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Research on the Influencing Factors and Development Strategies of the Under-forest Economy in Heilongjiang Province

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Abstract: To address issues such as the small scale of operations, low technological content, and opaque market information in the under-forest economy of Heilongjiang Province, this study employs descriptive statistics and multiple linear regression analysis methods based on 124 questionnaire responses from forest farmers in various cities and counties of Heilongjiang Province. The study explores the influencing factors of developing the under-forest economy in Heilongjiang Province. The results show that the number of family laborers, family wage income, forest product planting area, attention to forestry technology, and forestry bureau subsidies significantly impact the development of the under-forest economy. Factors such as forest product prices, product quality, the risk of unsold products, supply of production materials, and forest product cooperatives have a weaker influence on the development of the under-forest economy. Based on these influencing factors, relevant suggestions are proposed to promote the development of the under-forest economy, providing a more scientific theoretical basis for the development of the under-forest economy in Heilongjiang Province.

Keywords: under-forest economy, influencing factors, Heilongjiang Province, coping strategies, multiple linear regression.

1. Introduction

With the continuous advancement of the collective forest rights reform, the contracting rights of forest land and the ownership of forest trees have been implemented to households through family contracting. This has achieved “defining the ownership of mountains, stabilizing the roots of trees, and reassuring the people,” enhancing operational efficiency, activating forest resources, and unleashing development potential. Heilongjiang Province is a major forestry province in China, with abundant forest resources, making it highly suitable for developing the under-forest economy. The province’s forest area covers 20.12 million hectares, with a forest coverage rate of 44.47%, and a forest stock volume of 2.158 billion cubic meters. Developing the under-forest economy is an effective way to improve the utilization rate of forest resources, promote the development of characteristic industries, create jobs, increase income, and advance agricultural modernization, thereby achieving rural revitalization.

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In terms of basic research on the under-forest economy, Wu Juan et al. [1] believe that the under-forest economy relies on forest land resources and the ecological environment, focusing on under-forest planting, under-forest breeding, forest product processing, forest landscapes, and forest tourism. It is a three-dimensional composite economy and an important part of the agricultural and rural economy. Pu Wenbin et al. [2] argue that the development of the under-forest economy significantly improves the utilization efficiency of forest land, increases the comprehensive economic value of the forest industry, improves the ecological environment of forests, effectively protects biodiversity, and actively cultivates new green industries, thus promoting farmers' income and rural revitalization. Zhang Jiping [3] points out that current problems in the development of the under-forest economy include insufficient mastery of science and technology and knowledge, inadequate overall planning, insufficient market information flow, and inadequate financial support. Regarding development strategies, Ling Yue [4] suggests conducting reasonable and scientific planning and design, promoting policy support, exploring suitable development models, and continuously extending the industrial chain of the under-forest economy. In research on influencing factors, Wang Zi et al. [5], based on sample characteristics and factor correlation, use factor analysis for modeling and believe that industrial clustering, local policies and laws, and knowledge innovation are the main factors influencing the development of the under-forest economy. Lin Chaoren et al. [6], through the use of CiteSpace for visual literature analysis, find that financial and fiscal support, the construction of forestry talent teams, and the scale of industrial development significantly impact the development of the under-forest economy.

In summary, some scholars have conducted multi-dimensional and multi-perspective discussions and research on the concept, significance, existing problems, strategies, and influencing factors of the under-forest economy. However, due to the limited scope of research cases and subjects, there are gaps in the selection of empirical analysis indicators, and classifications are not clear enough. Additionally, few studies combine real-time survey data to specifically analyze the influencing factors of the under-forest economy development in a particular region, lacking targeted countermeasures. This paper addresses these issues and, using data from the National Forestry and Grassland Administration, analyzes the influencing factors and development strategies of the under-forest economy in nine prefecture-level cities and one region in Heilongjiang Province, aiming to expand and supplement the current research scope.

