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Can the Forestry Sector in Jiangsu Province Gain Competitiveness Under Impoverished Forest Resources?

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Abstract: Jiangsu province's forestry industry offers valuable insights for resource-poor regions in China. This study aims to determine the competitiveness of different forestry sectors in Jiangsu province and identify the industrial structural changes in this context. The shift-share method is employed to analyze the primary, secondary, and tertiary forestry industries, encompassing 17 sub-sectors, and investigate the industrial regional types. By combining location quotient values and inter-sector characteristics, the leading sectors are identified. The findings reveal that the Kuznets facts and the Engel effect in the industry structure have facilitated the process of increasing the value of ecological products; this is particularly evident between 2002 and 2018, as well as in 2021. Within the primary forestry industry, the Flower cultivation sector and the Economic forest product sector emerge as the leading sectors, outperforming the national growth effect by 7.18 and 1.02 times, respectively. In the secondary forestry industry, the Wood processing sector, the Furniture manufacturing sector, the Wood paper-making sector, and the Non-timber forest product sector mostly show the Progressive types as the leading sectors from 2006 to 2020. The tertiary industry's regional types fluctuate from the Progressive type to the Medium type, with the Forestry tourism sector, the Ecological service sector, and the Non-forestry service sector displaying leading industry characteristics. Recommendations for enhancing inter-sector integration include fostering collaborative agglomeration, unlocking the potential value of wetland resources, and strengthening cross-industry integration through e-commerce clusters to improve the forester's e-commerce operational capabilities.

Keywords: forestry industrial structure; Jiangsu province; shift-share analysis; leading industry

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1. Introduction

Industrial competitiveness is intrinsically linked to changes in industrial structure. Kongsamut et al. (2001) proposed 'Kuznets facts' as the process of allocating economic activities among different industries within a nation or region, resulting in a change in the industrial structure, and this concept is based on Kuznets' summary of the evolution path of the three industries of the national economy [1]. During the allocation of economic activities, production factors tend to migrate toward sectors with higher competitiveness or greater demand based on rational decision-making behavior, resulting in a greater number of final products in these competitive sectors. Apparently, Kuznets categorized all final products into three sectors, the categorization that has become one of the most widely adopted categorizations today. In the early stages of research in this field, changes in the industrial structure mostly occurred in non-agricultural industries. Some studies segmented the three

industries into two sectors, namely agriculture and non-agriculture (Dennis and Iscan, 2007; Restuccia et al., 2008) [2,3]. As part of the changes in the service economy, some scholars divided this economic sector into two sectors, namely goods and services (Boppart, 2014; Herrendorf and Schoellman, 2018) [4,5]. For this reason, final products should be categorized using reasonable criteria, which are dependent on research purposes. With the development of the forestry economy in China, the economic value and social function of ecological forestry products have expanded. More and more scholars have used the "Classification of Forestry and Related Industries (Trial)" and the "Classification of National Economic Industries" to study the industrial structure of the Chinese forestry industry (Li and Tang, 2000; Huang et al., 2008; Li and Wan, 2013; Lv et al., 2022) [6–9]. Therefore, to scientifically confirm the leading forestry sector, a thorough examination of the changes in the forestry industrial structure is required, along with choosing a reasonable classification standard and identification method for the leading industry.

Current research on the Chinese forestry industrial structure primarily focuses on five areas. The first area investigates the impact of changes in the forestry industrial structure on economic growth (Luo et al., 2017; Xiang et al., 2018; Jiang and Jiang, 2020) [10–12]. The second area examines the influence of external factors, such as "Collective Forest Rights System Reform", urbanization, green credit, and industrial policies, on the forestry sector's industrial structure (Liu and Zhang, 2018; Tang and Li, 2017; Lu and Zhang, 2022; Xiong et al., 2022) [13–16]. The third area explores technological progress, industrial linkage, and input–output efficiency within the forestry industry to optimize its industrial structure (Tao et al., 2006; Mi et al., 2013; Li and Liu, 2019; Jiang, 2020) [17–20]. The fourth area studies the interaction mechanism of the primary, secondary, and tertiary industries by considering forestry as an independent system (Zeng and Tao, 2023a) [21]. The fifth area focuses on the interactive relationship between the agglomeration of the forestry industry and its structural optimization (Yu and Liu, 2020; Jiang and Cheng, 2019) [22,23]; this research direction overlaps with this article. The results of the fifth research area show that, as the forestry economy develops, there is an intrinsic link between the forestry industry's structural changes and its competitive advantage. Nonetheless, further research is necessary to comprehensively measure the changes in the forestry industry's structure when studying industrial competitiveness. Scholars have previously only adopted the three forestry industrial classifications to assess structural changes in the forestry industry, thereby representing a process in which the distribution of productive capacity only evolves within the three forestry industries from a supply perspective. However, from a demand perspective, these structural changes reflect the shift in the demand for forest products and services during periods of economic growth. According to Herrendorf et al. (2013) [24], the transformation of industrial structure is also driven by the final expenditure–income effect. This study addresses both supply-side and demand-side indicators to evaluate structural changes in the forestry industry. Although trends in structural changes are consistent when viewed from these two perspectives, the underlying mechanisms and their importance differ noticeably. From a demand perspective, industries with higher price elasticity of demand in forestry will receive a greater allocation of production factors. This change highlights how demand structure shifts affect the choice of the leading industry.

The second dimension of the literature focuses on methodologies for identifying the leading industry. Since 1994, China has proposed the Industrial Policy of the 1990s, and the selection of leading industries subsequently shifted from the national level to the provincial economic level. Various evaluation methods have been employed in the selection of regional leading industries, contributing to valuable explorations, for example, principal component and factor analysis (Liu et al., 2003; Jiang and Feng, 2018) [25,26], grey relational analysis (Luo, 2005; Yu et al., 2013) [27,28], analytic hierarchy processes (Yan

