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長江の上中流域における松広葉樹混合林の水土保全機能

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The water holding and soil conserving capacity of pine and broad-leaved mixed forests in the middle and upper reaches of the Changjiang River

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Abstract: Pine and broad-leaved mixed forests play a very important role in holding water and conserving soil, and are good management patterns in the construction of the shelter forest system in the middle and upper reaches of the Changjiang River. This paper was aimed at determining the water holding and soil conservation capacities of the different components of pine and broad-leaved mixed forests (trees, shrubs, herbs, litter and forest soil). Based on the 3-10 years of investigation data at our study plots, we found that this kind of mixed forest has a complicated stand structure, with strong water holding capacity and soil conserving characteristics. The forest litter layer was shown to effectively absorb and hold rainfall, and its saturated water absorbing capacity reached 180%~296%. Moreover, the water holding capacity of the forest soil was shown to increase with increasing forest litter, enhancing the maximum amount of water held at a depth of 1m of soil (4,505 ~ 5,752 t/ha). The saturated water absorbing capacity of the forest canopy layer reached 94%~482%, and the water holding capacity of the soil was shown to be remarkably different between different types of parent rock, being optimal on slate and shale. The water holding and soil conserving capacity of the various forest-soil communities was further studied. Then we proposed a mathematical model for predicting and evaluating the water and soil conservation status of pine and broad-leaved mixed forests.

Key words: pine and broad-leaved mixed forest, water and soil conservation, middle and upper reaches of the Changjiang River

Introduction

Stretching 6300 km and with a catchment area of 1,800,000 ㎢, the Changjiang River is the longest river in China, and the third longest river in the world. In the main stream of the Changjiang River, the upper reach is located from the headwaters to Yichang in Hubei province, stretching 4,504 ㎞ and with a catchment area of 1,000,000 km^2. Subsequently, the middle reach is located between Yichang and Hukou in Jiangxi province, measuring 955 km, and with a catchment area of 680,000 km^2 (http://www.cjw.com.cn/index/river/liuyugk.asp, 2006).

In order to maintain the natural biological environment of the middle and upper reaches of the Changjiang River, countermeasures have recently been established by the Chinese government. These countermeasures mainly include two ecological engineering projects: construction engineering of a shelter forest system and protection engineering of natural for ests (Yang, 1994).

In a forest-soil community, if soil is lacking, the forest cover will be eroded, and consequently, the forest will not survive. The forest-soil community has a significant effect on the water holding and soil conservation capacity (Yang, 1994; Liu, 1993). Because of the complicated structure and uneven-age of mixed forests such as pine and broad-leaved forests, such forest ecosystems are relatively stable. In pine and broad-leaved mixed forests, the forest litter plays a significant role in holding water, because along with the A0 layer of the forest soil, it is highly permeable acting like a filter net. Moreover, the litter layer does not obstruct water absorption by the soil and has a very strong water holding capacity. The amount of water held by the litter can reach several times its own dry weight (Liu, 1993), and by absorbing and holding rainfall, it prevents runoff from the ground surface, thus holding water and conserving soil effectively (Qi,1990; Chen. *et al.*, 1991).

Rainfall interception by the forest canopy is another important component of the water holding capacity (Liu, 1993). The amount of intercepted rainfall depends on the water absorbency of the canopy surface, which is reflected by the saturated water absorbing capacity of the canopy surface. Therefore, the amount of saturated water absorption can also be used to indicate the water holding capacity of different tree species and forest stand types (Li, 1998; Wang, 1989).

Determining which forests have the best water holding and soil conservation capacity is important in maintaining great biodiversity and biological productivity, as well as maintaining sustainable development. Accordingly, research on the water holding and soil conservation capacity of pine and broad-leaved mixed forests is very important for construction of the shelter forest system in the middle and upper reaches of the Changjiang River.

