Research on forestry labor input measurement and forestry industry development in China

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Abstract

Purpose – At present, China's forestry development is mainly driven by the traditional production factors such as forestry labor force, land resources and capital and thus the top priority of forestry development is to optimize forestry production factors. Scientific and effective forestry labor input has a significant role in promoting the development of forestry industry. Given that the actual input to forestry labor is not clear, the accuracy of the forestry industry development may be slightly affected. Based on the monitoring project of collective forest tenure reform (RCFT), this paper uses the survey data of 3,500 rural households in seven provinces of China from 2010 to 2014 and 2016 to 2017 to measure the actual labor force in China, and empirically analyzes and studies the factors influencing the development of forestry industry based on the provincial data of forestry in China, and further discusses the heterogeneous impact of forestry production factors on the development of forestry industry.

Design/methodology/approach – In this paper, the generalized least squares estimation model is used to calculate the actual number of forestry labor in China, and then the Cobb–Douglas production function is selected to explore the influencing factors of forestry industry development.

Findings – The results show that the actual number of forestry labor force in China continues to decline and the degree of reduction varies from different regions. The forestry labor is a major factor that promotes the development of the forestry industry, but this promotion is affected by the low matching degree between the forestry production factors and thus further inhibits the development of the forestry industry. Due to the time lag of the reform, the implementation of RCFT first weakens and then promotes the development of forestry production. Further on, the forestry labor input is heterogeneous in land resource endowment, forestry investment source and the proportion of management personnel.

Originality/value – Therefore, researches show that the feasible way to promote the development of forestry industry is to expand the scale of forestry labor force, optimize the mutual allocation of forestry production factors, enhance the input of human capital in forestry and deepen the RCFT.

Keywords Forestry labour force, Forestry industry, RCFT

Paper type Research paper

1. Introduction

Ecological civilization is one of China's Five-sphere Integrated Plan. The report of the Party's 20th Congress points out that in promoting green development and promoting harmonious coexistence between man and nature, we must firmly establish and practice the concept that lucid waters and lush mountains are invaluable assets, and plan development from the height of harmonious coexistence between man and nature. Forestry industry is an important driving force to transform lucid waters and lush mountains into invaluable assets, an important carrier of ecological civilization construction, and the foundation of transformation to green economy. The high-quality development of forestry industry has become the key theme of China's

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forestry development. Under the existing resources constraints, the effect of relying on extensive growth model such as increasing forest land and capital investment is too limited, and from the perspective of the most active labor factors, we should increase the actual amount of labor, improve its effects in forestry industry development and further provide theoretical basis for the high quality of forestry economy development and decision-making process.

At present, the statistical indicators of forestry labor force used in forestry provincial studies mainly adopt the indicator of "the number of employees in forestry system at the end of the year" in the *China Forestry and Grassland Statistical Yearbook*, which only counts forestry labor force in forestry enterprises, institutions and agencies within the forestry system in China. In 2008, there is a new round of RCFT in the collective forest area, imposing a certain impact on the scale of forestry labor. The actual forestry labor scale is not yet clear. At present, the impact of "the number of employees in the forestry system at the end of the year" on the industrial development is not accurate enough, which may have a certain impact on the policy formulation of the relevant departments. In addition, there are few studies on the quality of forestry labor force. According to *China Forestry and Grassland Statistical Yearbook*, professional and technical personnel accounted for less than 25% of the forestry system in 2018 and the internal structure of forestry industry system is unreasonable; in 2018, the average annual salary is 58,420 yuan, which bears no attraction to young talents. The aging problem in the industry is serious. Forestry labor force is crucial to forestry development, and accurate estimation of China's forestry labor force is the focus of this paper.

2. Literature review

There are not many academic researches on the actual scale of forestry labor force. In the existing relevant literature on the estimation of the actual amount of forestry labor force, scholars have different opinions on the determination of the amount of forestry labor force. Some scholars try to use "the number of employees in forestry system at the end of the year" to represent the input of labor in forestry industry (Lai and Zhang, 2008; Tian and Xu, 2012; Pei, 2021). Although it is more available and accurate to use the number of employees in forestry system to reflect the input of labor in forestry, it is still quite difficult to predict the actual number of forestry labor force. In some studies, some calculations were added to the index of forestry labor force. The more common one is using the total agricultural labor force to get the number of forestry labor force according to the proportion of the forest output value in the agricultural output value. Wu *et al.* (2007), for example, in the study of contribution rate of forestry in science and technology progress of Guangdong province, Yang (2010) in China forestry total factor productivity research, using agricultural output, forestry output and agricultural labor quantity conversion gets the quantity of the forest labor input. In addition, combining with the industry sector of forest labor force, he calculated the input index of forestry labor. Cao and Wang (2012) obtained the forestry social labor force according to the year-on-year conversion of Hunan's total agricultural output value, the total output value of forestry and the number of agricultural labor force.

As an important production factor, the relationship between forestry labor and forestry development has received extensive attention from academics, and the development of forestry industry is closely related to labor input. From the perspective of human capital distribution structure, scholars use the panel data model and time series model of different countries to draw the conclusion that human capital structure is not conducive to economic growth (Fleisher *et al.*, 2009; Zhou *et al.*, 2021; Zeng *et al.*, 2022). Chinese scholars' research on forestry labor force focuses on the number of labor force and the influence of human capital on forestry development. From the perspective of labor force quantity, Cao *et al.* (2021) believe that forestry labor force is the key to the optimization and upgrading of forestry industry, and human capital significantly positively affects the development of forestry industry. Wei and Ren's (2000) research indicates that labor force quantity, labor quality, labor behavior and labor resource allocation are all labor drivers that affect forestry production efficiency. Tian and Guan (1995) applied the growth rate equation to analyze the labor factors and figured out that the contribution of the labor factors to the forestry economic growth reached 28.6%. From the perspective of human capital, Wei *et al.* (2019) pointed out that forestry human capital plays a significant role in promoting forestry economic growth, and the population quantity tends to weaken in effect, and the dividend effect of human capital gradually enhances. Liu *et al.* (2021) pointed out that the level of forestry human capital in each region can promote the convergence of regional forestry total factor productivity. Therefore, it is necessary to increase human capital and foreign investment to enhance the professional and systematic construction of talent teams. Yang *et al.* (2015) used systematic cluster analysis to study and found that forestry human capital is conducive to significantly promoting the regional ecological economy.

This paper focuses on measuring the number of forestry labor force in collective forest areas, estimating the actual size of China's forestry labor force, providing basic data support for subsequent forestry provincial studies, and conducting analysis of the factors influencing forestry industry development and research on the interaction effects of forestry production factors on forestry industry development. Based on the research data of RCFT, this study constructs a functional model of forestry labor force quantity, scientifically estimates the actual quantity of China's forestry labor force, fills the gap of inaccurate forestry labor force data, and provides reference for decision-making of relevant departments, which is highly innovative. This paper includes four parts, the second part is the calculation of the actual forestry labor force; the third part is the impact of the actual forestry labor force on the development of the forestry industry analysis; and the fourth part is the conclusions and suggestions.

