Viewing the Sustainable Development of the Qinghai-Tibet Plateau from Water Resources System

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Abstract. The Qinghai-Tibet Plateau is an Asian water source and Chinese water tower. The area has a large amount of water resources and great potential for hydropower development. However, there are problems such as unreasonable use, retreat of glaciers and pollution of the water environment. Water is a precious resource. The sustainable development of water resources in the Qinghai-Tibet Plateau has significant ecological and strategic significance for the Qinghai-Tibet Plateau and its surrounding areas. Therefore, this article will explore the status quo of water resources systems in the process of sustainable development in the Tibetan Plateau and provide some suggestions.

1. Introduction
The Qinghai-Tibet Plateau is known as the "third pole of the earth" and is the Asian water source and the Chinese water tower, whose water resources are of great value. As water is the source of life, which is the premise for the sustainable development of the Qinghai-Tibet Plateau. Based on the concept of sustainable development, we humanity need a road that can support the progress of all mankind in the distant future, a road of resource conservation and socio-economic development. Therefore, we must recognize the strengths and weaknesses of the water resources in the Qinghai-Tibet Plateau, exert their greatest economic value on the basis of environmental protection, and rely on water resources systems to promote the sustainable development of the Qinghai-Tibet region and its surrounding areas. This article is based upon to analyze the status quo of the construction of water resources system in the process of sustainable development in the Qinghai-Tibet Plateau and put forward some suggestions.

2. The strengths of water resources in the Qinghai-Tibet Plateau
The water resources in the Tibetan Plateau region are not only of great importance to the sustainable economic and social development in the region, but also to neighboring countries and regions, which have the following advantages:

2.1. Rich water resources
The water resources of the Tibetan Plateau are in the form of rivers, lakes, glaciers, groundwater, and other forms of water, and they are dominated by river runoff. The total water resources in the Qinghai-Tibet Plateau is 5463.4×108 m³, including 2548×108 m³ in the Pacific Ocean, 2400.4×108 m³ in the Indian Ocean, and 515×108 m³ in the inland. The average annual runoff of the Tibet Autonomous Region is 439.4 billion m³, accounting for 16.5% of the country. It is one of the provinces with the largest
number of rivers in China. It is also the home to many famous rivers in Asia, such as the Yangtze River, Yellow River, Nu River, Lancang River, Yarlung Zangbo River, Ganges River, India River and so on.

Tibet has four first national water resources indicators in terms of total water resources, the nation’s first per capital water resources, the nation’s largest per capital water resources, and the country’s water resources potential. Qinghai Province is the birthplace of famous rivers such as the Yangtze River, Yellow River, Lancang River, and Heihe River. It is known as the “Water Tower of China”. Qinghai is one of the largest glacier areas in the country. The glacier area in the country is 4620.7 km² and the water storage capacity is 398.787 billion m³. The total amount of water resources in Qinghai Province is 62.93 billion cubic meters, accounting for about 2.2% of the total water resources in the country. The per capital water resources share is 11,600 cubic meters, and the Qinghai Water Resources Index ranks 11th in the country.

2.2. Large potential for hydropower development

The outflow rivers in the Qinghai-Tibet Plateau are rich in water, which have great potential for development. Generally, rivers in outflowing rivers are wide and narrow, with large amounts of water and large gaps and high concentrations of water energy, which are mostly in the upper and middle reaches. According to statistics, the natural water energy reserves of several major river mainstreams can reach 243.154 million KW, accounting for 35.93% of the country's hydropower reserves; the rivers in southern and southeastern Tibet are abundant, with large riverbeds and extremely rich hydraulic resources. The theoretical reserve of hydropower resources in Tibet is 201 million KW, accounting for 15.83% of the national hydropower theoretical reserves. Among them, 56.6 million KW of hydropower resources can be developed, accounting for 17% of the nation's renewable hydropower resources, ranking first in the country. There are 108 rivers with reserves of more than 10,000 KW in the theory of hydropower in Qinghai, with a theoretical installed capacity of 21.65 million KW.

