

# Centennial Forestry Development of North Dakota State and its Lesson for China

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## ABSTRACT

The “Dust Bowl” happened in the Great Plains (including the North Dakota state) in the 1930s, and people wanted to plant trees to improve the environment. After a century of a hard work and many failures, forest land now covers 1.6% of the area in North Dakota. Now, the Conservation Reserve Program has been implemented in North Dakota, which is very similar to the Conversion of Cropland to Forest and Grassland project in China, such as Xilingol League. Tree species selection and price support measures will also be suggested for adoption in China.

**Keywords:** Conservation Reserve Program (CRP), Dust Bowl, North Dakota

## INTRODUCTION

Natural grassland in China is nearly 400 million hm<sup>2</sup>, accounting for 41.7% of the total land area, which is an important green ecological barriers and the basis for the development of animal husbandry resources (Zong 2005). However, as a result of regional population growth, overgrazing and other reasons, the grassland has degenerated seriously. At present, approximately 90% of the natural grassland has been degraded more or less, and another two million hectares grassland is deteriorating each year (Ecological Environmental, 2005). 10% of the grassland in Northeastern China disappeared in the past 300 years (Ye *et al.* 2009). In order to improve the environment of the western China, the state implemented the Grain for Green and other projects, and made remarkable achievements, but also triggered a lot of debates (Jiang 2003; Chen 2005; Li 2005). In order to protect and control sand storms, experts believe that it is necessary to jump the forest-center misunderstanding, emphasize the drought resistance role of grass and shrub vegetation in the arid and semi-arid area, and implement grassland restoration engineering. The continuing dust weather in spring seasons triggered the controversial dispute about forest and grass once again. Soil dissolved organic carbon decreased following 40-year grassland afforestation (Liu *et al.* 2009). The administration of Beijing and Tianjin Sandstorm Source project, changing from Forestry Bureau to National Development and Reform Commission, indicated that at the government level, some modification have taken place (Source: The Beijing News, April 28, 2006).

In fact, neither the grassland degradation, nor the implementation of afforestation are patents of China. For example, in the 1930s, from the northern state of North Dakota to the south-western state of Texas, the Dust Bowl shocked the whole world. In 1937, the president Roosevelt planned to spend 12 years constructing 160 kilometers Windbreak Forest Zone (FDR's Shelterbelt Project), from Canada extending to the northern part of Texas. In 2007, the state of North Dakota celebrated the establishment of the State Forestry College and the 100th anniversary of the development

of forestry. In order to make a comparison between the China and USA, the Xilingol League region in the Inner Mongolia was selected. We hope that recalling the century-long afforestation history and land use change in North Dakota will give some instruction to today's Grain for Green and Conversion of Cropland to Forest and Grassland project (Pan *et al.* 2010).

## NORTH DAKOTA AND XILINGOL LEAGUE

North Dakota state is located at 97 ° W to 104 ° W, 45 ° 55' N to 49 ° N, north-central United States, and Canada border, with an average elevation of 579 m, an area of 180,000 km<sup>2</sup>, and population 640,000 (Geography of North Dakota). The average annual precipitation was 330-508 mm, and multi-year average was 440 mm (North Dakota Climate Summary).

North Dakota was originally a prairie state. After 150 years of human activities, the majority of natural grassland has been reclaimed, and now has become a highly developed state of agriculture. The production of barley, oats, flax, sunflowers, honey, and so on ranks first in the United States. In addition, the cattle industry in the main body of animal husbandry ranks No. 16 (North Dakota Agricultural Statistics).

## DATA SOURCES

Due to the semi-arid climate and grassland fires, the dominate natural vegetation in North Dakota state is grassland. The area of natural forest is 280,000 hm<sup>2</sup>, mainly distributed around the lakes and rivers in the humid zone. According to the booklet published by North Dakota State Forest Service for celebrating its 100 years and since the settlement of migrants from the east coastal, North Dakota State experienced three stages of large-scale afforestation, the Homestead Act period, Dust Bowl period, and State Centennial period (website: <http://www.ndsu.nodak.edu/forests-service>). And the state of the natural grassland is now under the conservation reserve program (referred to as

CRP), similar to the existing implementation of Grain for Green and Conversion of Cropland to Forest and Grassland project in China. The efforts of people here, not only include the various stages of the cultivation of trees, but also involve the relevant legislation and regulatory bodies (the bill here uses units of acres, 1 acres = 0.4047 hectares).

Due to constraints, most of the information comes from the internet, including North Dakota State Forest Service (<http://www.ndsu.nodak.edu/ndsu/lbakken/forest/>) and the United States Department of Agriculture Economic Research Service (<http://www.ers.usda.gov/Data/MajorLandUses/>). Black Storm covers the entire North American Great Plains (Globe A, March 19, 1935; Dodge City Daily Globe, June 20, 1935; Report of the Chief of the Forest Service, 1937, 29; Forestry for the Great Plains, NARG 114; Report of the Chief of the Forest Service, 1936, 42; Lang, The Shelterbelt Project in the Southern Great Plains, 39). The contents of this article refer to the report of Forestry On The Great Plains, 1902-1942 (R. Douglas Hurt).

