ISSN: 2688-8645

Research Progress Over the Impact of Climate Change and Human Activities on Runoff Changes

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Abstract

The problem of water resources in semi-arid areas in my country is prominent. High-intensity human activity disturbance affects the evolution path and direction of water resources. The evolution law of regional river water cycle is very complicated.Human activities have changed the underlying surface conditions of runoff and confluence to different degrees, which have influenced the regional hydrological cycle and its response pattern. This article describes the research process of the impact of human activities on runoff changes and introduces the quantitative analysis methods of climate change and the impact of human activities on runoff changes.

Keywords

Human activity; Climate change; Runoff changes.

1. Introduction

With the intensification of global climate warming and the gradual expansion of human activities, the earth's water cycle system has undergone very big changes compared to the past. In recent years, many water problems have affected humans to varying degrees in many countries and regions around the world. Such as flood issues, water pollution issues, and drought issues. As far as the actual situation in many regions is concerned, the utilization and distribution of local water resources are gradually getting worse, and severely hinder the local economic development. On the other hand, human activities and other external environment are also affected by changes in regional hydrological processes. To the key influence, promote the distribution of local water resources in different ways. Because the intensity of human activities and their hydrological responses in different watersheds are not the same, it is difficult to quantitatively study the impact of human activities and other changes in the external environment on runoff.

The problem of water resources in semi-arid areas in my country is prominent. High-intensity human activity disturbance affects the evolution path and direction of water resources. The evolution law of regional river water cycle is very complicated. Since 1960, for the middle reaches of the Yellow River in my country, there have been large-scale human activities, mainly production activities, mainly including water and soil development, water conservancy project planning, coal engineering construction, artificial irrigation, etc. These activities are different The method affects the underlying surface conditions in the region. At the same time, coupled

ISSN: 2688-8645

with global climate problems, it has caused a relatively obvious change in the runoff situation within the section. It also affects the changes in the flood situation, such as the annual runoff. In other words, it is gradually decreasing, and seasonal dry-up occurs from time to time, and even more severe river dry-up. It is difficult to accurately quantify the time and spatial changes of water resources in river basins under the action of strong human activities, which not only increases the uncertainty of river water resources management and planning, but also seriously affects the survival and development of human society in the Loess Plateau. Therefore, how to correctly understand the evolution law of its water resources has become a critical issue that needs to be resolved.

2. Development History

2.1. Research Progress of Human Activities on Runoff Change

Since modern times, mankind has experienced many industrial revolutions, and the industrialization and modernization of society have advanced rapidly. The transformation of nature by mankind has become stronger, and the impact on the atmosphere, water cycle and ecological environment has increased. In recent years, the global temperature has risen, the natural conditions of the river basin have also been changed by climate change and human activities, and many environmental problems have occurred frequently; urbanization and water conservancy construction have greatly changed the law of river basin runoff generation. The impact of human activities and other external environmental changes on the hydrological process has entered the field of scholars and has become an important research hotspot with multiple temporal and spatial characteristics. From the perspective of watersheds, we will carry out two aspects of research: 1. Human activities related to climate change. Changes in the underlying surface of a river basin often change the regional climate, such as large-area reservoirs and irrigation projects, and changes in surface reflectance will affect regional heat and moisture. 2. Human activities related to land use. For example, the construction of reservoirs, farmland irrigation, and forest harvesting directly affect the hydrological cycle and water balance process, and the scope of influence gradually spreads from part to part over time.

The ecological environment of the Loess Plateau is relatively special and has obvious fragility. At the same time, the water resources in the region are also relatively poor, and there will be a lot of soil erosion every year. my country has adopted a large number of water and soil conservation measures and ecological restoration measures to control the soil erosion of the Loess Plateau, and a large number of studies on the Loess Plateau have been carried out at home and abroad [1], such as experimental observations, models and remote sensing studies. At present, great progress has been made in the study of the Loess Plateau. Li Zijun et al. [2] investigated and analyzed the runoff situation in the Chaohe River Basin. The runoff data samples were from 1961 to 2005. They found that the key influencing factor of the change was human activities. Li Qingyun [3] analyzed the hydrological process of the Jihe River Basin and found that there are two main factors affecting changes, one is local climate change, and the other is human activities. The main types of land use yield and flow: arable land>grassland>woodland>terraces.

