

# Human Alterations to the Water and Carbon Cycles in the Lake Yangzong Basin since the Yuan Dynasty

Kishmaat Khairta\*

Department of Ecological Research, Yunnan University, Kunming 650500, China

## Abstract

The Lake Yangzong basin, located in Yunnan Province, China, has a rich history dating back to ancient times. This area, part of the larger Yunnan-Guizhou Plateau, is known for its unique geographical features and ecological significance. This essay explores these impacts over centuries, highlighting significant historical, agricultural, industrial, and urban developments that have shaped the current environmental landscape. During the Yuan Dynasty, the Mongol rulers established a highly centralized administrative system that fostered agricultural expansion and infrastructure development. This era marked the beginning of significant human intervention in the Lake Yangzong basin. The Mongols implemented large-scale irrigation projects to boost agricultural productivity. These projects included the construction of canals and reservoirs, which altered the natural flow of water within the basin.

**Keywords:** Province • Historical • Fostered • Agricultural • Basin • Dynasty

## Introduction

The irrigation systems developed during the Yuan Dynasty changed the hydrological regime of the Lake Yangzong basin. The construction of canals diverted water from natural streams and rivers to agricultural fields, reducing the water flow into the lake itself. This led to changes in the lake's water level and its seasonal variation. The reservoirs built for irrigation purposes also affected the recharge rates of groundwater, which is a crucial component of the basin's water cycle. The expansion of agriculture during the Yuan Dynasty led to the clearing of forests and grasslands, which had been significant carbon sinks. Deforestation and land conversion released large amounts of carbon dioxide into the atmosphere, contributing to changes in the local carbon cycle. The introduction of rice paddies, a common crop in the region, also impacted the carbon cycle as flooded fields emitted methane, a potent greenhouse gas [1].

During the Ming and Qing Dynasties, the expansion of terraced farming became prevalent in the Lake Yangzong basin. Terraced fields helped in managing water efficiently by reducing runoff and promoting water infiltration into the soil. However, the construction of terraces also altered the natural landscape and hydrology, impacting the flow of water into the lake and its tributaries. Additionally, increased irrigation demands led to further extraction of water from rivers and streams, exacerbating the changes initiated during the Yuan Dynasty. The extensive land use changes during the Ming and Qing Dynasties continued to affect the carbon cycle. The conversion of natural landscapes to agricultural fields resulted in the release of stored carbon from soil and vegetation. Moreover, traditional farming practices, such as burning crop residues, added to atmospheric carbon dioxide levels. The introduction of new crops, such as maize and sweet potatoes, which were less water-intensive than rice, also influenced the carbon balance by altering the types of vegetation and organic matter inputs into the soil.

**\*Address for Correspondence:** Kishmaat Khairta, Department of Ecological Research, Yunnan University, Kunming 650500, China; E-mail: kkhairta@gmail.com

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## Literature Review

The 20<sup>th</sup> and 21<sup>st</sup> centuries have seen rapid industrialization and urbanization in China, profoundly impacting the Lake Yangzong basin. These developments have introduced new factors affecting the water and carbon cycles, including pollution, increased water extraction, and changes in land use patterns. Modern industrial activities in the Lake Yangzong basin have significantly disrupted the natural water cycle. Factories and urban centers require large amounts of water, leading to over-extraction from both surface and groundwater sources. This has resulted in lower water levels in the lake and reduced flow in rivers and streams. Additionally, industrial pollutants and urban runoff have degraded water quality, affecting the health of aquatic ecosystems [2].

## Discussion

Urbanization has also led to the creation of impervious surfaces, such as roads and buildings, which reduce the infiltration of rainwater into the ground. This increases surface runoff and the risk of flooding, while decreasing groundwater recharge. The construction of dams and hydropower projects has further altered the flow regime of rivers, impacting the timing and quantity of water entering the Lake Yangzong basin. The shift from an agrarian to an industrial economy has transformed the carbon dynamics in the Lake Yangzong basin. Industrial processes and increased energy consumption have led to higher emissions of carbon dioxide and other greenhouse gases. Urbanization has also reduced the area of vegetated land, diminishing the region's capacity to sequester carbon. The conversion of agricultural land to urban and industrial uses has released additional carbon stored in soils and vegetation.

Furthermore, the growing transportation sector, reliant on fossil fuels, has become a significant source of carbon emissions. The increased production and consumption of goods have also contributed to higher carbon footprints associated with manufacturing and waste disposal. Recognizing the environmental degradation, the Chinese government and local authorities have implemented various conservation measures to mitigate the impacts on the water and carbon cycles in the Lake Yangzong basin [3,4].

Efforts to manage water resources more sustainably include the promotion of water-saving technologies in agriculture and industry, the restoration of natural wetlands, and the implementation of stricter pollution control measures. The construction of wastewater treatment plants has improved water quality by reducing the discharge of untreated industrial and domestic effluents into the lake and its tributaries. Additionally, reforestation and afforestation projects

aim to enhance water retention in the soil and reduce surface runoff. To address carbon emissions, various afforestation and reforestation programs have been initiated to increase the region's forest cover and enhance carbon sequestration [5]. The promotion of sustainable agricultural practices, such as reduced tillage and organic farming, helps maintain soil health and increase its carbon storage capacity. Moreover, policies encouraging the use of renewable energy sources, such as solar and wind power, aim to reduce the reliance on fossil fuels and lower greenhouse gas emissions [6].

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## Conclusion

Since the Yuan Dynasty, human activities have significantly altered the water and carbon cycles in the Lake Yangzong basin. The expansion of agriculture, industrialization, and urbanization have transformed the natural landscape and disrupted ecological processes. These changes have had far-reaching consequences for water availability, quality, and carbon dynamics in the region. However, ongoing conservation efforts provide hope for restoring the balance of these vital cycles. Sustainable water management practices, pollution control measures, and carbon sequestration initiatives are essential to mitigate the impacts of past and present human activities. By understanding the historical context and the extent of human influence on the Lake Yangzong basin, policymakers and stakeholders can develop more effective strategies to protect and preserve this important ecosystem for future generations.

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## Acknowledgement

None.

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## Conflict of Interest

None.

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