2. Overview of the Study Area

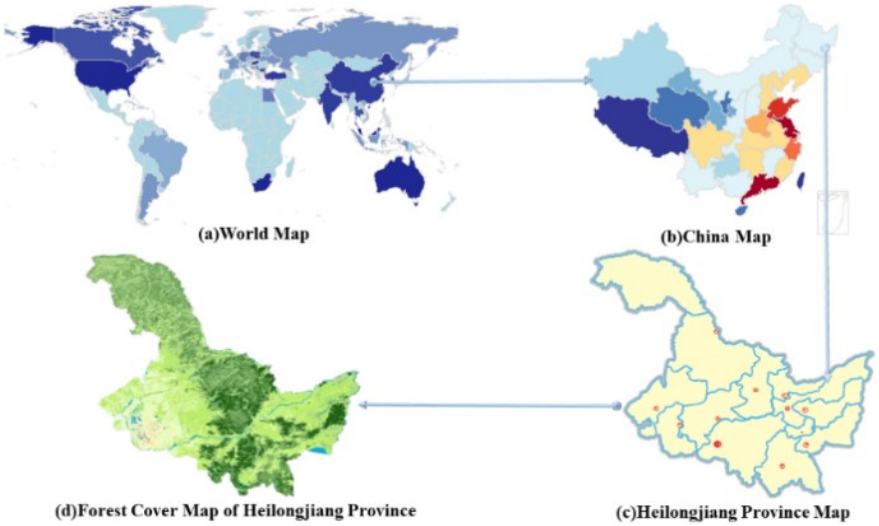

Figure 1: Maps of the study area

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Figure 1(a) shows the world map, Figure 1(b) shows the map of China, Figure 1(c) shows the map of Heilongjiang Province, and Figure 1(d) shows the forest coverage map of Heilongjiang Province. From these maps, it can be observed that Heilongjiang Province is located in the northeastern part of China, at the northernmost position and the highest latitude. The province is composed of mountains, plateaus, plains, and water surfaces, with high terrain in the northwest, north, and southeast, and low terrain in the northeast and southwest. The province is rich in natural resources, with forestry operations covering about two-thirds of the total area. Heilongjiang Province comprises 12 prefecture-level cities, 1 region, 21 county-level cities, and 67 counties (cities). Influenced by its geographical location, the output value of the under-forest economy in Heilongjiang Province has grown rapidly, with a compound annual growth rate of 34.29% from 2018 to 2022. This growth has significantly contributed to increasing employment opportunities for farmers and enhancing the income of forest area workers and residents.

3. Data Sources and Sample Characteristics

3.1. Data Sources

The data for this study were collected from April to May 2024 by a survey team composed of teachers and students from the School of Economics and Business Administration of a university. The survey investigated the basic situation of forest farmers' households and their under-forest management in different forest areas of Heilongjiang Province. Stratified random sampling was used to select the survey samples from Harbin, Qiqihar, Jixi, Heihe, Daqing, Yichun, Jiamusi, Mudanjiang, Suihua, and Daxing'anling Region in Heilongjiang Province. A total of 180 questionnaires were distributed, 160 were returned, and 124 valid questionnaires were obtained, with an effective rate of 68.89%. Table 1 shows the distribution of valid samples by location.

Table 1: Regional distribution of sample forest farmers

City (region)	Forestry bureau	Sample/House-hold	City (region)	Forestry bureau	Sample/Househ-old
Harbin City	Harbin Forestry and Grassland Bureau	30	Yichun City	Yichun Forestry and Grassland Bureau	12
Qiqihar City	Qiqihar Forestry and Grassland Bureau	15	Jiamusi City	Forestry and Grassland Bureau of Jiamusi City	8
Jixi City	Forestry and Grassland Bureau of Jixi City	12	Mudanjiang City	Mudanjiang Forestry and Grassland Bureau	11
Heihe City	Forestry and Grassland Bureau of Heihe City	15	Suihua City	Suihua Natural Resources Bureau	6
Daqing City	Daqing Forestry and Grassland Bureau	11	The Greater Khingan Mountains region	Forestry and Grassland Bureau of the Administrative Office of the Greater Khingan Mountains Region	4