For the past 10 years, we have been involved in evaluating the water holding and soil conservation capacity of pine and broad-leaved mixed forests in this area. The objectives were to establish study plots in which to conduct observations and collect and analyze data, with the aim of generating the evaluating and forecasting models (Zeng et al., 1996).

Material and Methods

1. Study site

The middle and upper reaches of the Changjiang River start in the southeast of Qinghai-Tibet Plateau, from where they spread southeast and enter the Szechwan Basin, ending up in the south Central China plains. The area is largely mountainous with a high plateau in the upper reaches, while the Szechwan Basin and southeast region consist mainly of mountains and hills. The middle reaches are characterized by hills and plains. The difference in elevation is over 3000 m from the headwaters to Szechwan Basin.

Most regions in the middle and upper reaches of the Changjiang River are located in the wet subtropical monsoon climate region, where annual rainfall is usually above 1000 ㎜ and can reach 2200 ㎜ ever and agah. The lowest monthly average temperature is below 0℃, and the annual accumulated temperature above 10℃ is 4500-6500℃. The growth period of vegetation is 241-285 days per year (http://www.cjw.com.cn/index/river/liuyugk.asp, 2006; Zeng *et al.*, 2005).

The soil in this region is categorized into many types such as red loam, yellow soil, yellow brown soil, drab soil, and purple soil. The natural tree cover is mainly subtropical evergreen broad-leaved forest. In the east, the main forest type is the transitional evergreen broad-leaved forest, and in the west is the subtropical evergreen forest. The variety and quantity of remaining natural forest is low because of frequent human activities, and thus most of the forest is the secondary forests. A few areas of good natural forest remain in the mountainous regions where human activities are lower (She *et al.*, 1997; Yang, 1994; Zeng *et al.*, 2005).

We selected sample plots of forest stand according to the following two principles. One, that they were similar in general view, species, composition and habitat, and two, that they were similar in stand structure, form, general view, seasonal aspects, bio-characteristics, and the inner and outer environment of the forest stand (Liu., 1998). Where possible, sample plots were established in areas with an intact forest form, diversiform species, a symmetrical mixture, and gaps. The sample plots area of the tree layer, shrub layer, the herbaceous layer and litter layer is 0.0667 ha, 0.011 ha, 1m2 respectively (Zeng *et al.*, 2005).

Ninety-five forest plots were established in a wide geographical area in Hunan, Hubei, Sichuan Guizhou and Yunan provinces and Chongqing City. Overall, they represented eight types of pine and broad-leaved mixed forests, and were representative of various forest ages, tree heights, diameters and densities and community structures. In addition, 10 simple runoff testing fields were also established. Observations were conducted for 3 to 10 years. A map of the research region and study plots is shown in Fig. 1.

2. Field survey

The main aim of the field survey was to investigate the following:

Habitat: landscape factors such as geographical position, landforms, elevation, gradient slopes, and aspect; soil factors including soil type, soil thickness, humus thickness (A_0 layer), the soil water ratio, and capillary and non-capillary porosity; vegetation cover factors including the main species, the biomass and their distribution (Liu, 1993; Yang, 1994).

The forest stand: the dimensions of all trees (D1.3, H, V, range of tree crown) and the biomass of the various components (leaves, branches, trunk, roots) of sample trees in the tree layer; the species, degree of coverage, height and biomass of each component in the shrub layer; and the species, degree of coverage, height and biomass of each component in the herbaceous layer (Roe et al., 2001; Ramnanthan, 2001; Liu, 1993; Zeng *et al.*, 2005).

Human activities: forest conservation and management measures and destruction and obstruction.

Next, the water holding and soil conservation capacity were investigated in the sample plots as follows:

The water holding capacity of the forest soil: soil samples were obtained by ring-cutting at depths of 20, 40 and 60 ㎝. Factors affecting the water holding capacity such as the capillary and non-capillary porosity, the dry weight and soil water ratio were also measured.

The water absorption capacity of the vegetation layers: The method was adopted to measure the water absorbency of the tree layer, shrub layer, herbaceous layer and litter layer.

