of the intentions. In this model, dependent variable is levels of dependence of households on forest, and independent variable is the livelihood capital indicators. Data is collected from household survey and analyzed using Stata 12.0 software.

Results

Household income and livelihood strategies

Households' income collected from agriculture, such as rice, maize, and other agricultural products, accounted for 47.8% of the totals in the study area (*Table 3*). The proportion of income from agriculture is nearly twice that of the forest. Out of a total of 446 surveyed households, 99 or 22% of households have a high degree of dependence on the forest. Meanwhile, the number of households with low dependence on the forest accounts for 49.56%. The proportion of income from forests is 28.9%; this figure is quite similar to other studies, such as the studies of Macura et al., 2011; Ratsimbazafy et al., 2012; Badola et al., 2012. This shows that the surveyed people have a high degree of dependence on the forest. However, this dependence is different among household groups. The dependence on forests is considerable for LS3 households, with the average proportion of income from forests being more than 50%, and there is not much variation among households in the group (standard deviation is 13.6%). The survey shows that this group of households often goes to the forest to harvest non-timber forest products such as bamboo shoots, vegetables, etc. At the same time, they use fuel, mainly firewood from the forest. In addition, other income sources, such as non-farm activities, tend to be lower from LS1 to LS3. It can be seen that the number of households heavily dependent on forests is still high, and it will create certain obstacles for the State's program to limit access to forests to protect and maintain forest areas.

Table 3 also describes the average level of total income and income from forests for each group of livelihood strategies. The average total income of surveyed households is more than 37 million VND/per year (1,500 USD). To compare income between groups of households according to livelihood quality with the T-test.

Table 3. Households' income and livelihood strategies based on the degree of forest dependence. (Source: Data processing results, 2022)

Strategy	Percentage of income from forests	Degree of dependence on the forest	Number of households	Percentage of income (%)			Income (million VND)	
				Forest	Agriculture	Others	Total	Forest
LS1	< = 20%	Low	221	12.4 (6.2)	59.1 (26.7)	28.5 (31.1)	56.404 (52.346)	4.224 (3.458)
LS2	(20-40%)	Medium	126	33.6 (5.56)	55.7 (21.84)	10.7 (21.01)	24.342 (17.23)	7.84 (5.03)
LS3	> 40%	High	99	51.3 (13.6)	43.4 (15.45)	5.3 (8.96)	23.392 (13.49)	11.1 (8.54)
Total			446	28.9 (20.7)	47.8 (25.03)	23.3 (26.99)	37.003 (39.06)	7.06 (6.26)

The value in parenthesis SD

The test results in *Table 4* show that the average income of households that are highly dependent on the forest tends to be lower than that of households that depend on the forest, with a statistical significance of 1% (total income of LS1 > LS2 > LS3).

Suppose total income is considered an essential indicator of household welfare. In that case, this result suggests that households with a high degree of dependence on forests will be more vulnerable than households with a selection of alternative livelihood strategies. When implementing the government's forest protection policy, they will suffer many negative impacts from the limited access to forest resources.

Table 4. *Testing the difference in income of households based on each group of livelihood strategies. (Source: Data processing results, 2022)*

Hypothesis	Difference	Standard error	t-value	p-value	Decision
H_0: LS1 = LS2; Ha:LS1 > LS2	25.242	6.204	5.356	0.000	Reject H_0***
H_0: LS2 = LS3; Ha:LS2 > LS3	8.012	3.223	2.897	0.001	Reject H_0***
H_0: LS1 = LS3; Ha:LS1 > LS3	32.392	5.367	7.001	0.000	Reject H_0***

H_0 = There is no difference between groups of households; Ha = households with high dependence on forests have lower incomes; *** level of significance 1%

Status of households' livelihood capital based on the degree of dependence on the forest

The results of descriptive statistics of the five types of livelihood resources for both the survey sample and the three groups of livelihood strategies in Tuyen Quang province and the value of testing the difference between the mean of the three groups are shown in *Table 5*. In general, the test results show a statistically significant difference between different groups of livelihood strategies, especially a clear difference with a high statistical significance (1%) between forest high-dependent and low-dependent groups (LS3 and LS1).

Human resources are measured by three indicators (*Table 5*). For the entire sample, 28% of households have at least one member with a stable income. These members usually participate as local government officials and workers of local factories and factories. They are a vital member of the household economy regarding quantity and sustainability. Therefore, stable-income households tend to be less dependent on the forest. The average age of the head of household is nearly 44 years old, and there are differences between the groups of households. The households with a high degree of dependence on the forest are usually those with older age. This can be explained by the fact that the elderly household head has less opportunity to acquire knowledge and skills to diversify income sources. They tend to access and exploit forest resources more; The average household size is 4.63 people/household, and there is no difference between groups of livelihood strategies.

