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Labor transfer, market development, and the outsourcing of forestry production by farmers: a case study in Fujian, China

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Introduction: The outsourcing of forestry production is an important form in the development of forestry specialization and is the compromise result of economic incentives, factor optimization and risk diversification for farmers. It can facilitate the collaboration between internal and external resources to improve the efficiency of resource allocation and promote the combination of small farmers and the high-quality development of modern forestry.

Theory and methods: In this research, we have analyzed the extrusion effect, the substitution effect, and the income effect of labor transfer on the outsourcing of forestry production by farmers based on the theory of farmers' behavior. In addition, we have constructed an influence mechanism for the development of the outsourcing services market according to the theory of division of labor. Moreover, we analyzed research data from farmers in Fujian Province using a probit model to determine the effect of labor transfer and market development on the outsourcing of forestry production by farmers.

Conclusions and discussion: The conclusions showed that several factors have a significant impact on the outsourcing of forestry production. These factors include labor transfer, market development, income level in the village, smaller machinery numbers, amount of forestry subsidies, extent of forest road construction to meet production demands, and degree of forest land fragmentation. We have discussed topics of the distribution of labor value, market structure cultivation, and forestry costs on conclusion.

Policy implications: We propose increasing farmers' income through labor transfer, fostering the market for outsourcing services in forestry production, and promoting the new classification of forestry.

KEYWORDS

labor transfer, market development, farmers, outsourcing, forestry production

1 Introduction

A new round of reforms of the collective forestry rights system was implemented in China in 2003. The reforms facilitated the granting of contractual rights to farmers, encompassing ownership, utilization, and profitability of forest land and trees (Zhang, 2018). It has led to heightened motivation and enhanced efficiency in the field of forestry production (Liu et al., 2017a; Xu et al., 2020), thereby releasing the development potential of the forestry. However, these advancements have also had adverse effects on the forestry, including land fragmentation, decentralized operations, limited risk resilience, diminished competitiveness, and a lack of specialization (Kong, 2008; Chen et al., 2017; Jin and Wu, 2020; Liang, 2022). With the development of the economy and the society,

the momentum of the reforms has been decreasing. A large number of rural laborers have been transferred to cities, especially the young and strong (Cheng et al., 2016), which has greatly increased the difficulty of improving the efficiency of forestry production. Therefore, how to change forestry production methods and accelerate the industry's transformation is an important issue in promoting the modernization of forest-ry and high-quality development.

In recent years, the Chinese Government has made efforts to solve the problems of fragmentation, small scale, and decentralization in forestry. One of the strategies is the introduction of new production factors through forest rights transfer, which aims to promote moderate-scale operations (Guan and Zhang, 2020). However, it can be argued that the policy has not yielded the anticipated outcome. The transfer rate of national forest land varies between approximately 7.15% or 8.34% (Liu et al., 2015; Xu and Zhang, 2015). In the context of the "three rights separation" pattern, which involves the separation of own, contract, and management rights of the land, it should be noted that the transfer of the management right does not always result in moderate-scale operations (Chen, 2020). Hence, under the premise of the long-term existence of the smallholder economy, how to solve the current dilemma and promote the combination between smallholder farmers and the modern forestry development is a crucial problem.

The survival and development prospects of the smallholder economy can be significantly influenced by the level of mobility of production factors and the efficiency of resource allocation (Jin and Wu, 2020). In order to increase mobility by the transfer of forest rights, the government is actively promoting the utilization of specialized outsourced production services to enhance the allocation efficiency of factors. Outsourcing is a significant approach to address the present challenge and promote the integration of smallholder farmers into the modern market in forestry (Ji, 2018). It is the third road of the "service-oriented forestry" that services smallholder farmers in China (Luo et al., 2021). This study will mainly discuss the outsourcing of forestry production.

With the development of urbanization and industrialization, a large number of rural laborers has migrated to cities for employment. With the increasing of rural labor transfer, non-farm income has emerged as the main source of family income (Kung, 2002). According to the theory of farmer behavior, modern farmers are rational and follow the principle of profit maximization. In order to meet the needs of forestry production, farmers make decisions between independently completing and purchasing outsourced services. The basis for decision-making is mainly influenced by changes of micro-environment and macro-environment. From a micro perspective, in the face of the transfer of rural labor force and the continuous increase of non-farm employment wages, according to the principle of maximizing family interests, most farmers will choose to transfer labor force to non-farm industries. From a macro perspective, the development of external market is related to the cost of outsourcing, which directly affects the farmers' choice of forestry production. Therefore, labor transfer and market development are important factors currently affecting the outsourcing of forestry production by farmers.

At present, academic research in this field mainly focuses on the following aspects: (1) The impact of labor transfer on outsourcing in agricultural and forestry production. (i) In agriculture, some scholars believe that labor transfer can encourage farmers to participate in agricultural production outsourcing and improve production efficiency

through the following ways: (a) Labor transfer does not always result in land transfer (Deng et al., 2019). Because high-quality land still has high profits, farmers are unwilling to abandon it and may even adopt modern methods. However, land with poor quality is easy to be extensively utilized and marginalized (Ranis and Fei, 1961; Wang et al., 2016a; Hao et al., 2017). (b) The high wages of labor transfer will increase the opportunity cost of engaging in agricultural production and alleviate financial constraints on agricultural production investment (Mochebelele and Winter-Nelson, 2000; Mendola, 2006; Yang et al., 2020). (c) The increase of labor price caused by labor transfer will increase agricultural production cost. (d) Labor transfer will encourage farmers to adopt labor-saving technologies (Ji et al., 2011; Xu et al., 2018). On the contrary, other scholars believe that labor transfer does not necessarily lead to outsourcing. Labor transfer will result in the loss of agricultural "elite labor," and decrease reliance on land and the scale of management (Carter and Yao, 2002; Gellrich et al., 2007; Yan et al., 2016; Min et al., 2017). In addition, labor transfer will result in an increase in the number of elderly and experienced farmers who are left behind and enter agricultural production. This, in turn, has a restraining effect on farmers' involvement in outsourcing agricultural production (Gunabhagya Joshi et al., 2017; Zhou et al., 2020). Above all, the conclusions on the impact of labor transfer on agricultural production outsourcing are inconsistent. (ii) In forestry, labor transfer results in a reduction in the availability of rural labor for forestry production (Hyde and Yin, 2018), which increases the price of forestry labor and promotes the capitalization of the forestry input structure (Zhang H. et al., 2022). The promotion effect is moderated by the level of supply of socialized forestry services. Meanwhile, labor transfer reduced farmers' reliance on forestry, which led to a decrease in the scale of land or even the withdrawal of land. It resulted in a direct effect on the decrease in forestry production inputs (Han et al., 2018). However, Li et al. found that the increase in labor costs resulting from labor transfer had a significant negative effect on farmers' forestry labor inputs, while the effect on capital inputs remained uncertain (Li et al., 2019). Instead, Liu et al. reported that there was no statistically significant impact of agricultural labor transfer on either labor input or capital input (Liu et al., 2017b). Zhu et al. concluded that labor transfer has a significant negative effect on small-scale farmer forestry input, but it has positive effects on large-scale farmers in terms of forest management (Zhu et al., 2019). Additionally, Labor transfer had an influence on the circulation of forest land because of the relatively low economic return rate of forestry (Siikamäki et al., 2015). (2) Research on the impact of market development on agricultural and forestry production. Market development can effectively reduce the transaction costs of agricultural land transfer, increase the benefits brought by market-oriented agricultural land transfer, reduce farmers' dependence on agricultural land, and narrow the price difference of farmers' willingness (Tang et al., 2023). At last, it can reduce the possibility of farmers transferring out of agricultural land and increase the possibility of transferring into agricultural land. Moreover, this impact will increase with the increase of land area (Hong, 2019). Therefore, the expansion of market scale is the key to the development of agricultural land scale management (Guo and Xu, 2021). Market development will motivate farmers to increase the level of input in forest production factors, enhance their production enthusiasm, and encourage them to purchase outsourcing services (Wen and Liu, 2023). The degree of marketization can be measured by market coverage index, market fund support index, market intermediary service index, and market informatization index (Wang, 2023).