Amount of runoff and erosion on the ground surface: field sites (50 ㎡, 5 m×10 m) for examining runoff were established in forest stand areas within the fixed sample plots. For each rainfall event, the amount of runoff and erosion on the ground

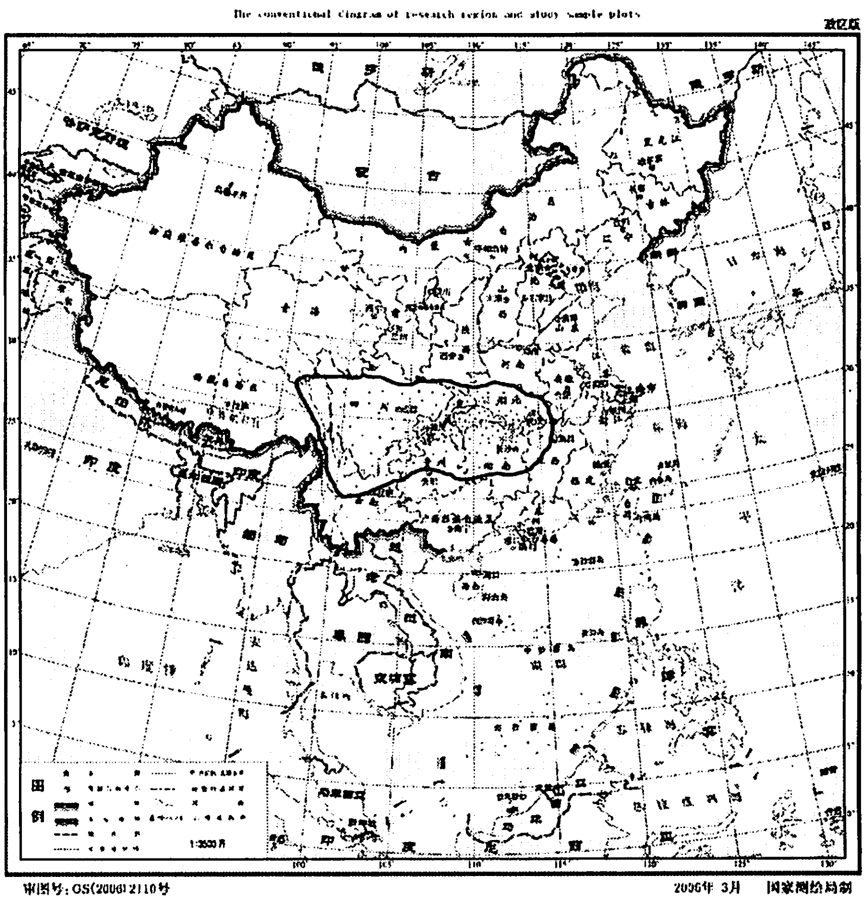

Fig. 1. Map of the research region and study plots.

surface were measured (Yang, 1994; Liu, 1993; Zeng *et al.*, 2005).

3. Modeling of the soil erosion

In order to determine the soil conservation functions of various types of forest-soil (parent rock) community in the pine and broad-leaved mixed forests, we constructed models for measuring, evaluating and predicting the soil erosion modulus. The sample data used in these models were obtained from the 10 simple runoff testing fields, and included information on the amount of rainfall and runoff and the silt content of the runoff during each rainfall event.

Results and analysis

1. The water holding capacity of the forest litter

The water holding capacity of the forest litter in the various types of pine and broad-leaved mixed forests is shown in Table 1. The saturated water absorbing capacity of the forest litter in the pine and broad-leaved mixed forest was generally larger than in the pure pine forest, while in the pine and fleshy broad-leaved mixed forest, the capacity was larger than in the pine and keratin-covered broad-leaved mixed forest.

The influence of the forest litter on the soil water holding capacity was also remarkable as shown in Table 2. That is the water holding capacity of the soil increased with an increasing amount of forest litter (Battaglia et al., 2003).

