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Human Resource Allocation in the State-Owned Forest Farm of China for the Changing Climate

Xiaofang Deng [1], Junkui Li [1,*], Lijuan Su [1], Shan Zhao [1] and Shaofei Jin [2,*]

[1] National Academy of Forestry and Grassland Administration of China, Beijing 102600, China
[2] Department of Geography, Minjiang University, Fuzhou 350108, China
* Correspondence: lgyxshqk@163.com (J.L.); jinsf@tea.ac.cn (S.J.); Tel.: +86-188-5010-2506 (S.J.)

Abstract: Global climate change has become a hot topic in today's international political, economic, environmental and diplomatic arenas. China has implemented a series of strategies, measures and actions to cope with climate change, which has promoted industrial transformation and human resource adjustment in China's state-owned forest areas. However, little is known about the role of current human resource allocation in adaptation to climate change in the state-owned forest farm of China. To address these gaps, this study calculated the current situation of human resource structure and the contribution rate of three industries to the allocation of human resources and the evaluation model of coordinated fitness to the climate changes in key state-owned forest farms. The results show that: (1) The current situation of talent in key state-owned forest areas shows a shortage of total amount, a shortage of high-level and highly educated talents, and aging of talents. (2) The coefficient of structural deviation increased and the coefficient of structural-change synergy kept decreasing, indicating that the coordination between human resource allocation and industrial structure in key state-owned forest areas nowadays is only at the intermediate level of synergistic fitness. The paper highlights the trained-professional human resource and the industrial structure changes in the context of climate change as the main limited factors for the key state-owned forest farms of China. Increasing the education investment for climate change and the economic income for the employees are suggested to be promoted for policy makers in future.

Keywords: state-owned forest farms; human resource allocation; industrial structure; coordination and adaptation; personal structure

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1. Introduction

The crisis brought about by climate change is a daily occurrence, and the Copenhagen Global Climate Change Summit in Denmark began to generate unprecedented global attention towards ecological protection and global warming. Since the 21st century, China has been very sensitive to global climate change and has gradually changed its strategy of trading the environment for economic growth, and has begun to establish a red line for ecological protection. The 17th National Congress of the Communist Party of China (CPC) included the Scientific Outlook on Development in the Party Constitution, the 18th National Congress of the CPC included the Scientific Outlook on Development in the Party's guiding ideology, and the 19th National Congress of the CPC held in 2017 made significant innovations in both theoretical thinking and practical initiatives for the construction of ecological civilization, including "Harmonious coexistence between human beings and nature" in the new era of adherence to and development of the country, all of which reflect the importance China attaches to environmental protection and sustainable development and its role as a great nation. Northeast and Inner Mongolia state-owned forest areas are an important part of China's forestry construction and development, the largest forest reserve resource cultivation base and timber and forest by-product supply base, and play an important role in the construction of the forestry ecological system, as

well as an irreplaceable ecological barrier for the country. Additionally, in the context of global warming, in order to further protect the ecological environment, China launched the implementation of the natural forest resources protection project for state-owned forest areas in 2000, and started to implement the policy of completely stopping commercial logging of natural forests in key state-owned forest areas in Northeast China and Inner Mongolia in 2015, which brings great challenges to the development of forestry economy in China's state-owned forest areas, but also brings important opportunities for industrial transformation. Green water and green mountains are golden mountains, and protecting ecology is the process of protecting natural values and value-added natural capital, and protecting the potential and backbone of economic and social development [1]. In the context of global warming, the development strategy of ecological civilization has put forward higher requirements for the development of state-owned forest areas, promoting the change in the forestry development mode of state-owned forest areas from timber-production-oriented to ecological-restoration-and-construction-oriented, and from using forest resources for economic benefits to protecting forests and providing ecological services [2]. The change in the development model represents a comprehensive transformation of the social, economic, and ecological fields in state-owned forest areas, and will inevitably have a significant impact on the human resource structure of state-owned forest areas.

In the context of global climate change, key state-owned forest farms in China have been influenced by relevant national policies, and industrial transformation has been more drastic and rapid. In this process, especially after the implementation of the natural forest protection project, the interaction and coordination between human resources allocation and industrial structure is of great significance in promoting the development of forestry economic transformation, but this issue has not yet received extensive attention. Therefore, we make assumptions: (1). Climate change has an impact on the personal structure of key state-owned forest areas. (2). Climate change has an impact on the industrial structure of key state-owned forest areas. (3). Under the background of climate change, the allocation of human resources and the coordination and adaptability of industrial structure in key state-owned forest areas have changed.

The aims of this study are to (1) explore the current situation of the team of state-owned forest farms; (2) discover the coordination of human resource allocation and industrial structure. Following these aims, this study can support scientific evidence for the future transformation and development of state-owned forest farms in team construction. Deeply, this study can put forward countermeasures and suggestions to strengthen team construction within a larger and more reasonable framework to provide strong support for the reform and development of state-owned forest farms and forestry and grassland industry.

This paper is organized as follows. The Introduction section introduces the research background, literature review and theoretical analysis. The Materials and Methods section explains the research design and data processing. The Results section describes the empirical results and analysis. The last section offers discussion, conclusions and policy recommendations.