3. Calculation of China's forestry labor force

3.1 Calculation method and model setting

At present, there are few studies on the measurement of forestry labor force, and the research on the measurement methods of labor force in the agricultural field mainly focuses on the measurement of rural surplus labor force. A survey of relevant research results shows that the estimation methods mainly include the per capita cultivated land method, the production function method, the workday calculation method and the output value proportion method. The estimation results of different methods are different (Table 1). Based on the characteristics of forestry industry, this paper calculates the amount of forestry labor force, which includes forestry labor force in collective forest areas and forestry labor force in state-owned forest areas. Among them, the number of labor force in collective forest areas is estimated by building a panel data model. The number of forestry labor force in state-owned forest areas is expressed by "the number of employees in the forestry system at the end of the year" in the *China Forestry and Grassland Statistical Yearbook*. The sum of the two is the amount of forestry labor forces in China.

Forestry has three major benefits: economic, ecological and social. As the main construction of China's ecological civilization and the basic industry of the national economy, forestry not only plays an important role in providing a good ecological environment, promoting economic growth, and promoting farmers' income but also provides jobs and increases social employment. Only when forestry achieves high-speed and high-quality development can it absorb more labor. According to Western economic theory, the three factors of production, capital, labor and land play an important role in economic development.

Table 1. Labor force estimation methods

Estimation method	Description	Model	Advantages and disadvantages	References	Adopt or not
Per capita cultivated land method	It is a method to estimate the demand for agricultural labor force according to the area of cultivated land that is affordable for each worker in the area to be assessed	Number of agricultural labor force = total cultivated land area/average cultivated land area borne by each labor force	The calculation is simple, but it can only calculate the number of labor force in the primary industry, and the dynamics of the arable area burdened by labor on average changes significantly as mechanization increases	Zhang (2019)	No
Output value proportion method	Assuming that the labor productivity of the agricultural industry is equal to the social productivity, the current agricultural labor quantity is estimated by the total social labor quantity and economic development level	Number of agricultural labor force = agricultural added value/(GDP/total social labor force)	Indicators are easy to obtain, but agriculture and forestry are weak industries, and the output value created by labor is not equivalent to that of secondary and tertiary industries	Wang and Zhao (2016)	No
Man-day calculation method	The labor demand is calculated by calculating the ratio of total labor man-days to full employment working hours	Number of agricultural labor force = sum of man-days required for production of various crops/full employment working hours of the year	This method has clear calculation connotation and small error, but the calculation amount is large and the calculation method is complex, and it is necessary to investigate the labor consumption of all crops, and the operability is poor	Sun and Huo (2019)	Yes
Production function method	Based on the production function model, the actual labor force required under the optimal allocation of capital and labor is determined according to the goal of maximizing income in the economic system	Build production function Number of labor force = F (land factor, labor factor, capital factor, other influencing factors)	This method has good coherence, but you need to overcome the limitations of the production function itself	Shi and Shi (2021)	Yes

Based on this, this paper uses the Cobb–Douglas production function that reflects the input–output relationship, and its function form is

$$Y = AK^{\alpha}L^{\beta} \tag{1}$$

Among them, Y refers to the level of forestry development in collective forest areas; A refers to technological progress; L refers to the input labor factor, that is, the amount of forestry labor, and K refers to the input capital factor.

In the traditional Cobb–Douglas production function, the relevant control variables are introduced and the terms are shifted to obtain the following model:

$$\ln(labor) = \beta_1 \ln(fi) + \beta_2 \ln(Y) + \beta_3 \ln(fa) + \beta_4 frate + \beta_5 \ln(rgdp) + \varepsilon_{it} \tag{2}$$

In the above formula, *labor* refers to the amount of forestry labor force (unit = 10,000 persons) in collective forest areas, which is calculated through the survey data of RCFT; *fi* refers to the completion of forestry social capital investment (unit = 100 million yuan); Y refers to the level of forestry development, expressed by the gross domestic product of the primary forestry industry in collective forest areas (unit = 100 million yuan); *fa* refers to the land element, which is accumulated by the unit forest area of the collective forest area (unit = cubic meter/hectare); *frate* refers to natural resource endowment, expressed in forest cover (unit: percentage); and *rgdp* refers to the level of regional development, which is reflected in per capita GDP (unit = 10,000 yuan). β_i refers to the elastic coefficient of the corresponding variable and ε_{it} refers to a random perturbation term.

3.2 Sample data source

This paper uses the survey data of RCFT from 2010 to 2014 and 2016 to 2017 for empirical analysis. In order to fully understand the progress of RCFT, the National Forestry and Grassland Administration conducted a follow-up survey in seven sample provinces of Yunnan, Jiangxi, Hunan, Gansu, Fujian, Liaoning and Shaanxi, and randomly selected ten counties from each sample province, five sample villages in each sample county and about ten rural households in each village. Each year, the sample data includes 70 sample counties, 350 villages and about 3,500 households. In order to ensure information integrity, meet the data requirements of efficiency measurement and eliminate the influence of outliers, the total sample observation value is 24,094 (as shown in Table 2). There are great differences in resource conditions and economic development levels among the sample provinces, and the basic conditions for forestry farmers to carry out forestry production and operation are also different, which are representative in the country.

The data on the completion of forestry social capital investment, the gross domestic product of forestry primary industry, forest coverage rate and GDP per capita involved in the study are all from the statistical yearbooks of previous years. Among them, the completion of forestry investment and the GDP of forestry primary industry come from the "*China Forestry and Grassland Statistical Yearbook*", the forest area and forest coverage rate come from the "*China Forest Resources Inventory Report*" and the GDP per capita comes from the "*China Statistical Yearbook*". The completion of forestry social capital investment, the gross domestic product of forestry primary industry and GDP per capita were all handled at constant prices in 1998.

3.3 Estimation of the number of labor force in the sample provinces

Forestry production has the characteristics of long cycle, and the difference in labor input in production and operation is small among different tree species. This paper draws on the daily labor measurement algorithm in the agricultural field: the first step is to obtain the average labor days input per mu in the sample province, and the labor days input of the collective forest area is obtained through the forest area of the collective forest area. The second step is to calculate the number of forestry labor in the sample provinces. Under the current labor productivity, the formula for calculating the number of forestry labor force in collective forest areas is as follows:

$$\text{Number of forestry labor force in the sample provinces} = \frac{\text{Total man} - \text{day input of sample provinces}}{\text{Full employment working hours of the year}} \quad (3)$$

In this formula, the full employment period is 250 days throughout the year. That is, assuming a five-day working week for each labor, plus statutory holidays, the actual man-days are about 250 days.