2. The water holding and soil conservation capacity of the various forest types

The water holding capacity of the various canopy species in the pine and broad-leaved mixed forests is shown in Table 3. The saturated water absorbing capacity of the various plant species is also shown calculated as follows:

$$(W_1 - W_2)/W_2 x100 \qquad (1),$$

Where W_1 is the weight of the sample after steeping in water, and W_2 is the absolute dry weight of the sample (Liu., 1993).

Referring to Table 3, it is notable that in the tree and shrub layers, the water absorbing and saturated water absorbing capacities of the broad-leaved tree species were remarkably larger than those of the coniferous tree species. On the other hand, the capacities of the soft- broad-leaved trees species were remarkably larger than those of the hard-broad-leaved trees species, averaging above 87.44%. Moreover, the values of the piliferous species were remarkably larger than those of the unpiliferous species, averaging above 59.10% (Machado et al., 1999; Liu, 1993).

Table 1. The water holding capacity of forest litter in the various types of pine and broad-leaved mixed forests and pine pure forests.

Forest community type	The amount of the sample plots	Average absolute dry weight of the forest litter (t/ha)	Average of holding water		saturated water absorbing capacity(%)
			t/ha	mm	
Pinus massoniana —Cyclobalanopsis mixed forest	22	3.47	8.88	0.89	256
Pinus massoniana —Liquidambar formosana mixed forest	20	1.81	5.36	0.54	296
Pinus massoniana —Schima superba mixed forest	12	3.76	7.26	0.73	193
Pinus massoniana —C. Sclerophylla mixed forest	10	1.44	3.3	0.33	229
Pinus massoniana —Quercus acutissima mixed forest	8	2.83	6	0.6	212
Pinus massoniana —Lithocarpus glaber mixed forest	6	2.42	5.74	0.57	237
Pinus massoniana —Cinnamomum camphora mixed forest	11	2.95	6.93	0.69	235
Pinus massoniana —Hartia.Sinensis mixed forest	6	2.18	4.53	0.45	208
Pinus massoniana —Loropetalum chinense pure forest	23	2.92	5.26	0.53	180
Camellia oleifera —Pinus massoniana pure forest	25	1.58	3.1	0.31	196
Tiezi—Pinus massoniana pure forest	10	2.98	6.5	0.65	218
Pteridium aquilinum —Pinus massoniana pure forest	32	0.96	1.89	0.19	197
Dicranopteris dichotoma —Pinus massoniana pure forest	27	0.38	0.8	0.08	210
Baimao — Pinus massoniana pure forest	19	0.21	0.38	0.04	183
Quercus fabri Hance+ Loropetalum chinense —Pinus massoniana pure forest	18	2.91	6.02	0.6	207

The maximum rainfall storage capacity of soil at a depth of 1m represents the capacity of the dammed-upping the rainfall of the various types of parent rock in the pine and broad-leaved mixed forests. The results of this study are shown in Table 4. The differences were very remarkable, and the coefficient of alteration calculated within the laboratory was very big, indicating that besides the parent rock material, other factors such as the vegetation type have a significant effect on the rainfall storage capacity of soil at a depth of 1m.

Table 2. The influence of forest litternon the water holding capacity of the soil.

Dry weight of the forest litter (t/ha)	Maximum water holding capacity of the soil at a depth of 1m (t/ha)	Water holding capacity of the soil hollow billet at a depth of 1m (t/ha)	Amount of precipitate water storage at a depth of 1m (t/ha)	Number of sample plots
<2	4,505	3,919	586.0	44
2-4	4,529	3,654	875.0	26
4-6	4,932	4,082	895.0	13
6-8	5,340	4,305	1,035.0	2
>8	5,752	4,654	1,098.0	4

Table 3. The water holding and saturated water absorbing capacity of the various forest canopy species in the pine and broad-leaved mixed forests.