and Zhang, 2010; Shi et al., 2015; Tong et al., 2021; Peng et al., 2023) [29–32], input–output analysis (Xu and Li, 2015) [33], shift-share analysis (Tong et al., 2007; Wu and Zhao, 2009; Liu, 2016; Xue, 2017; Zhou et al., 2020; Scarffe, 2021) [34–39], etc. The aforementioned studies, guided by theories such as industrial correlation theory, grey systems theory, comparative advantage theory, and economic growth theory, provided some insights into the selection and decision-making of leading industries. Chen et al. (2013) [40] proposed that methods such as location quotients, analytic hierarchy processes, and grey relational analysis can be employed when the data are insufficient or of low quality. Conversely, if the data are comprehensive or of high quality, commonly used methods include input–output analysis, shift-share analysis, and principal component analysis. Lv (2005) [41] suggested that the selection of the leading industry should follow the law of industrial structure evolution, which involves judging the stage and degree of industrial structure in the process of industrialization based on quantitative standards. Given that the data we have are relatively complete, shift-share analysis can better reflect the benchmark of the comparative advantage between the target region and the reference region, as well as the growth prospects of industrial development (Khusaini, 2015; Lv et al., 2021) [42,43]. Moreover, shift-share analysis is one of the most common and mainstream methods used in recent years for selecting leading industries. The SSM method possesses the advantage of decomposition. But, similar to the location quotients, they are all constrained by the classification of the final product. Scholars have previously used location quotients or SSM methods for two-digit sub-sectors to measure the agglomeration or competitive edge level of the forestry industry; these measures have been obtained previously by adding output values from three-digit and four-digit sub-sectors. For example, a four-digit sub-sector with a higher degree of industrial agglomeration or competitive edge may have a lower score than two three-digit sub-sectors that were originally less agglomerated. Therefore, there is a risk of drawing distorted conclusions and introducing bias. To address this issue, we have categorized these three forestry industries into four-digit sub-sectors to prevent bias, corresponding to the period of national and provincial industrial planning; this method can effectively capture the dynamic changes in the forestry industry in Jiangsu province.

Additionally, regions with richer forest resources in China, such as Heilongjiang province, Fujian province, and Jiangxi province, have received more attention from researchers due to their substantial forested surface area and growing stock. However, Jiangsu province, a region with a lower forested surface area and forest stock volume, is characterized by poor forest resources, a characteristic that tends to lead researchers to overlook these areas. Do areas with poorer forest resources lack the ability to gain competitive industrial advantages? The Ninth National Forest Resources Inventory in 2018 revealed that Jiangsu accounted for only 0.54% and 0.50% of the national total in terms of forested surface area and standing timber volume, respectively. Despite having limited forest resources, Jiangsu's forestry industry made a significant contribution to the national forestry output value that year, accounting for 6.22%. This trend continued in 2021, with the forestry industry in Jiangsu reaching a total output value of CNY 520.9 billion. These figures have demonstrated that Jiangsu province is a distinctive region characterized by "small resource, large industry". What changes have taken place in the industrial structure of Jiangsu province's forestry sector? Relative to the national forestry industry, which sub-sector of forestry exhibits leading industry characteristics?

This study aims to determine the competitiveness of forestry sectors in Jiangsu province and identify the industrial structural changes in the forestry industry in this context. Shift-share analysis and location quotients are employed to identify sub-sectors with relative competitive advantages, totaling 17 sub-sectors (see Table A1), and investigate the industrial regional types. The research findings contribute to our understanding of the

development of forestry sectors in areas with limited resources. Meanwhile, they also serve as a theoretical reference for developing a strategy for Jiangsu's leading industry and as a guide to achieve accurate and reasonable industry goals.

2. Material and Methods

2.1. Material and Data

Jiangsu province is located in the central coastal region of eastern China, spanning from 30°45′ to 35°08′ north latitude and from 116°21′ to 121°56′ east longitude. It covers an area of 102,600 square kilometers, accounting for 1.06% of the total national land area. According to the Ninth National Forest Resources Inventory in 2018, Jiangsu's forested surface area and standing timber volume account for 0.54% and 0.45% of the national total, respectively. While Jiangsu province owns relatively limited forest resources, it is characterized by the presence of two major river systems, the Yangtze River and the Huai River, numerous lakes, and over 2900 rivers of various sizes. The region is rich in wetland resources, despite its limited forest coverage.

The data for the three industries and sub-sectors of forestry in Jiangsu province were derived from the *China Forestry Statistical Yearbook* from 1997 to 2022 (renamed *China Forestry and Grassland Statistical Yearbook* in 2018). Data for the forestry industry at the municipal level were obtained from the *Yancheng Statistical Yearbook*, *Suqian Statistical Yearbook*, *Huaian Statistical Yearbook*, *Xuzhou Statistical Yearbook*, *Yangzhou Statistical Yearbook*, *Lianyungang Statistical Yearbook*, *Changzhou Statistical Yearbook*, *Zhenjiang Statistical Yearbook*, *Taizhou Statistical Yearbook*, *Nanjing Statistical Yearbook*, *Wuxi Statistical Yearbook*, and *Nantong Statistical Yearbook*, covering the years from 2015 to 2022.

2.2. Shift-Share Analysis

The shift-share analysis (SSA for short) was initially proposed by American economists Daniel and Creame, and later summarized and gradually improved by scholars such as Dunn (1960), after which several variants emerged (e.g., Esteban-Marquillas, 1972) [44]. SSA aims to understand how regional economic variables change over time, using the economic development of a larger region or the whole country as a reference frame. Economic variables, such as the growth or decline of the economy or an industry in a region during a specific period, are divided into the following three parts: the national growth effect, the industrial mix effect, and the shift-share effect. This study uses the classical decomposition formula and includes the 'Homothetic Effect' proposed by Esteban-Marquillas (1972) [45]. Standardization (e'_j, (see Formula (1)) is introduced in the industrial mix effect to reflect the impact of the deviation (share of a certain industry) in the structure of the Jiangsu forestry industry compared to the national forestry industry on the growth of the Jiangsu forestry industry, which is in line with the theme of this study on industrial structure and industrial competitiveness.