1.1. Literature Review

Human resources are an important subject of social and economic construction and development, and many scholars have studied the importance of human resources: Schultz believes that human capital is a form of capital that expresses the indicators including mental and physical labor condensed on the workers themselves in the form of quantity [3–5]; Becker believes that human capital is the cost of investment in human resources. Additionally, this investment is mainly in the form of money to influence the monetary income and psychological activities of the talent [6,7]. As the most basic production factor in the industrial sector, the reasonable allocation of forest workers will not only affect the effective performance of social productivity and the optimization and upgrading of industrial structure, but also affect the smooth transformation and development of the state-owned forest economy. The study of human resource allocation and industrial structure has been

a key concern in economics, and British economists put forward the "Allotment-Clark theorem", which holds that with the increase in productivity and per capita national income level, labor force employment is gradually transferred from primary industry to secondary and tertiary industries until tertiary industry employment takes absolute advantage [8]. Some scholars further explored the law of change in industrial structure and verified the theorem based on the time series data of 57 countries with different levels of development around the world [9], after which American economists also put forward the theory that employment structure transformation lags behind industrial structure transformation [10]. With the development of China's economy, the problem of rational allocation of human resources and industrial structure has gradually emerged, and more scholars have studied the relationship between economic growth and employment, the relationship between three industrial structures and employment in three industries, the impact of industrial structure upgrading on employment structure, the relationship between tertiary industry development and employment, and the interaction mechanism between talent structure and industrial structure in China [11–13], but state-owned forest areas as the key area of reform in the context of climate change. However, as a key area of reform in China under the context of climate change, not much attention has been paid to the human resource allocation problem in state-owned forest areas in the existing relevant studies, and they mainly focus on the development of micro subjects and their measurement, and labor migration [9,14–22].

1.2. Theoretical Contribution

According to the review for the existing theoretical research, the main contribution of this study is to extend the talent predicament theory. To adapt to climate change, state-owned forest farms in China have undertaken substantial activities to relieve the negative effect of global warming. The talent predicament occurred because the professional employees were needed when implementing these activities [23,24]. Therefore, this study can connect the talent predicament theory with climate change. The second contribution is to extend the study area of the climate change, from the physical theory to the human resource theory. As one of the consequences of climate change, state-owned forest farms in China are facing industrial transformation to better deal with the climate change; the human resource is also coevolutionary to these changes. Therefore, in the context of global warming and industrial transformation of state-owned forest areas in China, it is of great practical significance to study the coordinated allocation of industrial structure and human resources in state-owned forest areas to promote the development of economic and social transformation of state-owned forest areas.

2. Materials and Methods

In this section, two sub-sections were designed to describe the detailed calculation processes to address the aims concerned in this study. The first part is to introduce the data sources from where the data were obtained. The second part is to draw the entire models.

2.1. Data Sources

Data on the output value and number of employed persons in each industry from 1998 to 2018 were obtained from the *China Forestry and Grassland Statistical Yearbook* (1998–2018). As the *China Forestry and Grassland Statistical Yearbook* no longer provides statistics on the number of people employed in each industry after 2018, only specific data for the period 1998–2018 will be analyzed.

This study conducted a questionnaire survey from October to December 2021 using paper and electronic questionnaires to employees at all levels in key state-owned forest areas in China; 800 documents were distributed and 731 valid questionnaires were received. In general, the workforce in key state-owned forest farms is characterized by an obvious aging trend, a low level of education, unreasonable job title levels, diverse professional backgrounds and generally low incomes, etc. Various types of workforces have not had

many opportunities to participate in training and learning in recent years, and problems such as insufficient updating of knowledge, more serious brain drain and the need to strengthen their ability to perform their duties are also prominent.

2.2. Data Processing Methods

In this sub-section, the data model of the industrial structure and human resource industry structure and the construction of a coordinated suitability evaluation model are described, respectively.

2.2.1. Industrial Structure and Human Resource Industry Structure

This study explores the regional industrial structure in terms of the share of each industry in the regional economy in the total regional output, and measures its human resource industrial structure in terms of the share of the population employed in each industry in the total regional employment [18].

2.2.2. Coordinated Suitability Evaluation Model Construction

The evaluation model of the degree of coordination and appropriateness mainly constructs the structural deviation coefficient, structure departure degree coefficient and structural-change synergy coefficient to quantitatively evaluate the degree of synergy and appropriateness between the existing human resources allocation and industrial structure in key state-owned forest farms. The quantitative evaluation of the degree of synergistic appropriateness between the existing human resource allocation and industrial structure in key state-owned forest farms is calculated as follows [19,20]:

The structural deviation coefficient is a measure of the match with human resources at the level of a single industry. When the structural deviation coefficient is greater than zero, it indicates that the growth in output value of the industry is ahead of the growth in employment of people, indicating that the industry can absorb more people into employment. When the structural deviation coefficient is less than zero, it means that the growth of output value of the industry lags behind the growth of employment, indicating that there is already a certain number of hidden unemployed people in the industry, and this excessive number of people should be squeezed out from the industry. The closer the structural deviation coefficient is to zero, the more the industrial structure of the industry tends to match the human resource structure. The formula for the structural deviation coefficient is:

$$D_i = P_i / W_i - 1 \quad (1)$$

where D_i is the deviation coefficient of the structure of industry i; P_i is the ratio of the output value of industry i to the total output value of the forestry industry in that year (%); W_i is the ratio of the number of persons in industry i to the total number of employed persons at the end of the year (%).