3.3.1 Estimation of man-day input per mu in sample provinces. The total input of household labor days in the sample province is divided into the input of household labor days and the input of hired labor days, and the total household labor expenditure is divided into household labor expenditure and hired labor expenditure, which are summed up, respectively, to obtain the total input of household man-days, (unit: man-day) and total labor expenditure (unit: yuan). In the data processing, it is found that a small number of farmer households have nonzero forest land area and household labor expenditure behavior, but the survey data of man-days are missing. The man-day input level estimates and supplements missing values. The specific calculation process is as follows:

(1) Calculation of the village average unit man-day expenditure (yuan/man-day)

By taking the village as a unit, add up the total labor input (unit: man-day) and total man-days expenditure (unit: yuan) of peasant households, and divide the two to calculate the average unit man-day expenditure (yuan/man-day) of the village, that is,

$$\text{Average unit man} - \text{day expenditure} = \frac{\text{Total man} - \text{days expenditure of all peasant household}}{\text{Total labor input}} \quad (4)$$

(2) Supplementary estimated missing value of total household labor day input

	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014	Year 2016	Year 2017	Total
Yunnan	499	489	504	500	500	499	500	3,491
Jiangxi	491	498	591	500	503	502	508	3,593
Hunan	150	441	491	500	500	500	500	3,082
Gansu	502	500	509	500	500	500	500	3,511
Fujian	491	473	469	500	498	501	501	3,433
Liaoning	483	479	534	500	498	489	498	3,481
Shanxi	500	500	503	500	500	500	500	3,503
Total	3,116	3,380	3,601	3,500	3,499	3,491	3,507	24,094

Source(s): Monitoring Project of China's Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration

Table 2.
Sample data table (unit: household)

The total household labor input (unit: man-day) can be obtained by dividing the total household man-day expenditure (unit: yuan) and the village average unit man-day input (unit: yuan/man-day), and the missing value is estimated and supplemented, that is,

$$\text{Total household man} - \text{days input} = \frac{\text{Total household labor input}}{\text{The village average unit man} - \text{day input}} \tag{5}$$

(3) Calculate the average man-day input per mu in the sample province

Calculate the total input of household man-days and the total area of forest land in the sample province from 2010 to 2014 and 2016 to 2017, respectively, and divide the two to get the average input of labor days per mu in the sample province (unit: man-day/mu), that is,

$$\text{Total input of man} - \text{days per mu of the sample province} = \frac{\text{Total input of household man} - \text{days of the sample province}}{\text{Total area of forest land of the sample province}} \tag{6}$$

3.3.2 Estimation results of labor force in collective forest areas of sample province. Multiply the average man-day input per mu of the sample provinces calculated above by the forest land area in the collective forest area to estimate the number of forestry labor in the collective forest area of the sample province, that is,

$$\begin{aligned}\text{Amount of collective forestry labor force} &= \text{Average man} - \text{day income per mu} \\ &\times \text{Forest land area in collective forest area}\end{aligned} \tag{7}$$

The calculation results are shown in Table 3, and it can be seen that on the whole, the labor input in China's collective forest areas has increased steadily, the amount of forestry labor force has continued to rise, and there are obvious regional differences. After RCFT, the labor input of farmers in the operation of forestry in collective forest areas in China has continued to increase, and the characteristics of forestry absorbing rural labor force are obvious. Among them, the labor input of forestry labor force in the central and eastern regions represented by Hunan, Liaoning and Fujian has increased year by year, and the amount of forestry labor force has increased significantly. The average labor input of forestry in Jiangxi and Shaanxi is 0.33 and 0.14 man-days per mu, and the number of labor force fluctuates and rises. In the southeast region, Fujian Province has the largest labor input in forestry, with more than 0.5 man-days per mu of forest land, and the degree of refinement of forestry management is enhanced.

Forestry has the characteristics of long production and management cycle, which causes the forestry labor input in individual provinces to show an insignificant increase or decrease trend in the survey cycle. There are certain fluctuations in labor input in the northwest region represented by Gansu Province, and the increase in labor force is not obvious. The labor input in the southwest region, represented by Yunnan Province, showed a downward trend, because the sample farmers in the southwest region managed a large area of forest land, and forestry management is realized through short-term forestry employment. In the early stage of forestry production, the afforestation area is large and requires a large amount of labor. However, the workload of tending in the middle and later stages is relatively reduced, and the consumption of forestry labor is correspondingly reduced. This also reflects the cyclical characteristics of forestry production.

Table 3. Table of the amount of labor and the average man-day per mu in the sample provinces

	Liaoning		Fujian		Jiangxi		Hunan		Yunnan		Shaanxi		Gansu	
	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person	Man-day Per mu	Labor Person
2010	0.299	11.227	0.723	37.620	0.415	23.592	0.406	28.832	0.677	83.627	0.151	8.156	0.378	8.641
2011	0.262	9.834	0.714	37.176	0.286	16.271	0.570	40.488	0.705	87.139	0.111	6.000	0.419	9.561
2012	0.299	11.206	0.706	36.732	0.319	18.150	0.586	41.633	0.679	83.949	0.118	6.379	0.415	9.476
2013	0.335	12.579	0.724	37.692	0.239	13.600	0.587	41.730	0.609	75.270	0.105	5.645	0.339	7.734
2014	0.409	14.482	0.876	44.881	0.258	14.505	0.541	38.226	0.584	68.598	0.160	8.389	0.424	9.552
2016	0.522	18.489	0.945	48.384	0.276	15.549	0.700	49.440	0.582	68.427	0.161	8.461	0.381	8.588
2017	0.544	19.281	0.946	48.448	0.497	27.979	0.621	43.833	0.581	68.256	0.172	9.006	0.403	9.070

Source(s): Monitoring Project of China's Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration

In this study, the amount of forestry labor force in the collective forest area of the sample province is taken as the explained variable, and the variables such as forestry investment completion, unit forest land area forest stock volume, forestry, primary industry GDP, forest coverage rate, GDP per capita and other variables are used as explanatory variables. Using these variables, a measurement model of the influencing factors of forestry labor force in collective forest area is constructed, and the model is used to clarify the correlation coefficient between forestry labor force and its influencing factors in collective forest areas in China. In order to eliminate heteroscedasticity and sequence autocorrelation, the generalized least squares method is used to make model estimation and improve the robustness of the estimation results, and the specific regression results are shown in Table 4. On this basis, the amount of forestry labor force in collective forest areas in China from 1998 to 2019 is obtained by model coefficient fitting.

From the regression results, the development level of forestry economy and regional resource endowment have a significant role in promoting forestry labor, and the influence of variable capital input and land input on labor input of production feature class is positive and significant. Among them, the elasticity of the gross output value of the primary forestry industry is 1.074. The higher the level of forestry economic development is, under the same conditions of other factors, every 1% increase in the gross output value of the primary forestry industry will increase the amount of labor force in collective forest areas by 1.074%. The significance of forest coverage at the significance level of 1% has a significant effect on the amount of forestry labor forces in collective forest areas, indicating that areas with high forest coverage have a stronger ability to absorb forestry labor. Forestry investment and forestry labor force input increased significantly in areas with larger forestry areas. It is worth noting that the regional economic development level has a certain negative impact on the number of forestry labor force in collective forest areas, and the elasticity coefficient is −1.179, which indicates that the return period of forestry production is long, forestry labor will flow to jobs with higher wage return rates, and the high regional economic development level will increase nonagricultural employment to a certain extent, which has a diversion effect on forestry labor in collective forest areas.