We take Jiangsu province as the target region and China as the reference region. The amount of variation within the forestry sector j in Jiangsu province during the selected period is defined as FG_j, which consists of the following three components: the national growth effect ($N_j = \sum_{j=1}^{n} e'_j R_j$), the industrial mix effect ($P_j = \sum_{j=1}^{n} (e_{j0} - e'_j) R_j$), and the shift-share effect ($D_j = \sum_{j=1}^{n} e_{j0}(r_j - R_j)$), as shown in Formulas (2)–(4). e_{j0} and E_{j0} denote the output value of j sub-sectors in Jiangsu province and the national forestry sub-sectors during the selected base period, while e_{jt} and E_{jt} represent the output value of j sub-sectors in the selected final period. r_j and R_j represent the rates of output change of forestry sub-sector j in Jiangsu province and in China in the selected periods, respectively, as shown in Formulas (2) and (3). When the variables with identical expressions but opposite signs in Formula (4) cancel each other out, the original expression of $FG_j = \sum_{j=1}^{n} e_{j0}\, r_{jj}$ on the

left side of Equation (4) is regained. This also demonstrates that the SSM possesses robust decomposability.

$$e'_j = \frac{e_0 E_{j0}}{E_0} \quad (1)$$

$$r_j = \frac{e_{jt} - e_{j0}}{e_{j0}} \quad (2)$$

$$R_j = \frac{E_{jt} - E_{j0}}{E_{j0}} \quad (3)$$

$$FG_j = \sum_{j=1}^{n} e_{j0}\, r_j = \sum_{j=1}^{n} e'_j\, R_j + \sum_{j=1}^{n} (e_{j0} - e'_j) R_j + \sum_{j=1}^{n} e_{j0}(r_j - R_j) = N_j + P_j + D_j \; \mathrm{j} = 1 \cdots n \quad (4)$$

N_j represents the national average growth effect, indicating the change in the standardized output value of Jiangsu province's forestry sub-sector j based on the national average growth rate (see the left side of Formula (4)). P_j denotes the industrial mix effect; that is $((e_{j0} - e'_j)R_j)$, where $(e_{j0} - e'_j)$ shows how different the output value of sector j within the Jiangsu forestry industry is compared to the standardized output value during the base period, which takes into account the output change rate based on the national industry level (R_j). According to $(e_{j0} - e'_j) = e_0\left(\frac{e_{j0}}{e_0} - \frac{E_{j0}}{E_0}\right)$, the deviation above can be interpreted as whether there is a greater dominance of industrial structure within sub-sector j in Jiangsu province's forestry industry in the base period. The greater this deviation is, the more it contributes to industrial growth, and that is why P_j is also named the industrial structure effect. D_j refers to the deviation caused by the different growth rates of the forestry sub-sector j in Jiangsu and in the country as a whole, which demonstrates how competitive the forestry sub-sector j in Jiangsu is compared to the industry on a national level. The larger this value is, the greater the influence of industrial competitiveness on the output value of the forestry sub-sector j.

2.3. Classification of Industrial Regional Types of Forestry Sub-Sectors

In the majority of studies employing SSA, the decomposed industrial mix effect, which represents the changes in industrial structure, and the shift-share effect, which signifies industrial competitiveness, are plotted on a graph as horizontal and vertical coordinates to depict the relative position and scale of the analyzed industry (Ge and Liu, 2011; Xia and Zhou, 2013; Maspaitella and Parinusssa, 2021) [46–48]. Other scholars, particularly those who focus on multiple regions, utilize GIS technology to display the magnitude of these two effects (Dong and Li, 2022) [49]. In addition, some researchers employ decomposed variables to determine the types of industrial regions (Zeng et al., 2015b; Grčić et al., 2022) [50,51]. Since this study involves 17 sub-sectors and the data differ greatly, it is difficult to show the results in the figure. Based on the connotations of the industrial mix effect (P_j) and the shift-share effect (D_j), the following inferences are made by referring to previous research results and the matrix criteria. If $D_j < P_j$, this means that the growth level of sub-sector j in the target region is more influenced by the industrial structure effect; however, the extent to which the industrial structure effect drives the growth of this sub-sector depends on whether the other effect (D_j) is greater than zero. Therefore, if $0 < D_j < P_j$, the region of sub-sector j can be classified as a dominant zone in the industrial structure. If $D_j < 0 < P_j$, the target region of sub-sector j can be identified as a driving zone in the industrial structure. Similarly, if $D_j > P_j$, this indicates that the growth of sub-sector j in the target region is more influenced by the shift-share effect, which represents the level of competitiveness of the sector, and this also explains whether the region is a dominant zone or a driving zone in industrial competitiveness. The specific types of classification of industrial zones are described in Table 1 below.

Table 1. Classification of industrial regional types of forestry sub-sectors.

Regional Type	Definition and Description
Progressive type (P) $P_j > 0$ and $D_j > 0$	Type P_1: dominant zone in industrial structure $(0 < D_j < P_j)$; progressive type with dominant positive structural effect and positive competitive effect.
	Type P_2: dominant zone in industrial competitiveness $(0 < P_j < D_j)$; progressive type with dominant positive competitive effect and positive structural effect.
Medium type (M) $P_j > 0$ or $D_j > 0$	Type M_1: driving zone in industrial structure $(D_j < 0 < P_j)$; medium type with dominant positive structural effect and negative competitive effect.
	Type M_2: driving zone in industrial competitiveness $(P_j < 0 < D_j)$; medium type with dominant positive competitive effect and negative structural effect.
Regressive type (R) $P_j < 0$ and $D_j < 0$	Type R_1: lagging zone in industrial structure $(P_j < D_j < 0)$; regressive type with dominant negative structural effect and negative competitive effect.
	Type R_2: lagging zone in industrial competitiveness $(D_j < P_j < 0)$; regressive type with dominant negative competitive effect and negative structural effect.

2.4. Location Quotient

To detect industrial specialization, the location quotient (*LQ* for short) remains a simple and convenient calculation measure (Billings and Johnson, 2012; Feng, 2020) [52,53]. *LQ* represents the level of industrial specialization of sector *j* within forestry in Jiangsu. e_j and E_j represent the output value of sector *j* in Jiangsu and the entire country, respectively, while e and *E* denote the output value of the forestry industry in Jiangsu and in the country as a whole. If $LQ > 1$, this indicates that the supply capacity of sector *j* exceeds the demand capacity of Jiangsu province and that the sector has achieved specialization. If $LQ = 1$, this means that the supply capacity of sector *j* just meets the local demand. However, if $LQ < 1$, this implies that the supply capacity of sector *j* cannot meet the local demand.