The structure departure degree coefficient assesses the extent to which the industrial structure and human resources move in tandem at the overall regional level. The structure departure degree coefficient represents the difference between the distribution of human resources allocation and industrial structure in terms of "mean", while the structural deviation function measures the suitability of human resources and industrial structure between different regions in terms of "variance". The larger the actual measured value of the total variance function (L_{P-W}), the greater the variance between the human resource allocation and industrial structure of the region, and the less synchronous the development; conversely, the smaller the actual measured value (closer to zero), the more synchronous the development of the human resource structure and industrial structure of the region, and the closer to reasonable. The formula is:

$$L_{P-W} = \sum_{i=1}^{3} |P_i - W_i| \quad (2)$$

The structural-change coefficient describes the dynamic adaptation of the regional human resources due to changes in the industrial structure. The mathematical nature of the structural-change coefficient (C_{P-W}) shows that $0 \leq C_{P-W} \leq 1$. The closer the actual measured value of C_{P-W} is to 1, the better the synergistic change property between the 2 structures in the region, i.e., the more sensitive the change in human resources is to the change in industrial structure. The equation for the structural-change synergy function is

$$C_{P-W} = \frac{\sum_{i=1}^{3} P_i W_i}{\sqrt{\sum_{i=1}^{3} P_i{}^2 \sum_{i=1}^{3} W_i{}^2}} \quad (3)$$

using the grading standard of coordination fitness formulated, i.e., coordination fitness grade. It refers to dividing the range of coordination fitness into several continuous intervals; that is, dividing the coordination degree from 0 to 1 into 10 level intervals, each interval represents a coordination level, and each level represents a kind of coordination state, so as to form a continuous ladder (Table 1).

Table 1. Harmonized suitability grading scale.

C_{P-W} in the Interval	Degree of Coordination and Adaptation
Excellent coordination and adaptation	1.00 to 0.90
Good coordination and adaptation	0.89 to 0.80
Intermediate coordination adaptation	0.79 to 0.70
Primary coordination adaptation	0.69 to 0.60
Critical coordination adaptation	0.59 to 0.50
On the verge of maladjustment	0.49 to 0.40
Mild maladjustment	0.39 to 0.30
Moderate adaptation detuning	0.29 to 0.20
Severe maladjustment	0.19 to 0.10
Extremely well adapted to detuning	0.09 to 0.00

A linear regression analysis was used to investigate the trends in industrial structure, human resource structure, structural deviation coefficient, structure departure degree coefficient and structural-change coefficient in key state-owned forest farms during 1998–2018. The S-W test showed that all indicators were approximately normally distributed except for the structural deviation coefficients of secondary and tertiary industries, and data that did not conform to normal distribution were processed by taking the natural logarithm e.

3. Results

In this section, three sub-sections were displayed to answer, for the state-owned forest farms, (1) the current situation of the personal structure; (2) changes in industrial structure and human resource allocation; and (3) changes in human resource allocation and industrial structure coordination and adaptation, respectively.

3.1. Analysis of the Current Situation of the Personal Structure in State-Owned Forest Farms

The sample survey workers returned 731 questionnaires. In terms of academic structure, among the 731 people surveyed, 17 had postgraduate degrees, accounting for 2.33% of the total; 262 had undergraduate degrees, accounting for 35.84% of the total; 241 had college (secondary) degrees, accounting for 32.97% of the total; and 211 had high school degrees or below, accounting for 28.86% of the total (Figure 1). In terms of the structure of titles, among the 731 people surveyed, 143 had senior titles, accounting for 19.56% of the total; 205 had intermediate titles, accounting for 28.04% of the total; 154 had junior titles, accounting for 21.07% of the total; and 229 had no titles, accounting for 31.33% of the total (Figure 2). In terms of the gender and age structure of the trained human resources, among the 731 people surveyed, there were 497 men, accounting for 67.99% of the total; and 234 women, accounting for 32.01%. There were 92 young trained human resources

under 35 years old, accounting for 12.59% of the total; 437 trained human resources aged 36–50, accounting for 59.78% of the total; and 202 people aged 50 or above, accounting for 27.63% of the total (Figure 3).

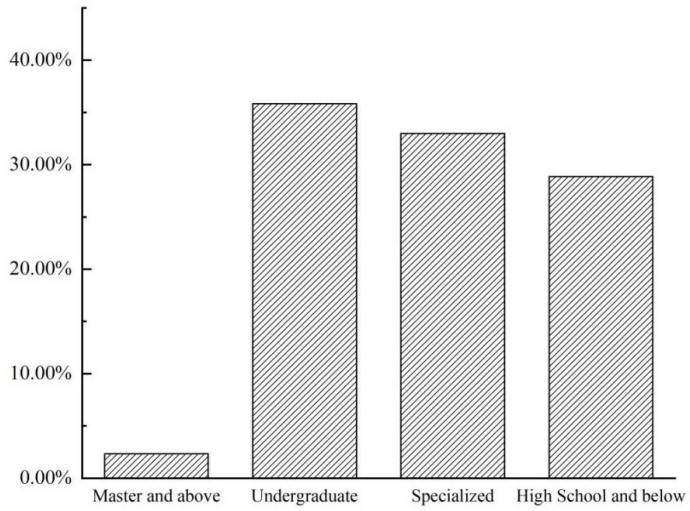

Figure 1. Educational structure of trained human resources in key state-owned forest farms.

