Article

Did Eucalyptus contribute to environment degradation? Implications from a dispute on causes of severe drought in Yunnan and Guizhou, China

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Abstract
Various viewpoints were proposed to explain the causes of recent years' severe drought occurred in Yunnan and Guizhou, China. In general there are two parties of viewpoints, the Eucalyptus cause and climate change cause. I think Yunnan-Guizhou drought has been mainly caused by abnormal climate change. Eucalyptus was not significant in the formation of Yunnan-Guizhou drought. However, the forestation effect of Eucalyptus in China was not good. Environment quality and biodiversity in Eucalyptus plantation forests has been degrading in last decades. Enhancement of alleopathy of Eucalyptus trees under drought conditions would partly contribute to biodiversity reduction and environment degradation in Eucalyptus plantation forests. For existing Eucalyptus plantation forests of Yunnan, I suggest that some improvement measures should be adopted. Artificial weeding and cleaning in Eucalyptus plantation forests should be banned. Density of Eucalyptus trees needs to be reduced. Biodiversity should be artificially improved in Eucalyptus plantation forests. In the future, the mountains and lands with better vegetation cover must not be reclaimed for Eucalyptus planting. Eucalyptus plantation forests should be made in barren mountains and lands with poor biodiversity.

Keywords Eucalyptus; environment; drought; biodiversity; soil and water conservation; Yunnan and Guizhou.

1 Introduction

Three years' drought has been parching Yunnan and Guizhou Province in China. Drought spread across Yunnan and Guizhou rapidly and which is beyond people's imagination. Springs and rivers dried up. Reservoirs, dams and ponds were filled with the scorching mud. Seedlings of large areas of farmlands dried and died. Fifteen of sixteen prefectures and cities of Yunnan fell in drought and more than 7.7 million people out 40 million people in Yunnan were affected. Yunnan, a world known center for biodiversity and natural landscape, is attracting strong attention from environmental scientists.

At present various viewpoints were proposed to explain the causes of Yunnan-Guizhou drought. In general, there are two main parties of viewpoints for the causes, i.e., the Eucalyptus cause and climate change cause.

2 About Eucalyptus

Eucalyptus is a kind of evergreen trees, which was indigenous to Australia, Indonesia and Philippines, and is grown to provide paper pulp, wood, gum, and oil used in medicines (Campinhos, 1999). Eucalyptus has 945 species, subspecies or varieties, among which 100 species (or subspecies or varieties) are economically

important (Wang, 2012). Eucalyptus, poplars and pines are three fast growing trees recommended by FAO. Eucalyptus plantation forests have exceeded 18 million hectares around the world and they distributed mainly in Brazil, China, Chile, Uruguay, France, Spain, etc. With a plantation area of 3.1 million hectares, Brazil is the world's largest country for the area of Eucalyptus plantation forests, seconded by China. Eucalyptus planting in China began 100 years ago, and the plantation area had exceeded 2.5 million hectares by 2010 (Wang, 2012).

3 Dispute

3.1 Negative viewpoint (NV Party) - Eucalyptus planting is the cause of severe drought

Eucalyptus forest is a plantation ecosystem. In last decades the biodiversity and environment have been significantly degrading in Eucalyptus plantation forests (Poore and Fries, 1995; Shao, 1991; Cheng, 1992; Sheng, 1992; Yao, 1992; Yu et al., 1999; Chen, 2002; Yu et al., 2008). Land fertility has severely degraded. The stability and elasticity of forest soil worsen. The soil structure and biological properties were injured. The irrational reclamation for Eucalyptus forest lands led to vegetation reduction and thus the biological debris and above-earth fertility reduced largely. Strong precipitation in rainy season of Yunnan sped up the loss of soil and water in Eucalyptus plantation forests. The vicious cycle further induced the continuous reduction of soil fertility and productivity and further deterioration of forest environment, and limited the growth and restoration of vegetation and biodiversity.

Another cause for degradation of biodiversity and environment in Eucalyptus plantation forests is that Eucalyptus grows faster than many other tree species. It thus needs a large amount of water for growing. This would lead to the drought in Eucalyptus plantation forests and the environment deterioration.

