

Study on the Utilization of Water Resources in Lanzhou City Based on Sustainable Development

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Abstract: In the 1970s, because of the aggravation of environmental pollution and the emergence of energy crisis, people gradually realized that separating economy, society and environment for development could only bring devastating disasters to the earth and human society. This sense of crisis led to the birth of the theory of sustainable development. Nowadays, the theory of sustainable development has been further developed and practiced in China, and the Chinese government has put forward a representative "China Plan" based on this. Under the tide of national sustainable development, Lanzhou, located in arid areas, is also facing the problem of sustainable development of water resources, and needs to make positive response. The sustainable landscape of Pune, India, has certain reference significance for the recycling of water resources in Lanzhou, and this measure can also be applied to water-saving activities in Lanzhou in the future.

Keywords: sustainable development, water resources recycling, rain garden

1 Introduction

The theory of sustainable development refers to the development that not only meets the needs of contemporary people, but also does no harm to the ability of future generations to meet their needs. It mainly lies in three aspects: economic sustainable development, ecological sustainable development and social sustainable development. The term "sustainable development" first appeared in the Outline of World Conservation of Nature in 1980, and was further improved at the United Nations Conference on Environment and Development in June, 1992, so that sustainable development is no longer in the stage of theoretical exploration, but put into global action. In the sustainable development, water resources, as the material basis of social and economic development, occupy a pivotal position. As the world's largest population country, China's water resources are unevenly distributed geographically, especially in northwest China, so it is more urgent and strategic to study the sustainable development of water resources in arid and semi-arid areas of northwest China. This paper will take Lanzhou City, Gansu Province, northwest China as the research object, and explore the present situation, existing problems and harm of water resources in Lanzhou City by consulting the literature, so as to understand the measures and effects taken by Lanzhou Municipal Government to solve the water resources problems. In addition, this paper also makes a case study of Lupin Institute in Pune, India, whose geographical environment is similar to Lanzhou, in order to learn from the relevant experience of rainwater garden construction and water resources recycling.

2 Introduction of Lanzhou City

Lanzhou, the capital city of Gansu Province, is located in the northwest of China, in the middle of Gansu Province, and in the geometric center of Chinese mainland's land territory. Lanzhou's annual average temperature is 10.3°C, with different altitudes and different temperatures. It has a temperate continental climate with no heat in summer and no severe cold in winter. Lanzhou's landform is complex and diverse, with mountains, plateaus, plains, river valleys, deserts and Gobi, with complete types and staggered distribution, and the terrain inclines from southwest to northeast.

As of 2018, Lanzhou has five districts and three counties under its jurisdiction, with a total area of 13,100 square kilometers and a built-up area of 321.75 square kilometers. Geographically, Lanzhou is not only a comprehensive transportation hub of railways, highways and aviation in northwest China, but also an important intersection of the Yellow River culture, Silk Road culture, Central Plains culture and Western culture, enjoying the reputation of "Silk Road Town", "Pearl of the Yellow River", "Summer Palace in the West", "Waterwheel Capital" and "Famous Fruit City".

In 2021, the regional GDP of Lanzhou reached 323.129 billion yuan, an increase of 6.1% over 2020, with an average increase of 4.2% in two years. Among them, the added value of the primary industry was 6.252 billion yuan, an increase of 7.4%; The added value of the secondary industry was 111.391 billion yuan, up by 5.6%; The added value of the tertiary industry was 205.486 billion yuan, up by 6.4%. The ratio of tertiary industry structure is 1.94 : 34.47 : 63.59. According to the resident population, the per capita GDP is 73,807 yuan, an increase of 5.0% over 2020 [1].

According to the data released by the Lanzhou Municipal Bureau of Statistics and the Office of the Leading Group of the Seventh National Census of Lanzhou, in the data of the seventh national census in 2020, there are 4,359,446 permanent residents in Lanzhou, and the proportion of people living in cities and towns has reached 83.10%. Compared with the data of the sixth national census in 2010, the proportion of urban population has increased by 6.82 percentage points, with an average annual population growth of 1.89%.

On the whole, Lanzhou's economy developed well in 2021, and it continued to pick up after the impact of the epidemic in 2020. However, the population was rising, especially the increase of urban population, which brought new challenges to urban development.

