Influence of Factor Input on Forestry Economic Growth of Jilin Province

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Abstract　Forestry is a fundamental industry of national economy． In social development of human beings，forestry plays an essential role in expanding employment，realizing rural prosperity and safeguarding ecological safety． This paper firstly introduced current development situations of forestry in Jilin Province． Then，it analyzed influence of factor input on forestry economic growth of Jilin Province by linear regression analysis method． Finally，it came up with pertinent recommendations．
Key words　Factor input，Forestry economy，Jilin Province

1　Overview of forestry development in Jilin Province

Jilin Province（E121°38′ － E131°19′，N40°50′ － 46°19′）is situated in the northeast of China． It is 769． 62 kilometers from the east to the west，and 606． 57 km from the south to the north． It is adjacent to Liaoning Province in south，Inner Mongolia Autonomous Region in west and Heilongjiang Province in north；it remains contiguous to Russia in east and borders the Democratic People's Republic of Korea along the Tumen River and the Yalu River in southeast． Jilin Province borders the coastal waters and the border line is 1 438． 7 km in total，including China-North Korea border line of 1206 kilometers and China-Russia border line of 232． 7 km． Huichun City at the eastern tip of Jilin Province is only 15 km away from the Sea of Japan and 4 km away from the Posyeta Bay of Russia[1]． Jilin is abbreviated as "Ji" and situated in center of Northeast China． Covering an area of 187400 km² (accounting for 1． 95% of the whole China），Jilin Province has population of 27． 5128 million，accounting for 2． 03% of the total population of China；in 2014，GDP of Jilin Province reached 1380． 381 billion yuan，accounting for 2． 16% of the total GDP of China． At present，Jilin Province administers 1 sub-provincial city，7 prefecture-level cities，Yanbian Korean Autonomous Prefecture，Management Committee of Changbai Mountain，and 60 counties (districts）[2]．

Modern forestry pursues optimal integration of ecological，economic，and social benefits，and puts ecological benefits in the most important position． It not only realizes adjustment and reduction of timber yield，but also realizes rehabilitation of natural forest． Therefore，it is required to study the influence of factor input on forestry economic growth of Jilin Province．

Jilin Province is an essential forestry province of China． Changbai Mountain in the east is reputed as Changbai Forest Sea is a key national timber production base，the birthplace of Songhua River，Yalu River，and Tumen River，and plays an essential position in the ecosystem of the whole northeast China and Northeast Asia． The whole province has 9． 299 million hectare forestry land，the forest land area is up to 8． 27 million hectare，forest coverage is 43． 9%，ranking the fifth position in China． The total standing stock volume is 970． 82 million cubic meters． In the whole province，there are 42 nature reserve areas，covering an area of 2． 613 million hectare，including 14 national level nature reserve areas and 21 provincial level nature reserves． Besides，there are 57 provincial and above level forest parks，covering an area of 2． 2398 million hectare，including 35 national and 22 provincial level forest parks． The whole province has 1． 728 million hectare wetland，including 1． 025 million hectare natural wetland and 0． 703 million hectare constructed wetland． There are various levels of 43 wetland protection zones and wetland forest parks，including 8 national level wetlands[3]．

In recent 30 years，total output value of forestry of Jilin Province remains at steady growth；in 2003，the total output value of forestry in Jilin Province reached 3377 million yuan． In 2013，the total output value of forestry in Jilin Province reached 135． 099 billion yuan，the output value of primary industry was 36． 232 billion yuan，the output value of secondary industry was 82． 7 billion yuan，and the output value of tertiary industry was 16． 166 billion yuan；the ratio of three industries was 27：61：12，with the secondary industry taking the dominant position．

2　Factor input of forestry

2． 1　Employment personnel　Since the production of primary industry of forestry is the interaction result of human labor and natural force，the production process can be divided into two parts from time：action time of natural force and working time of labor，and the proportion of them is 99：1． However，even the 1% time still plays a considerable role in forestry development． In the development of secondary and tertiary industries of forestry，the function of labor is powerful． Therefore，in forestry production activities，it is required to attach great importance to labor management[4]． In 1983 － 2012，number of people employed in agricul-

ture, forestry, animal husbandry and fishery in Jilin Province was influenced by various factors, and the number was dropping generally, but the rate of drop was not the same. From the areas, due to support and encouragement of various policies, employment personnel has certain fluctuation, but it tends to steady state in recent years. By the end of 2012, the total number of people employed in agriculture, forestry, animal husbandry and fishery in Jilin Province was 157076, there is obvious drop compared with statistical number in recent 30 years, and there is still decreasing trend.