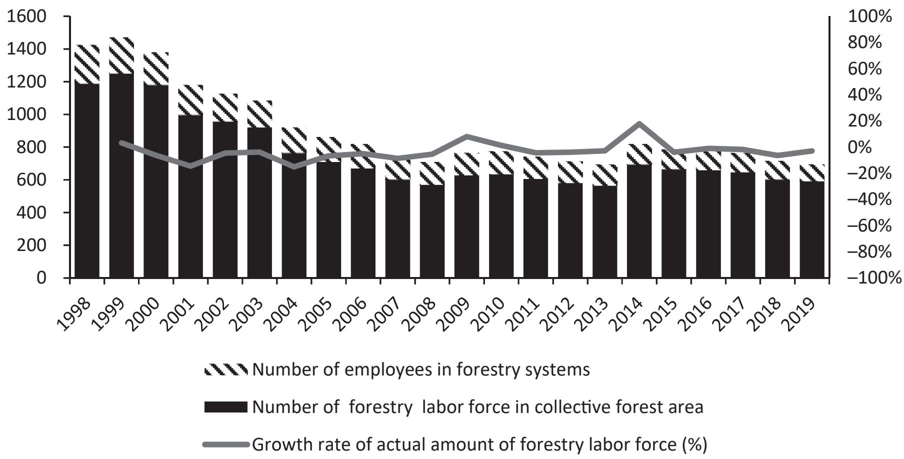
3.4 Characteristics of forestry labor force

3.4.1 The input of forestry labor gradually decreases, and the regional differences are obvious [1]. The total amount of forestry labor force in China shows a downward trend (in Figure 1). The amount of forestry labor force decreased from 14.2597 million in 1998 to 6.9579 million in 2019. In terms of time, it has obvious stage characteristics. From 1998 to 2007, the forestry labor force decreased year by year. During this period, China's Natural Forest Resources Protection Project began to be implemented. Natural forest cutting was stopped, and forest industry enterprises turned to forest management and protection. A large number of state-owned enterprises' forestry workers were transferred to other jobs, and the forestry labor force was significantly reduced. From 2008 to 2013, the total forestry labor force in China shows a trend of fluctuation and increase. In 2003, RCFT was piloted in Fujian, Jiangxi and other provinces, and fully implemented nationwide in 2008. This reform has enhanced the enthusiasm of forest farmers to participate in forestry management, absorbed more labor force to participate in forestry production activities, and the forestry labor force has increased significantly. From 2014 to 2019, the forestry labor force is basically stable, with a total of about 7 million people. With the full implementation of the second phase of the Natural Forest Resources Protection Project, in 2016, the cutting of natural commercial forests across the country was completely prohibited, the area of forest management and protection and the area of public

Variable type	Variable name	Index	Logarithm of forestry labor force
Variables of production factors	Capital element input	Ln (Forestry investment completion)	0.160* (0.084)
	Land element input	Ln (Unit forest land area forest stock volume)	0.887*** (0.137)
Variables of socio-economic factors	Development level of forestry economy	Ln (Gross output value of forestry primary industry)	1.074*** (0.096)
	Regional resource endowment	Forest coverage rate	1.794*** (0.420)
	Regional economic development level	Ln (GDP per capita)	−1.179*** (0.144)
		Constants	−5.804*** (0.607)

Note(s): ① N = 660; ② *** is significant at 1%, ** is significant at 5%, * is significant at 10%; ③ Standard error in parentheses

Table 4. Regression results of labor force estimation model in collective forest area



Source(s): ①Calculate by Monitoring Project of China's Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration; ②Forestry and Grassland Statistical Yearbook in China,1998-2019, the National Forestry and Grassland Administration

Figure 1. Forestry labor force and growth rate in China from 1998 to 2019 (unit: 10,000 persons)

ecological forests continued to increase, and the workload of forest protection and tending tended to normalize. At this stage, the amount of forestry labor force remained stable, showing a certain increase.

The development of China's forestry industry shows obvious regional differences. According to the tradition of the forestry system, this paper divides 30 regions into 6 regions: Northeast, North China, East China, Central South, Southwest and Northwest, and the amount of forestry labor input in China shows obvious regional differences. As shown in Figure 2, Central South and East China are located in the east of China. The main terrain is low hilly forest, with good water and heat conditions, high forest coverage, and the largest forestry labor force. The forest resources in the Northeast are mainly state-owned forest areas for ecological forestry. After the

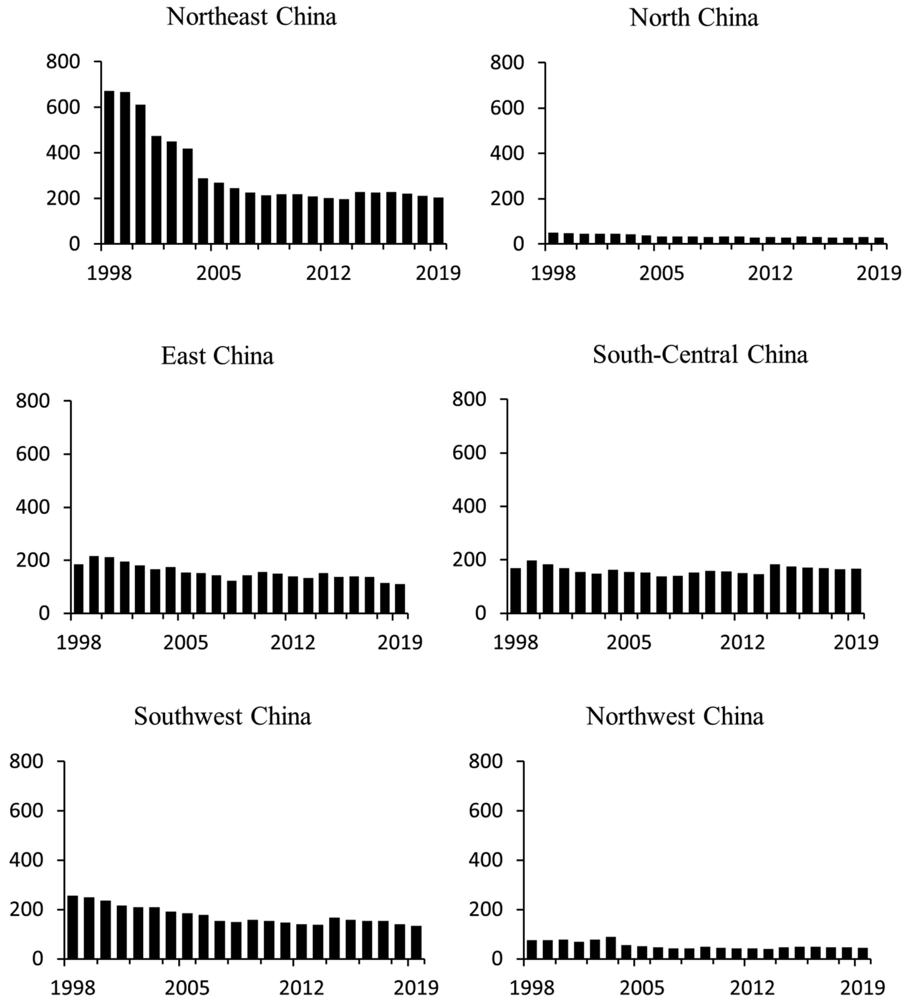


Figure 2.
Change in forestry labor force number by region from 1998 to 2019 (unit: 10,000 persons)