## THE DEVELOPMENT HISTORY OF FORESTRY IN NORTH DAKOTA

### Home act period

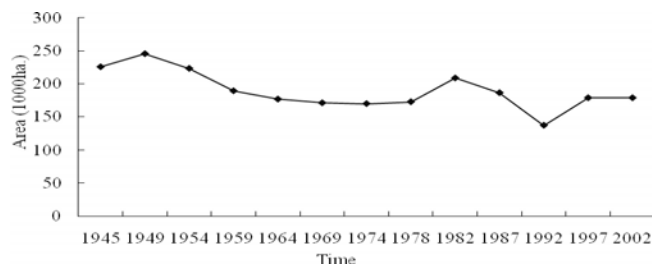
According to the promulgation of the 1862 Homestead Act, a million hectares of land in the western region were classified as private, which caused massive population migration from east coastal. Taking into account the habits of immigrants from the eastern part of the woodland, but also because the vast North Dakota prairie lacked sufficient trees to be used as construction, fuel and protective walls, the Timber Culture Act in 1873 regulated as long as 2.5 acres land were planted with trees, and managing trees more than 5 years, it would be free to get 40 acres of land. When the bill ceased in 1981, more than 8000 people in the state got 1.2 million acres of land under this act, and a total area of 1.2 million acres of land was planted. Huge demand for trees and shrubs lead to the establishment of many commercial nurseries, and tens of millions of trees is estimated to grow in these nurseries during the early 20th century. However, the survival rate was very low. In order to develop forestry in this specific environment, North Dakota State University (NDSU) established the Forestry College Bottineau in 1906. The experimental station in Mandon and Fargo, and their subsidiaries were actively looking for the species for the Great Plains region.

The early immigrants from the eastern sub-humid areas would wish to plant tree to increase precipitation, then change the bad weather in the Great Plains region of North America (Smith 1947). But the survival rate of their seedlings was very low. At last, not only North Dakota State, but also the entire Great Plain started a long quest to find suitable tree species. In 1891, the U.S. Department of Agriculture in Nebraska State Sand Hills region (annual rainfall less than 550 mm) established a tree-planting experiment station. In 1905, the Forest Service established a similar National Forest Park in Kansas. As a result of fires and drought, President Woodrow Wilson abandoned the Kansas National Forest Park in 1915 (Sorensen; Bates and Pierce).

Afforestation activities during this period were mainly the spontaneous activities from farmers. One reason was the original lifestyle of their living area, the second reason was that trees would help to improve their living environments, and protect housing and roads, and the third reason was that many people thought large scale afforestation activities could change the bad weather of the Great Plains region. In the process of fighting the low survival rate of trees, the Forestry Bureau had done a great deal of experimental research, and gained valuable experience.

### Dust bowl period

The unusual drought in the 1930s led to a black dust, and it is once again pinning hopes on the trees to slow down wind



**Fig. 1** The forest-use land area in North Dakota from 1945 to 2002. (1,958,000 acres forest area in 2007, Oduor and Kotchman 2007)

speed, prevent soil erosion, and provide employment opportunities. Thus, the re-afforestation passion was ignited again. In 1937, president Roosevelt planned to spend 75 million U.S. dollars and 12 years to construct a 160-km forest belt from Texas to Canada (Possibilities of Shelterbelt Planting in the Plains Region, 5, 17; Report of the Forest Service, 1935, 6- 7; Zon, Shelterbelts-Futile Dream or Workable Plan, 392; Droze, Trees, Prairies, and People, 115; Sorensen. The Kansas National Forest, 389-90, 393-394). The farms were responsible for planting and managing native trees, such as cedar and ash (FDR's Shelterbelt Project, Timeline of the Dust Bowl). Through the construction of shelterbelts and other land protection measures, 65% land had less soil erosion in 1938. And the precipitation in the fall of 1939 finally put an end to the drought.

Three amendments of FDR's Forest Service Shelterbelt Project stressed the project extension from the annual average rainfall not less than 390 mm to the south region with 550 mm average annual precipitation (Forest Service 1935). In the fall of 1937, due to the careful selection of suitable tree species and planting location, the survival rate was 90% (Globe 1935). In 1942, as a result of the war and the cessation of funding for the scheme, the entire Great Plains region planted a total of 220 million trees. Although planting trees had been partially successful, the prevention of black storm required a comprehensive soil conservation plan, including fallow land, planting grass irrigation, reducing grazing, agriculture protective operations and protective shelterbelts (Zon 1935).

