

Estimate of Forest Productivity for Taizhishan Forest Farm Administration Bureau of Hubei ProvinceLiu Gang¹, Ning Shuxin², Yao Chonghuai^{3*}¹The College of Horticulture and Forestry Science, Central China Agricultural University, Wuhan, China²Fuxin Higher Training College, Fuxin, China³The College of Horticulture and Forestry Science, Central China Agricultural University, Wuhan, China* Correspondence author: Email: yao_chonghuai@mail.hzau.edu.cn

Abstract: Based on the stocking total volume productivity grade, the forest volume average increment productivity grade, the forest volume average increment productivity grade, the stand average volume grade and grade of the merchantable outturn of cutting limit, forest productivity for Taizhishan Forest Farm Administration Bureau of Hubei Province was estimated. Regardless of the actual productivity (12) and expected productivity (23), both of Taizhishan Forest Farm Administration Bureau are belongs to the lower end of the national average.

[Liu Gang Ning Shuxin Yao Chonghuai. **Estimate of Forest Productivity for Taizhishan Forest Farm Administration Bureau of Hubei Province.** *World Rural Observ* 2017;9(4):11-14]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online). <http://www.sciencepub.net/rural>. 3. doi:[10.7537/marswro090417.03](https://doi.org/10.7537/marswro090417.03).

Key words: Actual productivity; Expected productivity; average increment grade

1 Calculation method

Real forest productivity refers to present forest volume and timber production capacity of the county (forestry bureau). The index with four indicators to reflect: (1) the stocking volume (10000 m³); (2) the average stand volume (m³/hm²); (3) annual volume growth (10000 m³/a); (4) the merchantable outturn of cutting limit (10000 m³).

1.1. The national average

By county (bureau) as the calculating unit., the national county-level administrative units is 2860, the state-owned forestry bureaus is 92, total units is 2952.

According to the 2006 national forest resources continuous inventory data, four indicators of the national average respectively is: (1) stocking volume is 4.54 million m³; (2) the average stand volume is 84.7 m³ / hm²; (3) annual volume growth is 165600 m³/a; (4) the merchantable outturn of cutting limit 33300 m³.

1.2 Calculate the ratio of 4 indicators and the national average for each county (bureau)

Stocking volume is from management inventory data; Stand average volume = stand volume ÷ stand area; Annual volume increment = Stocking volume × county (bureau) growth rate. If there is no county growth rate data, it can be replaced by city growth rate; the merchantable out turn of cutting limit was from legal cutting limit of different units in "11th five-year plan".

Computation formula is as follows:

(1) The stocking total volume productivity grade (*Mp*)

$$Mp_i = \frac{Mi}{M} \times 10 \quad (1)$$

Where: *M_i* = stocking total volume (10000 m³) of *i* county (bureau); *M* = the national average stocking

total volume (4.54 million m³).

(2) The forest volume average increment productivity grade (*Zp*)

$$Zp_i = \frac{Zi}{Z} \times 10 \quad (2)$$

Where: *Z_i* = forest volume average increment of *i* county (bureau) (10000 m³/a); *Z* = national forest volume average increment (165600 m³/a).

(3) The stand average volume grade (*Ap*)

$$Ap_i = \frac{Ai}{A} \times 10 \quad (3)$$

Where: *A_i* = stand average volume (m³/hm²) of *i* county (bureau); *A* = the national stand average volume (84.7 m³/hm²).

(4) Grade of the merchantable outturn of cutting limit (*Dp*)

$$Dp_i = \frac{Di}{D} \times 10 \quad (4)$$

Where: *D_i* = log outturn (10000 m³ of *i* county (bureau)); *D* = national log outturn (33300 m³).