$$LQ = \frac{e_j / e}{E_j / E} \tag{5}$$

2.5. Measurement of Engel Effect Within Forestry Industrial Structure

The Engel effect in industrial structure refers to the economic mechanism by which increasing income triggers demand changes for final products across the three industrial sectors [4]. This concept applies Engel's observation that as household income increases, the proportion of total expenditure spent on food gradually falls. The income elasticity of demand for three forestry industries is estimated using this concept, as Formula (6) shows. E_{fit} represents the income elasticity coefficient of demand for the *i*-th sector of three forestry industries at time t in Jiangsu province, FVA_{it} denotes the total demand value for the *i*-th sector of these three forestry sectors at time t in this province, ΔFVA_{it} represents the change in the total demand value for the *i*-th sector of these three sectors between periods t and $t-1$ in Jiangsu province, INC_t represents the disposable income of the provincial residents in period t, and ΔINC_t represents the variation in the disposable income of the provincial citizens between periods t and $t-1$. If $E_{fi} > 1$, this indicates a high-income elasticity of demand for the *i*-th sector, meaning that the increment in the demand of the *i*-th sector of these three sectors is greater than the corresponding increment in the disposable income of Jiangsu provincial residents; if $E_{fi} = 1$, this signifies that changes in income levels and variety in demand for the *i*-th sector of the three industries are proportionate; finally, if $0 < E_{fi} < 1$, this means a low-income elasticity of demand for the *i*-th sector of these sectors.

$$E_{fit} = \frac{\Delta FVA_{it} / FVA_{it}}{\Delta INC_t / INC_t} i = 1, 2, 3 \tag{6}$$

3. Results

3.1. The Typical Facts of the Structural Fluctuation in the Forestry Industry in Jiangsu Province

3.1.1. The Kuznets Facts of the Structural Fluctuation in the Forestry Industry in Jiangsu Province from a Supply Perspective

From a supply perspective, the shifting allocation of production capacity among the three forestry industries demonstrates the industry's internal structural changes. The proportion of the output value of the three forestry industries in Jiangsu province to the total national forestry output value for each year was calculated, as shown in Figure 1. It can be seen that during 1996–2001, the primary industry dominated forestry in Jiangsu province, accounting for more than 40% of the total output value of the forestry industry. After 2001, the proportion of the secondary industry within forestry increased rapidly, peaking at 68.41% in 2010, and its evolution process exhibited a typical pattern, namely rising and then falling. Additionally, the share of the tertiary industry gradually increased to 14.24% after 2012. During the period from 1996 to 2021, the forestry industry in Jiangsu province witnessed an industrial development from a low level to a high level, and this evolution pattern was aligned with the Kuznets facts.

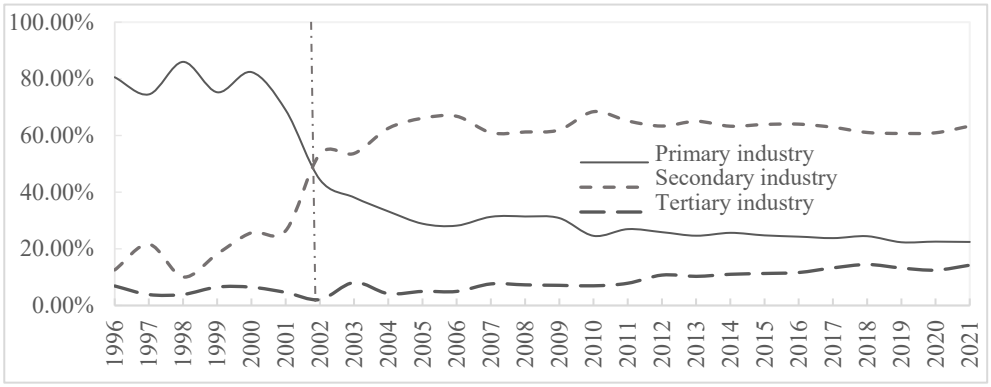


Figure 1. The Kuznets facts of the evolution of forestry's industrial structure in Jiangsu province between 1996 and 2021.

Source: The data were compiled from the *China Forestry Statistical Yearbook* (2007–2017) and the *China Forestry and Grassland Statistical Yearbook* (2018–2022). Calculations and design by authors (the same below).

3.1.2. The Engel Effect of the Structural Fluctuation in the Forestry Industry in Jiangsu Province from a Demand Perspective

From a demand perspective, the structural changes in the forestry industry reflect the distribution ratio and relationship of social purchasing power among the three forestry industries, which embody the demand structure in the three forestry industries. Jiangsu province is a more economically developed region in China. Its economic growth has benefited partly from increasing the disposable income of residents, which is encouraging the emergence of the Engel effect in the forestry industry. The time series of the Engel effect on forestry's industrial structure may indicate that the disposable income of residents resulted in increased demand for the forestry industry's final products. Let us suppose that the Engel effect exists in the industrial structure of forestry in Jiangsu province. In this case, there should be sequential signals of an increasing income elasticity of demand for products or services within the three industries (Table 2).

Table 2. The Engel effect of forestry industrial structure in Jiangsu province between 2006 and 2021.

Time	Income Elasticity of Demand for Products or Services in Forestry Industry				Gross Forestry Output Value (Hundred Million CNY)
	E_{f1}	E_{f2}	E_{f3}	E_f	
2002	3.17	27.58	−0.09	9.46	272.46
2003	1.90	3.20	28.45	3.16	421.60
2004	0.23	2.08	−2.00	1.04	505.39
2005	0.54	1.62	2.41	1.30	651.20
2006	0.43	0.66	0.58	0.59	717.17
2007	1.17	0.17	3.31	0.61	814.51
2008	0.81	0.81	0.51	0.79	937.41
2009	1.66	2.00	1.62	1.86	1136.47
2010	0.47	2.56	1.72	1.86	1559.88
2011	3.39	2.22	3.61	2.60	2291.62
2012	3.01	3.15	8.58	3.54	3099.36
2013	1.01	1.86	1.12	1.56	3608.6
2014	1.35	0.55	1.69	0.87	3897.66
2015	0.12	0.59	0.73	0.48	4084.33
2016	0.27	0.51	0.85	0.49	4256.42
2017	0.36	0.41	1.96	0.58	4527.06
2018	0.90	0.19	1.63	0.55	4738.99
2019	−0.97	0.47	−0.95	0.56	4893.45
2020	0.93	0.8	−0.66	0.72	5040.86
2021	0.20	0.52	1.25	0.24	5209.36

Source: the data were compiled from the *China Forestry Statistical Yearbook* (2003–2017), *China Forestry and Grassland Statistical Yearbook* (2018–2022), and *China Statistical Yearbook* (2007–2022).