The research discussed above has provided rich theoretical support and laid a good foundation for the present study. However, forestry lands are mostly located in hilly areas and forestry production has long operation cycles, high risks, typical positive externalities, and phased and intermittent factor inputs, which is unlike the agricultural production. Therefore, forestry is presently characterized by a labor-intensive industry. The machinery development of forestry is in the primary stage (Cheng et al., 2016, 2021). Future research can be improved in the following ways. Firstly, the literatures on the correlation between labor transfer and forestry production presents conflicting results. The impact of labor transfer on the outsourcing of forestry production has not been thoroughly stated, and the underlying mechanism remains unclear. Secondly, from a macro perspective, the market development plays a crucial role in influencing the production of outsourced forestry. But existing studies have failed to analyze the mechanism and outcomes of its impact. Last but not least, it pays less attention to the outsourcing of forestry production. The above deficiencies offer opportunities for further research in this study.

This study takes the forestry production outsourcing as the research object, and analyzes the impact of labor transfer and market development on the outsourcing of forestry production. The research question is as follows: how do labor transfer and market development affect the outsourcing of forestry production by farmers? Based on the theory of farmers' behavior and the theory of division of labor, we have constructed the impact mechanisms of labor transfer and market development on the outsourcing of forestry production by farmers. To validate impact mechanisms, we collected data from farmers in Fujian Province. The results of this study will help to promote the development of forestry specialization, improve the efficiency of forestry operations, accelerate the connection between small farmers and the modern forestry market, and realize the modern and high-quality development of the forestry industry.

The marginal contributions of this paper are mainly evident in the following three points. First of all, the concept of the outsourcing has been extended, expanding the range of applications for forestry and enriching the research findings. Next, we analyzed the extrusion effect, the substitution effect, and the income effect of labor transfer on the outsourcing of forestry production from the perspective of farmers. It contributes to deepen our comprehension of the inherent relationship between labor transfer and the outsourcing of forestry production by farmers. Finally, we have analyzed the influence mechanism of market development on the outsourcing of forestry production by farmers from a macro-market perspective. It aims to understand how market development motivates farmers to purchase outsourcing services and solves the challenges faced in forestry production.

The subsequent sections of this paper are organized as follows: Firstly, we construct the theoretical analysis. Secondly, we explain data sources and the method in this study. Next, we present the results of a descriptive analysis and an empirical analysis. Finally, conclusions are summarized and discussed and the policy implications are proposed.

2 Theoretical analysis

2.1 Outsourcing of forestry production

Outsourcing refers to the process by which a company gives its non-core business functions to external specialized companies in

order to focus on its core business and reduce costs. The outsourcing of forestry production refers to dividing forestry production activities into different segments and transferring some or all of them to other specialized organizations to reduce costs and enhance operational efficiency (Zhong et al., 2021a; Hong, 2022). In this study, the forestry production links mainly includes the stages of afforestation, nurturing (which involves fertilization, mowing, and weeding), protection (including fire prevention, pest control, anti-theft, etc.) and logging.

By introducing new production factors, outsourcing can acquire specialized production services and promote the integration of internal and external resources to improve resource allocation efficiency and transform traditional forestry management. The outsourcing of forestry production is the compromise result of economic incentives, factor optimization and risk diversification for farmers (Zheng et al., 2022). First and foremost, farmers evaluate the opportunity cost of their involvement in forestry production and the potential benefits of outsourcing. Secondly, factors such as labor shortage, technological limitations, and capital constraints in forestry production can be compensated by contractors who have comparative advantages in factor endowments. This approach not only alleviates the extent of improper factor allocation, but also improves the efficiency of factor allocation by incorporating new capital and technology into forestry production. Finally, farmers generally tend to pursue risk avoidance. The concept of outsourcing refers to the process in which farmers delegate the remaining claims and operational risks to contractors with advantages in production factors, entrepreneurial talent and a robust resistance to risk. Farmers are relieved from the burden of production risks. Therefore, the outsourcing of forestry production is considered the Pareto optimal choice for farmers, as it can effectively enhance the efficiency of resource allocation.

2.2 The impact mechanism of labor transfer on the outsourcing of forestry production by farmers

With the development of urbanization and industrialization, the productivity of non-farm industries surpasses that of forestry industries. Consequently, a large number of farmers have transitioned to non-farm industries to pursue higher returns. The rural labor transfer has significant effects, including a decrease in the number of laborers and an increase in income (Taylor et al., 2003; Yang et al., 2022), which influences on the outsourcing of forestry production. They can be observed through the extrusion effect, the substitution effect, and the income effect. The analysis of these effects will be presented in the subsequent sections.

First, the transfer of labor will drive farmers to choose to the outsourcing of forestry production through the extrusion effect. When more labor is transferred, high-quality labor will preferentially move to non-farm industries and create an "elite capture" phenomenon. This results in a decrease in the quantity and quality of labor and enhances the demand constraint for labor inputs (Zhang, 2018). And then, the extrusion effect of labor supply will increase. However, it should be noted that forestry production is a labor-intensive industry (Li et al., 2019). Afforestation, nurturing, and logging require an amount of high-quality labor. Due to the positive externalities of forestry production and strict policy and institutional constraints, labor input is difficult to replace with machinery. In fact,

farmers face challenges in acquiring adequate capital resources. It is difficult to satisfy the demand for capital, while the demand for labor inputs continues to remain robust (Zhang H. et al., 2022). Therefore, it becomes the optimal choice for farmers to alleviate labor shortages with outsourcing services (Hess, 2011; Wang et al., 2016b), which can resolve the contradiction between the high input demand and low purchasing power of forestry production (Cai and Liu, 2018; Yang et al., 2022).