DOI: 10.54254/2754-1169/119/20242552

3.2. Sample Characteristics

Due to the extensive scope of the under-forest economy, this study primarily focuses on under-forest planting. The survey content is mainly divided into the basic situation of forest farmer households, household income, under-forest production and management, financial and technical issues, and product sales issues. This paper selects 11 key data points from three aspects: individual characteristics of forest farmers, forest product management and sales, and external policy environment (Table 2). Additionally, some basic characteristics of the sample are analyzed (Table 3).

Table 2: Selection of Indicators

Indicator type	Evaluation type	variable
Individual characteristics of forest farmers	Number of household labor force	X_1
	Family wage income	X_2
	Planting area of forest products	X_3
	Attention to forestry technology	X_4
	Whether to join the cooperative	X_5
Management and sales of forest products	Selling price of forest products	X_6
	Forest product quality	X_7
	Will the product remain unsold	X_8
	Production material supply issues	X_9
External policy environment	Do you understand the subsidy policies for understory economy	X_{10}
	Whether to apply for subsidies	X_{11}

Table 3: Basic characteristics of samples

Project	Index	Frequency	Proportion (%)
Number of household labor force/person	1	23	18.55
	2	61	49.19
	⩾3	40	32.26
Household wage income/yuan	⩽10000	16	12.9
	10000<X⩽30000	74	59.68
	30000<X⩽50000	32	25.81
	>50000	2	1.61
Planting area of forest products/mu	⩽2	26	20.97
	2<X⩽5	56	45.16
	>5	42	33.87
Development model	Forest mushroom pattern	27	23.48
	Forest medicine mode	58	50.43
	Forest vegetable mode	30	26.09

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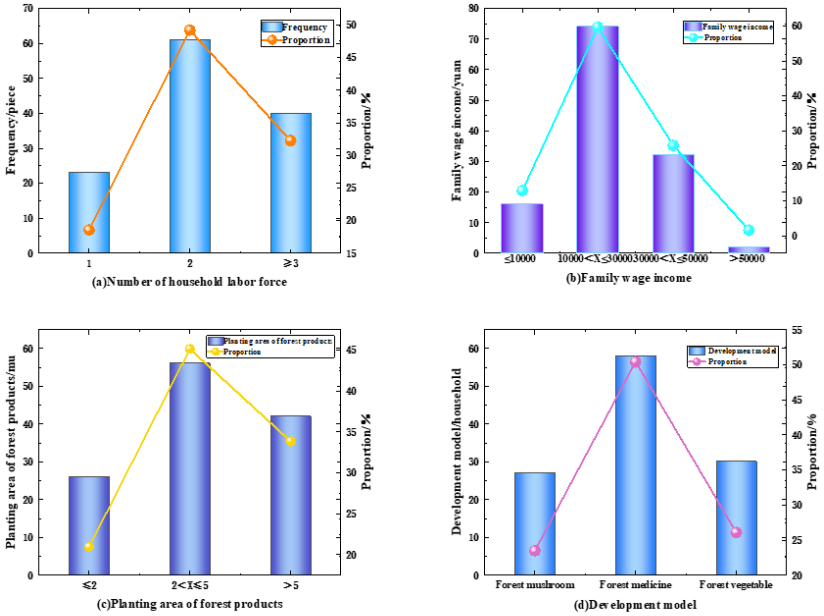

