ISSN: 18158129 E-ISSN: 18151027
Volume 20, Issue 10, October, 2024

Factors affecting the development of cinnamon production in Vietnam: A case study in Thai Nguyen province

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ABSTRACT— This study investigated the practices of cinnamon production by ethnic minority groups in the Thai Nguyen province. The study surveyed data from 343 cinnamon production households, using reliable analysis tools such as Cronbach's Alpha coefficient, EFA exploratory factor analysis, and linear regression models. Research results have identified 8 factors and the level of influence of each factor on the development of local cinnamon production. These factors include education level, age of the household head, government support policies, experience of the household head, capital, economic benefits, and science and technology. The study results also showed four factors greatly affect the development of cinnamon production in farmer households. They are capital, financial benefits, policy support, and the education level of the household. The magnitude of the standardized level of impact in descending order of the independent variables on the dependent variable of cinnamon production development (PD) is as follows: capital (β = 0.320), economic benefits (β = 0.294), Support policies (β = 0.252) and education level of the household head (β = 0.237). To limit the negative impacts of the above 4 factors, farmers need to change their awareness, boldly borrow capital to invest, and regularly update new knowledge. Local authorities issue specific policies for cinnamon households and coordinate closely and effectively with farmers.

KEYWORDS: Cinnamon, cinnamon production, households, Vietnam

1. INTRODUCTION

Cinnamon is one of the versatile non-wood forest products, with many applications in production and daily life. It can be used to make crafts, spices, flavorings, medicines, feed for livestock and poultry, and even as fertilizer. In Vietnam, cinnamon growing is the main source of livelihood for hundreds of thousands of ethnic minority households in remote provinces and an important contribution to the socio-economic development of many localities. Vietnam's cinnamon production area is 180,000 hectares, the third largest in the world, accounting for 18.2% of global cinnamon production. This made Vietnam the world's largest cinnamon exporter, accounting for 34.4% of the worldwide cinnamon export market share and having an export turnover of 292 million USD [1]. Although this is a production industry with many advantages in terms of weather, climate, soil, and land and is a long-standing traditional industry, the cinnamon production industry in Vietnam has not yet reached its full potential due to several limitations such as small scale and dispersion. Most workers in this industry are ethnic minorities so their education level is low. Moreover, the cinnamon industry also faces challenges such as a lack of investment capital, weak production organization, and weak value chain linkage. Furthermore, cinnamon planting, care, processing, and preservation techniques are still poor, leading to low productivity and economic efficiency [1], [2]. This study was conducted in Thai Nguyen province, one of the provinces with the large cinnamon growing areas in Vietnam. Cinnamon is primarily

grown in two mountainous districts Dinh Hoa and Phu Luong. Due to its suitability for the local climate and soil conditions, cinnamon trees thrive and have a high essential oil content. Research has shown that after approximately 15 years of care, 1 hectare of cinnamon can yield an income of 450-550 million VND, about four times higher than acacia trees and 5.5 times higher than local fat trees [3], [4]. In addition, this is a locality where over 80% of cinnamon growers are ethnic minorities, which has many difficulties and is slower to develop than other ethnic groups. This study aims to find out the positive and negative factors affecting cinnamon production by farming households in Vietnam in particular, and small-scale farming households in developing countries in general as a scientific basis to help them improve productivity and production efficiency.

2. MATERIALS AND METHODS

2.1 Literature review

Innovation Diffusion Theory, as proposed by Roger [5] explains the process of accepting new ideas and technologies by users. This theory outlines five stages of accepting innovation, including the awareness stage, persuasion stage, decision-making stage, implementation phase, and confirmation phase. Bernoulli's Expected Utility Theory [6]., suggests that effort will lead to positive results. When farmers decide to change their production model to participate in the cinnamon growing model, the appeal of this model must be high to attract farmers. This is because they may have high expectations for the model in various aspects. Theory of Reasoned Action [7] states that behavioral intentions lead to behavior and that these intentions are influenced by an individual's attitude towards the behavior, as well as subjective norms surrounding the performance of behaviors. Among these factors, attitude and subjective norms are particularly important in determining behavioral intention. Based on the theories just mentioned, this research is based on [8] which includes factors such as capital, economic benefits, policies, age of household head, education level, production experience, and science and technology.