Second, the high earnings from labor transfer will trigger the substitution effect, leading to an increase in the demand for the outsourcing of forestry production. As the degree of labor transfer increases, there will be an increase in the income of farmers. This, in turn, causes the budget constraint line to shift upwards and results in the dependence of forestry income transferring (Yin et al., 2016; Chang et al., 2021). Simultaneously, labor transfer brings sustained and stable long-term benefits. This not only helps to alleviate financial limitations (Kong et al., 2018), but also increases the opportunity cost of participating in forestry production (Yang and Chen, 2016). Therefore, the decision to outsource in small-scale forestry production is rational when labor transfer results in increased income and there is a shortage of labor (Huang and Gao, 2012; Xu et al., 2022). After all, outsourcing can both save production costs and enhanced production efficiency (Chang et al., 2021). It can effectively solve the problem of mismatches between management capacity and the available resources in family forestry.

Thirdly, the income effect resulting from high returns on labor transfer can potentially decrease farmers' reliance on outsourcing. The high returns from labor transfer can lead to a relative decline in forestry revenue. Forestry production is experiencing a decline in significance among farmers, resulting in a decrease in forestry production inputs and an increase in the transfer of rural labor to non-farm industries. The high returns of labor transfer prompt young and strong laborers to move to cities, which leaves elders to participate in forestry production (Zhong et al., 2016; Qiao and Huo, 2017; Xu et al., 2022). Elders have lower opportunity costs and are experienced, which generates the low demand for outsourcing.

To conclude, it is evident that the extrusion effect and the substitution effect resulting from labor transfer will motivate farmers to acquire outsourced forestry production services. However, the income effect will diminish farmers' inclination to outsource and instead encourage them to undertake production independently.

According to the theory of new labor transfer economics, the primary objective of labor transfer is to maximize income. Farmers will rationally allocate labor across various sectors according to income disparity, opportunity costs, and unemployment rates. They will take into account both the long-term and short-term interests (Todaro, 1969; Mundlak, 1978; Stark and Bloom, 1985; Barkley, 1990; Larson and Mundlak, 1997). In fact, labor transfer involves the process of reallocating the factors of production within farm households (Chang et al., 2021). With the deepening of urbanization, labor transfer in farmers will continue to increase. The decision made by farmers to either engage in non-farm industries or agroforestry will contribute to the acceleration of divergence. They will be confronted with the decision of either persisting, transferring, or relinquishing their forest land. Given the stronger endowment effect associated with forest land compared to agriculture, and the symbolic value of forest land as ancestral property, it is less probable for farmers to relinquish their ownership of forest land. Additionally, the security value and the property value will prevent

farmers from transferring forest land. Therefore, the majority of farmers opt to preserve forest land. The decision of farmers to either undertake production themselves or opt for outsourced services depends upon the net income. When the returns from non-farm employment exceed those from forestry, the opportunity cost of forestry production becomes higher than the cost of outsourcing. The net income demonstrates a positive value. According to the behavior theory of farmers, rational farmers will opt for outsourcing in order to fulfill their demands and achieve the optimal allocation of household resources (Schultz, 1993; Su et al., 2020). In this case, the extrusion effect and the substitution effect exceed the income effect. Research hypothesis 1 is proposed as follows:

Hypothesis 1: The labor transfer will play a significant role in the outsourcing of forestry production.

2.3 The influence mechanism of market development on farmers' forestry outsourcing

According to the theory of division of labor, the development of the division of labor is constrained by the size of the market (Smith, 1776), and the level of specialization must be proportionate to the extent of market development (Edwin, 1962). The division of labor depends on the level of market development (Young, 1928). Expanding the market plays a crucial role in promoting the development of the division of labor (Mill, 1848; Lewis, 1996). The social division of labor is attributed to the market capacity (Durkheim, 2000). Therefore, outsourcing, as the primary manifestation of the division of labor's development, is subject to the influence of market development.

For the forestry production, the presence of a well-established outsourcing market leads to an increase in the number of suppliers and demanders, consequently expanding the overall size. Accessing outsourcing information and services for farmers can provide a viable solution to overcome resource constraints. The market for outsourcing services can be improved with the development of specialization, leading to a higher frequency of outsourcing transactions. In a mature outsourcing market, the expenses associated with information retrieval, negotiation, and supervision are reduced. It has been suggested that outsourcing can be a more convenient alternative to substituting costly labor inputs by farmers (Zeng and Shi, 2022). Therefore, farmers are more inclined to choose outsourcing with the mature of market development. The second research hypothesis is formulated as follows:

Hypothesis 2: The outsourcing of forestry production is positively influenced by market development.

3 Data sources and econometric models

3.1 Data sources

The data used in this study was acquired from a survey conducted on outsourcing services in forestry production, which focuses on the

period from August to December 2021. The study was conducted in Fujian Province. The reasons behind the selection are outlined below:

To begin with, Fujian Province possesses a substantial amount of forestry resources and boasts a commendable forest coverage rate. Fujian Province is geographically situated between 23°31′~28°18′N, 115°50′~120°43′E, and along the southeast coast of China.¹ The location is in close proximity to the Pacific Ocean. The topography of the region exhibits significant variations, with elevated terrain in the northwest and lower elevations in the southeast. Approximately 90% of the overall land area is characterized by mountainous or hilly landscapes. A significant portion of the total land area is 76.10%. The region exhibits a subtropical marine monsoon climate and possesses abundant forest resources. Fujian Province is one of the collective forest regions in southern China. The forest coverage rate has achieved a remarkable 66.80%, securing the first in the country for a consecutive period of 44 years. This percentage surpasses both the national average of 24.02%² and the global average of 30.70%.³ The forest stock volume is 730 million cubic meters, and the ecological quality of its cultivation and ecological civilization index are ranked first in China.

Secondly, the forestry production in Fujian Province exhibits advanced and modern characteristics in China. The reform of China's collective forest rights system has undergone five distinct stages of development. These stages include the division of mountains and forests into households, the transition to cooperatives for the management of mountains and forests, the establishment of collective ownership and unified management, the exploration of forest rights reform with a focus on the "three fixed" principles in forestry (stabilizing mountain rights forest rights, defining private mountains, and determining forestry production responsibility system), the implementation of a forest cutting quota system, and the ongoing reform of the collective forest rights system. All of these processes have been undergone in Fujian Province. It took the lead in 2003 by implementing a comprehensive reform of the collective forest rights system. This reform focused on "clarifying ownership, granting management rights, implementing disposal rights, and ensuring income rights." The efforts in the area served as a significant demonstration of the reform's effectiveness. The input structure of machinery, technology, capital and labor has undergone continuous optimization in the course of development. The proportion of factor inputs has been consistently balanced, leading to an overall improvement in production efficiency. In summary, the forest resources and forestry production in Fujian Province have reached a high level of advancement at the national level. The province demonstrates progressiveness and modernity in the forestry practices, making it a prominent area for forestry production and development in China.

We adopted the methods of stratified sampling and random sampling to acquire the sample considering the reform of the collective forest rights system, the allocation of forest resources, and the degree of socioeconomic development. The sampling procedure was conducted according to the following steps.

