Statement on the Tianshui Experimental Site of Soil and Water Conservation in 1940s

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Abstract The Tianshui Experimental Site of Soil and Water Conservation was set up in 1942. Then the first construction publicized the thinking of soil and water conservation, and popularized the technologies of soil and water conservation and related plants. Their efforts established the foundation of the science of soil and water conservation with the first high-tech and high quality R&D team, and pushed the research of soil and water conservation building on the stage of systematization. All of this provided rare good scientific data and theoretical support for the soil and water conservation and the development of the regional economy in Northwest China.

Key words 1940s, Tianshui, Experimental site of soil and water conservation

The Yellow River Basin and its tributary in southwest China, as an essential headstream of People's Republic of China, provided an excellent ecological environment for the cultivation of early Chinese civilization. However, with the incessant land expansion and drastic human activity, the impressive nature and environment is gone for good. The grassland and forest are deteriorating gradually; rivers and lakes are disappearing; the soil erosion in the Loess Plateau is getting more and more serious. The ecological environment in northwest China has gained wide attention. The scientific conservation of water and soil in northwest China not only adds new members to china's scientific community, but also provide theoretical and technological support for the water and soil conservation, improvement of ecological environment and sustainable development of economy.

1 Reason for the construction of experimental site and reform

Before and after the outbreak of Anti - Japanese War, people started to care about the northwest crisis because of "the Northeast Incident" and regarded northwest China as the hope of national salvation. In order to increase production and contain the over-population, proposals were made for more and more people to move to northwest China. However, the result of field exploration is disappointing. Restricted by climate and territorial condition, the bearing capacity of land and material in northwest region is limited. The random reclamation not only wastes money and man power, but also destroys the production of land, which results in enormous economic lose in the country side[1]. Therefore, people advocate planting more trees to improve climate and solidify sand. He Yiyan once said that the reason why the climate in northwest China is not suitable to the crops' growth is the result of destroyed forests. If from now on, people encourage the plantation of trees, the climate can be improved, precipitation can be increased and moisture can be maintained[2]. Ceng Jikuan even stressed that besides being applied as wood and other byproduct, the forest can be used to prevent the exhaustion of water sources, the erosion of soil and sand, flood and drought. Flourishing forest can determine the destiny of a country to some extent[3]. Being pushed forward by the northwest development, the modern scientific way to conserve water and soil came into being.

China has been an agricultural country with a long history in water and soil conservation. However, the modern way to conserve water and soil is greatly influenced by America and becomes reality by the northwest development thoughts. Though the large scale of agricultural reclamation in America has only several hundred years of history, in the westward movement, the vandalization of ecology would lead to grave soil and water erosion, and result in the famous "black storm" in 1934. In the face of increasingly deteriorating water and soil erosion, the America federal government established soil prevention bureau in 1933. In 1935, the Congress passed the Water and Soil Conservation Law and prescribed that water and soil conservation bureau should be established under the agricultural department[4]. The attention that America paid on water and soil conservation and its scientific research not only cultivated many scholars for China through oversea education, such as Lin Daoyang and Han'an, but also trained lots of experts in water and soil conservation, such as Ren Chengtong, Fu Huanguang, Ye Peizhong and Jiang Deqi, *etc*. The most influential expert is Luo Deming who teaches in the forest depart of Jinling University.

Chinese modern scholars who are influenced by western science begin to study water and soil conservation from practical forestry and hydraulics aspects based on the reality. Famous foresters Lin Daoyang and Han'an came back from America to advocate afforestation and establish the Chinese Forestry Committee. The first Chinese forestry magazine Forest has been published. Motivated by foresters, governments of all levels have paid increasing attention to the significance of afforestation. In 1933, the Yellow River Hydraulic Committee came into being and Li Yizhi was appointed

Received: January 20, 2013 Accepted: July 15, 2013

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as chairman, who believed that the Yellow River problem was sand and the focus should be the northwest Loess Plain.

After the foundation of Afforestation Group, experts went into Shanxi and Gansu to study the soil erosion problem and to promote grass plantation. In 1939, Lin Daoyang presided afforestation group and realized the integration of hydraulics and afforestation. In 1940, afforestation Group expanded into Afforestation Design Committee. In August this year, Ren Chengtong invited relevant experts to convene meetings to study the water and soil conservation. It was at this meeting that the scientific term "water and soil conservation"[6] came into being. After the meeting, because of the destruction of forestry in the Yellow River and water and soil erosion, the production area narrowed down and the production amount declined. The current urgent problem is to carry out water and soil conservation work to prolong the permanent production capacity[7]. The first professional scientific research base of water and soil protection was established the next year.