2.2 Developing Hypotheses

Cinnamon Production Development (PD)

The research conducted by [9] has revealed several key factors that influence the crop structure of farming households in Ninh Thuan province. These factors include the place of consumption, level of education, consultation, participation in training, number of dependents in the family, number of workers in the family, and non-agricultural revenue [10] also found that perceptions and values play a significant role in the decision-making process of farming households. For farmers, the decision to switch to growing cinnamon can have a multitude of effects. Not only does cinnamon production improve the health of producers, but it also increases income and contributes to a healthier environment and safer food [11], [12]. Additionally, the cultivation of cinnamon relies on the effective utilization of local resources and knowledge, making it a potential solution for improving the food security of farming households [13].

Hypothesis 1 *The expectation of economic benefits (EB) has a positive impact on cinnamon production development*

The expectation of economic benefits strongly influences the cooperation of plant production farmers, as it helps to lower costs and ensures higher output prices [14]. Before deciding to participate in cinnamon production, farmers consider factors such as production costs, productivity, and selling price. and economic efficiency. These expectations play a crucial role in their decision to participate.

[15] suggest that expectations can influence behavior by creating a sense of belief and motivation to achieve desired results.

Hypothesis 2 *The age of the household head (AG) has a positive impact on cinnamon production development*

ISSN: 18158129 E-ISSN: 18151027
Volume 20, Issue 10, October, 2024

The household head is typically the individual responsible for making decisions regarding the main production and business activities of the household [16]. Older farmers often possess a wealth of knowledge and experience, making them better equipped to evaluate technology compared to younger farmers [17]. However, some studies suggest a negative correlation between age and the adoption of new technology. As farmers age, they tend to become more risk-averse, leading to a decrease in their interest in long-term investments in their farms. Instead, they rely on their experience to guide their production methods. On the other hand, younger household heads are more open to accepting and implementing new knowledge in their production practices [18].

Hypothesis 3 *Support policy (SP) has a positive impact on cinnamon production development* According to [19] farmers make production decisions based on the importance of production support policies. In Pakistan, the decision of the farmers to plant trees is strongly influenced by policies that support and encourage the production and consumption of products [17]. [20] argue that strong political and legal support for good land ownership is the main driver of eucalyptus plantation development in Thailand.

The study of [4] concluded that government support policies have an impact on increasing forest area, recommending the need to increase incentives for non-state economic sectors to invest in forest development, processing, and trading of forest products through attractive policies.

Hypothesis 4 *The experience of the household head (EX) has a positive impact on cinnamon production development*

Experience of the Household Head (EX): A study of [21] concluded that risk orientation, tree planting experience, and occupation are related to participation in afforestation cooperatives in Indonesia. Work experience affects income and production of coffee in Vietnam [22]; Work experience contributes positively to output and is meaningful to labor income in fruit farms [23].

Hypothesis 5 *The education level of the household head (ED) has a positive impact on cinnamon production development*

The higher a farmer's education level, the more likely he or she is to access and use information related to crop conversion and new technology applications. Research on organic fertilizer application [24] concluded that education level influences technology application. With all the same input resources, two farmers with different agricultural technical levels will have different production results [25]. A household's average educational outcome affects its income and decisions to apply science and technology to production and life [23].

Hypothesis 6 *Production scale (PS) has a positive impact on cinnamon production development*

Some studies suggest that households with large cultivated areas are more likely to apply technology and change crop structure because these households have available land and capital to easily switch to other production.

Hypothesis 7 *Capital (CA) has a positive impact on cinnamon production development*

Lack of investment capital leads to low productivity, due to the inability to buy raw materials for production and apply scientific and technical advances. Therefore, farmers need to borrow more capital to invest in production, which will help households expand production scale and apply advanced scientific advances to the production process [23]. Access to capital can also influence production transformation [15].