First, in accordance with the three classifications of forest resources, two sample counties were selected at random within each stratum. The classifications, namely excellent, medium, and poor, were assigned by the Fujian Provincial Forestry Department. A selection was made of six counties in total. Subsequently, in accordance with the varying levels of economic development (classified as excellent and poor) within each county of the province, a single county was randomly chosen from each layer based on its *per capita* GDP. A selection was made of two counties in total. Ultimately, a total of eight sample counties were acquired. The following areas are Yongan, Youxi, Zhangping, Yongding, Zhenghe, Wuyishan, Pingnan, and Xianyou, respectively.

Secondly, in order to assess the forest resources in the townships under the jurisdiction of the sample counties, the county forestry bureaus provided a classification system consisting of three categories: excellent, medium, and poor. From each category, one sample township was randomly selected, resulting in a total of three townships for analysis. Subsequently, in order to account for the varying levels of economic development (excellent and poor) in each town, a random sample was selected from each stratum, consisting of two samples in total. According to the level of economic development of the townships, which were categorized based on their GDP *per capita*, and if there was duplication, the sample was resampled. Finally, a total of five sample townships were chosen from each of the selected counties for the purpose of this study. The detailed information is presented in Table 1.

Next, a random selection was made of one village from each stratum based on the two categories of forest resources (excellent and poor) as classified by the forestry station in the town. This selection was conducted for the villages under the jurisdiction of the sample townships. A selection of two sample villages was made from each sample township.

Finally, employing the equidistant sampling method, a sample of six farmers was randomly chosen from a list of eligible voters provided by each village for the purpose of conducting a survey. If the head of the household was absent from home due to non-farm employment, but other members were present, the research was carried out without any disruptions. If the entire household was absent due to non-farm employment, alternative households in close proximity to the original household's residence were randomly chosen as replacement sample households for the research.

A total of 480 household surveys was undertaken. The total number of valid questionnaires amounted to 419, after excluding questionnaires that were deemed invalid due to being missed or incorrectly answered. Additionally, questionnaires from farmers with forest land area over 33 hectares, as well as those from farmers engaged in economic forest, were also excluded. The efficiency rate was 87.29%.

3.2 Econometric model and variable selection

In this study, we analyze the impact of labor transfer and market development on the outsourcing of forestry production. The dependent variable was the outsourcing of forestry production by farmers including their decision to purchase afforestation, nurturing, protection, and logging services. It can be classified as a typical binary decision problem. The analysis employed a binary probit model.

1 https://baike.baidu.com/item/%E7%A6%8F%E5%BB%BA%E7%9C%81/122534?fr=ge_ala

2 <https://wap.ceidata.cei.cn/detail?id=2DosoQLStDo%3D>

3 <https://baijiahao.baidu.com/s?id=1694838116216330293&wfr=spider&for=pc>

TABLE 1 Information on the research areas.

Counties	Towns	Notes
Yongan	Xiaotao, Xiyang, Huainan, Luofang, Caoyuan	These counties are located in the northwest of Fujian Province and are the main forest areas. They have a high accumulation of vitality trees.
Youxi	Xicheng, Xiwei, Meixian, Lianhe, Yangzhong	
Zhangping	Chishui, Shuangyang, Xinan, Nanyang, Xianghu	
Yongding	Chengjiao, Xianshi, Hulei, Xiayang, Hexi	
Zhenghe	Shitun, Waitun, Lingyao, Xingxi, Tieshan	
Wuyishan	Wuyi Street, Xingcun, Xingtian, Wutun, Langu	
Pingnan	Gantang, Changqiao, Daixi, Shuangxi, Shoushan	It is located in the eastern of Fujian Province. It has abundant forest resources and relatively backward economy.
Xianyou	Bangtou, Laidian, Youyang, Fengting, Gaiwei	It is located in the southern of Fujian Province. It has a high level of economic development and scarce forest resources.

$$Y = \beta_0 + \sum \beta_1 X_1 + \sum \beta_{2n} X_{2n} + \sum \beta_{3i} C_i + \varepsilon \quad (1)$$

In the equation 1, Y is the dependent variable. X_1 and X_{2n} denote, respectively, labor transfer and market development variables. C_i represents the control variable. The parameters of the model are denoted by β_1 , β_{2n} , and β_{3i} . β_0 is a constant term. ε is a random error variable that follows a normal distribution.

In this study, the dependent variable is the outsourcing of forestry production, which was measured by whether farmers purchased outsourcing services of forestry production. This measurement is based on the research conducted by Su et al. (2020). If the decision was made not to purchase any outsourcing services, the option “0” was selected. Otherwise, the option “1” was selected.

The primary explanatory variables include labor transfer and market development. (1) For the labor transfer, scholars have previously used different measures. Chen et al., and Zhang et al. used the ratio of labor transfer to household labor force (Chen et al., 2020; Zhang D. et al., 2022). Chen et al. directly adopted the number of labor transfers (Chen et al., 2022). Hu et al. and Yang et al. chose to measure the income of labor transfer (Hu et al., 2022; Yang et al., 2022). Other researchers have used the location (Yang et al., 2022) or the experience of labor transfer (Luo and Lei, 2020). In this study, the decision was made to use the proportion of labor transfer income to total income as a measure of labor transfer in order to improve the coherence of the dataset. (2) Regarding the market development, the primary indicators utilized were the extent of development and information services of the outsourcing market (Ma et al., 2022). The former is determined by the proportion of surrounding farmers’ (mainly living in this village) participation in outsourcing (Su et al., 2020; Zhang D. et al., 2022), the degree of influence on the price of outsourcing services, and the contract forms of outsourcing. The main reason that when the market development is higher, there are more suppliers and demanders, resulting in lower transaction costs associated with outsourcing. The maturity of a market is directly proportional to the level of market development. In a mature market, the level of standardization in outsourcing transactions is expected to increase, leading to a higher participation rate of farmers in outsourcing activities. The impact of supply and demand on market prices is determined by the level of competition between the two parties involved. The party that holds greater influence in this competition is more motivated to successfully accomplish the market transaction. Hence, it can be suggested that an

increase in the percentage of surrounding farmers participating in outsourcing activities leads to a greater prevalence of standardized outsourcing contracts, resulting in a significant influence on prices and a higher level of market development. Meanwhile, the degree of knowledge of outsourcing service providers (Zhong et al., 2021a), the difficulty of obtaining outsourcing information, the difficulties in searching for outsourcing suppliers (Li and Luo, 2022), and the existence of a local outsourcing service agency, organization, or platform are main factors that indicate the availability of information services (Zhang D. et al., 2022). In a mature market, the information exchange between supply and demand is adequate, and there is a greater availability of platforms that provide information. The cost of searching for information is lower, and farmers will have a better understanding of their suppliers. In this situation, acquiring outsourcing services will be relatively straightforward, thereby reducing the challenges associated with supplier search.