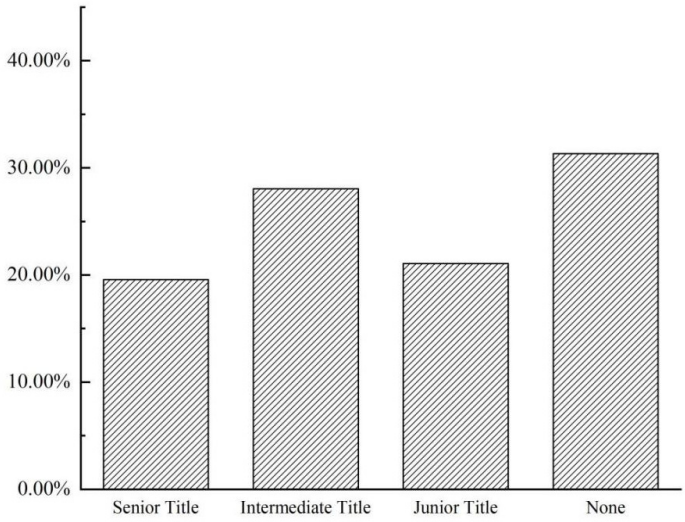

Figure 2. Structure of trained human resources titles in key state-owned forest farms.

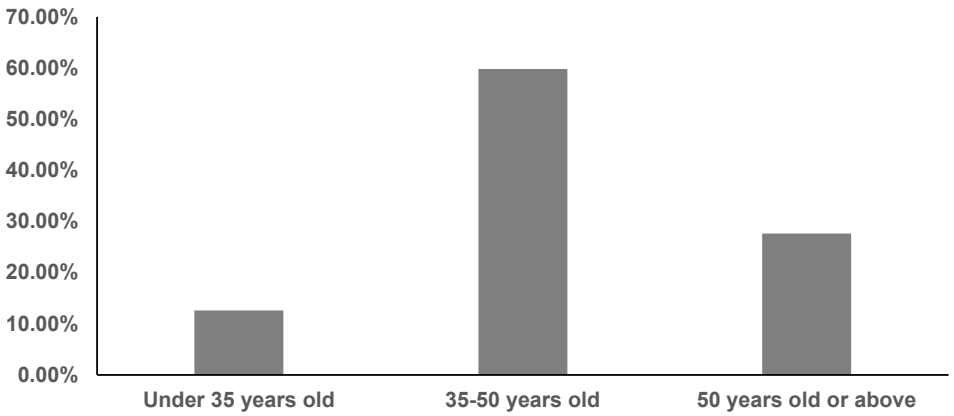

Figure 3. Age distribution of employees in key state-owned forest farms.

The survey results found that there is a lack of participation in education and training activities for cadres and workers in state-owned forest farms to update their knowledge and improve their quality and ability. The investigation shows that 31.33% of the trained human resources participating in the survey have not participated in any form of education and training activities in the past three years, and only 23.12% of them have participated in more than three training activities. The investigation shows that 67.72% of the respondents have a sense of career crisis, of which 15.18% of them had a very strong sense of occupational crisis, and only about 32% did not feel occupational crisis or did not think about the issue of occupational crisis; when faced with the question of whether they were confident in completing their work tasks, only 24.49% gave a positive answer, and nearly 80% said they could not very well or were not sure whether they could complete their work tasks.

According to the survey results, 74.56% of the respondents believe that the current human resources situation in state-owned forest farms is serious or very serious. As for the current talent environment and talent policy, nearly half of the respondents thought that the talent environment and policy were relatively good or very good. In terms of income, only about 12% of the state forestry employees surveyed were satisfied with their current income, and more than half were less than satisfied, with nearly 16% being very dissatisfied with their income.

3.2. Changes in Industrial Structure and Human Resource Allocation in State Forestry from 1998 to 2018

There are differences in the trends in changes in the three industries in terms of industrial structure (Figure 4): the proportion of primary and secondary industries in the total output value of key state-owned forest farms in the 20-year period both show fluctuating changes until 2010, reaching maximum values in 2002 (42.83%) and 2007 (30.84%), respectively, while both start to decline rapidly around 2010, reaching minimum values (39.10% and 22.63%). Linear regression analysis showed that the primary and secondary industries in key state-owned forest farms showed a significant downward trend between 1998 and 2018 ($p < 0.05$). The proportion of the output value of the tertiary forestry industry in the total forestry output value increased year by year, especially after 2015, and gradually exceeded the proportion of the output value of the secondary industry, and was roughly the same as that of the primary industry (Figure 4), with the smallest proportion occurring in 1998 (12.53%) and the largest in 2018 (38.28%). Linear regression analysis showed that the tertiary industry in key state forest areas showed a significant upward trend ($p < 0.05$) during 1998–2018.