| River         | station          | Natural water energy reserves (10,000 KW) | Average river length | Natural water energy reserves (10,000 KW) | Water resources in the region (%) | Water resources in the country (%) |
|---------------|------------------|------------------------------------------|----------------------|------------------------------------------|----------------------------------|----------------------------------|
| Jinsha River  | Rapu Estuary     | 12158.3                                  | 14.2                 | 50.00%                                   | 17.97%                           |
| Brahmaputra   | to the border    | 7011.6                                   | 3.9                  | 28.84%                                   | 10.36%                           |
| Nu River      | Zana             | 1829.5                                   | 1.5                  | 7.52%                                    | 2.70%                            |
| Yellow River  | Lanzhou          | 1196.8                                   | 0.6                  | 4.92%                                    | 1.77%                            |
| Yagong River  | Litang Estuary   | 1159.1                                   | 1.2                  | 4.77%                                    | 1.71%                            |
| Minjiang River| Slide River      | 812.1                                    | 0.8                  | 3.34%                                    | 1.20%                            |
| Dadu River    | Asbestos         | 148.0                                    | 1.8                  | 0.61%                                    | 0.22%                            |
| Total         |                  | 24315.4                                  |                      | 100.00%                                  | 35.93%                           |

3. Inferiority of regional water resources in the Tibetan Plateau

After decades of development, the water resources in the Qinghai-Tibet Plateau have initially achieved comprehensive social functions such as flood prevention and mitigation, urban and rural water supply, hydroelectric power generation, and water and soil conservation. Water resources system construction
has also made significant progress. However, there are certain difficulties in the water resources system to promote the sustainable development of the Qinghai-Tibet Plateau:

3.1. Low degree of exploitation and utilization of water resources
The development and utilization of water resources in the Qinghai-Tibet Plateau is relatively low, and water conservancy projects are ageing and disrepair. The existing project standards are low, management measures are extensive, and water utilization rate is low. At present, the utilization rate of Tibetan water resources development is less than 1%, far below the national average of 18%. In the management of water resources, due to weak awareness of resource management, the lack of comprehensive development and scientific management, water resources have aggravated the conflicts in the development and utilization of water resources. This is not conducive to the full use of water resources and the sustainable development of the Qinghai-Tibet Plateau.

3.2. Deterioration of the water environment
With the global warming and melting of glaciers, the water environment in the Qinghai-Tibet Plateau deteriorates: glaciers recede, snowlines rise, lakes shrink, river runoff decreases or stops, and the swamp disappear. The overall water ecology on the plateau deteriorates sharply. There are 4077 lakes in Maduo County, which is the source of the Yellow River where has appeared 2017 dry lakes, and thousands of rivers around the lake are dry. The phenomenon of flow-breaking in the Yellow River originated in Qinghai. According to a survey conducted in 1998, the snow line in the source area of the river has increased significantly and the glaciers have receded. The runoff from the Yellow River to Qinghai has dropped by 23%. The deterioration of the water environment is not conducive to the sustainable development of the Qinghai-Tibet Plateau.

4. Countermeasures for Water Resources System to Promote the Sustainable Development of the Qinghai-Tibet Plateau
Rational use of water resources can promote the sustainable development of the Qinghai-Tibet region. Based on the foregoing, two suggestions are proposed: Firstly, unified management of water resources is the key, water is a limited natural resource, and the Qinghai-Tibet region has abundant water resources and development potential. We must rationally develop and use scientifically, fully consider the level of economic and social development and the carrying capacity of the ecological environment and work out plans for the sustainable use of water resources with different time scales to enhance predictability and preventability. Secondly, we must protect the water environment and control the problems of water pollution in some regions. We can’t take the roads that treating after pollution, and we must also respond to global warming and glacial retreat in time to maintain a good lake environment on the Qinghai-Tibet Plateau.

5. Conclusion
The Qinghai-Tibet Plateau is rich in water resources and has great potential for hydropower development, accounting for about 40% of the country's total area. It is a key development area. However, there are problems such as unreasonable exploitation of water resources, retreat of glaciers, and pollution of the water environment. This is not conducive to the Regional sustainable development of Qinghai-Tibet Plateau. Therefore, we should make full use of the advantages of water resources in the Qinghai-Tibet Plateau, manage water resources in a unified manner, and protect water resources so that they can be fully and reasonably used, thus promoting the development of ecological economy in the Qinghai-Tibet Plateau.

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