The selection of control variables focused on the household level and the forest land level. (a) At the household level, there is a positive correlation between the age of the farmer and the level of difficulty in independently completing forestry production. In general, older farmers are more reliant on outsourcing services (Chen et al., 2018; Cao et al., 2021; Wang et al., 2021; Zhong et al., 2021b). The level of education of farmers positively correlates with their willingness to outsource tasks and their likelihood of procuring such services (Cao et al., 2021; Zhong et al., 2021b; Zhang D. et al., 2022). When the income level of farmers in rural areas is higher, they face fewer financial limitations in participating in outsourcing activities (Chen et al., 2018). The greater the number of machineries possessed by farmers, the more likelihood that they will carry out production activities independently rather than resorting to outsourcing (Su et al., 2020; Zhong et al., 2021b). The higher the proportion of farmers’ income derived from forestry, the greater the attention and investment in forestry, and the greater motivation to purchase outsourcing services (Wang et al., 2021). The more times a farmer receives scientific and technological services, the higher the level of their forestry production, the less likely they are to purchase outsourcing services (Cao et al., 2021; Wang et al., 2021). If additional subsidies are allocated to the forestry, farmers will have access to invest in forestry activities. Thus, the cost of participating in outsourcing will reduce, which stimulates more outsourcing transactions (Chen et al., 2018; Wang et al., 2021; Hu et al., 2022). (b) For the forest land, the transportation conditions around the forest land (expressed by the

TABLE 2 Definitions of variables and descriptive statistical results.

Variable	Definition	Mean	Std. dev.	Min	Max
Dependent variable					
Whether to purchase forestry production outsourcing service	1—yes; 0—no	0.8735	0.3328	0	1
Core explanatory variables					
Labor transfer					
Proportion of labor transfer income	=Labor transfer income/ total income	0.5376	0.3665	0	1
Market development					
Proportion of surrounding farmers participating in outsourcing	Calculated by percentage (%)	70.9642	28.9745	0	100
Impact of outsourcing service price	1—no impact; 2—less impact; 3—average; 4—large impact; 5—very large impact	2.0573	1.1139	1	5
Contract forms of outsourcing	1—no agreement; 2—only oral agreement; 3—signed detailed written service contract; 4—signed intention contract; 5—signed collective agreement through village committee or cooperative organization	1.6563	0.5839	1	4
Degree of understanding of outsourcing providers	1—understand; 2—do not understand; 3—yes but not clear; 4—other	1.5704	0.6464	1	4
Difficulty in obtaining outsourcing information	5—very difficult; 4—relatively difficult; 3—general; 2—relatively easy; 1—very easy	2.1241	0.8879	1	5
Difficulties in searching for outsourcing suppliers	The higher the score, the greater the difficulty	4.0907	2.6899	1	10
Is there a local outsourcing service organization or platform?	1—yes; 0—no	0.1790	0.3838	0	1
Control variable					
Age	According to actual age	54.2721	8.9714	20	85
Education	1—primary school and below; 2—junior high school; 3—technical secondary school or high school; 4—college or above	1.9427	0.7743	1	4
Family income level in the village	1—high; 2—medium; 3—low	1.9952	0.6030	1	3
Total number of farmer's machines	According to the actual number of units	2.4606	15.3835	0	303
Farmers' income derived from forestry	1—yes; 0—no	0.2005	0.4008	0	1
Times scientific and technological services for forestry production received	0—no; 1—only once; 2—2–3 times; 3—4–5 times; 4—6–7 times, 5 = 8 times and above	0.7613	1.3162	0	5
Forestry subsidies	Yuan	11,950.9500	30,913.3500	0	265,000
Degree to which forest roads meet the demands of production	3—completely; 2—partially; 1—do not; 0—hard to say	2.2792	0.8727	0	3
Degree of fragmentation in forest land	=Total area of forest land/number of plots	43.7278	59.1910	0.37	491

extent to which roads are built to meet production demands), and the degree of fragmentation of the forest land, have an impact on farmers' outsourcing decisions. The improvement of transportation conditions is directly proportional to the increase in forest roads that can fulfill production demands. Furthermore, the higher convenience and the lower cost for outsourcing, which encourages farmers to purchase outsourcing services (Cao et al., 2021; Zhong et al., 2021b; Li and Luo, 2022; Yang et al., 2022). The degree of fragmentation in forest land can be measured by the average size of the blocks. The smaller the average block size of the forest land, the greater the cost of purchasing outsourcing services, and the stronger the consistency of demand for outsourcing services (Chen et al., 2018; Su et al., 2020; Zhong et al., 2021b; Li and Luo, 2022; Zhang H. et al., 2022).

The names and definitions of each type of variable are presented in Table 2.

4 Empirical analysis results

4.1 Descriptive analysis results

Table 2 shows the results for the descriptive statistics of the variables. The findings reveals that 87.35% of the farmers purchased outsourcing services for forestry production, which suggests that the outsourcing of forestry production is prevalent among farmers. The average proportion of income derived from labor transfer was found to be 53.76%, which

TABLE 3 Empirical analysis results.

Variable		Coef. (std. err.)	Dy/dx
Proportion of labor transfer income		2.4440 (1.3075)*	0.0652
Proportion of surrounding farmers participating in outsourcing		0.0440 (0.0178)**	0.0012
Impact of the outsourcing service price		4.0707 (1.4462)***	0.1086
Contract forms of outsourcing		2.7303 (0.9206)***	0.0728
Degree of understanding of outsourcing providers		-1.4502 (0.5694)***	-0.3869
Difficulty in obtaining outsourcing information		1.2476 (0.5152)**	0.0333
Difficulties in searching for outsourcing suppliers		0.9791 (0.4465)**	0.0261
Is there a local outsourcing service organization or platform?		-8.1983 (2.4357)***	-0.2187
Age		-0.5323 (0.0434)	-0.0014
Education		0.2557 (0.4655)	0.0068
Family income level in the village		-2.7751 (1.4347)**	-0.0740
Total number of machines		-0.2473 (0.0928)***	-0.0066
Farmers' income derived from forestry		0.7060 (0.8676)	0.0188
Times scientific and technological services for forestry production received		-0.2240 (0.3629)	-0.0060
Forestry subsidies		0.0002 (0.0001)*	-0.0001
Degree to which forest roads meet the demands of production		-0.9275 (0.4015)**	-0.0247
Degree of fragmentation in forest land		0.0294 (0.0131)**	0.0008
LR chi ² (17)	277.1300	Log likelihood	-20.5113
Prob > chi ²	0.0000	Pseudo R ²	0.8711

*, **, and *** are significant at the 10%, 5%, and 1% levels, respectively.

indicates that labor transfer income constitutes a significant portion of family income with non-farm income serving as the primary source for farmers. The average percentage of surrounding farmers' participation in outsourcing activities is found to be 70.96%. Furthermore, it is observed that farmers have a relatively limited impact on the pricing of outsourcing services. It is found that farmers had relatively easy access to outsourcing information, suggesting that the development of outsourcing has reached a certain level of maturity. The majority of the outsourcing service contracts are only oral agreements, which implies that there is a need for enhanced regulation of the outsourcing service market. Farmers' understanding of providers is average, indicating that they find it difficult to more details information on outsourcing. The average difficulty score for searching suppliers is 4, suggesting that the task of finding suppliers was relatively easier. The average value for the presence of outsourcing institutions, organizations or platforms is 0.18, which shows that these corresponding entities exist in the majority of areas.