Using data from 2002, when the output value of the primary industry was suppressed by that of the secondary industry, to 2021, the income elasticity of the forestry industry was calculated using Formula (6). In most years between 2002 and 2010, the income elasticity of goods from secondary forestry industries was higher than that of the tertiary forestry industry. Excluding the COVID-19 period (2019–2020) and 2013, the income elasticity of demand of the tertiary industry after 2011 has been much higher than that of the primary and secondary industries, especially during 2017–2018 and 2021. Here, $E_{f3} > 1$, indicating that the income elasticity of demand of the tertiary forestry industry in Jiangsu province has been relatively significant in recent years. During the same period, as income has grown, the income elasticity of demand for products within the forestry industry in Jiangsu province has increased from the primary industry through the secondary industry to the tertiary industry, implying that the Engel effect exists and has been significant in the forestry industrial structure in Jiangsu province. Significantly, the tertiary industry was affected severely by the COVID-19 pandemic.

3.2. The Evolutionary Trajectory of Industrial Regional Types in the Leading Forestry Sector

The sample data cover three 'Five-Year Plans'. The dynamic shifts in the industrial regional types should be taken into account to find the leading industry in Jiangsu's forestry industry. The following inferences are drawn based on the classification outlined in Section 2.3. Firstly, if a forestry sub-sector is initially classified as P_1, this implies a robust industrial structure foundation, and, sequentially, if the sector experiences a high growth rate, it will transition to P_2. Significant absolute values of P_2 always lead to a modest growth rate, less than other types with high growth rates and small absolute values; thus, P_2 may shift to M_1. Secondly, if a sector is assessed as P_2 originally, this indicates that the sector has a certain industrial structure advantage and high growth rate, and, if it later turns to P_1, this implies that, relative to the national level, the advantage of its industrial structure has been

enhanced; for the same reason as above, the industrial regional type will also become M_1. If the actual growth of M_1 declines continuously, its industrial regional type will turn to R type, indicating that it does not possess the fundamental characteristics of a leading forestry sub-sector. In cases where the initial type is M, evolutionary paths such as $M_2 \rightarrow P_1 \rightarrow P_2$ and $M_1 \rightarrow P_1 \rightarrow P_2$ may also emerge; the sector experiencing the $P_1/P_2 \leftrightarrow M_1/M_2$ evolutionary paths generally corresponds to the characteristics of a leading or competitive forestry sector.

3.3. The Shift-Share Approach of Forestry Sectors in Jiangsu Province

3.3.1. The Shift-Share Approach of the Three Industries of Forestry in Jiangsu Province

Table 3 displays the results of the SSA calculation and the classification of industrial regional types for the three forestry industries in Jiangsu province. The industrial regional types and decomposed components are analyzed as follows:

Table 3. SSA of forestry industrial structure in Jiangsu province between 2006 and 2020 (unit: hundred million CNY).

Forestry Industry	Period	FG_j	Nj	P_j	D_j	Industrial Regional Types	LQ Value
Primary industry	2006–2010	181.59	79.46	100.29	1.85	P_1	0.68
	2011–2015	394.02	184.86	326.71	−117.55	M_1	0.74
	2016–2020	100.71	74.76	149.61	−123.66	M_1	0.73
$Total_1$		676.32	339.08	576.61	−239.36		
Secondary industry	2006–2010	587.92	300.41	315.17	−27.66	M_1	1.30
	2011–2015	1116.63	644.62	537.24	−65.23	M_1	1.22
	2016–2020	384.21	182.79	186.92	−21.50	M_1	1.33
$Total_2$		2088.76	1127.82	1039.33	−114.39		
Tertiary industry	2006–2010	73.19	4.25	56.47	12.48	P_1	0.84
	2011–2015	282.06	37.69	366.65	−122.28	M_1	0.82
	2016–2020	134.60	55.40	265.96	−186.76	M_1	0.62
$Total_3$		489.85	97.34	689.08	−296.56		

The national growth effect (N_j) represents the increment in the three forestry industries in Jiangsu based on the growth rate of these industries at the national level. Thus, the larger the difference is between FG_j and N_j, the less dependency there is on the Jiangsu forestry industries (the target region) in contrast to the national forestry industries (the reference region). During the three Five-Year Plan periods, FG_j was always greater than N_j and the values of the two columns were greater than zero. The total forest growth of the three forestry industries (FG_j) in Jiangsu province amounted to CNY 676.32, 2088.76, and 489.85 billion, respectively, which were 1.99, 1.85, and 5.03 times greater than their national share scale. These numbers demonstrated that the tertiary forestry industry experienced a significant expansion rate and the secondary forestry industry achieved considerable scale within Jiangsu over the last 15 years.

The industrial mix effect (P_j) indicates whether the merit of the industrial structure of the three forestry industries in Jiangsu province is superior to the overall level of the reference region. From 2006 to 2020, all P_j values were greater than zero, which means that the advantage of the forestry industrial structure in Jiangsu Province surpassed that of the country as a whole, making a significant contribution to the development of the national forestry industry. Among them, the secondary industry accumulated the highest value in structural deviation, indicating a relatively stronger structure advantage than the national average level; it experienced rapid growth during the '11th Five-Year' and '12th Five-Year' periods but declined during the '13th Five-Year' period. Furthermore,

the tertiary industry demonstrated a large comparative advantage in industrial structure during the '12th Five-Year' and '13th Five-Year' periods.

The shift-share effect (D_j) shows how much the growth rate of sub-sector j in Jiangsu differs from the national average level, which reflects the industrial competitiveness of the forestry industry in Jiangsu province compared with that of the country as a whole. During the period from the '11th Five-Year' to the '13th Five-Year' periods, the primary, secondary, and tertiary forestry industries in Jiangsu province had mostly negative competition deviation compared to the national level, which indicates that their overall industrial competitiveness was not particularly prominent.

The primary and tertiary forestry industries in Jiangsu followed the evolution path of $P_1 \rightarrow M_1$ in terms of industrial regional types, indicating certain characteristics of a leading industry. During the three 'Five-Year Plan' periods, the secondary industry was defined as an M_1 type and its value of LQ was greater than one for the whole period, which implies that the secondary industry had a strong foundation in industrial structure and achieved specialization. Additionally, in the following sections, more authentic levels of industrial specialization or relative competitive advantage will be discussed using four digital decompositions.