Financial resource indicators have a clear and reliable difference between LS1 and the other two groups, while the difference between LS2 and LS3 is not statistically significant. Generally, households with substantial financial capital will be less dependent on forests; they tend to diversify their income from non-agricultural activities. The survey sample focuses on households living near forests in highland areas, mainly ethnic minorities with a high poverty rate. Therefore, on average, for the entire sample, only 42.6% of households have income that can meet their basic needs. Accumulation is only deficient (13.4%), and about 50% of households only have income from three primary sources: cultivation, husbandry, and forestry.

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Table 5. *Current status of household's livelihood capital. (Source: Data processing results, 2022)*

Variable	Overall		LS1		LS2		LS3		Deference Testing		
	TB	SD	TB	SD	TB	SD	TB	SD	LS2&LS1	LS3&LS2	LS3&LS1
Human Capital											
Hhlabor[b]	0.32	0.34	0.54	0.48	*0.17*	*0.4*	*0.11*	0.31	*0.33****	*0.13[NS]*	*0.47****
Hhage	44.02	11.03	42.67	*11.27*	*45.34*	9.98	47.78	*12.67*	*-2.45[NS]*	*-2.34[NS]*	*-4.56***
Hhsize	5.01	1.56	4.86	1.69	*4.62*	1.47	4.64	1.59	*0.32[NS]*	*-0.03[NS]*	*0.19[NS]*
Financial Capital											
Need[b]	0.426	0.549	0.605	0.560	0.325	0.515	0.224	0.459	*0.28****	*0.11[NS]*	*0.36****
Saving[b]	0.134	0.370	0.224	0.448	0.090	0.302	0.034	0.202	*0.11***	*0.4[NS]*	*0.18****
incomesour[b]	0.605	0.560	0.795	0.515	0.549	0.560	0.347	0.526	*0.19****	*0.18[NS]*	*0.4****
Social Capital											
Hamletmeeting[b]	1.075	0.224	1.086	0.179	1.086	0.179	1.030	0.302	0.01[NS]	0.06[NS]	0.04[NS]
Forestpatrol[b]	0.504	0.560	0.571	0.560	0.504	0.560	0.381	0.538	0.07[NS]	0.12[NS]	0.19*
Helpgetting[b]	0.862	0.470	0.952	0.403	0.907	0.437	0.661	0.560	0.02[NS]	0.24***	0.31***
Trust[b]	0.941	0.403	0.974	0.381	0.952	0.403	0.896	0.459	0.00[NS]	0.07[NS]	0.06[NS]
Natural Capital											
Agriland	0.571	0.325	0.582	0.325	0.560	0.314	0.538	0.325	0.03[NS]	0.01[NS]	0.03[NS]
Forestland	3.976	8.926	6.429	11.368	1.680	2.912	2.352	7.672	4.34***	-0.61[NS]	3.73***
Othersland	0.112	0.381	0.168	0.560	0.078	0.090	0.056	0.067	0.07[NS]	0.01[NS]	0.1[NS]
forestacces[b]	0.414	0.538	0.426	0.549	0.414	0.549	0.370	0.526	0.02[NS]	0.02[NS]	0.06[NS]
Physical Capital											
Housing[b]	0.526	0.560	0.672	0.549	0.459	0.560	0.347	0.526	0.22**	0.09[NS]	0.32***
Assets[b]	0.571	0.560	0.448	0.549	0.549	0.560	0.806	0.504	-0.1[NS]	-0.19**	-0.29***

[a]Variable names, definitions, and units are explained in *Table 1*
[b]Dummy variable
***, **, and * at 1%, 5%, and 10% significance levels, respectively; NS: Not statistically significant

For social capital, indicators including participation in village meetings, participation in forest protection groups, and the level of trust in local people are pretty high and synchronized among household groups. This is explained by the fairness of local authorities when selecting households to participate in forest protection and inviting people to participate in meetings. However, transitioning from being trusted to getting help when needed is different. The test results show that the LS3 group of households is more complicated than the other two groups of households in finding help from friends and neighbors when facing difficulties, especially material help. This can be explained by weakness from other resources; they are vulnerable, so friends see a high risk when helping materially.

As for natural resources, except for forest land, the remaining indicators of the groups of households are equal, and there is fairness in distribution according to the demographic norms from the local authorities at all levels. Besides, the ease of access to forest resources does not affect the degree of dependence on forests of people in the study area. However, the target of forest land area is clearly different; the households with a low degree of dependence on the forest own a larger forest area than the other two groups of households.