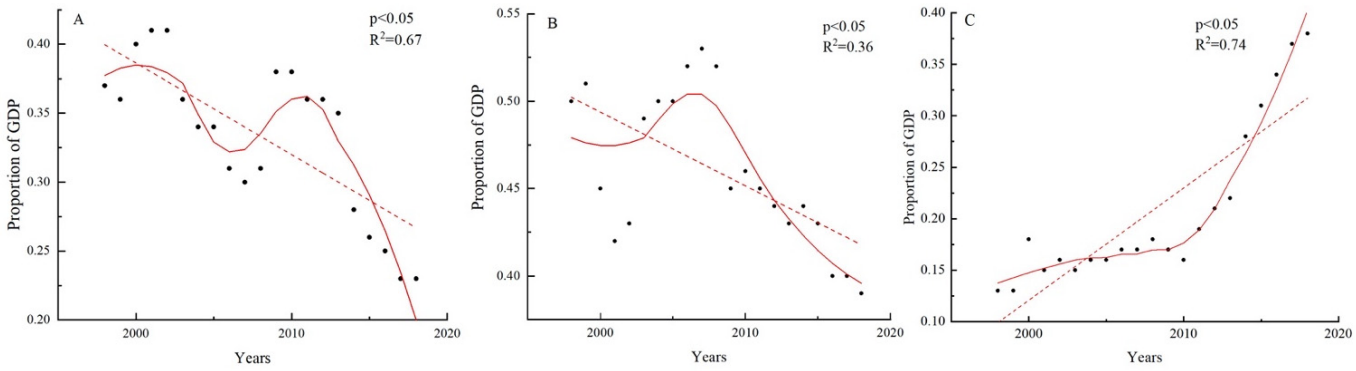

Figure 4. Changes in the structure of output value of three industries in 20a key state-owned forest farms. Note: (**A**–**C**) refer to primary industry, secondary industry and tertiary industry, respectively. The dot represents the observed data; the solid line represents the locally weighted scatterplot smoothing line; the dot line represents the linear regression.

In Figure 5, the allocation of human resources in the three industries in key state-owned forest farms shows the following characteristics: (1) The proportion of employment

in the primary industry fluctuated continuously between 1998 and 2018, without showing a significant trend of change, reaching a maximum value of 95.16% in 2008 and a minimum value of 90.32% in 2005, respectively, with an average value of 92.06%, which is significantly higher than the proportion of employment in the primary industry in that period. The average value was 92.06%, which was significantly higher than the proportion of the primary industry in that period, and higher than the proportion of employment in the secondary and tertiary industries in key state-owned forest farms in the same period. (2) Linear regression analysis shows that the proportion of employment in the secondary industry in key state-owned forest farms showed a significant downward trend during the period 1998–2018 ($p < 0.05$), with the proportion of employment in the secondary industry decreasing from the highest value of 7.87% in 1998 to 3.15% in 2010 from 1998 to 2010, with an average decrease of 0.22 percentage points per year, and from 2011 to 2015 produced some fluctuations and showed a downward trend again after 2016. (3) The share of employment in the tertiary industry in key state-owned forest farms showed a steady upward trend from 1998 to 2018 ($p < 0.05$), similar to the trend in the share of the tertiary industry in GDP, rising from 0.08% in 1998 to 4.21% in 2018, with an average annual increase of 0.21 percentage points, which indicates that the tertiary industry has a strong characteristic of absorbing labor.

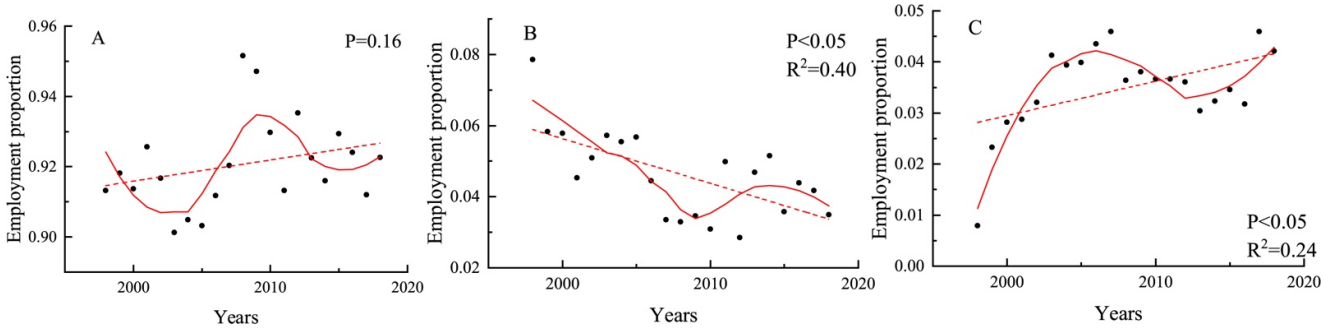

Figure 5. Changes in human resource allocation in the three industries in 20a key state-owned forest. Note: (**A**–**C**) refer to primary industry, secondary industry and tertiary industry, respectively. The dot represents the observed data; the solid line represents the locally weighted scatterplot smoothing line; the dot line represents the linear regression.

3.3. Changes in Human Resource Allocation and Industrial Structure Coordination and Adaptation in State-Owned Forest Farms

The deviation coefficient of primary industry structure (D1) in key state-owned forest areas was negative from 1998 to 2018 (Figure 6), and it showed fluctuations between 1998 and 2007, while it rapidly decreased after 2008, showing a significant downward trend overall ($p < 0.05$). The structural deviation coefficient (D1) of the primary sector reached a minimum value of −0.58 in 2018, indicating that the negative deviation of the primary sector from the structural equilibrium reached 0.58%, i.e., at least 0.58% of the employees in the primary sector urgently need to shift to other industrial sectors. The coefficient of deviation from the structure of the secondary industry in key state-owned forestry areas was positive over the 20-year period, with a mean value of 8.03, and experienced a trend of increasing and then decreasing: it increased each year between 1998 and 2009, with the minimum value (3.75) occurring in 1998 and the maximum in 2009 (10.18), while rapidly declining after 2010 and stabilizing after 2015, with the structural deviation coefficient in 2018 (5.42) basically the same as in 1998, which also indicates that there is still a small shortage of forestry secondary industry personnel. The structural deviation coefficient of the tertiary forestry industry in key state-owned forest farms gradually decreased between 1998 and 2009, then rapidly increased after 2010, and generally showed an upward trend between 1998 and 2018 ($p < 0.05$), reaching a maximum value of 9.78 in 2018, which indicates that there is still a large human resource gap in the tertiary forestry industry in 2018, with a strong ability to absorb surplus personnel.