3.3.2. Decomposition-Based Shift-Share Approach of Sub-Sectors of Forestry Industry in Jiangsu Province

The forestry industry is a complex entity with a long industrial chain. According to the industrial catalog, it encompasses 17 sub-sectors. These sub-sectors, decomposed from the three forestry industries in Jiangsu province, were identified using SSA and LQ and categorized into different industrial regional types (see Tables 4–6). Among the sub-sectors within the primary industry in Jiangsu, the Economic forest product sector and the Flower cultivation sector exhibited the characteristics of leading industries, as evident in their evolutionary paths, which followed $P_1/P_2 \leftrightarrow M_1/M_2$, and their output values (FG_j), which were higher than the national average growth effect (N_j). Although the LQ value for the Economic forest product sector was not greater than one, it still showed a few increments. Currently, China has almost 1000 species of economic forest trees in its forests, with only about 60 species having been widely planted. As a result, there is a low level of substitution for economic forest products because of the longer production cycles and the limitations of site conditions, which is the reason why the Economic forest product sector is considered a leading industry.

Table 4. The SSA of the industrial structure of sub-sectors within the primary forestry industry in Jiangsu province between 2006 and 2020 (unit: hundred million CNY).

Period	Sub-Sector	Type	FG_j	N_j	LQ Value
2006–2010	Forest planting sector	M_1	55.88	13.29	1.56
2011–2015		M_1	150.11	26.73	1.30
2016–2020		M_1	19.18	11.34	1.22
2006–2010	Timber transportation sector	M_1	−1.66	1.58	0.55
2011–2015		M_1	−12.43	0.20	0.4
2016–2020		M_1	−12.52	0.36	0.57
2006–2010	Economic forest product sector	P_1	61.04	24.44	0.33
2011–2015		P_2	233.88	84.45	0.46
2016–2020		M_1	62.66	61.48	0.49
2006–2010	Flower cultivation sector	P_2	59.63	2.2	1.92
2011–2015		M_1	56.21	16.81	1.71
2016–2020		M_1	36.56	5.09	1.56
2006–2010	Wildlife utilization sector	M_1	−1.78	0.16	0.47
2011–2015		M_1	1.88	0.10	0.78
2016–2020		R_1	−3.30	−0.07	1.15

Table 5. The SSA of the industrial structure of sub-sectors within the secondary forestry industry in Jiangsu province between 2006 and 2020 (unit: hundred million CNY).

Period	Sub-Sector	Type	FG_j	N_j	*LQ* Value
2006–2010	Wood processing sector	M_1	245.08	190.8	2.13
2011–2015		P_1	780.02	236.12	1.85
2016–2020		P_1	317.74	94.31	2.23
2006–2010	Furniture manufacturing sector	P_2	58.48	1.40	0.49
2011–2015		M_1	64.39	11.54	0.34
2016–2020		P_2	89.78	6.20	0.52
2006–2010	Wood paper-making sector	P_2	167.5	3.92	0.42
2011–2015		P_2	167.82	21.72	0.97
2016–2020		M_1	73.47	18.26	1.06
2006–2010	Forest chemical product sector	M_1	−8.01	0.31	0.19
2011–2015		M_1	−56.58	0.14	1.49
2016–2020		M_2	66.16	−0.32	1.88
2006–2010	Wooden crafts sector	M_1	−1.90	0.13	0.60
2011–2015		P_1	12.51	0.16	0.56
2016–2020		M_1	0.11	0.49	0.50
2006–2010	Non-timber forest product sector	P_2	26.12	0.45	1.84
2011–2015		P_1	174.34	11.24	0.59
2016–2020		M_1	−59.89	3.42	0.64

Table 6. The SSA of the industrial structure of sub-sectors within the tertiary forestry industry in Jiangsu province between 2006 and 2020 (unit: hundred million CNY).

Period	Sub-Sector	Type	FG_j	N_j	*LQ* Value
2006–2010	Forestry tourism sector	P_2	50.42	12.11	0.48
2011–2015		M_1	186.84	154.84	0.64
2016–2020		M_1	117.02	165.70	0.53
2006–2010	Ecological service sector	-	-	-	-
2011–2015		M_1	28.37	3.43	1.71
2016–2020		M_1	3.00	1.74	1.02
2006–2010	Forestry product service sector	-	-	-	-
2011–2015		-	-	-	-
2016–2020		M_1	33.77	1.39	1.56
2006–2010	Forestry technical servicesector	M_1	1.53	0.09	1.63
2011–2015		M_1	8.40	0.59	2.18
2016–2020		M_1	4.72	0.18	1.38
2006–2010	Forestry public service sector	M_1	−4.35	1.48	1.37
2011–2015		M_1	16.82	3.60	1.79
2016–2020		M_1	−13.12	0.81	1.36
2006–2010	Non-forestry service sector	-	-	-	-
2011–2015		M_1	3.65	1.09	0.28
2016–2020		P_2	34.55	0.28	0.30

Note: "-" indicates that data are not available for the specified period.

There are prominent differences from those presented in Table 3 for the secondary industry M_1 type. From the four-digit sub-sector angle, the Wood processing sector, the Furniture manufacturing sector, the Wood paper-making sector, and the Non-timber forest product (NTFP for short) sector are considered to be leading industries within the secondary industry, considering their industrial regional type evolutionary paths, which were $P_1/P_2 \rightarrow M_1/M_2$, and their output values (FG_j), which exceeded the national average growth effect (N_j) (see Table 5). Despite the negative growth of the NTFP sector during the 'Thirteenth Five-Year Plan' period, because the NTFP sector may have a forward correlation with the Economic forest product sector in the primary industry, this will increase the processing of forest products, forming a positive external sub-sector cycle. Although the *LQ* value for the Furniture manufacturing sector was less than one, the Wood processing sector and the Furniture manufacturing sector are forward-integrated sub-sectors, and this

relationship benefits furniture companies by providing low-cost wood and rattan boards and encouraging cooperation among companies.

Among sub-sectors within the tertiary industry in Jiangsu, the Forestry tourism sector, the Ecological service sector, and the Non-forestry service sector demonstrate the characteristic features of leading industries, which can be attributed to the evolutionary paths of the two sub-sectors aligning with $P_1/P_2 \leftrightarrow M_1/M_2$, their output values ($FG_j$) surpassing the national growth effect (N_j) (see Table 6), and the Engel effect in the tertiary industry being more prominent (see Table 2), excluding the period of the COVID-19 pandemic. This implies that an increase in consumer income leads to increased spending on products and services in the tertiary industry, despite the lower LQ. Meanwhile, scholars argue that consumers' preferences for these products and services are non-homothetic; that is, their utilities depend not only on the number of products but also on variety and distinctiveness (Zhang and Xiong, 2021) [54]. Jiangsu province is situated in the central coastal region of east China and is distinguished by two major river systems, the Yangtze River and the Huai River, and its proximity to lakes and seas. The province possesses abundant wetland resources, ranking first nationwide. Additionally, Jiangsu province has a distinctive ecological landscape which facilitates the formation of a local market effect.