Hypothesis 8 *Science and technology (ST) have a positive impact on cinnamon production development*

Previous studies have shown that technical training plays a crucial role in transforming crop structure. Farmers who receive training are more likely to switch to organic agricultural production than those who do not [26], [27]. According to [28], farmers must possess appropriate technical qualifications and professional skills to change their farming practices. This includes not only training in production techniques but also the ability to apply the knowledge learned to real farming situations.

2.3 Methodology

Secondary data was collected at the Statistics Department and the Department of Agriculture and Rural Development of Thai Nguyen province. Primary data were collected through direct interviews with 343 cinnamon farmer households. The sample number was selected according to the Slovin method from the list of cinnamon-growing households in Dinh Hoa and Vo Nhai districts. To measure the attitudes and evaluation levels of survey participants, observed variables were measured using a Likert scale with the following 5 common levels: (1) Strongly disagree; (2) disagree; (3) normal; (4) agree; (5) strongly agree. All valid samples were processed using SPSS 22.0 software to conduct reliability analysis, correlation analysis, factor analysis, regression analysis, and hypothesis testing. To evaluate the factors affecting the development of cinnamon production in Thai Nguyen, the author uses reliability analysis tools through Cronbach's Alpha coefficient and EFA (Exploratory Factor Analysis). PD is the development of Cinnamon production in Thai Nguyen, ED is the level of education of the household head, AG is the age of the household head, SP is the support policy, EX is the production experience of the household head, EB is the expected economic benefits of cinnamon production, PS is production scale, CA is capital, and ST is science and technology.

3. RESULTS AND DISCUSSION

3.1 Data collection

Survey results of 343 cinnamon production households in 2 districts of Thai Nguyen province show that most household heads are men (84.26%); The highest proportion of household heads are aged 31 to 40 (44.31%). Regarding education, up to 58.58% of household heads have graduated from high school, and 34.34% have graduated from university. In particular, most household heads are ethnic minorities (84.35%).

Table 1: Profile of respondents (n =343)

Measure	Value	Frequently (%)
1. Gender	Male	84.26
	Female	15.74
2. Age of the household head (year old)	<20	0.00
	21-30	18.65
	31-40	44.31
	41-50	21.87
	>50	15.17
3. Education level of the household head	Primary school	0.29
	Junior high school	3.50
	High school	58.58
	Undergraduate	34.41
	Postgraduate	3.22
4. Ethnicity of the head of household	Ethnic minority	84.35
	Not an ethnic minority	15.65

3.2 Measurement model development

Agarwal and Prasad [29] proposed using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to assess the construct validity. The results of the EFA support the existence of construct validity in the questionnaire. The CFA results also confirm the structural validity of the measurement model, with high factor loadings and acceptable fit indices.

The results of the EFAs in this study showed that the KMO coefficient is 0.808 and the factor loadings of the observed variables are all satisfactory (> 0.50). Bartlet's test for coefficient Sig = 0.000 shows that the

ISSN: 18158129 E-ISSN: 18151027
Volume 20, Issue 10, October, 2024

statistical significance of the analysis results is guaranteed and the factor analysis conclusion is guaranteed to be reliable (Table 2). The variance extracted (AVE) is equal to 70.222, showing that the variation of the factors given from factor analysis will explain 70.22% of the variation of the overall original survey data. This ratio is quite high, showing that the given factors have a good representation of the original data, which increases the representative significance of the factors analyzed for the original data. The Eigenvalues of the 8th factor is 1.601, the smallest value greater than 1, which reaffirms that 8 factors can be derived from the analysis

Table 2: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	**Bartlett's Test of Sphericity**		
	Approx. Chi-Square	**df**	**Sig.**
0.808	4641.150	435	.000

The results of Table 3 show that the factor loading coefficients are all greater than 0.5, and there is no case of variables loading on both factors simultaneously with loading factors close to each other. Therefore, the factors ensure convergent and discriminant validity when EFA is analyzed. Additionally, all the factors in the model demonstrate internal consistency reliability, with a Cronbach's alpha value higher than 0.7 [30].