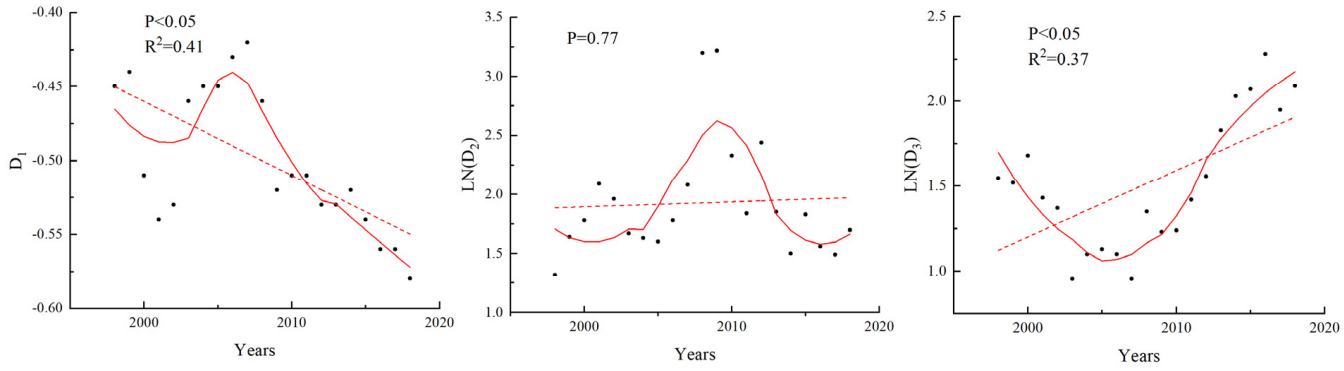

Figure 6. Coefficient of deviation of the structure of the three industries in 20a key state-owned forest farms. Note: D1, D2 and D3 represent the primary, secondary and tertiary industries of state-owned forest areas, respectively. The dot represents the observed data; the solid line represents the locally weighted scatterplot smoothing line; the dot line represents the linear regression.

From Figure 7, it can be seen that the overall industrial structure deviation $L_{P\text{-}W}$ in key state-owned forest farms is relatively small, maintaining a mean value of 0.93, with greater volatility between 1998–2010, while showing a significant upward trend overall between 1998–2018 ($p < 0.05$). While the synergy coefficient of structural change in key state-owned forest farms $C_{P\text{-}W}$ increased and then decreased during the 20a period, reaching a maximum value (0.86) in 2007 and rapidly decreasing after 2010, reaching a minimum value of 0.70 in 2018, showing a significant downward trend overall ($p < 0.05$), the synergy suitability grading scale shows that the human resource allocation in state-owned forest farms increased from 1998. This may be closely related to the reform of state-owned forest farms and the promotion of natural forest protection projects.

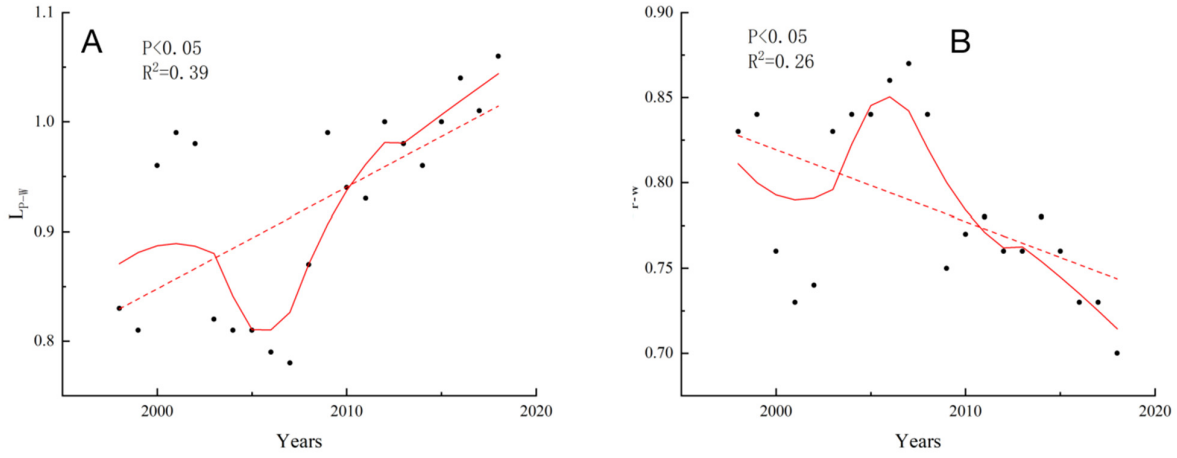

Figure 7. 20a structure departure degree coefficient (**A**) and synergy coefficients (**B**) for structural change in key state forest areas. The dot represents the observed data; the solid line represents the locally weighted scatterplot smoothing line; the dot line represents the linear regression.