4. Summary and Recommendations

4.1. Summary

This study aims to establish an intrinsic link between the fluctuating industrial structure and the selection of leading sectors from the 17 sub-sectors of the forestry industry in Jiangsu province.

The analysis yields the following findings: Firstly, in recent years, the structure of Jiangsu province's forestry industry has demonstrated typical "Kuznets facts" and a typical "Engel effect". Furthermore, the industrial structural change has facilitated the process of valuing ecological products. Notably, the tertiary forestry industry exhibits a higher income elasticity and leads in sub-sectors such as the Forestry tourism sector and the Ecological service sector. Secondly, Jiangsu province's forestry is a paradox. It has developed a large-scale industry, even though its forest resources are poor and the industry's growth rate is slightly below the national average. Thirdly, the secondary forestry industry in Jiangsu province has been the primary driver of growth in the forestry industry, with each sub-sector having an established place in the industrial structure. Sub-sectors such as the Wood processing sector, the Furniture manufacturing sector, the Wood paper-making sector, and the NTFP sector all display distinct signs of being leading sectors. Fourthly, the primary forestry industry has played a significant role in the growth of the forestry industry as a whole. Except for the Wildlife utilization sector, all sub-sectors have solid industrial structure merit. The Flower cultivation sector and the Economic forest product sector show strong leading industry characteristics. Finally, the tertiary forestry industry, however, contributes less to the growth of the forestry industry. Each sub-sector has a good industrial structure foundation, with the Forestry tourism sector, the Ecological service sector, and the Non-forestry service sector exhibiting promising leading industry characteristics.

4.2. Recommendations

Upon investigation, municipal data for all sub-sectors are actually incomplete for Jiangsu province. Thus, this study proposes four suggestions, combining theoretical angles and empirical investigations, to focus on the development of these sub-sectors.

First, inter-sector integration within Jiangsu province's forestry industry requires enhancement, which would benefit the valuation of ecological goods and services and foster the high-quality development of leading sectors. Theoretically, structural changes

within an industry are often driven by variations in quantitative demand, income elasticity of demand, and factor productivity across sub-sectors. These changes can manifest as inter-sector integration in the forestry sector, given its significant dependence on regional spatial natural resources, especially forest resources, which differ from the three industries in the traditional economy. The degree of inter-sector integration between the primary and tertiary sectors in the forestry industry is contingent upon their differences in income elasticity and the utilization of shared spatially dependent natural resources, in contrast to the secondary forestry sector, which can leverage more tradable production factors.

Second, enhancing the collaborative agglomeration and using cleaner production technology in sub-sectors within Jiangsu's secondary forestry industry is essential for promoting this industry's comprehensive upgrade. The three leading sectors—the Wood processing sector, the Furniture manufacturing sector, and the Wood paper-making sector—are interconnected through their supply and demand relationships. Strengthening this collaborative agglomeration will not only reduce production costs but also optimize resource allocation. Moreover, the Suzhou Likou furniture market is the second largest in China and the largest in east China, which can reduce transaction costs and provide the locative advantage characteristic of leading industries. Furniture manufacturing and wood processing enterprises are predominantly concentrated in Suqian, Huai'an, Yangzhou, and Changzhou, accounting for 55.47% of the provincial total output in 2020. Notably, wood processing products, wood products, and wood-based panel products represented 6.57%, 18.80%, and 14.88% of the national totals, respectively. Additionally, following the "Guidance Catalogue for Industrial Structure Adjustment" and the regulatory policies implemented by the National Development and Reform Commission, effective 1 January 2021, the production process of wet fiberboard has been phased out. Furthermore, production lines for plywood and particle boards with an annual output below 10,000 cubic meters have been subject to regulation. These changes in industrial policy push the industry toward resource-efficient, eco-friendly methods, driving overall sector advancement and upgrading.

Third, leveraging e-commerce clusters or social networks in the primary forestry industry's two most prominent sectors, namely the Flower cultivation sector and the Economic forest product sector, can enable the implementation of a "one district, one product" strategy. This is a form of cross-industry integration that would facilitate the development of regional brands. Key productive regions for flower and seedling cultivation include Shuyang County, Jurong City, Jintan City, and Rugao City. Several regions have developed e-commerce clusters, known as "Taobao villages" and "Taobao towns". For example, Miaotou Town in Suqian City has successfully integrated "e-commerce with gardening", resulting in its vegetable seedlings being sold online. In 2020, Miaotou was recognized as a state-level industrial village, with its unique products surpassing a value of CYN 10 billion. In contrast, the Economic forest product sector is relatively dispersed. The primary products are ginkgo nuts (predominant ginkgo production areas are located in Shuyang County in Suqian City, Xuanbu Town in Taixing City, Tiefu Town in Pizhou City, Xuzhou City, etc.), walnuts (predominant productive areas of walnuts are located in Xiangshui County in Yancheng City), figs (principal productive areas of figs are distributed in Rudong County in Nantong City, Fuan Town in Dongtai City, Yancheng, Jurong City, and Jiangning and Lishui Districts in Nanjing City), tea (predominant tea-producing regions are situated in Wuzhong District in Suzhou City, Gaochun and Pukou Districts in Nanjing City, Dantu District in Zhenjiang City, and Jintan District in Changzhou City), and silkworms (predominant silkworm-producing areas are in Fuan Town in Dongtai City, Tieshan District in Xuzhou City, and Zhonglou District in Hai'an City); however, only some farmers utilize live broadcasts on e-commerce platforms for sales. Therefore, agriculture and forestry

departments should provide free e-commerce training programs. Such initiatives could harness farmers' social networks to enhance regional geographic branding efforts.