2.2 Capital The investment amount of forestry in Jilin Province is not steady, but it still remains increasing status from the entire trend. According to data statistics, state government provides energetic support for forestry in policies and funds. There are two times of increase in the investment amount. The first time was in 1997, and the second time was in 2005. In these two years, there was great increase in investment amount. The data of recent 10 years indicate that the annual investment amount rose greatly in 2007 – 2010. In 2010, the investment amount of forestry reached the peak value. However, in 2011, the investment amount greatly dropped. In 2012, it returned to rising trend.

2.3 Afforestation area For reproduction of forest resources, land is irreplaceable object and means of labor, and also a key factor restricting forestry development[5]. On the whole, in 1983 – 2012, the total afforestation area of Jilin Province took on decline trend. Data statistical analysis indicate that there are several times of obvious fluctuation in afforestation area of Jilin Province. The average afforestation area in thirty years is 115620 hectare. However, in recent years, there is a great gap between afforestation area and average afforestation area, and the increase-decrease trend of afforestation area is very unstable, irregular, and unreasonable.

The above data statistical analysis indicates that factor input is an original force for forestry economic growth. The forestry development of Jilin Province is inseparable from factor input and state policy support. Therefore, it is extremely necessary to analyze the influence of factor input on forestry economy.

3 Analysis of factors influencing forestry economic growth of Jilin Province

3.1 Data selection and source Data in this study were selected from *Statistical Yearbook of Jilin Province*, *China Statistical Yearbook*, and forestry information of Jilin Province in China forestry website. Due to lack of data of certain years, data of these years were estimated by scatter diagram, and arranged on the basis of collected data. Since factors influencing forestry economic growth are various, we selected capital, labor, and land factor as analysis objects.

3.2 Establishment of input-output model Economic growth is a hot issue of economists, also essential target pursued by many countries. Schools of economics also never stop researches of economic growth. In 1928, American mathematician Charlie Le Corbusier and economist Paul H. Douglas created the input-output

model through discussing the input-output relationship. They applied a production function, namely, Cobb-Douglas production function[6].

From neoclassical growth theory, we established input-output model as basic model for analyzing factors influencing forestry economic growth, *i. e.* Cobb-Douglas production function ($Y = AK^{\alpha}L^{\beta}$). Factors influencing forestry economic growth include capital input, labor and afforestation area input, and current technological level and policies. This function is a widely used economic mathematical model for analyzing and predicting relationship between resource input and output in national and regional development and economic growth.

Introducing the stochastic disturbance term, we established econometric model: $Y = AK^{\alpha}L^{\beta}\varepsilon^{\mu}$

where ε is base number of natural logarithm. For the purpose of estimation, the above model must be converted to linear model.

In sum, substitute estimation value of factors into the model, we obtained $Y = AK^{\beta 1}L^{\beta 2}AR^{\beta 3}$

Take the logarithm of both sides and make arrangement, we obtained following econometric model for forestry economic growth:

$$\text{Ln}Y = \beta_0 + \beta_1\text{Ln}K_1 + \beta_2\text{Ln}L_1 + \beta_3\text{Ln}AR_1 + \mu_1$$

where Y denotes total output value of forestry, K denotes input of capital factor, L denotes input of labor factor, AR is input of land factor. β_0, β_1, β_2, and β_3 are parameters to be estimated, β_0 denotes certain technological level, β_1, β_2, and β_3 are output elasticity of respective factor input, μ refers to stochastic disturbance error and represent factors of disaster and emergency accidents.

To make the estimation results of multiple regression model reliable, we make following hypotheses:

Hypothesis 1: explanatory variables $LnK1$, $LnL1$, and $LnAR1$ are certain variables, not random variables, and have fixed values;

Hypothesis 2: stochastic disturbance term μ_i has feature of zero-mean and equal variance;

Hypothesis 3: stochastic disturbance terms are mutually independent;

Hypothesis 4: stochastic disturbance terms are not correlated with explanatory variables;

Hypothesis 5: stochastic disturbance term conforms to normal distribution of zero-mean and equal variance;

Hypothesis 6: there is no linear relationship between explanatory variables.

3.3 Model establishment Substitute collected statistical data into econometric model, and make multiple linear regression using Eviews3.1 software.