In 1941, the Agricultural and Forestry Department established the Central Forestry Test Bureau. The delegation of Northwest Construction stressed that the problem of the Yellow River was in the Weihe[8]. Fu Huanguang, the director of the Agricultural and Forestry Department, established another experiment area and said that the erosion in Weihe was the most drastic one. The construction of water and soil conservation test area in Tianshui was to ensure the work in Gangu, Wushan, Longxi and Weiyuan[9]. Until 1945, the experiment area came into being, covering 1 hm^2 of waters of Hebei nursery for grass cultivation experiment, 2 hm^2 of Henan nursery for grass and seedling plantation, and 221.9 hm^2 of Nanshan experiment field. Offices were set up in Liangjiaping for the storage of climate prediction tools and daily experiment. Yellow River Water Source and Forest Management Center was in Pingliang with 4.7 hm^2 of dry land for grass plantation. Lanshan work station bought hundreds of acres to be permanent experiment field and changed the deserted islands as nurseries.

Right now, professional staffs include Ye Peizhong, Huang Xizhou, Zhang Shaofang and Zhang Dechang, Wei Zhanggeng, Xu Xuexun, Lv Benshun, Li Shoujing, Gao Jishan, Xu Rencun, Yan Wenguang, Ren Chengtong, Jiang Deqi, Yuan Yisheng, Yuan Yitian, Niu Chunshan, Wu Jinli and Wu Zhonglun, the first professional scientific research team. Those experts are hardworking and responsible for their work, which laid a solid foundation for the scientific research on water and soil erosion in China.

2 Scientific experiments of Water and Soil Conservation Experimental Site

The prevention of water and soil erosion is a systematic project. In terms of its measures, afforestation, water conservation, soil proliferation and valley treatment project were covered, including geology, agriculture, forestry and hydraulic project. After the foundation of water and soil conservation experimental site in Tianshui, experts overcame a series of problems, conducted lots of experiments in seven days, and eventually opened a new space for the scientific research of water and soil conservation in China.

2.1 Runoff experiment The purpose of the runoff experiment was to study the basic situation of soil and water erosion to improve the reasonable utilization of farmland. This experiment was designed in 1943 in Liangjiaping and was finished in four days. Since June in 1944, nineteen sinks, two cement sediments and thirty-five soil sediments were constructed. Through the analysis of five runoff records, following conclusions were made. Firstly, with the same cultivation policy, the larger the gradient, the more soil and water erosion, and there was little erosion when the gradient was around 5°. Secondly, at the same gradient, the influence of crops on water and soil erosion varied. Thirdly, the soil erosion amount was greatly influenced by the precipitation intensity. Fourthly, the gradient increased while the output decreased. Fifthly, the soil erosion can be reduced by moderate cultivation methods[10]. Later, based on the experimental site, further studies were made. In 1949, the influence of agriculture on soil erosion was studied to improve the influence of agriculture on erosion[11].

2.2 Terrace canal experiment The terrace canal experiment refers to the digging of terraces in the slope to study the canal type, slope gradient and storage for the conservation of fertile soil. In 1943, 10 hm^2 were used for various water conservation projects to dig 981 m of conservation canal, 238 m of land and 69 m of gutter. In 1944, 293.5 m was used to dig various kinds of gutter and 301 m was dug by farmers. This experiment found that the gutter would conserve water and fresh sand was above the land. The outlet at each level can prevent the dam from bursting[10]. In 1945, the terrace was designed in Fenshanding in Nanshan trial ground so as to control the water conservation in the field. 32 633.1 m was dug and to start the terrace canal experiment. In the same year, the relations between the size of horizontal gutter and conservation amount of terrace, the size of wide gutter and conservation amount were examined respectively through the drainage test[12]. In 1946, 2 742 m of gutter was revised and 9 684 m of new gutter was dug. Experiment showed that the mixing plantation of sorghum, alfalfa and sweet clover can keep water and soil without reduction of production. The sorghum and corn field were not lost[13]. In 1947, conclusions were made about the complicated factors in the terrace canal. Firstly, the limited canal capacity would result in erosion. Secondly, the trample from men and animals would lead to erosion. Thirdly, it is difficult to form a terrace based on natural force. Fourthly, as canal went through the cave, it would have erosion. Fifthly, a complete drainage system was needed in concentrated areas. Sixthly, the land should be used reasonably. Seventhly, rent policy should be polished[14]. In 1948, though the horizontal canal was effective, the grass around the canal wasn't growing well enough. The intensity was poor[15]. Therefore, earth bank was used to replace grassland. Experiment proved that the earth bank can become terrace based on runoff and increase yield[16].