Species	*Pinus massoniana*	*Liquidambar formosana*	*C. Sclerophylla*	*Symplocos paniculata*	*Clerodendron cyrtophyllum*	*Rhododendron simisii*	*Loropetalum chinense*	*Lespedeza davidii*
Water absorbency(%)	17.4	27.9	25.8	56.8	43.3	60.4	42.8	44.8
Saturated moisture absorption(%)	180	224	118	388	343	301	297	582
Species	*Eurya patentipila*	*Symplocos summuntia*	*Vaccinium bracteatum*	*Dalbergia hupeana*	*Quercus fabri*	*Castanea henryi*	*Clethra faberi*	*Rhus chinensis*
Water absorbency(%)	21.8	33.2	19.1	33.6	26.6	44.2	73.8	39.9
Saturated moisture absorption(%)	219	198	196	194	233	186	577	482
Species	*Ilex purpurea*	*Syzygium buxifolium*	*Adinandra millettii*	*Styrax japonica*	*Glochidion puberum*	*Smilax china*	*Ilex aculeolata*	*Photinia parvifolia*
Water absorbency(%)	19.5	26.9	29	62	35.5	26.6	32.7	63.8
Saturated moisture absorption(%)	220	94	245	326	292	296	258	278

Table 4. The maximum rainfall storage capacities at a depth of 1m with the different parent rock materials in the pine and broad-leaved mixed forests.

Type of parent rock	Number of samples	Average of the maximum rainfall storage capacities at a depth of 1m(t/ha)	Variance	Standard deviation	Coefficient of alteration
Granite	16	360.4	2	0.39	0.4
Sandstone	22	488.9	8	0.51	0.59
Slate and shale	29	619.2	11.7	0.42	0.56
Quaternary period red loam	26	461.5	13.6	1.02	0.8

3. Modeling of soil erosion

The water holding and soil conservation capacity of forest-soil communities largely depend on the inner characteristics of the soil and terrain, but there is also a close relationship with the species and biomass of trees, shrubs and herbs. Thus, we applied three indexes to describe the water holding and soil conservation capacity of the different pine and broad-leaved mixed forest communities: the maximum rainfall storage

Table 5. The water holding and soil conservation capacity of the different forest—soil (parent rock) communities in the pine and broad-leaved mixed forests.

Type of forest-soil (parent rock)	Maximum rainfall storage capacity of soil at a depth 1m□t/ha□	Ratio of annual runoff to annual rainfall					Soil erosion modulus ($t/a.km^2$)				
		1998	1999	2000	2001	2002	1998	1999	2000	2001	2002
Pinus massoniana +*Liquidambar formosana* —Slate and shale	730.9	0.291	0.282	0.293	0.312	0.298	440	432	450	512	463
Pinus massoniana +*oak*—Slate and shale	628.7	0.312	0.298	0.325	0.331	0.305	417	356	395	412	432
Pinus massoniana +*Cinnamomum camphora* — Quaternary period red loam	573.2	0.262	0.287	0.276	0.287	0.265	257	278	232	298	285
Pinus massoniana +*oak*— Quaternary period red loam	527.4	0.301	0.294	0.322	0.296	0.290	362	389	322	319	342
Pinus massoniana +*Schima superba* —	512.8	0.332	0.326	0.317	0.345	0.289	613	587	569	622	543
Pinus massoniana +*Cyclobalanopsis* —Granite	629.1	0.413	0.424	0.389	0.427	0.418	846	916	887	932	895

capacity of the soil at a depth of 1m, the ratio of the annual runoff to rainfall and the soil erosion modulus. The runoff coefficient and soil erosion modulus are shown in Table 5.

The findings revealed that the water holding and soil conservation capacities depend on the forest type, the soil type and the rainfall type, and in this study, the differences among different community types were remarkable. Moreover, the water holding capacity was shown to be directly proportional to the maximum rainfall storage capacity of the soil, while the soil conservation function was inversely proportional to the soil erosion modulus and ratio of annual runoff to rainfall.