3 Problems and Harms of Water Resources in Lanzhou

Water resources, as the foundation and premise of urban continuity, is a factor that cannot be ignored in many challenges. Lanzhou is the only provincial capital of the Yellow River, but because it is in a semi-arid area, precipitation alone is not enough to supplement daily water, and the economic and social development is backward, so people have a weak awareness of water resources recycling [2]. Therefore, Lanzhou City is also facing a severe shortage of water resources.

3.1 Lanzhou City, the Source of Water Supply Is Small

Because it is deep in the inland of northwest China, it is difficult to reach the ocean warm and humid air, and the summer time is short, and the precipitation is only concentrated in June to September [3]. On the whole, Lanzhou has less annual precipitation and a relatively dry climate. The average annual precipitation is 341mm, but the average annual evaporation is 1400mm, so after it rains, the rain will evaporate quickly [4]. If it is not collected, rainwater cannot be effectively recycled.

At present, the Yellow River water is still the main source of water resources supply in Lanzhou. However, the runoff of the Yellow River is greatly affected by the weather and natural disasters. For example, if the upstream encounters dry weather, the precipitation decreases and the runoff of the Yellow River decreases, it may greatly affect the overall water safety of Lanzhou City. Moreover,

blindly extracting the Yellow River water for use is not only a long-term solution, but also inconsistent with the current concept of environmental protection, and will also affect people's lives in downstream cities.

3.2 Lanzhou Has a Large Population, and the Per Capita Water Consumption Distribution Is Limited

In 2014, there was a heated discussion about the per capita water consumption of Lanzhou citizens. At that time, the per capita water resources of Lanzhou citizens was only 720 cubic meters, which was only 33% of the national per capita water consumption of 2,150 cubic meters. People were very worried that the lack of water consumption would lead to more social problems.

Although in 2020, the total water resources in Lanzhou will reach 41.09 billion cubic meters, and the per capita water resources will be 1642.2 cubic meters [5]. Although the current per capita level is much higher than six years ago, it is still lower than the national per capita water resources of 2,239.8 cubic meters [6].

The factor that directly affects the allocation of water resources is the population. In 2020, the resident population of Lanzhou has reached 4.36 million. It can be predicted that the population will only increase in the future, but will not decrease. It is an arduous task for both Lanzhou municipal government and Lanzhou citizens to allocate the limited water resources to the growing urban population so that every household can have enough and safe tap water.

3.3 Water Resources Utilization Efficiency Is Low, and People's Awareness of Water Saving Is not High

Some water conservancy projects in the Yellow River basin of Lanzhou have been aging, lacking timely maintenance and renewal. Secondly, the monitoring and control means of water resources in Lanzhou are still relatively backward compared with other cities [7]. Water resources recycling facilities are rarely seen in Lanzhou cities. At the same time, the government lacks publicity or lectures on water conservation and water resources protection for people. Lanzhou citizens do not have a strong awareness of water conservation in their daily lives.

To make a city's water resources utilization enter a virtuous circle, solving the water resources problem can't only rely on the government, but more importantly, the participation of all sectors of society, that is, to establish the awareness of saving water, protecting water and resisting pollution, so that the idea of protecting water resources is deeply rooted in the hearts of the people [8]. Only with the support of the people can the government better implement relevant policies and the people truly abide by relevant laws and regulations.

4 Measures and Evaluation of Sustainable Utilization of Water Resources in Lanzhou City

Although there are still problems in the sustainable utilization of water resources in Lanzhou, the Lanzhou municipal government is actively solving them and implementing various measures to change the current situation of water resources shortage in Lanzhou.

4.1 Establishment of Liujiaxia Reservoir

Liujiaxia Reservoir is a large hydropower project designed, constructed and built by China during the first five-year plan period. It is located in the upper reaches of the Yellow River, only 75 kilometers away from Lanzhou. Liujiaxia Reservoir is not only the seventh cascade hydropower station in the development planning of the upper reaches of the Yellow River, but also has many functions such as

power generation, flood control, irrigation, aquaculture, shipping and tourism [9]. The reservoir is located in the plateau canyon, and is known as the "Pearl of the Plateau", with spectacular scenery. Liujiaxia Reservoir, as a tourist attraction, has attracted a large number of tourists for its high-quality service function and tourism characteristics, and has made contributions to the economic development of Lanzhou.