2.3 Gutter-controlling experiment The gutter-controlling ex-

periment was to arrange drainage system to conserve and recover the growth of plants. There were three aspects to control erosion, the top of the gutter, the body of the gutter and two banks of the gutter. The gutter-controlling method started in 1944 in Liulifangyan to preserve the canal from erosion. In 1948, there were two Shifangyan[15]. Various kinds of plants which can conserve soil were planted on the both sides of the gutter. Experiments showed that the kudzu vine, acacia and aspen had the best effect on the prevention of soil erosion[16].

2.4 Using the willow fence to control soil erosion Willow fence was used to prevent the sand from running away. In 1944, experiment was carried out in Lvergou where 10 664 trunks of willow and poplar were planted. 0.33 hm^2 of sand was collected[10]. In order to solidify the sand collection and realize effective economic transformation, sludge has been used to cultivate plants which can conserve soil since 1 046. 0.33 hm^2 was cultivated to plant various kinds of plants[17].

2.5 Afforestation The purpose of afforestation was to study the benefits that various kinds of plants can bring. Hence, this experiment is for economic consideration. Besides normal plants that can conserve soil, economic plants were also cultivated. After the foundation of experiment area, various kinds of plants were collected for experiment. In 1944, 1345 new fruit plants, 99509 plants which can weather a drought and 19 780 willow trees were planted in each station. Preliminary study indicated that the acacia and white elm can be planted as frontier plants. Plants were used to protect the slope. It was not suitable to plant willows in the large gutter[10]. In 1945, 60 000 plants were planted in the experiment area to record relevant data of precipitation and evaporation capacity[12]. In 1947, 192 984 plants were cultivated in each station[14]. More than 16 800 plants were cultivated in spring. According to the observation, the fertility capacity of aspen and Chinese aspen was high. The survival rate of acacia and poplar was 96.6%.

2.6 Trail and cultivation to conserve soil and plant The trail to conserve soil stressed the study on relevant plants of water and soil conservation and paid attention on its distribution and its application so as to study its cultivation method. At the early period of the foundation of experiment area, various kinds of plants were brought in from abroad. In 1944, 98 kinds of plants were collected to cultivate grass which can resist drought and coldness. 35 kinds of seedlings were introduced from foreign countries[10]. In 1945, through exchange, more than 50 kinds of plants were obtained from abroad for investigation, collection and replantation of wild animals[12]. In 1947, 192 984 seedlings were sowed and 27 497 plants were cultivated in each station[14]. More than 16 800 plants were sowed in spring for afforestation experiment. Observation showed that the fertility of aspen and Chinese aspen was high and the survival rate of acacia and poplar was close, one is 98% and another is 96.6%.

2.6 Experiment and multiplication of plants for soil conservation The experiment for soil conservation focused on the study about the plants which can conserve water and soil. Attention was paid on its distribution and capacity to resist drought. At the beginning of the foundation of experiment area, seedlings that can resist drought were obtained from China through exchange and collection. In 1944, 98 kinds of plants were collected from Shanxi, Gansu and Qingdao. 35 kinds of plants were introduced from abroad for observation[10]. In 1945, through exchange, more than 50 kinds of herbs and vines were obtained[12]. In 1946, observation experiment was carried out in the experiment area. 1.27 hm^2 was planted with grass to observe its growth. In 1947, observation suggested that the kudzu vine in Tianshui had strong resistance to winter and the grass in Tianshui grew the best. The advanced way to plant Kudzu vine can enhance its survival rate[14]. In 1948, there were 59 kinds of plants which can conserve soil. The clone of hybrid pennisetum and Kudzu vine was carried out to observe its growth and effect on soil conservation[16].

2.7 Experiment on soil conservation and production of picked seeds At the beginning of the foundation of experimental site, a gradient cultivation experiment was conducted with the Central Agricultural Experiment Bureau by planting potato and glutinous millet[10]. Later, there were many methods for the experiment. Firstly, the cover-up experiment aimed to study whether the coverage of gradient would influence water and soil erosion, and whether the addition of moisture in soil would enhance grain production after 1945. Secondly, crop rotation aimed to study the suitable rotation policy on the gradient in the hope of keeping water and soil. Thirdly, the cultivation method aimed to study the reasonable gradient cultivation method so as to reduce the soil erosion. Fourthly, experiment to keep soil was suitable to green crops in the gradient in south Shanxi in summer so as to increase the organic materials in soil and reduce soil and water erosion. Fifthly, the ridge demonstration experiment aimed to study the influence of ridge on the output of crops. The ground gradient was around 15%. Sixthly, the banding cultivation experiment aimed to reduce the soil and water erosion to increase production. Seventhly, the corn observation experiment compared the growth and output of three kinds of corns in Tianshui. Eighthly, the area to observe the capacity of wheat against coldness and to observe grain was founded so as to get seeds with good quality for promotion[12]. Besides the above scientific experiments, soil measuring, meteorological observation and hydrology survey were carried out to make preliminary progress.