The following models (2) and (3) were developed to measure, predict and evaluate the soil erosion modulus:

$$y = 3.06e^{(4.3367x_1 - 0.2692x_2 - 0.1401x_3)} \quad (2),$$

where is the amount of annual soil erosion (the soil erosio n modulus), and represent the volume weight of soil in the full section, the non-capillary porosity of the ground surface, and the total shrub and herb biomass respectively. The relate d coefficient of this model was 0.72.

$$y = 0.152e^{(6.2549x_1 - 0.2039x_2 - 0.3642x_3)} \quad (3),$$

where y is the amount of annual soil erosion (the soil erosion modulus), and x_1, x_2, x_3 represent the volume weight of soil in the full section, the non-capillary porosity of the ground surface, and the biomass of forest litter respectively. The related coefficient of this model is 0.78.

Discussion

Although we investigated the water holding and soil conservation capacity of the sample plots for about 3-10 years, all factors affecting the findings were not completely elucidated. Nevertheless, the results provide important information for the construction of the biggest ecological forestry engineering project in China, the shelter forest system in the middle and upper reaches of the Changjiang River.

The factors affecting the water holding and soil conservation capacity include direct and indirect factors, or in other words, biological and non-biological factors. In order to fully elucidate the interactions between these factors further as well as their individual contributions, the following investigation and analysis are proposed. Investigation at the complete stand level using online monitoring and collecting devices, and construction of more detailed mathematical models(Yang, 1994; Zeng *et al.*, 2005).

Despite the above limitations, the models presented here can be used to measure, evaluate and predict the status of annual soil erosion in pine and broad-leaved mixed forests in the future. Moreover, the partial correlation revealed between runoff and the biomass of shrubs-herbs and forest litter is also important. These factors have a significant effect on soil quality as well as water and soil conservation. Moreover, in the soil erosion modulus obtained in the present study, the total biomass of shrubs and herbs' and biomass of forest litter were not correlative in the same model. This was also verified in our sample plots. If the shade density is large, the biomass of shrubs and herbs and weed is small, thus, we separated the models into two, we also evaluated the volume weight of soil in the full section and the non-capillary porosity of the ground surface. These two factors describe the different parent rock materials, and represent the maximum water storage capacity of the soil and degree of water infiltration.

Conclusion

Because pine and broad-leaved mixed forest have a complicated stand structure, such forest ecosystems are relatively stable. They are therefore very important and good management patterns in the construction of the shelter forest system in the middle and upper reaches of the Changjiang River.

The forest litter layer can effectively absorb and hold rainfall, thus preventing runoff on the ground surface, thus helping hold water and conserve soil. The saturated water absorbing capacity of the forest litter in the pine and broad-leaved mixed forests was generally larger than in the pure pine forests, while that in the pine and fleshy broad-leaved mixed forests was larger than in the pine and keratin-covered broad-leaved mixed forests. The water holding and storage capacity of the forest soil was also shown to be positively correlated with the dry weight of forest litter.

Rainfall interception by the forest canopy is also an important component of the water holding capacity. The difference in the water holding and saturated water absorbing capacity of the different forest canopy species was remarkable. Capacities of the broad-leaved tree species were remarkably larger than those of the coniferous tree species. Moreover, those of the soft- broad-leaved species were remarkably larger than those of the hard-broad-leaved species, averaging above 87.44%, and those of the piliferous species were remarkably larger than those of the unpiliferous species, averaging above 59.10%.

Three factors were used to characterize the water holding and soil conservation capacity of the various forest-soil (parent rock) types: the maximum rainfall storage capacity of the soil at a depth of 1m, the ratio of annual runoff to rainfall, and the soil erosion modulus. The water holding and soil conservation capacity of forest-soil communities largely depend on the inner characteristics of the soil and terrain of the forest site, but are closely related to species, the types, their biomass and the shade and degree of tree, shrub and herb coverage. Overall, the findings suggest that the differences in the water holding and soil conservation capacity of different pine and broad-leaved mixed forests are remarkable.