2 Estimate of realistic forest productivity

Realistic productivity is as follows:

$$Pi = Mpi + Zpi + Api + Dpi \quad (5)$$

The stocking total volume grade

$$Mpi = \frac{Mi}{454} \times 10$$

M_i = total volume of *i* county (10000 m³);

The average increment grade

$$Zp_i = \frac{Z_i}{15.56} \times 10$$

Z_i = average increment of i county (10000 m³/a);
The average volume grade

$$Ap_i = \frac{A_i}{84.7} \times 10$$

A_i = average volume (m³/hm²) of i county;

Grade of the merchantable outturn of cutting limit

$$Dp_i = \frac{D_i}{3.33} \times 10$$

limit D_i = the merchantable outturn of i county (10000 m³).
The classification standard is shown in table 1.

Table 1 Standard of Classification

class	1	2	3	4	5	6	7	8	9	10	11	12
grade	<2	4	6	8	10	12	14	16	18	20	33	>22

It is to be illustrated:

1. Some counties (bureau) have no cutting limit, in order to ensure comparability of data, its grade of the merchantable outturn of cutting limit is 10.

2. The actual productivity grade is set for the national 2884 counties (bureau) unit, because 454,84,7,16.56, 3.33 is the nation's average of all counties (bureau) of.

Due to the limitation of productivity scale, so the actual productivity grade is not applicable to calculation of Taizhishan Forest Farm Administration Bureau, but it's available using Jingshan County (belongs to IV 04-02 level 3 area) which Taizhishan Forest Farm Administration Bureau is located at to estimate its actual productivity grade.

Data of Jingshan County is as follows:

County stocking total volume $M_i = 181.6$;

County average increment $Z_i = 13.24$;

County average volume $A_i = 67.76$;

County (bureau) cutting quota the quantity of material goods material $D_i = 1.33$;

The stocking total volume grade

$$Mp_i = \frac{181.6}{454} \times 10 = 4$$

is grade 2;

The average increment grade

$$Zp_i = \frac{13.24}{16.56} \times 10 = 8$$

is grade 4;

The average volume grade

$$Ap_i = \frac{67.76}{84.7} \times 10 = 8$$

is grade 4;

Grade of the merchantable outturn of cutting limit

$$Dp_i = \frac{1.33}{3.33} \times 10 = 3.9$$

is grade 2;

Then $P_i = 2 + 4 + 4 + 2 = 12$.

The average national county (bureau) actual productivity grade = 16, it is shown in Fig. 1.

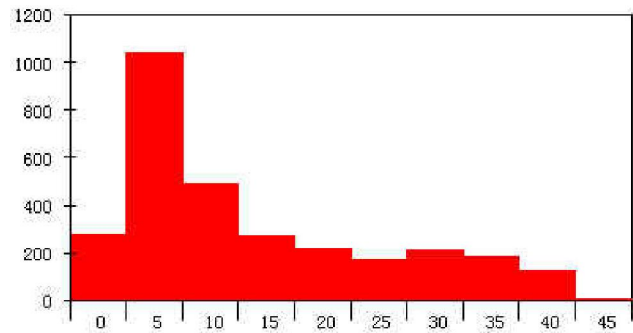


Fig. 1 Distribution of actual productivity grades of China

3 Estimate of expected forest productivity

Expected forest productivity is through scientific management to give full play to the present woodland and forest production potential, the county (bureau) may reach ability of forest production. Four indicators is: (1) expected stocking volume; (2) expected stand average volume; (3) expected annual volume increment; (4) merchantable outturn of cutting limit as a function of the ratio of the national average, then expected productivity grade is as follows:

$$Pp = Mpp + Zpp + App + Dpp \quad (6)$$

Where: the expected stocking total volume grade

$$Mpp = \frac{Mp}{454} \times 10$$

; $M_p = p$ county total volume (10000 m³);

The expected average increment grade

$$Zpp = \frac{Zp}{16.56} \times 10$$

; $Z_p = p$ county average increment (10000 m³/a);

The expected average volume grade

$$App = \frac{Ap}{84.7} \times 10$$

; $A_p =$ average volume (m³/hm²) of p county;

The expected grade of the merchantable outturn

of cutting limit $D_{pp} = \frac{D_p}{3.33} \times 10$; D_p is the

merchtable outturn of p county (10000 m^3). The classification standard is shown in table 2.