Source(s): ①Calculate by Monitoring Project of China's Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration; ②Forestry and Grassland Statistical Yearbook in China,1998-2019, the National Forestry and Grassland Administration

implementation of the second phase of the Natural Forest Protection Project (NFPP), the logging of commercial forests is completely prohibited, the labor force for types of work related to wood mining has been greatly reduced, and a large number of workers in the forestry system have been laid off and transferred after the reform of state-owned forest areas, the forestry labor force is relatively small. In Northwest China, the climate is dry all year round, the annual precipitation is small, the growth of forest resources is less, the distribution is not concentrated, and the scale of forestry labor input is the smallest. North China is located on a plain, densely populated, with a high level of social and economic development. The region attaches great importance to the social benefits of forestry, and the labor force grows steadily.

3.4.2 The amount of forestry human capital decreases, and the quality of labor force drops. As a high-quality labor force in the forestry industry, forestry system employees represent the level of forestry human capital (as shown in Table 5). From 1998 to 2019, the proportion of forestry system employees in forestry labor force decreased year by year, and the proportion of forestry employees decreased to less than 20% in 2014 and continued to decline. On the one hand, due to the reform of state-owned forest labor and the merger and reorganization of state-owned forest enterprises, a large number of employees have been laid off and transferred, and the forestry labor force has decreased; on the other hand, due to the low wage level of the forestry industry, the ability to absorb high-quality labor is constantly weakening.

4. Analysis of the influence factors of forestry industry development

4.1 Model construction and variable setting

Forest production activity is the process of allocation of production factors within the forestry system. It is influenced by various factors such as economic environment and social development, resource endowment, policy and system, etc. It is an economic process under the joint influence of internal environment and external environment. This paper is based on the influence of existing researches on the development of forestry industry and divided the influence factors into production factor variables, social and economic variables, and regional, policy dummy variables, mainly exploring the influence of the forestry labor force for forestry industry. This paper uses C-D production function that reflects the input–output relationship. The model is specifically expressed as follows:

$$Y_{it} = \beta_0 + \beta_1 Labor_{it-1} + \beta_2 Forestry_{it-1} + \beta_3 Social_{it-1} + \varepsilon_{it-1} \quad (8)$$

In formula, i represents the province and t represents the year. Y_{it} is the explained variable, *Labor* represents the amount of forestry labor force, *Forestry* is forestry production factor, *Social* is control variable in socio-economic area and ϵ_{it} represents random perturbation term. All explanatory variables are lagged by one stage, which can explain causality and solve endogenous problems to a certain extent. The following is a specific description of the indicator selection:

4.1.1 Explained variable. The explanatory variable in this paper is Y_{it}, which is expressed by the gross output value of forestry per capita and the value of primary, secondary and tertiary forestry industries per capita. The gross output value of forestry industry per capita is a visual representation of the quality of forestry industry development, therefore, the gross output value of forestry industry per capita is one of the explanatory variables in this paper.

Year	Amount of employees in forestry systems	Amount of forestry labor force	Proportion of employees in forestry systems (%)
1998–2003	195.067	816.223	23.899
2004–2008	147.250	659.998	22.311
2009–2013	134.390	624.411	21.523
2014–2019	115.172	608.939	18.914

Source(s): ① Calculated by Monitoring Project of China’s Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration; ② Forestry and Grassland Statistical Yearbook in China, 1998–2019, the National Forestry and Grassland Administration

Table 5. Changes in the number of forestry labor force in China during 1998–2019 (unit: 10,000 persons)

4.1.2 Explanatory variable. Labor is the key explanatory variable, the amount of forestry labor force calculated in the first stage and divided by the population number, i.e. the number of forestry labor force per capita.

Forestry indicates the investment and land in the forestry factors of production, measured by forestry investment per capita and forest land area per capita. The development of forestry industry is affected by the allocation between forestry production factors. In order to further explore the interaction between the variables of forestry production factors, the interaction term of production factors is introduced in the model.

The *Social* is the control variable. This paper includes three control variables: social economy, forestry policy and regional endowment. The control variables at the social and economic levels include forestry economic development, regional economic development and forestry industrial structure, which are expressed by the proportion of forestry gross output value in GDP and GDP per capita, respectively. The control variables at the forestry policy level include RCFT and the NFPP, which will indicate the significant policy of China's forestry state-owned forest area and the collective forest area. The measurement index is whether it is the nth year after RCFT and whether the NFPP is implemented. The control variables of regional endowment level are forestry resource endowment and regional dummy variables, which are expressed in the six common zones of forest system and forest coverage rate, respectively. The above variables related to value were all reduced according to the period of the local consumer price index based on 1998. Considering that the regional economic development level has a certain time lag for the industrial development, the lagging per capita GDP variable was used for regression.

Variable selection and data description are shown in Table 6.

4.2 Variant descriptive analysis

4.2.1 Increased output and optimized structure. As shown in Figure 3, from 1998 to 2019, the gross output value of the national forestry showed an increasing trend and showed a good development momentum. Since 1998, the gross output value of forestry has grown rapidly and the speed tends to slow down. The output value increased from 27.2845 million yuan to 7.62 trillion yuan in 2019, up nearly 27 times, with the annual average growth rate of around 5.54%, indicating that China's forestry has shifted from the wood production stage to a new stage of ecological protection. The output value of the three major forestry industries all increased significantly, the proportion of the primary industry decreased significantly, and the proportion of the output value of the secondary and the tertiary industry increased.

4.2.2 Significant capital investment and slowing speed-up. As shown in Table 7, from 1998 to 2019, the total forestry investment in all regions continued to grow. Nationwide, the average annual forestry investment in all regions increased from 8.372 billion yuan in 1998–2003 to 12.338 billion yuan in 2014–2019, an increase of nearly 47.38% (taking 1998 as the actual price). By region, the northeast and southwest regions are the most important areas of forestry capital investment. In contrast, the national investment in forestry in North China is the least, which only reaches 22% of the national average; followed by the northwest region. From the perspective of investment growth rate, the growth rate between 1998 and 2013 was around 16%, and the growth rate slowed down significantly from 2014 to 2019. The absolute amount of investment in central and southern China was relatively small, but the growth rate was at the forefront of the country, and the northeast region significantly reduced in the later period.