Figure 2: Basic characteristics of the sample

Figure 2(a) shows the number of household laborers, Figure 2(b) shows the household wage income, Figure 2(c) shows the under-forest planting area, and Figure 2(d) shows the development models. Among the 124 sample forest farmer households, 27 have an educational level of primary school or below, 39 have a junior high school education, 41 have a high school (including vocational school) education, and 17 have an education level of college or above. The percentage of those with a high school education or above is 46.77%. All 124 households are involved in the under-forest economy, with some developing a single model and most engaging in multiple models simultaneously. About 81.45% of households have two or more laborers. In terms of annual household wage income, forest farmers generally have low income with significant disparities, averaging about 11,938.5 yuan. More than half of the sample forest farmers have an income of less than 20,000 yuan. The low income is attributed to the small number and low quality of laborers, while higher income is due to supplementary engagement in industrial and commercial activities. There is a wide range in the planting area, from a minimum of 1 mu to a maximum of 13 mu, indicating varied levels of development. Most forest farmers are involved in under-forest planting, mainly using forest-fungus, forest-medicine, and forest-vegetable models. The forest-medicine model is the most favored, accounting for over 50% because of its low cost and low risk. As market demand for high-quality food increases, more forest farmers are engaging in under-forest planting, leading to improved quality of forest products.

4. Empirical Research

4.1. Model Establishment

Based on the survey data and sample characteristics analysis, it can be preliminarily analyzed that the development of the under-forest economy by forest farmers in Heilongjiang Province is influenced by various factors. This means that a dependent variable is affected by several independent variables, making multiple linear regression analysis appropriate. This paper describes the influencing factors of the development of the under-forest economy in Heilongjiang Province from the perspective of the

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income of forest farmer households engaged in under-forest management and establishes a multiple linear regression model with the following structure:

$$Y = \beta_0 + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + X_6\beta_6 + X_7\beta_7 + X_8\beta_8 + X_9\beta_9 + X_{10}\beta_{10} + X_{11}\beta_{11} + \mu$$

Where Y is the dependent variable representing the income (in yuan) of forest farmer households from under-forest management; X_1 to X_{11} represent each independent variable; β_0 is the constant term; β_1 to β_{11} represent the regression coefficients of each factor; and μ is the random error term, representing factors that are difficult to quantify and have a minor impact.

The specific statistical characteristics of the variables are shown in Table 4. Other factors affecting the profitability of the under-forest economy, such as management level, economic management system, and social services, also impact the income of forest farmers but are not easily quantifiable and, therefore, not well represented in the model. Additionally, since the products managed by forest farmers in the under-forest economy rarely involve processing, this factor is also not considered in the model.

Table 4: Descriptive statistics of variables

variable	Variable Description	Mean value	Standard deviation
Number of household labor force (X_1)/ person	Continuous variable	2.043	0.769
Household wage income (X_2)/ yuan	Forestry bureaus, enterprises and institutions, working or part-time, and individual industrial and commercial operations; continuous variable	11938.5	13430.6
Planting area of forest products (X_3)/mu	Continuous variable	4.73	2.69
Attention to forestry technology (X_4)	1=not following, 2=occasionally following, 3=frequently following; Dummy variable	2.07	0.714
Whether to join the cooperative (X_5)	0=No, 1=Yes; Dummy variable	1.48	0.5
Selling price of forest products (X_6)/(yuan · kg^{-1})	Forest product sales prices, continuous variables	30	13.81
Forest product quality (X_7)	0=average,,1=high-quality;Dummy variable	1.44	0.497
Will the product remain unsold (X_8)	0=No, 1=Yes; Dummy variable	1.45	0.498
Production material supply issue (X_9)	0=no problem, 1=there is a problem; Dummy variable	1.36	0.481
Understand the subsidy policy for understory economy (X_{10})	0=No, 1=Yes; Dummy variable	1.24	0.433
Whether to apply for subsidies (X_{11})	0=No, 1=Yes; Dummy variable	1.44	0.497
Household understory operating income (Y)/ yuan	Continuous variable	18207.5	14937.6

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4.2. Regression Analysis

Based on the valid data provided by the questionnaire, multiple linear regression analysis was performed using Eviews software, with the results shown in Table 5. The Eviews regression analysis results indicate that R^2= 0.654, suggesting a high goodness-of-fit for the regression model. The F-value is 19.243, with a significance level of 0.000, indicating that all explanatory variables have a significant linear impact on the dependent variable Y. However, the significance of each individual variable varies.