The Jinghe River Basin is located in the semi-humid and semi-arid transition zone. It is located in the Yellow River Basin and belongs to the loess plateau zone. Since the 1980s, human activities have had a greater impact on the underlying surface of the region. Studies have shown that the runoff of the Jinghe River Basin has obviously shown a decreasing trend in recent decades. Wei Xiaoting et al. used hydrological models to analyze the attribution of runoff changes in the Jinghe River Basin and found that human activities are the main reason for the decrease of the Jinghe River runoff. . Zhang Shulan analyzed the temporal and spatial characteristics of runoff in the Jinghe River Basin and assessed the impact of human activities

ISSN: 2688-8645

on runoff. The results show that: after 2001, human activities have affected more than 76% of runoff.

At present, most eco-hydrological research mainly studies the response of hydrological processes to human activities. The impact of different human activities in the Jinghe River Basin on runoff and its mechanism still need to be studied more deeply.

2.2. Progress in Quantitative Analysis of Impacts of Climate Change and Human Activities on Runoff Change

In recent years, various methods have been proposed in the study of the quantitative analysis of the impact of climate change and human activities on runoff changes [4]. The non-linear statistical method is widely used in the quantitative research of hydrological response. The method has strong practicability and does not require high data. Xu Jiongxin [5] established a series of multiple regression equations to study the impact of annual precipitation and irrigation area on the Yellow River runoff. Zhang et al. [6] improved the double accumulation curve (DMC) method and quantitatively studied the impact of forest vegetation on the annual runoff of the watershed. Wang Guoqing and Wang Suiji used basin hydrological simulation and cumulative slope change rate analysis method (SCRCQ) to estimate the contribution rate of climate and human activities to the change of runoff production in the Yellow River Basin. The analysis by Li et al. [7] showed that the contribution rate of water conservation measures to the reduction of runoff was as high as 87%, while rainfall and potential evaporation only accounted for 13%. Zhang et al. [8] found that in the 11 watersheds of the Loess Plateau, land use change in 8 watersheds contributed more than half of the annual average flow reduction, while climate played a more important role in reducing runoff in the remaining three watersheds. In the water and soil conservation measures, the construction of sand blocking dams and reservoirs and the extraction of irrigation water from the reservoirs are the main reasons for the reduction in runoff.

The quantitative description of the hydrological process needs to be based on the construction of its model. The latter is an important means and tool to analyze the hydrological cycle and study the changes in its process. Since the 1990s, many hydrological models such as SWAT [9], VIC, and SHE have emerged at home and abroad. They are used in water resources planning and utilization, management strategy formulation, and flood disaster prevention. Played a very active role. Wang et al. [10] used a distributed time-varying model (DTVGM) to analyze the attribution of runoff from the Chaobai River and found that in terms of the actual impact on runoff, climate change accounted for 32% and human activities accounted for 68%. Li Lijuan et al. [10] conducted an in-depth study on the impact of land use on hydrological process changes in the Dali River Basin. There are two main methods and technical methods used, one is the characteristic variable time series method; the other is Precipitation-runoff model. According to their research results: soil and water conservation activities have a positive effect in reducing flood disasters. Chang et al. [11] based on the elastic coefficient method, TOPMODEL and VIC hydrological models, and carried out some work on the changes in the regional runoff of the Jinghe River Basin, mainly attribution analysis. These three methods have been used to obtain basically consistent studies. Conclusion: For human activities and changes in regional climate, these two influencing factors together lead to changes in runoff, and the degree of influence varies with the age.

3. Summary

At present, most eco-hydrological research mainly studies the response of hydrological processes to human activities. The impact of different human activities in the Jinghe River Basin on runoff and its mechanism still need to be studied more deeply.

ISSN: 2688-8645

For the comprehensive situation at home and abroad, the technical methods used usually include the following: one is statistical methods; the other is climate sensitivity analysis; the third is classic graphical analysis; the fourth is elastic analysis, which is established On the basis of the conceptual hydrological model; the fifth is the distributed hydrological model method; the sixth is the decomposition method, which is based on Budyko's assumption. As for the method to be used for analysis and research, the selection is based on regional hydrological data and related information.

Acknowledgments

This work was supported by the Fundamental Research Funds for the Central Universities (300102351502); Inner scientific research project of Shaanxi Land Engineering Construction Group (number SXDJ2021-10, SXDJ2021-30, SXDJ2020-22); Shaanxi Land Construction-Xi'an Jiaotong University Land Engineering and Human Settlement Environment Technology Innovation Center Open Fund (2021WHZ0092); Shaanxi Provincial Natural Science Basic Research Program (2021JQ-961).

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