Due to reasons as mentioned above, many people believed that the severe drought in Yunnan and Guizhou had been caused by the large scale of planting of Eucalyptus trees. Since March 20, 2010, a web report, "30 million mu's (2 million hectares) of Eucalyptus plantation forests in Yunnan have lead to the century's ecological catastrophy", attributed the drought and barren to the huge amount of requirement for water and fertility of Eucalyptus trees (Nan Fang Web, 2010). A series of web reports thereafter formed a party that the drought had been caused by large scale planting of Eucalyptus trees in Yunnan Province.

3.2 Positive viewpoint (PV Party) - Eucalyptus planting is irrelevant to severe drought

The positive viewpoint held that Eucalyptus planting is irrelevant to severe drought in Yunnan and Guizhou. Some people even maintained that Eucalyptus planting has contributed to conservation of soil, water and biodiversity.

A study by Yunnan Academy of Forestry showed that the water content for Eucalyptus forest soil was 20.4%, for mingled forest soil was 20% and for barren land was 18.4% (Wang, 2012). China Eucalyptus Research Centre (2009) pointed out that the water consumption to synthesize 1 kg dry matter is 1000 litre for pine, more than 800 litre for coffee, cotton, banana and Dalbergia respectively, and 510 litre for Eucalyptus (Davidson, 1989). A study conducted by South China Agricultural University in 1989 demonstrated that annual transpiration of *Eucalyptus torelliana* was 4800 ton/hectare, only 27% of annual evaporation of Guangzhou (1760 mm). However, the annual transpiration of *Cunninghamia lanceolata* reached 13000 ton/hectare, two times of that for *E. torelliana*.

A study conducted in Guangxi, China, showed that after planting Eucalyptuss, annual precipitation around two regions of Guangxi increased by 152.5 mm, the annual evaporation reduced by 75.3 mm, and the annual precipitation days increased by 6.6 days.

According to China Eucalyptus Research Centre, with 8% of forest cover, Leizhou Peninsula was a barren land about half century's ago. A large scale of Eucalyptus planting has been conducted since 1954. There are

now 0.2 million hectares of Eucalyptus plantation forests in Leizhou Peninsula and forest cover has reached 24%. Environment in Leizhou Peninsula was considered to be largely improved.

According to a report from South China Agricultural University, conducted in Leizhou Peninsula, there were totally 61 families, 127 genera and 150 species of plants in Eucalyptus plantation forecasts. In Zhangzhou, Fujian Province, a survey indicated that there were 29 families, 49 genera and 53 species of plants in Eucalyptus plantation forests.

According to some experts, Eucalyptus plantation forests are 0.24 million hectares, accounted for 7.3% of plantation forests only and 1.3% of total forests in Yunnan.

Based on these data, many people held that the severe drought had not been caused by Eucalyptus planting.

3.3 Climate change interpretation of severe drought

Most of meteorologists in China believed that the Yunnan-Guizhou drought was caused by abnormal climate change. Professor Qian from Beijing University said that it contributed to weak atmospheric circulation, i.e., the warm and wet air flow from ocean was weak. The cold climate on mainland and warm climate on ocean led to a weak water-vapor transport from ocean to Yunnan and Guizhou. As a consequence, the precipitation in Yunnan and Guizhou was rare in recent period and thus a severe drought occurred. In general, three years' rare precipitation and abnormal atmospheric circulation have contributed to the drought (Yunnan Daily, 2012). And all these may be attributed to global climate change (Ferrarini, 2012; Zhang and Liu, 2012).

Fig. 1 Eucalyptus seedlings intercropping with leguminous plants, Hainan Province.

4 Some Implications from the Dispute

From viewpoints above, we may find that PV Party supported Eucalyptus mainly based on theoretical interpretation and experimental studies. However, NV Party negated Eucalyptus mostly based on field investigations and some facts. Based on all facts and viewpoints, I draw some implications bellow:

(1) The Yunnan-Guizhou drought was mainly caused by abnormal climate change. Current state of Eucalyptus plantation forests may only cause the local drought inside forests and a limited range around forests.

(2) Eucalyptus is theoretically a good candidate trees for plantation forest. However, the forestation effect of

Eucalyptus in China seems to be worse. Environment quality and biodiversity in Eucalyptus plantation forests have been degrading in last decades. If this situation is not improved, the environment degradation would further deteriorate in the future.