Table 5: Estimation results of regression model for the influencing factors of understory economy

Variable	**Correlation coefficient**	**Standard error**	**Variable**	**Correlation coefficient**	**Standard error**
(Constant)	-24040.193	9165.463	Selling price of forest products (X_6)/(yuan · kg^{-1})	376.378*	1381.662
Number of household labor force (X_1)/ person	3289.349***	1629.743	Forest product quality (X_7)	531.777*	1934.219
Household wage income (X_2)/ yuan	0.317***	0.077	Will the product remain unsold (X_8)	-1275.114	1743.082
Planting area of forest products (X_3)/mu	2329.799***	161.169	Production material supply issue (X_9)	-3367.020	1829.027
Attention to forestry technology (X_4)	3856.685***	1346.508	Understand the subsidy policy for understory economy (X_{10})	418.875*	1978.001
Whether to join the cooperative (X_5)	-7640.318	2399.558	Whether to apply for subsidies (X_{11})	6367.789***	2007.544
R^2	0.654		F − statistic	19.243(Sig = 0.000)	

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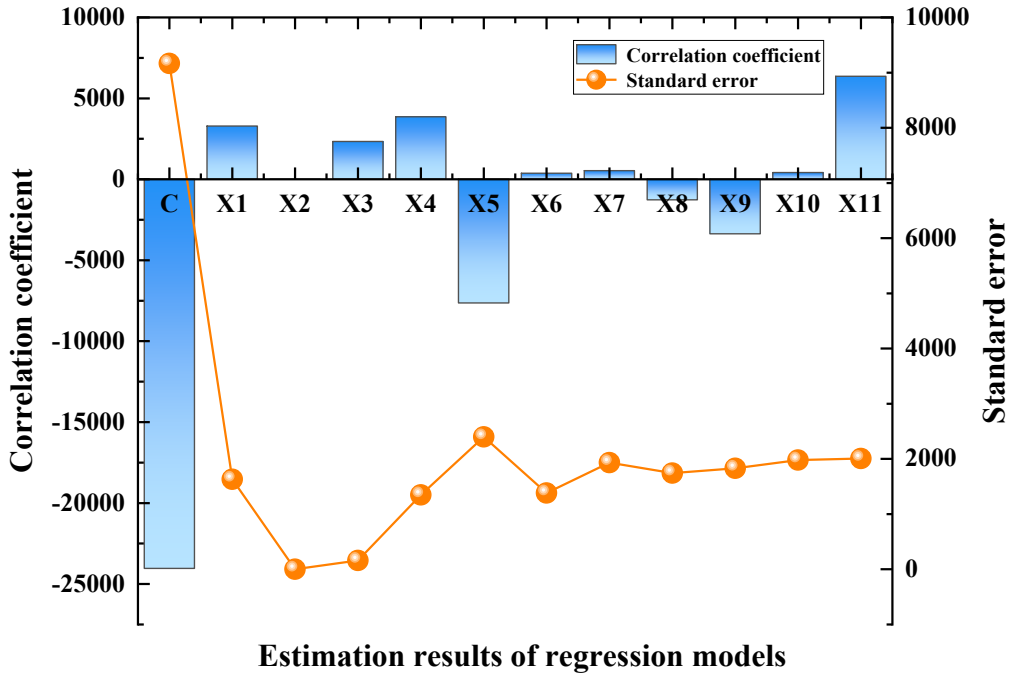