In 1931, North Dakota State Forest established Denbigh Experimental Station, collecting trees from New Mexico, Montana, even Asia and Europe, and carrying out the durability and usability testing of these trees for Shelterbelt Project. In the March 1935, North Dakota state finished 56 km of windbreak forest belt.

During this period, afforestation was raised to the national policy. Due to price and subsidies support, the project won the support of farmers. Based on the constant failures and lessons, the Forestry Bureau in the Great Plains region has achieved limited success by using appropriate species and selecting the appropriate location.

### State centennial period

When the weather returned to normal, and the farming methods were improved at the same time, the state was no longer interested in planting trees. From 1949 to 1978, the forest area in North Dakota state declined (**Fig. 1**). In 1989, in order to celebrate the 100 anniversary of its statehood, North Dakota state encouraged residents to plant 100 million trees until 2000. By May 2001, a total of seventy four million trees were planted. Related projects are listed as follows: Centennial Trees Bowl (33200 trees), Family Forests (42897 trees), Living Snow Fences (615 km, funded more than \$ 1,199,000), School Tree Program (544615 trees), Patch Program, and Trees for North Dakota Legislation. Here various plans were voluntary, but combined with other activities, they received strong financial support. The purpose was to educate people more about nature and the environment, and cherishing the memory of their ancestors.

## CRP program

Since the 1930s, the United States implemented a series of policies to protect the land. Now the country is undergoing CRP. Beginning in 1986, through the government subsidy to encourage farmers to voluntarily plant long-term protective vegetation to improve soil, water and wildlife resources. Until April 2004, North Dakota state had 17,301 farms planning to participate in CRP, an area of 1.36 million  $\text{hm}^2$ , including the existing pasture 566,000  $\text{hm}^2$ , wetland restoration 312,000  $\text{hm}^2$ , wildlife habitats 231,000  $\text{hm}^2$ , the introduction of alien species planted 166,000  $\text{hm}^2$ , salinity reduction in vegetation 46,000  $\text{hm}^2$ , and the planting of trees 178  $\text{hm}^2$ . Government subsidized \$ 82/ $\text{hm}^2$ , a statewide total 110 million U.S. dollars (CRP 2004). In a CRP farm survey for participation, 73.2% of respondents believed that the scheme of the protection for wildlife was indeed very important, and 85% of people thought that the project was effective in soil erosion control. In its negative effects, the main focused was on the source of weeds and fire, and 7.8% thought the project undermined the local economy accounted (Allen and Vandever 2003). In the average sheet flow erosion and rill erosion survey of the non-federally owned land in North Dakota, the average annual soil loss in CRP was 2.5 tons/ha in 1987, and by 1992 only 0.7 tons/ha, while farming land was more than 3 tons/ha (U.S. Department of Agriculture 2000).

## Forestry status

1.6 percent of the land (about 300,000  $\text{hm}^2$ ) in North Dakota state in 2004 was forest-use land, of which 92% were broad-leaved forest, while coniferous forest accounted for 6% (Haugen *et al.* 2006). Of species within these areas, maple, beech and birch trees accounted for 29%, elm, cottonwood and ash, 24%, oak and hickory 21%, poplar 17%, and pine and cypress 6%. And these lands were not fully protected woodland. Forest logging accounted for 220,000  $\text{hm}^2$  and plantation, 2400  $\text{hm}^2$ .

In the North Dakota spatial analysis project 2007, the forest area is 1,958,000 acres, 4.4% of total land area, including rural tree plantings, riparian forests, and upland forests (deciduous and coniferous forests and wooded shrublands) (Oduor and Kotchman 2007). The difference of data from United States Department of Agriculture Economic Research Service and from North Dakota spatial analysis project 2007 is caused by the different statistical criteria.

## INSTRUCTION

After one century of efforts, forest area is approximately 1.6% in North Dakota. Like the other places of the Great Plains, the state also experienced a failure of afforestation, and ultimately obtained valuable experience of forestry development. From the Three-North Shelterbelt project to the present Conversion of Cropland to Forest and Grassland policy, China also learned many lessons. It is not forbidden to plant trees in the western region. We should be very careful to choose which tree species are planted in the specific places and abandon the bias caused by departmental interests.

As private ownership was dominant in the United States, afforestation activities usually select voluntary approach

during ordinary periods. In the emergency period, price support measures would be used to encourage farmers planting trees. The benefits of these measures could make a win-win result for the whole society and mobilize the enthusiasm of residents. However, the demerit is that after a difficult period, the forest may be destroyed, and even further transformed into arable land.

National policy about afforestation in the Xilingol is quite different from North Dakota. Further, precipitation is a key ecological factor which largely decided the effects of afforestation, but the relationships between precipitation and afforestation in both spaces are quiet similar. Such factors should be carefully studies in the future.

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