According to results of regression analysis, we can obtain following regression equation:

$$\text{Ln}Y = 21.013 + 0.389\text{Ln}K - 1.660\text{Ln}L - 0.450\text{Ln}A$$
$$(2.1636)\ (3.9158)\ (-2.2900)\ (-3.1507)$$

$R_2 = 0.894751$ $\bar{R}^2 = 0.882607$ $F = 73.67777$ $D.W. = 0.956126$

According to regression results, the coefficient of determina-

tion $R^2 = 0.894751$, adjusted coefficient of determination $\overline{R}^2 = 0.882607$, indicating the model has high goodness of fit, the Prob values corresponding to constant term, $\ln K$, $\ln L$, and $\ln A$ are respectively 0.0304, 0.0399, 0.0006, and 0.0041, all of which are smaller than 0.05, reflecting estimation values of parameters are significant at 5% level. Prob (F-statistic) is zero, so the overall significance of the model is high. As stated above, $0 \leqslant \alpha \leqslant 1$, $0 \leqslant \beta \leqslant 1$, the estimated coefficient of $\ln K$, $\ln L$, and $\ln A$ is 0.389400, -1.659877, and -0.150154, conforming to economic significance.

The model estimation results show that when other variables are not changed, 1% increase of forestry investment will increase total forestry output value about 0.389%; supposing other variables not changed, 1% increase of agriculture, forestry, animal husbandry, and fishery personnel, the total forestry output value will increase -1.660%; suppose other variables not changed, 1% increase of afforestation area, the total forestry output value will increase -0.450%.

3.4 Result analysis

3.4.1 Capital input and utilization are to be raised. The coefficient of capital Lnk is positive 0.389, showing forestry investment amount of Jilin Province has positive influence on forestry economic growth, while the regression coefficient of LnL and LnA is negative. Therefore, from the positive influence, increasing investment amount in factor input is a method of rapidly accelerating forestry economic growth. But its influence is still smaller than influence of employment personnel and afforestation area, indicating there are still drawbacks in capital input. Only when there is insufficient capital input, may the economic growth have development foundation. However, the state investment in fixed assets of forestry is largely utilized in forestry infrastructure construction, indicating the investment in forestry infrastructure is specific. Therefore, it is required to increase capital investment in forestry, and make reasonable allocation of funds, to better promote forestry economic growth.

3.4.2 Forestry human resources are insufficient and utilization is not reasonable. The LnL regression coefficient of employment personnel is -1.660, indicating the number of employment personnel has significant negative influence on forestry economic growth, and its absolute value is greater than absolute value of regression coefficient of capital LnK and afforestation area LnA. The influence of human resources on economic growth should not be neglected, because human resource is an essential factor. In recent years, the number of employment personnel of forestry in Jilin Province tends to steady level for many reasons, such as low remuneration level, rights and interests of forestry personnel failing to get secured, and poor working environment. In consequence, excellent talents are insufficient, and existing personnel may not make all-out efforts for various reasons.

3.4.3 Expansion of afforestation area is not reasonable. The regression coefficient of afforestation area LnA is -0.450, the regression coefficient of number of employment personnel LnL is negative -1.660, but the influence degree is smaller than the number of employment personnel, but greater than the influence of capital input LnK. Statistical data indicate that growth rate of afforestation area in Jilin Province fluctuates without the planning trend. This is because there is no reasonable plan for expansion of afforestation area, no scientific operation and utilization of expanded afforestation area, leading to extremely low output value; the fixed land area restricts increase of afforestation area. As essential factor, land capital influences forestry economic growth. Climate of Jilin Province is relatively stable, there are few rain and snow disasters, little changes in forest land. Only through expanding afforestation area, may it be able to increase output value of forestry. Therefore, reasonable planning for expanding afforestation area will promote forestry economic growth.

4 Recommendations

4.1 Keeping increasing capital input and raising capital utilization
From the above analysis, it can be known that capital has positive influence on forestry economic growth, but there are still many drawbacks. Capital input is an essential precondition for forestry economic growth. There should be reasonable arrangement and favorable policies. Firstly, development level of forestry economy in Jilin Province is restricted by forestry characteristics and regional economic development level. Therefore, fund input should be provided with investment mechanism suitable for Jilin Province in accordance with actual forestry conditions and regional conditions. Secondly, Jilin Province should expand the opening level, to attract domestic and foreign enterprises to establish forestry enterprises in Jilin Province, and increase foreign investment, which will promote development and maintenance of forestry economic growth of Jilin Province. Thirdly, many forest regions of Jilin Province are contracted to local residents. Therefore, it is recommended to formulate pertinent protection policies for individual contractual households, and safeguard rights and interests of contractors, so as to promote investment of individual households in forestry. The fourthly, different counties of a city has different conditions, distribution of forest areas is not even, and economic growth level and potential are not completely same. Therefore, it is necessary to make overall consideration of forestry conditions and regional conditions of each county and city.