Figure 3: Estimation results of regression models

In multiple linear regression, a significant regression equation does not necessarily mean that each independent variable has a significant impact on Y. In Table 5, the significance of variables X_5 to X_{10} is weak. Generally, cooperatives have a positive impact on the development of the under-forest economy. However, there are currently few cooperatives in forest areas, with limited participation from sample forest farmers and weak cooperative awareness, resulting in weak significance. Typically, higher product quality leads to higher prices, but the demand for forest products is relatively stable, with weak brand effects and low price elasticity, so the impact is not significant. The supply of production materials and unsold products are negatively correlated with under-forest management income, but due to the specificity of the products, the impact is not significant. The subsidy application process is complex, making it difficult and costly for forest farmers to obtain subsidies. The regression results show that the number of household laborers, wage income, planting area, attention to forestry technology, and subsidies from the forestry bureau have significant and positive impacts on under-forest management income. Among these, planting area has the greatest impact, as scaling up operations can reduce costs and increase income. An increase in household wage income promotes growth in under-forest economy income. The number of laborers also has a positive correlation with under-forest economy income. Forest farmers who pay attention to developments in forestry technology tend to expand their business scope, increase market opportunities, and improve income. Subsidies from the forestry bureau represent government support, and increasing subsidy amounts and relaxing application conditions can help develop the under-forest economy.

Although there may be errors in the regression model analysis results that need improvement, the findings of this study's regression model analysis align with most people's experiential intuition.

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5. Conclusion and Policy Recommendations

5.1. Conclusion

Based on the analysis of influencing factors, this study finds that the development of the under-forest economy in Heilongjiang Province has shown initial results but still faces the following issues: the plots of land used by forest farmers for under-forest economy are small and fragmented, not reaching a sufficient scale; there is limited use of new technologies in the management process, and information flow among forest farmers is poor during sales; there are few forest product cooperatives and their development is inadequate, with weak willingness among forest farmers to participate in cooperatives; and there is insufficient publicity and implementation of subsidy policies from the forestry bureau.

5.2. Policy Recommendations

Based on the descriptive statistics and multiple regression analysis results, the following recommendations are proposed:

(1) Concentrate Land for Scaled Operations: The government should provide policy support and assistance to ensure that forest farmers can effectively utilize resources and achieve scaled operations in the under-forest economy. (2) Increase Technological Investment and Establish Information Platforms: Utilize the internet to establish platforms for sharing information and expanding sales channels. Enhance technological support to improve production efficiency. (3) Increase the Number of Cooperatives and Boost Forest Farmers' Participation: The government should encourage the establishment of cooperatives by providing financial and technical support. Collaborating within cooperatives can reduce costs and increase income for forest farmers. (4) Enhance the Promotion of Under-Forest Economy Subsidy Policies: Increase the amount of subsidies and simplify the application process. The government should introduce policies to raise subsidies, streamline procedures, and strengthen publicity and supervision to provide better services for forest farmers.

References

[1] *Wu, J., & Chen, J. (2022). Under-forest economy and high-quality agricultural development: Coupling logic and implementation pathways. Journal of Northwest A&F University (Social Sciences Edition), 22(4), 153-160. https://doi.org/10.13968/j.cnki.1009-9107.2022.04.16*

[2] *Pu, W., & Feng, H. (2022). Research on the high-quality development path of the under-forest economy in Guizhou Province under the background of rural revitalization. Productivity Research, (7), 45-49+161. https://doi.org/10.19374/j.cnki.14-1145/f.2022.07.003*

[3] *Zhang, J. (2021). Current situation and countermeasures for the development of the under-forest economy industry. Southern Agriculture, 15(26), 50-51. https://doi.org/10.19415/j.cnki.1673-890x.2021.26.024*

[4] *Ling, Y. (2018). A brief discussion on the current situation and countermeasures for the development of the under-forest economy in China. Shanxi Agricultural Economics, (15), 60. https://doi.org/10.16675/j.cnki.cn14-1065/f.2018.15.035*

[5] *Wang, Z., Zhang, P., & Quan, L. (2018). Research on the influencing factors of the under-forest economy industrial cluster development in Heilongjiang Province. Forestry Economics, 40(8), 61-67. https://doi.org/10.13843/j.cnki.lyjj.2018.08.012*

[6] *Lin, C., & Zhang, H. (2023). Research on the influencing factors of the development of the under-forest economy industry in Heilongjiang Province: A visual analysis based on CiteSpace. Forestry Exploration and Design, 52(2), 63-66.*