4.3 Empirical results and analysis

4.3.1 Baseline regression results and analysis. This paper used the generalized least squares estimation model based on the panel data, and the regression results are shown in Table 8. (1),

	Variable	Variable description	Unit	Mean	Std. dev.	Min	Max
Explained variable	Tp_per	Gross output value of forestry per capita	10^4RMB	0.037	0.033	0.002	0.271
	Tp1_per	Gross output value of primary forestry per capita	10^8RMB	0.026	0.024	0.002	0.234
	Tp2_per	Gross output value of secondary forestry per capita	10^8RMB	0.009	0.013	0	0.077
	Tp3_per	Gross output value of tertiary forestry per capita	10^8RMB	0.002	0.002	0	0.023
Core explanatory variable	Labor_per	Forestry labor force per capita	persons	0.005	0.004	0.01	0.029
Production factors explanatory variable	Rfi_per	Completed forestry investment per capita	10^4RMB	0.001	0.001	0.01	0.006
	Per_tfld	Forest area per capita	hm^2/person	0.003	0.004	0.02	0.019
Socio-economic factor variable	Rgdp	GDP per capita	10^8RMB	2.586	2.465	0.236	17.258
	Percent	The proportion of the forestry industry in GDP	%	2.182	1.611	0.064	8.947
	Frate	Forest coverage rate	%	0.313	0.179	0.029	0.668
Forestry policy variable	RCFT	Whether it is the year that carries RCFT	–	0.633	0.482	0	1
	NFPP	Whether to carry out the NFPP	–	0.532	0.499	0	1

Source(s): ① Monitoring Project of China's Collective Forest Tenure Reform, Economic Research Center, the National Forestry and Grassland Administration; ② Forestry and Grassland Statistical Yearbook in China, 1998–2019, the National Forestry and Grassland Administration. ③ China Forest Resources Report, 1999–2018, the National Forestry and Grassland Administration. ④ China Statistical Yearbook, 1998–2019, the National Bureau of Statistics of China. The same below

Table 6. Variable definition and descriptive statistic

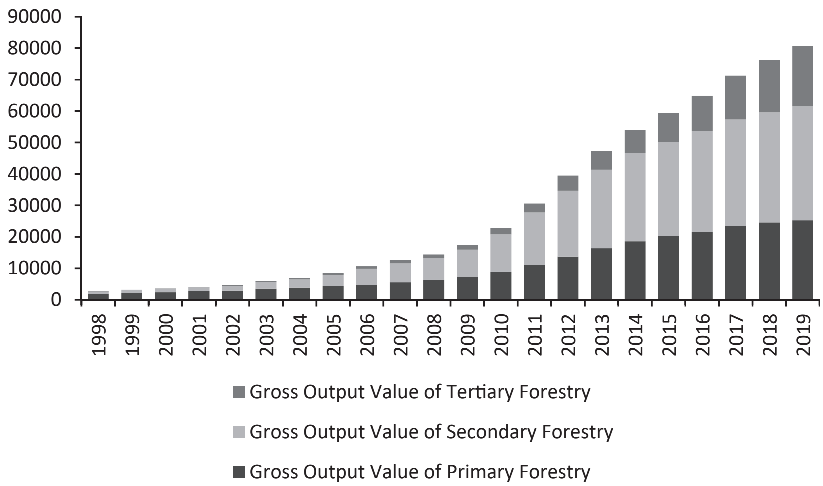


Figure 3. Stacked graph of China's forestry gross output value from 1998 to 2019 (unit: RMB 100 million)

(3), (5) and (7) only include the core explanatory variables of forestry labor force; (2), (4), (6) and (8) further add the variables of production factors, social and economic control variables, various production factors, and forestry policy variables, and control the regional heterogeneity at the regional level.

According to the panel data model, the explanatory variables and the explained variables were calculated with STATA16.0 software. The results are shown in Table 8, Prob > χ^2 was 0.000. All of the regression model was overall significant. The analysis of the results of the influencing factor model of forestry industry development shows that

(1) The impact of forestry labor force input on forestry gross of output value.

Table 8 shows that the amount of forestry labor force was significant and the coefficients were positive. This shows that the more the forestry labor input, the higher the development of forestry industry. From the horizontal comparison, after the addition of various explanatory variables and control variables, the influence of the labor force in the columns of (1), (3), (5) and (7) on the forestry gross of output value is all positive and significant. This estimate may be biased without considering the influence of other factors. Therefore, further control for more factors is necessary. After the addition of various control variables, the number of forestry labor force is still significantly positive, that is, the increase of the number of forestry labor force has a positive effect on the development of forestry industry.

Numerically, the coefficient of labor input tends to increase when considering all the control variables. The regression results show that for every 1% increase in forestry labor input, the gross of output value increased by nearly two percentage points compared with that of no control variables, the GDP of the primary and tertiary industries of forest land increased by 39 and 20 percentage points, respectively, while the secondary industry fell by 20 percentage points before it was relatively controlled. The forestry labor force has a positive and significant impact on the development of the three forestry industries, and the influence degree from large to small is as follows: the tertiary industry, the secondary industry and the primary industry.

(2) Analysis of the regulation effect of forestry production factor allocation.

The columns (2), (4), (6) and (8) in Table 8 show that the interaction items between forest land area and forestry labor force, forestry labor force and forestry investment completion amount have a significant negative impact on the development of forestry industry. This shows that the impact of increasing forestry labor input per capita on the development of forestry industry will be regulated by the forest land area per capita and the investment completion amount per capita. When the forest land area per capita is small, the forestry labor force responds strongly to the development of the forestry industry. The impact of forestry investment completion on the development of forestry industry will also be regulated by the production factor of forest land area per capita. When the per capita forest land area is high,

Table 7.
Annual forestry investment in each region (unit: RMB 100 million)

	1998–2003	2004–2008	Growth rate (%)	2009–2013	Growth rate (%)	2014–2019	Growth rate (%)
Nationwide	83.72	97.76	16.77	114.65	17.28	123.38	7.61
North China	14.44	16.94	17.31	19.91	17.56	21.03	5.63
Northeast China	18.35	21.06	14.77	24.62	16.90	25.95	5.40
East China	9.21	10.72	16.48	12.41	15.71	13.32	7.38
Central and southern regions	16.44	18.90	14.94	22.06	16.72	24.40	10.61
Southeast	17.10	20.48	19.77	24.08	17.58	26.13	8.53
Northwest	8.18	9.66	18.07	11.57	19.86	12.54	8.32