4.2 Increasing remuneration for forestry workers and improving working environment of forest regions
Human capital plays a positive role in forestry economic growth, but current data analysis results indicate there is great negative influence, so it is extremely important to solve the problem of human capital. In recent years, the number of employment personnel for agriculture, forestry, animal husbandry and fishery of Jilin Province keeps a low level, and there is decline trend. Therefore, it is recommended to take a series of measures to alleviate the problem of insufficiency or even loss of forestry labor capital, to keep sustainable economic growth of forestry of Jilin Province. Firstly, it is recommended to improve awareness of people about forestry work,

change people's attitude towards forestry work, and make people willing to do forestry work. Secondly, it is recommended to raise remuneration of forestry workers, and provide adequate securities for various interests and rights of grass-roots workers, to retain existing talents and prevent loss of talents. Thirdly, it is recommended to improve working environment of forest regions, construction of infrastructure because excellent working environment can attract more talents to engage in forestry construction.

4.3   Increasing afforestation area and making reasonable utilization planning   From the above analysis, we know that afforestation area exerts negative influence on forestry economic growth, which is inconsistent with actual situation. Forestry economic growth is inseparable from forestry development and utilization. Expanding afforestation area exerts a positive role in forestry economic growth of Jilin Province. In the context of energetically implementing conceding the land to forestry, expanding afforestation area has excellent implementation guarantee. Therefore, it is recommended to promote forestry economic growth through making proper planning for expanding afforestation area of Jilin Province. At current development level of science and technology, it is necessary to establish a reasonable conversion system, to reflect forestry output conditions in a more systematic and comprehensive manner. In addition, it is recommended to improve afforestation and utilization in scientific operation and management manner.

4.4   Strengthening input of forestry science and technology and construction of policies and institutions   Nowadays, science and technology are powerful factors influencing economic development. Therefore, it is recommended to take full advantage of technological progress, and increase input in science and technology for forestry in Jilin Province. Government should formulate policies and institutions to support forestry economic growth, to realize better development of forestry. China should strengthen financial support for agricultural and forestry universities and colleges, to cultivate forestry talents, and reinforce grass-roots construction of scientific and technological work of forestry, so as to improve management level of forestry operation.

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an activity in six tobacco producing areas in Qiubei County of Yunnan Province and Dechang County of Sichuan Province to eradicate *Eupatorium adenophora Spreng.* and other alien pests and make local residents realize the harm of alien invasive organisms. (iii) For Risk 5 (soil erosion due to wind, rain and landslides), the goal is to stop the soil erosion and restore natural vegetation surrounding soil. The action and monitoring plan is as follows: discussing with the tobacco companies and farmers to avoid planting tobacco in the plots with slope greater than 15°; applying green manure to improve soil in winter. (iv) For Risk 6 (contamination of residual soil mulching film), the goal is to eliminate contamination of residual soil mulching film and make farmers realize the hazards of contamination of residual soil mulching film and consciously implement film uncovering management in the late crop growth period. The action and monitoring plan is as follows: communicating with the tobacco companies and local agricultural departments and pointing out the hazards and seriousness of contamination of residual soil mulching film; carrying out the survey and writing reports on contamination of residual soil mulching film and sharing reports with the tobacco companies and local agricultural departments; urging farmers to clean residual plastic film when using mulching film. (v) For Risk 8 (number and type reduction of natural aquatic species due to fishing), the goal is to stop excessive predation of natural aquatic organisms, effectively protect and rationally use natural aquatic organisms. The action and monitoring plan is as follows: informing the relevant departments of any violations of relevant laws and regulations to catch and feed on aquatic organisms; organizing reforestation in the regions with rich aquatic organisms in the cooperative tobacco-growing areas to prevent water sources from pollution and better protect aquatic organisms. (vi) For Opportunity (implementation of GAP management to reduce Risk 6), the goal is to ensure that there is no residual film contamination to soil, and make local agricultural department technical staff and farmers understand the requirements of GAP and consciously implement management. The action and monitoring plan is as follows: conducting GAP management training for the technical staff and farmers in the assessment areas; strictly implementing GAP management in the crop production process.

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