Among the control variables, the average age of farmers is 54.27, indicating a relatively high. The average level of education is at the junior high school level. The village exhibits a moderate average income level, with farmers possessing an average of two machines. Of the total family income, 20.05% is derived from forestry, suggesting that the contribution of forestry to the overall income is relatively insignificant. The mean value of scientific and technological services received is approximately 0.76, indicating a relatively lower average. The average amount of forestry subsidies received is CNY 11950.95. However, it is important to note that these subsidies vary widely and have a highly heterogeneous. The current road systems are found to partially meet the demands and it needs further development. The average area of a block is 43.73 mu, suggesting a high degree of fine fragmentation.

4.2 Empirical analysis results

In this study, a probit model is used for the empirical analysis. The core explanatory variables are labor transfer and market development, while the dependent variable is the outsourcing of forestry production. Furthermore, given that marginal effects are analyzed as the impact of changes in the independent variables (which include the core explanatory variable and the control variable) on the dependent variable, we conduct an analysis of marginal effects across the variables. The results are presented in Table 3.

For the labor transfer, the proportion of labor transfer income has a significant and positive impact on farmers' decision to purchase outsourcing services for forestry production, as evidenced by the results at the 10% significance level. It indicates that there is a positive correlation between the proportion of labor transfer income to total income and the likelihood of farmers purchasing outsourced services. Furthermore, it is observed that with each 0.1 increase in the proportion of labor transfer income, there is a corresponding 6.52% increase in the probability of procuring outsourcing services of forestry production, while controlling for other relevant factors. It indicates that labor transfer promotes the outsourcing of farmers' forestry production, which provides support for hypothesis 1. The possible reasons are that forestry production has a long production cycle, high risk, prolonged investment period, delayed returns, and substantial one-time investment. These factors necessitate a certain level of capital contribution from the farmers themselves. Therefore, as the farmers' income from labor transfer increases, their financial resources for forestry production become more adequate, thereby increasing the likelihood of them procuring outsourcing services of forestry

production. The extrusion effect and the substitution effect of labor transfer surpass the income effect. This is consistent with reality and with the research findings of [Yang et al. \(2022\)](#) and [Chen et al. \(2021\)](#).

Among the variables of market development, each variable has a significant impact on farmers' forestry outsourcing services.

At a significance level of 5%, it is found that the proportion of surrounding farmers participating in outsourcing, the degree of difficulty in obtaining the relevant outsourcing information, and the difficulty in searching suppliers have a statistically significant positive impact on the outsourcing. Moreover, when other variables are controlled, the probability of choosing the outsourcing of forestry production increases by 0.12% for each 1% rise in the proportion of surrounding farmers participating in outsourcing. The likelihood of choosing the outsourcing of forestry production increases by 3.33% for each unit decrease in the level of difficulty in obtaining information. The probability of opting for outsourcing services exhibits a 2.61% increase with each increasing one point in the difficulty score associated with supplier search. The findings indicate that the higher the proportion of surrounding farmers involved in outsourcing, the easier it is to obtain information about outsourcing services, the more difficult it is to find outsourcing suppliers, and the more farmers will choose the outsourcing of forestry production. Possible reasons are as follows: First, the acquaintance society is the boundary of farmers' economic activities. For an economic activity, farmers often opt to outsource services from individuals who are familiar to them within their local communities ([Li and Zhong, 2020](#)). Therefore, the participation of surrounding farmers in outsourcing will affect farmers' outsourcing options. That is, when there are more surrounding farmers choosing outsourcing services, the local outsourcing market will become more developed, resulting in an increased supply of such services. The greater the farmers master the information regarding suppliers, the more inclined they will be to outsource forestry production. Secondly, the easier it is for farmers to obtain information about outsourcing services, the lower the transaction cost in the outsourcing market. It will generate a positive incentive for farmers to purchase outsourcing services and motivate them to successfully complete the transaction. Thirdly, the difficulty in searching suppliers is linked to the supply. The greater the ease of searching for market suppliers, the higher the number of suppliers available, resulting in a closer alignment between the market price and the equilibrium price.

At a significance level of 1%, the degree of influence on the price of outsourcing services and the form of outsourcing contract signed have a statistically significant and positive impact on the outsourcing of forestry production by farmers. The outsourcing of forestry production by farmers is found to be significantly negatively influenced by the degree of knowledge about the main suppliers and the existence of a local organization or platform for supplying. Meanwhile, under the condition that all other variables remain constant, an increase of one unit in the degree of influence on the price of outsourcing services and the contract form of outsourcing leads to a respective increase in the probability of farmers outsourcing forestry production by 10.86 and 7.28%. For every one unit increase in the degree of knowledge regarding outsourcing service suppliers and the existence of a local organization or platform of outsourcing service institutions, the probability of farmers outsourcing forestry production increases by 38.69% and decreases by 21.87%, respectively. The above results show that the greater the degree of farmers' influence on

outsourcing service prices, the standardization of outsourcing contracts, the knowledge degree of outsourcing service suppliers, and the farmers' motivation to choose the outsourcing of forestry production. The reasons can be outlined as follows. Firstly, the degree of farmers' influence on the pricing of outsourcing services directly impacts their market positions. The greater the degree of influence, the higher the market position, and the more farmers can make choices. Secondly, when the form of the service contract becomes more standardized and there is a higher the degree of knowledge of the suppliers of outsourcing services, it leads to a decrease in market transaction costs and an increase in the frequency of participation in outsourcing. However, with fewer outsourcing service suppliers, organizations, or platforms, there is a higher probability that farmers will choose the outsourcing. This is contrary to the outcomes of the theoretical analysis, possibly due to the fact that in practice, farmers mainly purchase outsourcing service through acquaintances and have limited demand for outsourcing service suppliers, organizations, or platforms. In this case, even if the transaction price deviates from the market equilibrium price, a "price paradox" will occur. Considering the constraints of human relationships and the trust mechanism on both parties of the transaction, these services have the characteristics of flexible prices, non-market transactions, and contractual stability. These characteristics are determined by the strength of social relations ([Li and Zhong, 2020](#)). However, from the perspective of the market economy, the strengthening of the competition mechanism in the outsourcing market is still in line with the objective of maximizing farmers' interests. Therefore, it remains crucial to promote the construction of outsourcing service institutions, organizations, and platforms as a means to promote the development of the outsourcing market. In conclusion, the development of the market will prompt farmers to choose the outsourcing of forestry production, thereby verifying hypothesis 2.