Table 2 Standard of classification

class	1	2	3	4	5	6	7	8	9	10	11	12
grade	<2	4	6	8	10	12	14	16	18	20	33	>22

Data of Jingshan County is as follow:
 County expected stocking total volume $M_p = 569$;
 County expected average increment $Z_p = 32$;
 County expected average volume $A_p = 51$;
 The expected merchtable outturn of cutting limit $D_p = 1.3$;
 The expected stocking total volume grade $M_{pp} = \frac{569}{454} \times 10 = 12.5$ is grade 7;
 The expected average increment grade $Z_{pp} = \frac{32}{16.56} \times 10 = 19$ is grade 10;
 The expected average volume grade $A_{pp} = \frac{51}{84.7} \times 10 = 6$ is grade 3;
 The expected grade of the merchtable outturn of cutting limit $D_{pp} = \frac{1.3}{3.33} \times 10 = 3.9$ is grade 2;

Then $P_p = 7+10+3+2=22$.
 The average national county (bureau) expected productivity grade = 23, it is shown in Fig. 2.

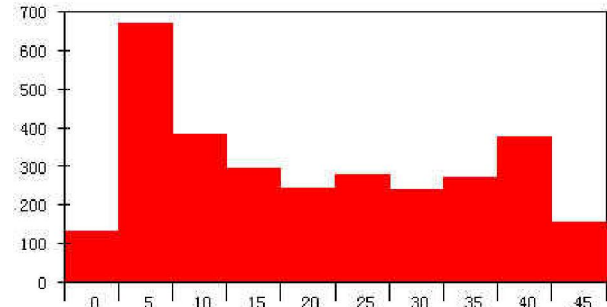


Fig. 2 Distribution of expected productivity grade of China

Comparison of average series of actual and expected productivity of Taizhishan Forest Farm Administration Bureau with other large regions in China is shown in table 3.

Table 3 Comparison of average grade of actual and expected productivity of Taizhishan Forest Farm Administration Bureau with other large regions in China

Region of Class 1	Actual productivity grade	Expected productivity grade
I	38	43
II	24	30
III	9	15
IV	18	26
V	24	33
VI	23	34
VII	31	38
VIII	9	12
IX	10	11
X	11	13

As can be seen from table 3, regardless of the actual productivity (12) and expected productivity (23), both are belongs to the lower end of the national average.

4. Summary

1. Average of our country actual forest productivity grade is 16, about 63% lower than the average. Average of our country expected forest

productivity grade is 23, about 41% lower than the average. High productivity grade is mostly distributed in the Daxing'anling mountains, Tibet, West of Sichuan province and other inaccessible areas. This is because where are the main forestry county (bureau) regions in China.

2. Regardless of the actual productivity (12) and expected productivity (23), both of Taizhishan Forest Farm Administration Bureau are belongs to the lower

end of the national average.

Acknowledgements

Authors thank for the help of Prof. Lang Kuijian, and sponsored by NSFC 51478202 (China).

Reference

1. State Forestry Administration. Division map collections of Chinese forestry development [M]. 2011, China Forestry Publishing House.
2. Hyytiäinen K, Tahvonen O, Valsta L. Optimum Juvenile Density, Harvesting, and Stand Structure in Even-Aged Scots Pine Stands[J]. Forest Science, 2005, 51(2):120-133.
3. Jack S, Long J. Linkages between silviculture and ecology: an analysis of density management diagrams[J]. Forest Ecology and Management, 1996, 86 (1-3):205-220.
4. Karlsson K. Impact of the thinning regime on the mean diameter of the largest stems by diameter at breast height in even-aged *Picea abies* stands [J]. Scandinavian Journal of Forest Research, 2006, 21(1):20-31.

12/4/2017