Table 3: Confirmatory factor analysis

Constructs	**Factor loading**	**Mean**	**SD**	**Cronbach's Alpha**
The Expected Economic Benefits (EB)		3.65	0.862	.882
EB1: Cinnamon offers a high income potential.	.868			
EB2: The production of cinnamon is cost-effective.	.846			
EB3: Cinnamon products are convenient and easy to consume.	.813			
EB4: Cinnamon has a high yield rate.	.824			
Age of the household Head (AG)		3.52	0.905	.872
AG1: The older the household head is, the more experience they have in growing cinnamon	.878			
AG2: The older the household head is, the more confident they are in growing cinnamon	.828			
AG3: The older the household head is, the more conscious and responsible they are in developing cinnamon	.780			
AG4: The older the household head is, the more proactive they are in changing the cinnamon growing model	.869			
Supporting Policies (SP)		3.48	0.840	.885
SP1: Tax and credit incentives have a significant impact on the development of cinnamon production.	.857			
SP2: Policies that provide scientific and technical support play a crucial role in the growth of cinnamon production.	.837			
SP3: Trade promotion policies and support for the consumption of cinnamon products are essential factors	.840			
SP4: A policy aimed at supporting cinnamon production can greatly contribute to its overall development.	.854			
Experience of the Household Head (EX)		3.67	0.791	.772
EX1: Experience in production.	.780			

EX2: Experience in accessing the cinnamon product market.	.784			
EX3: Experience in managing and calculating Cinnamon's economic efficiency	.848			
Education Level of the Household Head (ED)		3.65	0.819	.850
ED1: A high level of education means a lot of knowledge in production	.826			
ED2: With a high level of education, households can quickly grasp new techniques	.801			
ED3: A high level of education allows households to be proactive in the decision-making process to develop cinnamon	.809			
ED4: A high level of education makes households confident in developing cinnamon	.792			
Production Scale (PS)		3.74	0.722	.654
PS1: Large-scale production makes it easy to grow cinnamon	.743			
PS2: The large production scale makes it easy to sell cinnamon products	.757			
PS3: Large production scale, easy-to-apply techniques	.782			
Capital (CA)		3.50	0.803	.790
CA1: Investment funds for cinnamon production	.724			
CA2: Family capital for cinnamon production	.801			
CA3: Loans from friends and relatives to produce cinnamon	.829			
CA4: Bank loans and credit funds for cinnamon production	.793			
Science and Technology (ST)		3.40	0.753	.856
ST1: Technical training	.795			
ST2: Techniques applied in cinnamon production	.818			
ST3: Trained on markets and marketing	.816			
ST4: Be trained in management	.890			

Table 4 shows that the Pearson correlation t-test between the eight independent variables and the dependent variable is all less than 0.05. This showed that there is a linear relationship between the independent variables and the dependent variable. There is no too strong correlation between the independent variables when the absolute value of the correlation coefficient between pairs of variables is less than 0.5, which proves that the possibility of collinearity/ multicollinearity is also lower. Thus, the independent variables are suitable for use in the model. According to [29] the VIF value is used to evaluate the problem of multicollinearity between the independent variable and the dependent variable. The analysis results in this study showed that all VIF values between the independent and the dependent variable in the research model from 1.046 to 1.214 are all less than 5, meaning the model does not have multicollinearity.

Table 4: Correlations among variables

	EB	**AG**	**SP**	**EX**	**ED**	**PS**	**CA**	**ST**	**PD**	**VIF**
EB	1	.227**	.219**	.207**	.299**	.095	.052	.057	.516**	1.184
AG	.227**	1	.045	.081	.189**	.136*	.016	-.034	.267**	1.090
SP	.219**	.045	1	.232**	.209**	.044	.114*	.097	.463**	1.118
EX	.207**	.081	.232**	1	.270**	.107*	.077	.158**	.414**	1.154
ED	.299**	.189**	.209**	.270**	1	.142**	.145**	.080	.518**	1.214

ISSN: 18158129 E-ISSN: 18151027
Volume 20, Issue 10, October, 2024

PS	.095	.136*	.044	.107*	.142**	1	.118*	.058	.282**	1.051
CA	.052	.016	.114*	.077	.145**	.118*	1	.122*	.443**	1.051
ST	.057	-.034	.097	.158**	.080	.058	.122*	1	.250**	1.046
PD	.516**	.267**	.463**	.414**	.518**	.282**	.443**	.250**	1	