4. Discussion

Through the analysis of the current situation of the structure of the people in the key state-owned forest farms, the following points can be found: (1) Trained human resources are still in short supply. There is a lack of high-level innovative scientific and technological trained human resources, and there are few leading forestry-trained human resources with high visibility and greater influence, showing a trend of youthfulness. There is a shortage of urgent specialists in emerging fields such as wetland protection, forestry to cope with climate change, and forest rights transfer assessment. There is a large gap between the supply and demand of practical and skilled trained human resources in forest

management, forest breeding and cultivation, forest tourism, landscape engineering, wood processing and special industries. The proportion of biased trained human resources is large, and the number of composite trained human resources is too small. There is a relative lack of trained human resources in the western region, and a general shortage of trained human resources in grassroots units and small and medium-sized enterprises. Some practitioners have low professionalism. Forestry system grassroots workers do not have many opportunities to receive education and training, and the speed of knowledge updating lags behind. Through continuing education and learning, employees' cultural literacy has improved, but most of the professions studied are non-forestry professions; there is the problem of "learning not using". In cadres of workers newly entered into the forestry system and a large number of new forestry construction and production practitioners, professional literacy needs to be improved. There is an urgent need to supplement the learning of forestry knowledge and skills [23,24]. Grassroots units to attract the workforce are not strong. Forestry is a tough industry with a long growth cycle and slow output, in the fierce competition for workforce, placing it in a disadvantageous position. In particular, forestry and grassroots units are remote, have difficult conditions, are closed information, and suffer from economic underdevelopment and a low level of treatment; the attractiveness of trained workforce is not enough, there is a long-standing shortage of trained human resources into the problem, and the best workforce cannot be stabilized. In one study [25], there was insufficient investment in the development of talent resources for forestry enterprises and institutions for staff education, and training funds did not reach the actual proportion of national regulations. Special funds for the development of the forestry workforce were not included in the stable financial budget; workforce-training funds for forestry key projects and major scientific research projects were not guaranteed, resulting in the training and introduction of high-level forestry human resources. There is an urgent shortage of trained human resources, forestry workforce education, and training infrastructure and weak infrastructure for the education and training of forestry-trained human resources; in addition, and the construction of a trained-human-resources service system is relatively lagging behind. Zhi et al. [26] conducted a study on the current situation of human resources in state-owned forest farms in China, which include state-owned forest areas. The results indicate that state-owned forest farms tend to suffer from a lack of human resources, aging employees, and a shortage of managerial and technical employees, similar to the findings of this study [27–29].

The degree of coordination between human resource allocation and industrial structure determines the effective development of regional social productivity and the optimization and upgrading of industrial structure [30]. This study is based on data related to industry and employment in key state-owned forest farms during 1998–2018. Based on the data related to industry and employment in key state-owned forest farms during 1998–2018, this study calculates the "structural deviation coefficient", "structure departure degree coefficient" and "structural change synergy coefficient" to establish a model for evaluating the coordination and appropriateness of industrial structure and human resource allocation in each year. The results are as follows: the coefficient of structural deviation of the primary industry in key state-owned forest farms was negative from 1998 to 2018, and showed a rapid decline after 2008, while the coefficients of structural deviation of the secondary and tertiary industries were all positive, and the coefficient of structural deviation of the tertiary industry decreased from 1998 to 2007. The coefficient of structural deviation of the tertiary industry declined from 1998 to 2007, but increased rapidly after 2008, showing a significant upward trend overall (Figure 6). The above may indicate that the primary forestry industry in key state-owned forest areas does not have the ability to absorb more labor, and the number of existing workers is still high, while there is a large employment gap in the tertiary forestry industry, and the gap has gradually expanded after 2008. The coefficient of structural deviation and the coefficient of structural-change synergy in key state-owned forest farms showed significant upward and downward trends during 1998–2018, respectively, but both of them fluctuated significantly during the period 1998–2007, and showed a more

obvious increase and decrease after 2008. In recent years, the coefficient of structural change in state-owned forest farms has been hovering between 0.7 and 0.8, while the coefficient of structural deviation has been increasing (Figure 7). Although the theoretical level indicates that the development of human resources and industrial structure in key state-owned forest farms is more synchronous, in terms of the volume of the economy and the actual situation, there are no obvious leading industries in key state-owned forest farms today, and the scale of high-value-added industries is small. The changes in the industrial structure, human resource allocation and the suitability of the two in key state-owned forest farms over the past 20 years are due to two reasons: firstly, the adjustment of the industrial structure due to the change in national industrial policy during the period; and secondly, the lag in the transformation of the workforce compared to the adjustment of industries. The second is the lag in labor force conversion relative to industrial restructuring. Li and Wang [27] analyzed the coordination measures of human resource allocation and industrial structure in key state-owned forest areas in China from 2007 to 2015, and the results showed that the coordination of human resource allocation and industrial structure in state-owned forest areas was at the primary synergistic adaptation stage, similar to the findings of this study.