Table 8. Regression results of forestry industry development

	Ln(Tp_per)		Ln(Tp1_per)		Ln(Tp2_per)		Ln(Tp3_per)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Labor_per)	0.267***	0.281***	0.083***	0.259***	0.648***	0.446***	0.381***	0.587***
	(0.018)	(0.019)	(0.021)	(0.019)	(0.026)	(0.027)	(0.019)	(0.042)
Ln(Per_tfld)		−0.135***		−0.238***		0.122***		−0.294***
		(0.025)		(0.025)		(0.036)		(0.053)
Ln(Rfi_per)		−0.121***		−0.167***		0.017		−0.029
		(0.016)		(0.018)		(0.017)		(0.044)
Ln(Rgdp)		0.923***		0.858***		1.075***		1.082***
		(0.023)		(0.023)		(0.029)		(0.065)
Percent		0.356***		0.364***		0.283***		0.202***
		(0.009)		(0.010)		(0.014)		(0.020)
Ln(Rfi_per) × Ln(Labor_per)		0.039**		0.015		−0.149***		−0.191***
		(0.018)		(0.021)		(0.025)		(0.038)
Ln(Per_tfld) × Ln(Labor_per)		−0.175***		−0.179***		0.030**		−0.096***
		(0.011)		(0.012)		(0.015)		(0.017)
Ln(Rfi_per) × Ln(Per_tfld)		0.082***		0.005		0.267***		0.298***
		(0.013)		(0.015)		(0.020)		(0.022)
NFPP		−0.004		−0.018		0.022		−0.009
		(0.012)		(0.014)		(0.017)		(0.030)
RCFT		−0.05		−0.02		−0.097*		−0.051
		(0.043)		(0.044)		(0.050)		(0.083)
RCFT 1st		−0.099*		−0.047		−0.157***		−0.107
		(0.053)		(0.052)		(0.059)		(0.093)
RCFT 5th		−0.075		−0.026		−0.134**		−0.068
		(0.055)		(0.054)		(0.061)		(0.096)
RCFT 7th		−0.056		−0.016		−0.136**		−0.029
		(0.053)		(0.052)		(0.059)		(0.092)
RCFT 10th		−0.017		0.002		−0.043		0.061
		(0.043)		(0.044)		(0.052)		(0.085)
Frate		−0.056		−0.797***		2.603***		1.197***
		(0.066)		(0.068)		(0.097)		(0.133)
Constant term	−2.068***	−4.765***	−3.477***	−5.925***	−1.849***	−4.539***	−4.889***	−6.436***
	(0.102)	(0.106)	(0.123)	(0.120)	(0.149)	(0.161)	(0.108)	(0.237)
Variable controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	660	620	660	620	660	620	660	620

Note(s): ① *** is significant at 1%, * * is significant at 5%, * is significant at 10%; ②Standard error in parentheses increasing the completion of forestry investment will respond weakly to the development of forestry industry. The output value of forestry industry is affected by the mutual allocation of various production factors, and it is likely that the mismatch between production factors leads to the slow improvement of the development of forestry industry. Numerically, when at the same time the forestry production factors configuration were controlled, every 1% increase in forestry labor input, forestry output value only changed 2% forest area per capita. Every 1% increase of forest land area and labor force per capita will lead to a 17.5% fall in forest output value. Therefore, the development of forestry output is a little slow, which reflects that the mismatch between forestry factors of production is the key constraint in the slow development of forestry industry.

(3) Effect analysis of policy factors.

The implementation of NFPP has not much significant impact on the development of forestry industry. The variable of RCFT in the secondary industry is significant, with the coefficient of −0.097. Under the background of the main RCFT, the change coefficient of collective forest is negative, indicating that there are still systematic constraints to the further improvement of forestry development. Due to the obvious lag of policy implementation, the variable coefficient of RCFT is decreasing with the increase of time, which reflects that the negative effect of RCFT on the development of forestry industry is gradually weakening, which also verifies the importance of property rights system arrangement to factor allocation. Specifically, RCFT has greatly improved the enthusiasm of forest farmers in managing the forest land through the issuance of forest rights certificate, promoting the circulation of forest land, and gradually promoting the market-based reform of factors. Therefore, the explanatory power of the property rights system barriers to the weak promotion of forestry industry development in China's specific forest conditions is limited.

4.3.2 Robustness test. In order to verify the robustness of the estimated results of this study, we not only correct the heteroscedasticity during the regression treatment but further replace the regression estimation method and use the seemingly unrelated regression for estimation to obtain the regression results of Table 9. Comparing the direction and coefficients of the benchmark regression model, the significance and direction of the two key variables are roughly the same, indicating that the model estimates in this study are robust.

4.3.3 Heterogeneity analysis. Given that the allocation of forestry production factors is the key constraint to further improve the development of forestry industry, it is necessary to further analyze the heterogeneity of production factors. This paper focuses on whether there are differences in the development of forestry industry under different land resource endowment, forestry investment source and the proportion of management personnel. If it is yes, what is the direction and size of the difference? This paper continues the regression using the panel data GLS (Generalized Least Squares) models. The first is land resource endowment: according to the tiles of forest scale, it is divided into "small scale", "medium scale" and "large scale", among which small scale is 225–5.2074 million hectares, medium scale is 556.28–1042.6,5,000 hectares and large scale is 1044.69–4499.170,000 hectares. The second is the source of forestry investment: according to the classification of the *Forestry and Grassland Statistical Yearbook*, the completed amount of forestry investment is divided into national investment and social investment according to the investment sources. Finally, the proportion of administrative personnel, as administrative personnel in the forestry system, to the total forestry labor force can be regarded as the degree of input of administrative personnel in the forestry system. The proportion of forestry practitioners in forestry labor force is divided into "high input", "medium input" and "low input" according to three digits, with low input being 2.64–12.37%, medium input 12.41–33.22% and high input 33.33–93.20%. The results of the heterogeneity analysis are shown in Table 10.

	Ln(Tp_per)	Ln(Tp1_per)	Ln(Tp2_per)	Ln(Tp3_per)
Ln(Labor_per)	0.309***	0.316***	0.549***	0.698***
	(0.022)	(0.023)	(0.043)	(0.066)
Ln(Rfi_per) × Ln(Labor_per)	−0.034*	−0.141***	−0.159***	−0.347***
	(0.020)	(0.021)	(0.039)	(0.059)
Ln(Per_tfld) × Ln(Labor_per)	−0.057***	−0.028**	0.014	0.051
	(0.011)	(0.012)	(0.021)	(0.033)
Ln(Rfi_per) × Ln(Per_tfld)	0.009	−0.042***	0.308***	0.259***
	(0.119)	(0.175)	(0.472)	(0.420)
NFPP	0.011	−0.010	0.056	0.090*
	(0.018)	(0.019)	(0.035)	(0.053)
RCFT	−0.113**	−0.109*	−0.145	−0.122
	(0.055)	(0.058)	(0.108)	(0.165)
RCFT 5th	−0.141**	−0.142**	−0.153	−0.117
	(0.063)	(0.068)	(0.125)	(0.191)
RCFT 10th	−0.071	−0.063	−0.080	−0.005
	(0.056)	(0.060)	(0.111)	(0.170)
Variable controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes

Note(s): ① N = 620; ② *** is significant at 1%, ** is significant at 5%, * is significant at 10%; ③ Standard error in parentheses; ④ All control variables, year dummy variables and regional dummy variables in the benchmark regression are included in the model, and the estimation results of dummy variables are omitted

Table 9. The result of robustness analysis

(1) The result of heterogeneity analysis

Based on land resource endowment. The forestry labor force per capita is always significant under different forest land scale, which proves that the input of forestry labor force with different land resource endowment is heterogeneous for the development of forestry industry. When other conditions are the same, the smaller the scale of forest land, the more obvious the role of forestry labor force in promoting the development of forestry industry. It shows that the forestry management should advocate moderate scale, and the management mode of intensive cultivation is an effective means to realize the high-quality development of forestry.