As an aquaculture and ecological protection area, the biomass and density of animals in Liujiaxia Reservoir have been kept in a balanced state in recent 10 years, and the fish resources in the reservoir are abundant, and the number of them is gradually increasing. Although the growth of aquatic animals and plants in Liujiaxia Reservoir can meet the needs of people's production and life, the diversity of fish and other aquatic organisms in the reservoir is decreasing. Therefore, the species diversity of aquatic animals and plants should be improved in the future, and aquatic animals and plants suitable for aquaculture should be introduced to protect the species diversity [10].

4.2 Lanzhou Yanerwan Sewage Treatment Plant

Yanerwan Sewage Treatment Plant in Lanzhou is the largest sewage treatment plant in Lanzhou at present, and it is also one of the largest sewage treatment plants in China. Lanzhou produces about 520,000 tons of sewage every day, and Yanerwan Sewage Treatment Plant will treat about 230,000 tons of sewage.

According to Mr. Yang Xiaozhou, the captain of Lanzhou Ecological Environmental Protection Comprehensive Administrative Law Enforcement Team, at present, the Lanzhou municipal government has plans to expand and renovate the sewage treatment plant. It is estimated that after the renovation, it will be able to treat about 300,000 tons of sewage every day, and the discharge level of sewage can be raised from Grade B to Grade A. These purified sewages can be used as supplementary water for ditches and rivers, landscape water in parks, and even recycled in factories, mines and power plants, which undoubtedly greatly reduces the production cost and improves the economic benefits. Of course, Grade A purified sewage has reached the standard of direct discharge into the Yellow River, which is not only a supplement to the runoff of the Yellow River, but also an important embodiment of the sustainable development of water resources.

4.3 Yintan Wetland Park in Lanzhou City

Lanzhou Yintan Wetland Park covers an area of about 800 mu, and is located on both sides of Yintan Bridge on the Yellow River Baili Fengqing Line in Anning District, Lanzhou City. It was built by Lanzhou Municipal Government with an investment of 27 million yuan, with a total planned area of 286,400 square meters. It is the first wetland park in Gansu Province and the first ecological wetland park along the Yellow River.

Wetland is a non-urban center, far away from the urban pollution areas, but it has very convenient external traffic conditions. Lanzhou citizens often come here to play, breathe fresh air and exercise during holidays [11].

Although the Yintan Wetland Park in Lanzhou is a man-made wetland, its ecological and social benefits are far greater than the economic benefits. It is not only a recreational place for Lanzhou citizens, but also an ecological home for conserving the water source of the Yellow River and creating wetland animals and plants [12].

4.4 Summary of the Chapter

In addition, Lanzhou municipal government is also vigorously promoting the recycling measures of the Yellow River water, such as irrigating trees and flowers in the city with the Yellow River water,

or changing sprinklers to the Yellow River water for sprinkling water to reduce dust, which effectively prevents urban air pollution.

On the whole, Lanzhou has done a lot of work in sewage treatment and water conservation, but there is still a shortage in rainwater recycling. Because of the high degree of road hardening and perfect roof drainage system in cities, urban rainwater is better collected than that in rural areas. Secondly, rainwater has better water quality than sewage, and it can be directly used for urban green plant irrigation and other purposes by simple filtering means, thus reducing the water cost [13].

The advantage of the rainwater recycling project is that it can reduce the amount of rainwater discharged into the municipal sewage pipe network, relieve the current pressure of drainage facilities in Lanzhou, and focus on the daily sewage treatment and discharge in the city, thus reducing the maintenance and construction costs of the municipal sewage pipe network [14]. Therefore, for Lanzhou municipal government, the construction of rainwater recycling project can not only reduce the expenditure of daily water use in the city, but also ease the financial pressure of Lanzhou municipal government, so that the city can run faster and better, and it can recycle water resources, so that more citizens can afford water, so that Lanzhou can have a sustainable development.