Among the control variables, at a significance level of 5%, the income level in the village, the extent to which forest roads meet demands of production, and the degree of forest land fragmentation significantly affect the outsourcing of forestry production by farmers. That is, the higher the income level in the village, the greater the extent to which forest road construction meets production needs, and the higher the degree of forest land fragmentation, the more likely farm households choosing the outsourcing of forestry production. At a significance level of 1%, it is observed that as the number of machines decreases, the likelihood of farmers opting to outsource forestry production increases. At a significance level of 10%, there is a positive correlation between the amount of forestry subsidies and the probability of farmers purchasing outsourcing services. However, at a significance level of 10%, age, education, the primary source of family income from forestry, and the frequency of receiving forestry production technology services have no statistically significant impact on the outsourcing of forestry production services. Moreover, when all other variables remain constant, the probability of outsourcing increases by 7.40% for every unit of income level in the village. The probability of outsourcing decreases by 0.66% when the number of machines is increased by one unit. When the amount of forestry subsidies increases by CNY 1, the likelihood of outsourcing increases by 0.01%. The probability of farmers acquiring outsourcing services increases by 2.47% for each additional unit of forest road construction meeting production requirements. When the degree of fragmentation in forest land increases by one unit, there is a corresponding increase in the probability of outsourcing by 0.08%.

TABLE 4 Robustness test results after variable substitution.

Variable	Coef. (std. err.)	Dy/dx
Proportion of labor transfer	1.5608 (0.9490)*	0.0441
Proportion of surrounding farmers participating in outsourcing	0.0299 (0.0116)***	0.0008
Impact of the outsourcing service price	2.8517 (0.8271)***	0.0805
Contract forms of outsourcing	2.7649 (0.8605)***	0.0780
Degree of understanding of outsourcing providers	-1.6644 (0.5838)***	-0.0470
Difficulty in obtaining outsourcing information	0.7905 (0.3392)**	0.0223
Difficulties in searching for outsourcing suppliers	1.5380 (0.6829)**	0.0434
Is there a local outsourcing service organization or platform?	-7.5344 (1.8971)***	-0.2127
Age	-0.0471 (0.0387)	-0.0013
Education	0.5322 (0.4482)	0.0150
Family income level in the village	-2.1445 (1.0392)**	-0.0605
Total number of machines	-0.2108 (0.0662)***	-0.0060
Farmers' income derived from forestry	1.6917 (1.0758)	0.0477
Times scientific and technological services for forestry production received	-0.0599 (0.3379)	-0.0017
Forestry subsidies	0.0002 (0.0001)**	0.0001
Degree to which forest roads meet the demands of production	-0.6788 (0.3355)**	-0.0192
Degree of fragmentation in forest land	0.0186 (0.0125)	0.0005

*, ** and *** are significant at 10%, 5% and 1% levels, respectively.

4.3 Robustness tests

In order to assess the reliability of the results, it is necessary to evaluate the robustness of the data. We adopt two methods to accomplish this task.

The first method involves replacing the key variable. The labor transfer is replaced by the proportion of labor transfer income to total income to the proportion of labor transfer to total labor. The regression results are presented in Table 4. As can be seen from the table, the regression coefficients, magnitude, direction, and marginal effects of the labor transfer and market development variables remain consistent with the results shown in Table 3.

Secondly, in order to avoid interactions between labor transfer and market development, the two variables are put into models separately for the regression analysis. The results (given in Table 5) show that both labor transfer and market development significantly influenced the outsourcing of forestry production services by farmers at the 10% significance level. The results confirm the validity of hypotheses 1, 2 and also consistent with the analysis presented in Table 3.

In summary, the results of the previous empirical analysis are stable.

5 Conclusion, discussion, and policy implications

5.1 Conclusion and discussion

As a result of the development of forestry specialization, the outsourcing of forestry production is an important way to promote the convergence between small farmers and the development of the modern forestry industry. Based on the theories of farmers' behavior and division of labor, we have constructed an analytical framework for the impact of labor transfer and market development on the

outsourcing of forestry production by farmers and collected data from farmers in Fujian Province to verify the theoretical mechanism. The conclusions of this study can be summarized as follows.

Firstly, a higher proportion of labor transfer income to total income increases the potential for farmers to purchase forestry production outsourcing services. That is to say, labor transfer will prompt the outsourcing of forestry production by farmers. This conclusion is consistent with the conclusion of outsourcing of agricultural production by farmers, such as Ranis and Fei (1961), Mochebelele and Winter-Nelson (2000), Mendola (2006), Ji et al. (2011), Wang et al. (2016a), Hao et al. (2017), Xu et al. (2018), Deng et al. (2019), and Yang et al. (2020). In fact, a higher proportion of labor transfer income shows two important facts. Firstly, it suggests that the overall income of farmers relies more heavily on labor transfer income and is relatively less dependent on income from other assets. If farmers choose to participate in forestry production, it is likely that their family income will experience a significant decline, which leads to a substantial reduction in the value of their labor time. Farmers will face a greater opportunity cost in forestry production, which goes against the rational choice to pursue the maximization of benefits. On the other hand, the greater farmers' labor transfer income, the lower the value of their leisure. Consequently, they may lack the motivation to save leisure time by participating in outsourcing. In the field of classical economics, the labor theory of value has formed the core idea of "labor determines value." Therefore, in forestry production, attention should be paid to guiding the adjustment of the industrial structure and the transfer of rural labors from the perspective of the whole society, increasing non-farm employment opportunities and augmenting the proportion of labor remuneration in the initial distribution process, thereby bolstering the income of farmers. This viewpoint is consistent with the policy objectives of the Chinese government.

Secondly, the higher the proportion of surrounding farmers participating in outsourcing, the greater the impact of outsourcing

TABLE 5 Robustness test results of the core explanatory variables.

Variable	Coef. (std. err.)	Dy/dx	Coef. (std. err.)	Dy/dx
Proportion of labor transfer income	0.4331 (0.2546)*	0.0690	---	---
Proportion of surrounding farmers participating in outsourcing	---	---	0.0262 (0.0101)*	0.0008
Impact of the outsourcing service price	---	---	2.6182 (0.7212)***	0.0799
Contract forms of outsourcing	---	---	2.3951 (0.7330)***	0.0731
Degree of understanding of outsourcing providers	---	---	-1.4424 (0.4844)***	-0.0440
Difficulty in obtaining outsourcing information	---	---	0.8466 (0.3412)**	0.0258
Difficulties in searching for outsourcing suppliers	---	---	1.1721 (0.5034)**	0.0358
Is there a local outsourcing service organization or platform?	---	---	-6.3460 (1.4243)***	-0.1936
Age	-0.0212 (0.0107)**	-0.0034	-0.0540 (0.0354)	-0.0016
Education	-0.0376 (0.1395)	-0.0060	0.4613 (0.3986)	0.0141
Family income level in the village	-0.3714 (0.1823)**	0.0592	-2.0848 (0.9501)**	-0.0636
Total number of machines	-0.0402 (0.0211)*	-0.0064	-0.1849 (0.0560)***	-0.0056
Farmers' income derived from forestry	0.8663 (0.3518)**	0.1380	1.0620 (0.8542)	0.0324
Times scientific and technological services for forestry production received	-0.0264 (0.0850)	-0.0042	-0.1065 (0.2822)	-0.0032
Forestry subsidies	0.0001 (0.0001)*	0.00001	0.0002 (0.0001)*	0.0001
Degree to which forest roads meet the demands of production	0.0148 (0.1085)	0.0024	-0.6351 (0.3159)**	-0.0194
Degree of fragmentation in forest land	0.1989 (0.0067)***	0.0032	0.0161 (0.0108)	0.0005