Lastly, Jiangsu's tertiary forestry industry should capitalize on its wetland resources to boost the value of its ecological products. This is essential for both environmental protection and economic growth. Jiangsu province, circled by lakes and seas, has 2,821,900 hectares of wetlands, accounting for 27.5% of its surface area. Moreover, 49.8% of its natural wetlands are preserved. Wetlands form the cornerstone of the local ecology. Two sites hold international prestige, while five boast national significance. Provincial-level designations abound; there are 71 wetland parks and 71 forest reserves. The region's natural charm extends to 22 scenic areas, which are region-certified or higher. This network of protected spaces safeguards vital ecosystems. Among these natural wetlands, the Yancheng Yellow Sea wetland, the largest coastal wetland on the edge of the Asian continent, stands out for its exceptional ecological protection. In July 2019, the coastal wetland was designated as a World Natural Heritage site by UNESCO. Wetland reserves and forest parks can develop a range of products, including eco-tourism, scientific research tourism, nature education, forest experiences, and forest healthcare. Meanwhile, forestry authorities can explore developing wetland carbon sink trading products to strike a balance between ecological protection and economic development.

5. Discussion and Limitations

5.1. Discussion

5.1.1. The Interaction Between Forest Resources and the Forestry Industry at the Provincial Level

This study aligns with previous research on forest resources and provincial forestry industrial development, yet it centers on a distinct objective. Zhang et al. (2018) found a positive relationship between Zhejiang province's forestry industry and its forest resources, using the EKC (Environmental Kuznets Curve) model [55]. The perspective that treats the forestry industry as an independent system is consistent with this paper. However, Zhang's article did not emphasize Zhejiang's industrial competitiveness. According to the tenth national forest resources survey, Zhejiang province possesses 2.03% of the nation's forested surface area and 2.00% of its standing timber volume and contributes 6.26% to the national output value. In contrast, Jiangsu province accounts for 0.54% of the country's forested surface area and 0.46% of its standing timber volume, with an output value of 5.64% of the national total. Applying the same method could result in a larger variable coefficient for Jiangsu province.

5.1.2. The Inter-Relationship Between Forest Resource Abundance, Forest Resource Dependence, and Regional Economic Growth

The forest resources' scarcity paradoxically reflects the abundance of such resources. Liu (2015) and Wang (2020) have explored the "forest resource curse", with their findings partially overlapping with this study. The two researchers agree that the Jiangsu province forest resource curse does not exist. Despite these similarities, the conclusions drawn by Liu and Wang differ. Liu (2015) argues that abundant forest resources boost regional economies. This implies no evidence of a forest resource curse. However, reliance on these resources is a key factor [56]. Conversely, Wang (2020) identifies Tibet and Jilin provinces as high-risk areas for the forest resource curse [57].

5.2. Limitations

This study has several limitations. First, it lacks an effective exploration of the leading forestry industry at Jiangsu's municipal level. Our survey highlighted a troubling trend in Jiangsu's Wood processing sector. Some enterprises have relocated due to environmental

regulations. They chose this over adopting clean technology at their current sites. Future studies should consider the issue of potential enterprise relocation which affects the competitiveness of the Wood processing sector in the future. Second, the analysis of industrial structure only considers supply and demand perspectives. Jiangsu's tertiary industry demand is more responsive to disposable income, though its secondary forestry industry has an output value 4.26 times higher than its tertiary industry. This implies that, in response to changes in the industrial structure, this paper focuses primarily on the valuation of natural resources and the enhancement in industrial competitiveness. Consequently, it does not delve into a more detailed analysis of industrial structure transformation. Current methods for measuring industrial change focus on three sectors for final products. Future research should establish spatial panel models that improve the connection between the forestry industry's structure and its competitiveness.

6. Conclusions

This study explores the forestry sector's competitiveness in Jiangsu province, a region with limited forest resources. First, changes in the forestry structural industry are described from both supply and demand perspectives, which indicates that the tertiary forestry industry has a higher income elasticity of demand than the primary and secondary sectors. So, Jiangsu province can boost the value of its ecological products by exploiting this shift in demand, and the forestry industry has a long supply chain. So, we should facilitate the allocation of production factors toward the tertiary sector to enhance the degree of forestry inter-sector integration. Second, many sub-sector clusters exist, especially in the secondary forestry industry. However, there has been a regional shift within the province. Clean production technologies have not gained widespread adoption. These factors may impede the future competitiveness of these subsectors. Third, boosting digital literacy among these sectors can develop their human capital level. This study provides a valuable reference case for developing forestry industries in regions with scarce forest resources, offering strategic insights for planning and managing Jiangsu province's forestry sectors.

The results of this study not only involve the decomposition of variables using the SSM method to classify regional industry types but also employ matrix thinking to derive insights that align with the five-year planning of leading industries. The sector that establishes the evolution path for $P \leftrightarrow M$ industrial regional types exhibits characteristics typical of a leading industry. Furthermore, this study analyzes how the selection of final product categorization and the number of digits can introduce measurement biases in industrial competitiveness, contingent upon the specific research question. Consequently, similar issues may be addressed by revising the method. The SSM method, grounded in the theory of spatial disequilibrium development, is a widely used analytical tool. This paper adopts the Esteban-Marquillas model, and spatial deviation-share analysis could be considered for multi-region studies to mitigate uncertainties associated with spatial factors.

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Appendix A

Table A1. Abbreviated name of three forestry industries and their sub-sectors.

Abbreviation in the Main Text	Full Name of Primary Forestry Sector
Forest planting sector	Cultivation and planting of forest trees
Timber transportation sector	Harvesting and transportation of timber and bamboo
Economic forest product sector	Cultivation and collection of economic forest products
Flower cultivation sector	Cultivation of flowers
Wildlife utilization sector	Breeding and utilization of terrestrial wildlife
Abbreviation in the Main Text	**Full Name of Secondary Forestry Sector**
Wood processing sector	Wood processing and wood, bamboo, rattan, palm, and reed manufacturing
Furniture manufacturing sector	Wood, bamboo, and rattan furniture manufacturing
Wood paper-making sector	Wood, bamboo, and reed pulp paper making
Forest chemical product sector	Forest chemical products manufacturing
Wooden crafts sector	Wooden crafts manufacturing
Non-timber forest product sector	Non-timber forest product processing manufacturing
Abbreviation in the Main Text	**Full Name of Tertiary Forestry Sector**
Forestry product service sector	Forestry production services
Forestry tourism sector	Forestry tourism and leisure services
Ecological service sector	Forestry ecological service
Forestry technical service sector	Forestry professional technical service
Forestry public service sector	Forestry public management and service
Non-forestry service sector	Non-forestry industries in the forestry system

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