References

Battagli MA, Mitchell RJ, Mou PP, Pecot SD. 2003. Light transmittance estimates in a longleaf pine woodland. For Sci 49: 752-762.

Chen Z., Zeng S. 1991. The simulating system of Pinus Massoniana [M]. Beijing: Forestry Press of China (in Chinese):22-89.

Fung T., Siu W. 2000. Environmental quality and its changes: an analysis using NDVI [J]. International Journal of Remote Sensing, No.5:246-253.

http://www.cjw.com.cn/index/river/liuyugk.asp (2006)

Li M. 1998. Study on the benefit of holding water in the testing fields of minor watershed of Fenghuangshan forest management area. Forestry Resource Management, No.6 (in Chinese):147-152.

Liu X. 1993. Location study on the forest ecosystem [M]. Beijing: Forestry Press of China (in Chinese):87-122.

Machado J, Reich PB. 1999. Evaluation of several measures of canopy openness as predictors of photosynthetic photon flux density in deeply shaded conifer-dominated forest understory. Can J For Res 29:1438-1444.

Qic C. 1990. Hunan vegetation [M]. Changsha: Hunan Science and Technology Press (in Chinese): 28-48.

Ramananthan R. 2001. A note on the use of the analytic hierarchy process for environmental impact assessment [J]. Journal of Environmental Management, No. 63: 27-35.

Roe, E., M. VANEETEN. 2001. Threshold-based resource management: a framework for comprehensive ecosystem management. Environmental Management, No. 27(2): 195-214.

She J., Zeng S. 1997. The site classification and evaluation of in the Middle and Upper Reaches of Changjiang River. Journals of Central-South Forestry University, No.1: 19-24 (in Chinese).

Wang R. 1989. Several question about the construction offorest conservation of water supply. Journals of Water and Soil Conservation, No.4 (in Chinese).

Xie X., Hu M. 1992. Measuring and evaluating of comprehensive benefit of forest. Beijing: Forestry Press of China (in Chinese):188-197.

Yang Y. 1994. Study on the shelter forest in the upper reaches of Changjiand River [M]. Beijing: Press of Science (in Chinese):102-195.

Zeng S., She J. 1996. Study on the hydrographical function of Pinus Massoniana Water and Soil Conservation Forests. Journals of Central-South Forestry University, No. 3: 1-8 (in Chinese)

Zeng S., She J. 2005. Study on the alteration technologies on the low-benefit secondary forests in the upper and middle reaches of the Changjiang River: Forestry Press of China (in Chinese):11-30.

長江の上中流域における松広葉樹混合林の水土保全機能

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要 旨

松広葉樹混合林は、河川域の保水機能や土壌保全機能などの役割を果しており、中国の長江上・中流域における森林管理および保護に関する施業方法はきわめて重要である。本研究は、松広葉樹混合林の異なる構成種（高木性樹種、潅木性樹種、草本植物ハーブ）およびリター、森林土壌による保水能、土壌保全機能の管理方法を知ることを目的とした。研究プロットの3-10年間の調査データから、松広葉樹混合林は複雑な林分構造を持ち、高い保水能力と土壌保全機能を有することがわかった。森林のリター層は雨水の効果的な吸収と保水力を示し、飽和吸水能は180%~296%に達した。さらに、森林土壌の保水能は森林リターを増加にともなって増大し、1mの土壌深で保持される最大水量は4,505~5,752 t/haであった。森林の林冠層の飽和吸水能は94 % ~ 482 %に達した。土壌の保水能は母岩の種類によって著しく異なり、粘板岩と頁岩の土壌が最適だった。各種森林土壌の保水能と土壌保全機能について研究を遂行し、松広葉樹混交林の水土保全機能の予測と評価のための数学的モデルを考案した。

キーワード：松広葉樹混合林，水土保全機能，長江上中部流域