*, **, and *** are significant at the 10%, 5%, and 1% levels, respectively.

service prices on farmers. Additionally, the greater the farmers' influence degree of the outsourcing price, the more standardized the outsourcing contract signed, the higher the degree of knowledge regarding the suppliers, the easier it is to obtain information, the more difficult it is to find outsourcing service suppliers, and the more farmers will choose the outsourcing of forestry production. That is, the degree of market structure approaching pure competition, the more favorable it is for outsourcing. It is consistent with the study of the division of labor theory. In a perfectly competitive market, everyone is a price taker and has access to freely enter and exit the market. Therefore, the establishment of a development platform for outsourcing services is deemed imperative. It is market-oriented and has appropriate competition mechanisms to improve the completeness and sufficiency of market information solve the problem of information asymmetry, reduce transaction costs, and access freely entry and exit the market for both supply and demand. Ultimately, this platform can maximize the interests of both supply and demand, enhance the efficiency of resource allocation, and achieve Pareto improvement.

Thirdly, the income level in the village, smaller machinery numbers, the amount of forestry subsidies, the extent to which forest roads are constructed to meet production demands, and the degree of forest land fragmentation have a significant impact on the outsourcing of forestry production. In reality, if a forest land can receive additional subsidies and has a substantial average area and the well-maintained road for the forest land, the operation cost is relatively lower. Only forest land with low operating cost has the investment value, and social capital will involve the production. After all, the low profitable of forestry leads to the less importance of forestry land when compared to the industrial, commercial and agricultural sectors. Forestry does not hold significant appeal for potential investors. Only forest land that possesses a high operating value will receive the attention from

social capital. Therefore, according to the perspective of the forestry division of labor theory, we can enrich and improve the classification management theory of forestry based on operating costs. That is, we should classify low operating costs of forestry as timber forests, while high operating costs of forestry be classified as public welfare forests. This approach deviates from the traditional concept of forestry classification management. Traditional forestry classification management refers to the division of forests into public welfare forests and commercial forests according to the different purposes of forest dominant utilization and the different attributes of products and services provided by forests. What we advocate is to classify forestry operations based on operating costs. What we encourage is to choose specialized outsourcing services for farmers with low operating costs, optimize resource allocation, improve production efficiency, and promote the modernization of forestry. In addition, when the number of forestry machinery is small, the utilization rate of the existing forestry machinery will increase, which decreases the investment cost per unit area of forest land decreases. The classification induces social capital to intervene in forest land management, but also improves the efficiency of resource allocation. Then, farmers will choose to purchase specialized outsourcing services. This conclusion is consistent with the reasons for sample selection.

To sum up, forestry is not only natural resources and ecological resources, but also serves as a source of social and economic wealth. Forestry development is closely related to the enhancement of carbon sequestration, ecological security, social production, and rural revitalization, thereby generating a significant positive externality. We should look at forestry beyond forestry and firmly establish and practice the idea that lucid waters and lush mountains are invaluable assets. It is necessary to strengthen and deepen the collective forest rights system, enhance the internal impetus for forestry development, promote high-quality forestry development and farmers' prosperity,

and strive to attain the organic integration of ecological beauty and people's wealth. And then, the development of forestry should be coordinated with the economic development of the whole society. Forestry cannot be discussed solely. On the one hand, changes in market structure and labor transfer will affect the effective supply and actual demand of farmers' outsourcing. This kind of influence is comprehensive and complex. The discussion of one-way influence is not enough, which points out a new direction for our future in-depth study. On the other hand, the complexity of forestry problems requires a multi-sectoral cooperation. Market development is a macro issue that cannot be achieved without the guidance of the government's visible hand during the development process. The transfer of labor involves multiple departments such as finance, taxation, housing et al. Only by working together can we promote long-term stable non-farm employment for farmers.

5.2 Policy implications

The policy implications of the above conclusions for promoting the modernization and high-quality development of the forestry industry are as follows.

Firstly, we should spare no effort to increase the income of labor transfer. The labor transfer will gradually increase with the development of the economy and society, and the income of labor transfer will be more important. The government should focus on the formulation of policies for household registration, housing, medicine, and education. It can break down barriers to labor transfer and increase non-farm employment opportunities to speed up the transfer of rural laborers. And also it is crucial to vigorously develop the secondary industry and the tertiary industry in order to promote an increase in labor transfer income for farmers.

Secondly, efforts should be made to foster a market for the outsourcing of forestry production. On one hand, policies should focus on keeping in line with social development, providing desirable services to diverse specialized forestry organizations and institutions, improving service standards and establishing a favorable institutional environment for market development. On the other hand, we should build different levels of information dissemination platforms for the outsourcing services of forestry production and provide timely information on specialized service organizations, distribute relevant information to farmers in need based on forestry records from relevant sectors. It can enhance the convenience and effectiveness of farmers' access to outsourcing service information, reduce transaction costs and facilitate the purchase of outsourcing services. Anyway, we should strive to establish a fully competitive market with free access, sufficient information, and a combination of high quality and low price to promote the vigorous development of outsourcing services.

Finally, the government should promote the new forestry classification. In accordance with the theory of timber cultivation, the theory of forestry division of labor and the rationalization of industrial structure, the traditional forestry classification management is carried out according to the nature of management institutions and geographical areas. It is from the perspective of the macro management in forestry. However, it is more appropriate to consider the issue from a micro perspective for farmers. From the perspective of forest land management cost, it is crucial to promote the outsourcing development of forestry production and the introduction of social capital to classify

forest land with low management cost as timber forest and forest land with high management cost as public welfare forest. Hence, the government not only needs to encourage the appropriate scale management of forest land, increase forestry production subsidies, strengthen the infrastructure construction around forest land, but also needs to according to the different operating costs of forest lands in order to formulate policies for classified management.

There are also some limitations in this study. For example, the area only covers Fujian Province, and other provinces with abundant forest resources (such as Jiangxi, Hunan) are not chosen, which affects the applicability and scope of the conclusions. In the future, further in-research will be conducted.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

YW: Formal analysis, Writing – original draft, Funding acquisition, Investigation, Methodology. LF: Data curation, Methodology, Resources, Writing – review & editing, Conceptualization, Funding acquisition, Investigation. WL: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Writing – review & editing.

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Conflict of interest

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

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