Based on the heterogeneity of forestry investment sources. The number of forestry labor force is significant in the completion amount of forestry investment from different sources, which verifies that the number of forestry labor force from different forestry investment sources is heterogeneous for the development of forestry industry. Under the social investment of forestry labor force in secondary and tertiary industries, the labor force plays a more obvious role in promoting the development of forestry industry. This shows that with the development of emerging forestry industries, the emergence of "Internet +" new business forms in the forestry industry, attracting more social capital into the forestry industry, can more effectively improve the impact of forestry labor force on production and development. In the more traditional primary forestry industry, considering the characteristics of the long forestry production cycle, we should more often rely on the national investment to play the role of the forestry labor force in promoting the development of the forestry industry.

Based on the heterogeneity of the proportion of personnel. Under the different proportion of forestry human capital input, forestry labor input has different influence on the development of forestry industry. When the forestry human capital input is relatively low, the forestry labor force promotes the forestry industry significantly. It should be pointed out that on theoretical level the higher the input of human capital, the more obvious the impact of forestry

Amount of forestry labor force per capita		Gross output value of forestry industry	Gross output value of primary industry	Gross output value of secondary industry	Gross output value of tertiary industry
Land resource endowment	Small scale	0.696***	0.690***	0.282***	1.284***
		(0.077)	(0.077)	(0.079)	(0.146)
	Middle scale	0.589***	0.604***	0.694***	0.505***
		(0.063)	(0.061)	(0.062)	(0.062)
	Large scale	0.220***	0.287***	0.02	0.531***
		(0.037)	(0.035)	(0.041)	(0.033)
Sources of forestry investment	Social investment	0.271***	0.253***	0.388***	0.358***
		(0.021)	(0.021)	(0.026)	(0.047)
	National investment	0.234***	0.321***	0.233***	0.343***
		(0.025)	(0.030)	(0.022)	(0.045)
Proportion of management personnel	Low level	0.102***	0.070**	0.118***	0.203***
		(0.016)	(0.029)	(0.039)	(0.048)
	Medium level	0.018	−0.050*	0.092***	−0.091*
		(0.017)	(0.028)	(0.027)	(0.052)
	High level	0.227***	0.233***	0.402***	0.590***
		(0.022)	(0.025)	(0.020)	(0.026)
Controlled variable		Yes	Yes	Yes	Yes
Region FE		Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes

Note(s): ① N = 620; ② *** is significant at 1%, ** is significant at 5%, * is significant at 10%; ③ Standard error in parentheses; ④ Models include control variables, year dummy variables and regional dummy variables in Table 8, and the estimation results of dummy variables are omitted

Table 10. Heterogeneity analysis of the impact of forestry production factors on the development of forestry industry

labor force on the development of forest industry. While the empirical results show that when the proportion of managers input is on a small scale, the maximum role of the forestry labor force in the forestry industry can be played. This may be because forestry administrators in the forestry system, namely the forestry practitioners, need to be kept at a moderate scale, in order to avoid the administrative management redundancy and other problems, thus inhibiting the development of the forestry industry.

5. Conclusions and suggestions

5.1 Conclusions

Human resource is the first resource for development. This paper starts from the point that "the number of employees in forestry system" cannot reflect the real forestry labor force input. This paper calculates the amount of collective forest labor force based on the research data of RCFT, and estimates China's forestry labor input from 1998 to 2019. Based on this, this paper conducts an empirical test of the actual amount of forestry labor force in China on forestry industry development, using the provincial panel data. The conclusions are as follows: Firstly, the actual amount of forestry labor force in China is decreasing, which varies from different regions, showing strong spatial heterogeneity. Meanwhile, the proportion of forestry employees in the amount forestry labor force is decreasing. Secondly, the forestry labor force has an obvious role in promoting the development of the forestry industry, but this role is regulated and defined by the allocation of other forestry factors of production. At present, the low allocation efficiency between forestry production factors is an important factor restricting the high-quality development of forestry labor force to forestry industry.

Thirdly, RCFT has a negative impact on the development of the forestry industry in the early stage. With the implementation of the policy, the negative effect of the labor force on the forestry industry is gradually weakened. Fourthly, the influence of forestry labor force on the development of forestry industry is heterogeneous in the three dimensions of land resource endowment, forestry investment source and the proportion of forestry human capital. The smaller the utilization area of forest land, the higher the national investment in forestry, the smaller the management personnel, and the stronger influence will labor force have on the development of forestry industry.

5.2 Suggestions

According to the research conclusion, the following suggestions are as follows: Firstly, expand the scale of forestry labor force in forestry production; pay attention to the promoting role of forestry labor force on the development of forestry industry; optimize the allocation between forestry labor force, forestry investment and land factors according to local conditions; and improve strategic layout of talents. Secondly, it is necessary to further deepen and continue RCFT. In the process of reform, we should strengthen reforms focusing on property rights, elements and market and give full play to the property rights incentive mechanism. We should focus on improving the property rights system and optimizing the market-oriented allocation of factors to further stimulate the enthusiasm of the forestry labor force. Thirdly, we should further improve the introduction, use mechanism and talent evaluation mechanism of forestry talents and realize the efficient utilization and optimal allocation of human capital in the forestry industry. In addition, we should formulate specific supporting policies and measures to attract and cultivate talents to solve the problems of insufficient salary attraction and serious aging problems in forestry industry. To increase the salary, bonus and welfare treatment, enhance the role of forestry in absorbing labor force. In terms of forestry management and investment, we should further enhance refined forestry management and guide more social investment to the emerging forestry industries to broaden the channels for forestry to absorb social investment, thus boosting the development of the forestry industry and realizing the high-quality development of forestry.

Note

1. According to the division of six major geographical divisions in the Ninth Forest Resources Inventory Report, North China includes Beijing, Tianjin, Hebei, Shanxi and Inner Mongolia, Northeast China includes Liaoning, Jilin and Heilongjiang, East China includes Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi and Shandong, South-Central China includes Henan, Hubei, Hunan, Guangdong, Guangxi and Hainan, Southwest China includes Chongqing, Sichuan, Guizhou, Yunnan and Tibet, and Northwest China includes Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

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