** Correlation is significant at the 0.01 level; * Correlation is significant at the 0.05 level

3.3 Test of structure model

The R^2 value ranges from 0 to 1. Higher values indicate a higher level of prediction accuracy in the model. When the R^2 value is 0.75, 0.50, or 0.25, it reflects the level of accuracy in significant, moderate, and weak predictions of the influence of independent variables on dependent variables. The results in Table 5 showed that R2 = 0.698, which means 69.8 % of the variation in the dependent variable was explained by the independent variables in the model. In other words, 69.8% of the variation in cinnamon growth was explained by the factors in the model.

The results of Table 5 also provide the Durbin–Watson value to evaluate the phenomenon of first-order serial autocorrelation. DW value = 1.929, within the range of 1.5 to 2.5, so the result does not violate the assumption of first-order serial autocorrelation [31], [32].

Table 5: Model Summary [b]

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.835[a]	.698	.691	.2720567	1.929

a. Predictors: (Constant), ST, AG, SP, PS, CA, EX, ED, EB b. Dependent Variable: PD

The analysis of variance by ANOVA (Table 6) showed that the F test has a significant level with Sig. = 0.000 (< 0.05) means that the proposed linear regression model is suitable for the data collected and the variables are statistically significant, with a significance level of 5%.

Table 6: ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	57.137	8	7.142	96.496	.000[b]
Residual	24.721	334	.074		
Total	81.858	342			

a. Dependent Variable: PD; b. Predictors: (Constant), ST, AG, SP, PS, CA, EX, ED, EB

Table 7 lists the variables in the structural model: age of the household head, education level of the household head, support policy, experience of the household head, science and technology, production scale, capital, and the expectation of economic benefits. All variables have a plus sign and are statistically significant (Sig. < 0.05), showing that all 8 variables impact the development of cinnamon production. Based on the magnitude of the standardized regression coefficient Beta, the level of impact in descending order of the independent variables on the dependent variable of cinnamon production development (PD) is as follows: capital (β = 0.320), economic benefits (β = 0.294), Support policies (β = 0.252), education level of the household head (β = 0.237), experience of the household head (β = 0.164), production scale (β = 0.132), science and technology (β = 0.122) and the variable age of the household head have the least impact on the development of cinnamon

production (β = 0.112).

Table 7: Hypothesis test results

Hypothesis		**β**	**Result**
H1	The expectation of economic benefits has a positive impact on cinnamon production development	.294	Supported
H2	The age of the household head has a positive impact on cinnamon production development	.112	Supported
H3	Support policy has a positive impact on cinnamon production development	.252	Supported
H4	The experience of the household head has a positive impact on cinnamon production development	.164	Supported
H5	The education level of the household head has a positive impact on cinnamon production development	.237	Supported
H6	Production scale has a positive impact on cinnamon production development	.132	Supported
H7	Capital has a positive impact on cinnamon production development	.320	Supported
H8	Science and technology have a positive impact on cinnamon production development	.122	Supported

4. CONCLUSIONS AND RECOMMENDATION

The study identified all eight factors including education level, age of household head, state support policies, experience of household head, capital, economic benefits, and science and technology all have an impact on the development of cinnamon production of farming households, of which, there are four factors capital, financial benefits, policy support and education level of household head are the factors with the greatest influence. The magnitude of the standardized level of impact in descending order of the independent variables on the dependent variable of cinnamon production development (PD) is as follows: capital (β = 0.320), economic benefits (β = 0.294), Support policies (β = 0.252) and education level of the household head (β = 0.237).

The limitation of this study is that in addition to the eight factors mentioned, other factors can affect the development of local cinnamon production but have not been mentioned such as transportation infrastructure, electricity, water, availability, access to credit sources, role of agricultural extension services, etc. In addition, the subjects of this study are cinnamon farmer households, not to mention small and medium-sized enterprises involved in growing and processing cinnamon products. The authors hope that these limitations will be addressed in future studies.

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