With global climate change and the strengthening of China's attention to environmental protection, China carried out a series of reforms in key state-owned forest areas from 1998 to 2018, and the Natural Forest Resource Protection Project is one of the most important reform measures. As the world's first super ecological project focusing on the protection of natural forests, the Natural Forest Resources Protection Project included more timber restriction and logging suspension policies for key state-owned forest areas in Northeast China and Inner Mongolia, which also led to the industrial transformation of state-owned forest areas and gradually reduced timber production, which had a great impact on the industrial structure of state-owned forest areas during 1998–2007, leading to fluctuations and repetitions. Meanwhile, the secondary industry in state-owned forest areas began to develop high-value-added products and large-scale production in this phase, which also led to its GDP share reaching the highest value in this phase during 1998–2018 (Figure 4) [31]. With the acceleration of climate change, and in accordance with the principle of "common but differentiated responsibilities" established by the UNFCCC [32,33], although China is not currently obligated to reduce GHG emissions, as a responsible power, China is very concerned about the unique role and strategic position of forestry in addressing climate change. In 2007 and 2008, the State Council released the National Program for Addressing Climate Change in China (hereinafter referred to as the National Program) and the Policies and Actions for Addressing Climate Change in China, which explicitly included forestry among the six priority areas for climate change mitigation and the four priority areas for climate change adaptation in China. The 17th National Congress of the Communist Party of China (CPC) held in 2007 included the scientific concept of development in the party constitution, and strict forest harvesting limits were set in the 11th, 12th and 13th Five-Year Plans [33]. The above national policy adjustments led to an accelerated industrial transformation in key state-owned forest areas after 2008, with the GDP share of primary and secondary industries rapidly decreasing and the share of tertiary industries increasing (Figure 4). However, there is often a lag in the transformation of human resources allocation relative to changes in industrial structure (Figure 5) [34] Although the change in the industrial structure of key state-owned industries has caused changes in the allocation of human resources in the three industries, a cross-sectional comparison between industries reveals that, compared to the gradually declining marginal output levels per capita in the primary and secondary industries, there is still a large degree of room for improvement in the productivity and innovation development levels of the tertiary industry, and there is still a large human resource gap, and the industry has a large potential for allocating human resources in the future.

5. Research Limitation

This study theoretically contributed one new line between the climate change and personal structure in the state-owned forest farms, which are facing multiple challenge to adaptation to climate change. The behavior of the educated trained employees will play crucial roles in mitigation of climate change [35]. The main limitations of the study and future direction of research will be considered as follows: (1) The latest data were not collected. The time range of this study is from 1998 to 2018, and there is no relevant collection from 2019 to 2021, which can be collected and further studied in the future. (2) In addition to state-owned forest areas, there are also certain changes in the personal structure of state-owned forest farms in various regions of China under the background of climate change, but our study does not involve state-owned forest farms, which can be studied in the future. (3) Due to limited conditions, only 731 questionnaires were withdrawn. The number of questionnaires should be increased in future research.

6. Policy Recommendations

The current situation of trained human resources in key state-owned forest farms shows a shortage of the total number of trained human resources, a shortage of high-level and highly educated trained human resources, and the aging of trained human resources, which requires strengthening and improving the work of trained human resources in state-owned forest farms in terms of the concept and development direction of the workforce, the key workforce, the working system and mechanism, the education and training system, and the livelihood protection. During the period 1998–2018, the contribution rate of the primary industry in state-owned forest areas to the economy and to the allocation of human resources in key state-owned forest farms gradually declined. The contribution rate of the secondary industry in state-owned forest areas to the allocation of human resources gradually stabilized, and its ability to absorb surplus workers was limited. The tertiary industry developed most rapidly among the three industries, and its development efficiency showed a gradual improvement, with a greater potential to absorb surplus workers subsequently. The development of human resources and industrial structure in key state-owned forest farms has generally been relatively synchronous over the past 20 years, and the degree of coordination and appropriateness of the two can be maintained at an intermediate level or above, but the fluctuation and repetition of industrial structure and human resources allocation in each industry were more drastic between 1998 and 2007, and the coordination between human resources allocation and industrial structure in key state-owned forest farms has been decreasing in recent years since 2008, with 2018's coefficient of structural deviation and synergy coefficient of structural change both reaching their maximum values during the period 1998–2018, showing that the allocation of human resources in industrial sectors is not as reasonable and at a lower level. The reasons for this may be (1) the industrial restructuring in key state-owned forest farms due to the promotion of the CPC's natural forest protection project and the policy of banning logging and halting logging in forestry; (2) the large lag in labor force conversion itself compared to the rapid restructuring of industries driven by national policies.

The large-scale reduction in forestry production as well as the transformation and development process of key state-owned forest farms, human resources allocation, and industrial structure adjustment are the two key issues of concern in the transformation and development to achieve a reasonable and coordinated development of human resources allocation and industrial structure. In terms of the workforce, it should not be rushed, and the solution should be combined with the actual situation to explore and innovate a reform path suitable for the development of trained human resources in forest areas according to local conditions, which can be started from the following aspects: In terms of industrial structure, firstly, the construction and investment of the tertiary forestry industry should be strengthened to increase the ability of the tertiary industry to absorb surplus personnel. The tertiary industry in forestry is the main direction of comprehensive transformation and development in key state-owned forest farms; key state-owned forest farms can make

full use of natural snow and ice resources in winter with skiing and fog sightseeing as the main content. The forest recreation industry can implement forest rafting in summer with forest resources as the main content throughout the forest area as the theme, and gradually expand and strengthen the tertiary industry chain to provide employment opportunities for surplus personnel. Secondly, the industry should actively promote the optimization and upgrading of the secondary industry; deepen the wood deep-processing industry chain; increase investment in science and technology; expand the scale of production; enrich the variety of forest products in order to achieve the purpose of driving the development of other production projects; change the situation of the primary industry and the raw material production industry to make a large contribution to employment; and enhance the ability of the secondary and tertiary forestry industries to absorb human resources.

7. Conclusions

This study analyzes the current situation of personal structure in key state-owned forest farms of China under the background of climate change, and empirically analyzes the coordination between human resource allocation and industrial structure in key state-owned forest farms within the background of climate change by establishing an evaluation model of the contribution and coordinated suitability of each industry to human resource allocation. The trained-professional human resources and the industrial structure changes in the context of climate change are the main limited factors for the key state-owned forest farms of China. Therefore, increasing the education investment for climate change and the economic income for the employees are suggested to be promoted for policy makers in future.

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