The status of housing and assets of the household measures the physical capital of the household. In this study, we survey and review poor households according to the

People's Committee of Tuyen Quang Province (2021). Research results show that 52.6% and 57.1% of surveyed households have poor housing and assets, respectively. The difference in material resources is quite apparent among household groups.

Analysis of the influence of livelihood capital on the selection of livelihood strategies

The results of estimating the hierarchical Logit model using Stata 12.0 software are presented in *Table 6,* showing that the Wald chi2 test value = 62.30 and the statistical significance at 1% level has proved the appropriateness of the model. We did not detect multicollinearity of the independent variables in the research data. In addition, the z-test and robust standard error are used to avoid heteroscedasticity. The results show that six estimated parameters affect households' ability to choose livelihood strategies. For human resources, two indicators, hhlabor and hhage have a statistically significant influence on the ability of households to choose the degree of dependence on the forest. The probability that a household chooses a livelihood strategy that is less dependent on the forest is negatively affected by the hhlabor indicator and positively by the hhage criterion. For the remaining four resource groups, only one indicator of each group has a statistically significant impact on the ability of households to choose a forest-dependent livelihood strategy, including income to meet essential needs. Weaknesses (financial capital), ability to get help when needed (social capital), area of forest land (natural capital), and housing status (physical capital). The impact direction of statistically significant variables is in the opposite direction, which is consistent with the results of the t-test above. In other words, the model estimation results show that households with vital livelihood resources tend to choose a livelihood strategy that is less dependent on forests.

Table 6. *Estimation results of the Hierarchical Logit model on the ability of households to select livelihood strategies. (Source: Data processing results, 2022)*

Variable	Estimated coefficient	Robust std. err.	Test value (z)	Probability (P)
1.hhlabor	-1.321***	0.466	- 3.545	0.002
Log(hhage)	1.893**	0.844	2.702	0.021
Log(hhsize)	-0.684[NS]	0.663	- 1.174	0.348
1.need	-0.598*	0.372	- 2.143	0.070
1.saving	-0.803[NS]	0.531	- 1.949	0.099
1.incomesour	-0.199[NS]	0.378	- 0.821	0.539
1.hamletmeeting	0,923[NS]	1.238	1.037	0.416
1.forestpatrol	0.544[NS]	0.393	1.653	0.169
1.helpgeting	-0.934**	0.518	- 2.280	0.051
1.trust	0.804[NS]	0.633	1.482	0.222
Log(agriland)	0.121[NS]	0.377	0.342	0.874
Log(forestland)	-0.357***	0.131	- 3.466	0.002
Log(othersland)	-0.304[NS]	0.207	- 1.824	0.124
1.forestacces	0.215[NS]	0.358	0.752	0.583
1.housing	-0.705*	0.388	- 2.177	0.064
1.assets	-0.178[NS]	0.412	- 0.467	0.781
/cut1	6.233	3.451		
/cut2	8.021	3.483		

Log-pseudolikelihood = -180.02; Number of obs = 210; Wald chi^2(16) = 62.30; Prob > chi^2 = 0.0000; Pseudo R^2 = 0.1923

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Out of six variables with statistical significance, five are consistent with previous related studies, such as Tuyen et al. (2019) research on forest dependence and household livelihood strategies. However, the variable forest area of households in this study has the opposite direction. The studies show that households with more forest areas tend to depend more on forests. However, in the highland area of Tuyen Quang province, in recent times, the exploitation of timber has not been much because the planted forest area is not yet of harvest age, and at the same time, traffic difficulties also limit the exploitation of the people. The forest income of people in Tuyen Quang is mainly non-timber forest products such as firewood, vegetables, bamboo shoots, etc. The exploitation of these non-timber forest products (NTFP) is carried out in easily accessible forests, regardless of whether they are community forests or owned. At the same time, forests in the highland areas are mainly protection forests, special-use forests are assigned to the community for management, and households' forests are mainly regenerated. In addition, households with large forest areas tend to hire much labor in planting, exploiting, and harvesting timber, so the net value obtained is not high. Households with high forest dependence are usually low-income households with low-income sources, so they tend to access and exploit non-timber forest products more.

Based on the estimated results of *Table 6,* the author evaluates the probability of choosing a livelihood strategy for each household in *Table 7*. The results show that the correct prediction ability of the model is nearly 65%. The model's accurate prediction rate for the group of households that choose a strategy of low dependence on forests is the highest (76.8%). This level of correct prediction is acceptable for the hierarchical Logit model, which once again confirms the appropriateness of the estimated model.