(3) Eucalyptus trees contain allelochemicals like phenols and terpene. These substances will suppress the growth of many other plants by inhibiting seed germination and seedling growth (Moline, 1991; Cao and Luo, 1996; Yu et al., 2008). This will further lead to biodiversity reduction in the Eucalyptus plantation forest. It was proved that the allelopathy was negatively correlated to the precipitation (Cao and Luo, 1996), and a longer interterm between precipitations is beneficial to accumulation of allelochemicals. Thus, the climate in Yunnan and Guizhou is likely beneficial to accumulation of allelochemicals in Eucalyptus trees, and thus is more disadvantageous to establishment and preservation of biodiversity in Eucalyptus plantation forests. This would partly explain biodiversity reduction and environment degradation in Eucalyptus plantation forests of Yunnan. The severe drought may further strengthen the biodiversity inhibition by Eucalyptus trees and thus led to a vicious cycle.

(4) For existing Eucalyptus plantation forests of Yunnan, I suggest that some improvement measures should be adopted. Artificial weeding and cleaning should be banned. Density of Eucalyptus trees needs to be reduced. Some plants, like leguminous plants (Fig. 1), etc., can be considered to be planted in Eucalyptus plantation forests and forest biodiversity should be artificially improved. In the future, the mountains and lands with better vegetation cover must not be reclaimed for Eucalyptus planting. Eucalyptus plantation forests should be made in barren mountains and lands with poor biodiversity, such as in barren and stony mountainous areas of Guizhou.

References

Campinhos E. 1999. Sustainable plantations of high-yield Eucalyptus trees for production of fiber: the Aracruz case. New Forests, 17: 129-143

Chen BH. 1992. Current status, causes and control measures of land fertility degradation of plantation forests in China. In: Studies on Land Fertility Degradation of Plantation Forests (Sheng WT, ed). 20-26, China Science and Technology Press, Beijing, China

Chen QB. 2002. Conceptual indicators for biodiversity in Eucalyptus plantation forests. Chinese Journal of Tropical Crops, 23(1): 95-111

China Eucalyptus Research Centre. 2009. An Explanation on Ecological Impact of Eucalyptus Plantation Forests. Zhanjiang, Guangdong, China

Cao PR, Luo SM. 1996. Studies on the allelopathy of *Eucalyptus citriodora* Hook. Journal of South China Agricultural University, 17(2): 7-11

Ferrarini A. 2012. I think different: Models of climate warming impact on plant species are unrealistic. Environmental Skeptics and Critics, 1(2): 30-33

Moline A. 1991. Release of Allelo-chemical agents from litter through fall and topsoil in plantation of *E. globules*. Journal of Chemical Ecology, 17(1): 147-159

Nan Fang Web. 2010. Tracking Yunnan Drought: To Correctly Understand Eucalyptus Needs Scientific and Rational Spirit. http://qcyn.sina.com.cn/news/shwx/2010/0806/15255871617.html. Aug. 6, 2010

Poore MED, Fries C. 1995. The Ecological Effects of Eucalyptus. FAO, Rome, Italy

Shao QH. 1991. The second forestry revolution. World Forestry Research, 4(4): 8-15

Sheng WT. 1992. Land fertility degradation and control measures for plantation forests in China. In: Studies on Land Fertility Degradation of Plantation Forests (Sheng WT, ed). 15-19, China Science and Technology Press, Beijing, China

Wang W. 2012. Yunnan Drought-Eucalyptus Is Innocent. http://discovery.163.com/12/0327/07/7TJ9GO4600014N6R.html. Mar. 27, 2012

Yao MH. 1992. Problem on land fertility degradation of plantation forests. In: Studies on Land Fertility Degradation of Plantation Forests (Sheng WT, ed). 27-30, China Science and Technology Press, Beijing, China

Yu DG, Liu GD, Bai CJ, et al. 2008. A study on evaluation of Graminaceous grass adaptability under Eucalyptus. Chinese Agricultural Science Bulletin, 24(10): 521-527

Yu XB, Li WG, Wang SM, et al. 1999. Research advances in several ecological problems of Eucalyptus plantation forests. In: Studies on Long-term Management of Productivity of Eucalyptus Plantation Forests. 19-26, China Forestry Press, Beijing, China

Yunnan Daily. 2012. Experts Explained Three Causes of Drought-Abnormal Air Flow and Rare Precipitation. http://qcyn.sina.com.cn/chuxiong/cxxwq/cxshxw/2012/0220/09353270414.html. Feb. 20, 2012

Zhang WJ, Liu CH. 2012. Some thoughts on global climate change: will it get warmer and warmer? Environmental Skeptics and Critics, 1(1): 1-7