3 Promotion and publication of soil and water conservation technology

As a systematic project, the operation to conserve water and soil determined the diversity of organizations and popularity of principle parts. Whether more government departments and scientific research organizations can be motivated, whether knowledge to conserve water conservation can be popularized to enhance the public's awareness and capacity to take part in water conservation determined the outcome of water and soil conservation to a great

degree. Experimental site didn't only focus on scientific research, but on publicizing the significance of water and soil conservation, on building cooperation relation with relevant organizations, and on motivating people to join this career.

3.1 Cooperation with local government to get their support on water and soil conservation career At the beginning of the foundation of experimental site, Fu Huanguang managed to contact with local governments and to build intimate relation with Gansu Provincial government, the Fourth Department and Tianshui government to solve the field problem effectively. In order to make convenience for work, Fu Huanguang encouraged Zhang Xinyi, an agricultural economist, to participate in the career to conserve water and soil. In 1945, having been invited by Zhang Xinyi, staff in the experimental site publicized the significance of the terrace canal project while supervising the small farmland hydraulic project. Being supported by provincial government, staff in Tianshui County built 369 m of terrace in Shimaping, 23 438.7 m for terrace canal project, nine projects to promote small agricultural hydraulic demonstration projects. 6 750 m horizontal gutter was dug[12]. The fourth administrative supervision staff cooperated with Tianshui Province to supervise small agricultural project for close cooperation[18]. The Tianshui government used to invite citizens to conduct afforestation[10]. In 1949, Tianshui government assigned afforestation date and location in spring to provide assistance[11].

3.2 Cooperation with relevant departments to push forward water and soil conservation project In 1940, the operation in experimental site met with great difficulties. In order to ensure the successful operation of scientific research, the experimental site was considering obtaining resources from various sites for scientific research. Firstly, business cooperation was made with each committee of agricultural afforestation department[19]. Fifty thousand Yuan was used for the cultivation of seedlings[12]. In October 1942, the experiment area cooperated with the Agriculture Bureau of Gansu Province to promote water and soil conservation. The experiment area was responsible for the investigation, design and demonstration of relevant agriculture and forestry work[20]. 1.26 hm^2 in south bank of Jihe was used especially to produce selected grass[13]. The water and soil conservation can ensure the safety of traffic and water and soil conservation. In order to carry out relevant studies, the experimental site signed a contract with the northwest road bureau and Baotian Railway Office. Such cooperation provided convenience for the experimental site to improve the scientific research.

3.3 Connection with the society In order to obtain support from citizens, the experimental site managed to connect with local social elites to build a group organization to conserve water and soil. In 1943, the Tianshui Water and Soil Conservation Committee was founded in Gansu. The committee cooperated with local social elites from every walk of life to work on the water and soil conservation. The priority of the committee was to examine the soil and water erosion degree, to study various simple method for field study, to train various local youth, to attract more talented people, and to assist the trainees[21].

3.4 Assistance on scientific research In order to promote academic study, the experiment plot did not restrict its attention on northwest China, but participated in various scientific research projects. In 1943, Doctor Luo Deming organized a northwest water and soil conservation trip. The experiment area participated in various kinds of committees. What's more, the researchers in the experimental site started the Chinese Water and Soil Conservation Committee in 1945, which turned a new page for the development of water and soil conservation in China[22].

3.5 Popularization of knowledge on water and soil conservation Water and soil conservation was still strange to many Chinese, so it was urgent to enhance people's understanding of water and soil conservation. Therefore, the experimental site promoted knowledge about water and soil conservation. Many audiences came to the meeting which would summarize the work that the experimental site had made. Ding Eryu, the staff of eighth area sent officials to promote this project[13].

3.6 Promotion of selected seeds and technologies The complication of water and soil conservation, multiplication of main body and decisions of publics only depend on some organizations or scientific research companies. Therefore, the experimental site was actively promoting technologies. In 1944, each office and citizen was given seedlings and seeds[10]. In the autumn of 1945, the Water Power Electricity Company sent technicians to provide assistance[12]. After 1946, the experimental site even bred wheat and selected seeds. In 1946, loans were given to farmers who planted wheat[16].

Through flexible operation, the experimental site not only created a favorable work environment in only seven days, but also enhanced people's awareness of water and soil conservation, and made contributions in the promotion of water and soil conservation technology.

4 Conclusions

The foundation of Tianshui Water and Soil Conservation Experimental site in 1940 has great significance. It is the first systematic experimental site to preserve water and soil in China, as well as the first structurally sound team, which provides favorable clues on the development of organizations. The study provided independent field experience and laid a thoretical basis. The sustainable development in northwest China provided indispensable theoretical support. Though there are still many disadvantages, the influence of the experimental site on water and soil conservation in China should be remembered forever.

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