Table 7. *The model's prediction accuracy rate. (Source: Data processing results, 2022)*

Livelihood strategy		Prediction (household)			
		LS1	LS2	LS3	Total
Reality (household)	LS1	136	28	12	176
	LS2	39	39	27	105
	LS3	11	25	41	77
	Total	186	92	80	358
Accurate prediction rate (%)		76.8	47.3	59.0	65.1

Discussion

Research on capital and livelihood strategies is constantly developing both abroad and at home (Mamo, 2015; Hieu and Tam, 2022; Kuang et al., 2019). Based on the characteristics of sustainable livelihood security of farmers in the highlands of Vietnam, a model of minimum working capital and strategies to ensure farmers' livelihoods has been developed in this study and conduct data analysis. This study showed some similar results with previous studies.

The studies of Kuang et al. (2019) shown that of the five types of living capital, the value of natural capital of farmers is the highest and the value of social capital is the lowest. The research results of this thesis show that the value of human capital is the highest while the value of social capital is the lowest. The reason for the higher value of human capital is that the food and inputs used by farmers have increased and the types of fixed assets owned by households have also increased significantly (Matsalabi,

2019). In addition, the government has renovated the homes of many farmers as part of the fight against poverty. Many farmers' houses have been renovated and housing conditions have improved. However, low financial capital mainly due to low family income, limited accessibility to credit, fewer sources of income, and other factors. These evaluation results are essentially consistent with other studies in this area (Babulo et al., 2008; Macura, 2011; Mahahanta, 2013).

In this work, logistic regression model was used to conduct an empirical study on the relationship between livelihood capital and livelihood strategies. The results indicate that the choice of survival strategy of farmers depends on different livelihood conditions. The results of this study are consistent with the results of this study other scientists in the academic field. Hieu and Tam (2022), for example, conduct a quantitative analysis of working capital and survival strategies of farmers and ranchers in Central Vietnam. The results show that farmers have more human and financial capital with more human and financial capital choose off-farm activities as their main livelihood strategy, while farmers with more natural capital chooses agricultural production as the main livelihood.

The results of the study are consistent with the results of other investigations in this area (Chahambers, 1992; Ayuttacorn, 2019). In addition, most scholars have only studied the impact of natural capital on livelihood strategies and have not studied further what factors influence the change in farmers' livelihood strategies. As livelihood capital changes, the nature of livelihood strategies will change (Badola, 2012; Bao et al., 2021).

In this work, the factors influencing the transition from pure forest to a "partially non-agricultural" living strategy were analyzed individually. The results show that the change in farmers' income strategy is influenced by many key factors. This research can help farmers quickly understand the influencing factors of different life strategies to optimize their strategies, thereby better solving the problems of farmers in poor areas of Vietnam.

Conclusions

Forests play an essential role in people's livelihoods in mountainous areas, ethnic minority areas in general, and Tuyen Quang province in particular. In the process of people's economic development, on average, forests contribute 29% of income (*Table 3*). People's dependence on the forest is still high. The survey results show that 50.4% of households choose the livelihood strategy of medium and high dependence on the forest. However, the dependence on forests is different among household groups. Low-income households have a higher dependence on forests than those with higher incomes. Households with solid resources tend to be less dependent on forests as they can choose more or diversify their income from different sources, such as livestock and non-forestry occupations. Among the five groups of households' livelihood resources, the group of human resources has the most significant influence on people's ability to choose a forest-dependent livelihood strategy, followed by financial, physical, natural, and social capital.

To contribute to the protection and maintenance of forest areas for implementing the REDD + program, the State should have policies to reduce dependence on forest resources, upgrade infrastructure and support activities for people, contribute to diversifying income sources, and reduce dependence on forests. At the same time, improving livelihood resources for people, especially human resources, helps them gain

more knowledge and skills to choose activities that generate stable income. Diversify the training content, focusing on market knowledge to help them develop commodity agriculture. For social resources, building a village culture, a community of solidarity, harmony, and mutual trust is necessary: households help, share experiences in using economic resources, and develop the household economy; encourage households to actively and actively participate in the activities of associations and, promote the role of associations, improve livelihood results of households. Regarding financial resources, it is necessary to guide households to meet their essential needs to ensure food security. At the same time, there are solutions to support the diversification of income sources. For material resources, it is necessary to implement a group of solutions to improve the quality of housing, and assets/work tools of the household should be prioritized. With natural resources, it is necessary to perform well the planning and management of agricultural land use planning in the area; organize the implementation of master plans and plans on land use; publicize master plans and plans on land use under regulations; review planning of sectors and fields that use the land to be consistent with the province's master plans and plans on land use; propagandize on forest protection and forest exploitation according to planning, efficient and rational use of forest resources.

Conflict of interests. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interests.

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