5 From the Sustainable Landscape of Pune, India, See the Inspiration of Rainwater Recycling in Lanzhou

Pune, India, has a high temperature all the year round, which leads to severe local climate and soil drought. Landscape designer Shma, based on the local climate characteristics, relevant agricultural knowledge and ecological cognition, put forward the concept of sustainable landscape, and designed and built a "rainwater garden" in the local Lupin Research Center to collect runoff rainwater from the site and achieve sustainable utilization of water resources [15].

The success of rainwater garden construction in Lupin Research Center is mainly due to the unique design of "Rainwater Garden Corridor". Lanzhou is also an arid area. It can be said that the successful application of water circulation measures in Pune, India has great reference significance for rainwater recycling in Lanzhou.

5.1 Construction of Rainwater Garden Corridor

Rainwater corridor is the core highlight of the whole project. In the corridor, the whole area is low-lying, so that rainwater from the whole site and the roof of the building can be collected, and these water resources can be used for plant irrigation, so as to recycle and save water resources. In Lupin Research Center, many PVC porous water tanks were built along corridor roads, with the purpose of collecting rainwater and storing it in rainy season, and then using the stored rainwater for irrigation of adjacent land through osmotic reaction in dry season. This not only prevents floods caused by excessive precipitation, but also makes sustainable use of rainwater and saves water resources.

5.2 Expectation of Rainwater Garden Construction in Lanzhou City

The sustainable utilization mode of rainwater resources in gardens has good "elasticity" in adapting to environmental changes and responding to natural disasters. When it rains, it can absorb water, store water, seep water and purify water. When necessary, it can "release" the stored water and make use of it.

The overall construction of Lanzhou Rainwater Garden can refer to Lupin Research Center, and the construction site can be set at the edge of the Yellow River. Rainwater is collected mainly through low-lying green space technology, green planting racks or pebbles, and finally collected into the reservoir, forming a good process of rainwater collection and reuse [16].

In addition, in Lanzhou's residential areas, roads, green spaces and squares, sunken green spaces can be laid in green spaces, which will not affect the beauty, but also can store a large amount of rainwater in rainy season, reduce the flood disaster in the city, increase the amount of soil water resources and groundwater resources, reduce the irrigation water of green spaces, and create a suitable living environment for insects and other animals [17].

Traditionally, the impervious pavement design is used in the pavement design of residential areas. This impervious pavement design will lead to water accumulation on the pavement, and in the daily process of watering flowers and trees and cleaning the pavement, the excess water will be quickly evaporated, which reduces the efficiency of water use [18]. If the pavement in Lanzhou is paved with permeable pavement, the excess water can not only be stored underground through permeable pavement, but also be used to spray and cool the pavement in summer, which greatly improves the water utilization efficiency.

5.3 Predict the Completion Effect

The precipitation in Lanzhou is mainly concentrated in summer. When the amount of rain increases, the rain garden plays an important role in regulating the urban flood discharge, alleviating the municipal drainage pressure of the city. In addition, the construction of rain garden can also eliminate the social loss caused by runoff pollution discharge. In the construction of rain garden, the treatment measures of filtration and disinfection are added, which not only reduces the discharge of polluted rainwater into the water body, but also the purified water body can be used to supplement the groundwater [19].

Secondly, through the purification function of plants, the harmful substances in water can be preliminarily filtered, and then poured into a specific reservoir for secondary filtration and storage, and finally supplied to the community residents for domestic water, such as car washing or plant irrigation in the community, so as to achieve the effect of sustainable utilization. This not only saves water resources, protects the environment, but also reduces water charges [20].

6 Conclusion

The theory of sustainable development represents that people have re-recognized the symbiotic relationship with nature. Although China's sustainable development has just started, it has constantly explored a sustainable development model suitable for China's localization. Paying attention to the sustainable utilization of water resources in Lanzhou and studying the sustainable landscape in Pune, India is also to find the best solution to the water resources problem in Lanzhou. Although there are still many deficiencies in the sustainable utilization of water resources in Lanzhou, it is believed that through continuous study and construction, Lanzhou will get rid of the predicament of water resources shortage and find a sustainable development model suitable for the city.

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