Ecological impact and restriction mechanism of urbanization on remote lakes in China's Hubei Province

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Abstract. [Purpose/significance] In order to effectively control the ecological impact of urbanization construction on lake in remote urban areas of Hubei province in China, the characteristics of remote urban areas of Hubei province and some pollution governance experience of lakes in city center were considered. [Results/conclusion] Then the corresponding restriction mechanism on lake in remote urban areas of Hubei province in China are put forward: such as perfecting the far city lake management rules and regulations, establishing an effective governance mechanism of cross-domain, using the water environment monitoring system of keeping record lake down core magnetism characteristics, improving the town planning with paying equal attention to far city lake ecological protection and so on.

1. Background
The so-called urbanization refers to the process of population gathering to cities and towns. In this gradual process, the number of cities and towns, urban population and urban land will increase significantly[1]. Urbanization can firstly promote economic development by adjusting industrial structure, consumption demand structure, investment structure and employment structure. Secondly, we can promote balanced development between urban and rural areas and narrow the gap between them. Thirdly, we can also stimulate domestic demand in rural areas, improve the overall quality of the rural population, and speed up the building of a new socialist countryside. In addition, urbanization can decompose urban functions, divert urban population to alleviate urban problems, reduce urban development burden, and promote healthy and sustainable urban development. However, while urbanization has brought rapid development to the social economy, it has also left many hidden crises. The ecological impact caused by urbanization construction is an important aspect of the potential crisis[2]. How to realize the urbanization construction of sustainable development is the key to ensure the sustainable development of social economy. In the current stage of vigorously promoting urbanization, we should make a good plan for sustainable development and strive to achieve coordinated development of economic, social and ecological benefits.

As the main type of wetland system, lakes have the functions of flood storage, irrigation, reducing agricultural natural disasters, regulating micro-climate, protecting ecological environment, providing abundant and diverse habitats for animals and plants, providing sightseeing and recreation places and education places for the public, and providing a variety of ecological and social services. The lakes in the main and near urban areas have always been the focus of experts and scholars, while the lakes in the far urban areas are seldom taken as research objects due to their geographical location, better
ecological environment and attention. Now the acceleration of urbanization will make lakes in the far urban areas face serious ecological threats. For example, Hubei province in China, historically known as "the province of thousands of lakes", had 1,066 lakes in the late 1950s, and about 309 in the early 1980s. There are only 181 lakes with an area greater than 1 km2 and only 44 lakes with an area greater than 10 km2. In the famous Sihu area, only two lakes, long lake and Honghu lake remain (among them, Sanshan lake and Bailu lake are reclaimed)[3]. We must pay enough attention to the ecological impact of urbanization on the lakes in the remote urban areas. Based on the characteristics of the lakes in the remote area of Hubei province in China and the pollution control experience of the lakes in the main area of Hubei province, this paper puts forward the corresponding restriction mechanism for the potential ecological threat of the lakes in the remote area of Hubei province.

2. Overview of lakes in remote urban areas

Far city generally refers to the area far away from the center of the city. Due to the dynamic characteristics of administrative division, the areas that are included in the administrative division later will be called far city. Compared with the main urban area and the near urban area, the lakes in the far urban area of Hubei have the following characteristics: firstly, the lake area is larger, the lake branch is more, the river basin involves wide. For example, Liangzi lake in Hubei province, whose water spans the Liangzi lake basin district of Ezhou city and Jiangxia district of Wuhan city, covers 17 towns in four cities (districts) including Jiangxia district of Wuhan city, Daye city of Huangshi city, Liangzi lake district of Ezhou city and Xian'an district of Xianning city[4]. Secondly, the ecosystem is more complete, the lake water quality is better. Because the lake in the far city is a certain distance from the central city, it is less affected by the urban construction, and its ecological system is less damaged, so the ecological environment and water quality in the lake area are better. Thirdly, the resource industry has obvious advantages. The lakes in the remote urban areas generally rely on their superior geographical location and abundant resources to vigorously develop such advantageous industries as fishery and tourism, thus accelerating the economic development of the lakes. Fourthly, the comprehensive management of the lake is not perfect, once destroyed, it is difficult to control. Because the lake area in the far city is large and the basin involves a wide area, it is difficult to manage the lake comprehensively. Especially when the river basin involves different administrative regions, cross-domain governance is more difficult. The coordination and interest competition among different administrative regions often complicate simple problems, thus prolonging the time for pollution treatment and possibly missing the best and most effective treatment time.

3. The ecological impact of urbanization on lakes in remote urban areas

Many scholars have made in-depth discussions on the ecological problems of lakes located in the main urban areas, but lakes in the far urban areas are less affected by urban production and life, so their ecological security has been preserved to some extent. Gone are the days of destroying while protecting, or exchanging ecological environment for economic development. Environmental protection in the new era needs to be prevented before destruction. The significant increase in urban population and land use brought by urbanization and the impact on the economic pattern of the far urban areas of Hubei province have brought ecological crisis to the lakes in the far urban areas, which can be reflected in the following aspects:

3.1. Lakes were shrinking in large areas, and the water pattern changes were complicated of Hubei province

With the accelerating of urbanization construction, the speed of urban land expansion, would fill in the lakes, resulting in large lakes atrophy, lakes were large fill could lead to a lake reservoir regulating function abate, purification ability carrying a recession, which could make the lake water quality worsening, and aquatic animals and plants living environment, to a certain extent of damage to a virtuous cycle of ecological system would be destroyed. In addition, with the change of lake area and water volume and the intervention of construction process in the process of urbanization on river channels, some river channels in the lake area tended to shrink and change frequently. Meanwhile, the original natural drainage network would gradually be replaced by numerous artificial river channels, making the changes of river systems more complicated. For example, after the founding of the
People's Republic of China, the Sihu land area of Hubei province experienced three large-scale model of constructing farmland around the lake (1957-1962, 1963-1971, 1971-1976), Large lakes were further shrinking, and small and medium-sized lakes were rapidly disappearing[5], as shown in table 1 and figure 1.

Table 1. Changes of lake surface area before and after three times of reclamation in four lakes

| Time  | Number of lakes | > 333 hm² lakes | Area(hm²) | The ratio of the total area (%) |
|-------|-----------------|-----------------|-----------|-------------------------------|
| 1960  | 260             | 104             | 2650      | 21.86                         |
| 1980  | 100             | 31              | 763       | 6.3                           |
| amplitude | -150          | -73             | -1887     | -15.56                        |

![Figure 1. Changes of lake surface area before and after three times of reclamation in four lakes.](image)

3.2. Industry was developing rapidly, water quality continued to decline of Hubei province

With the acceleration of urbanization, the pollution source structure of the lake water quality in the far urban areas had gradually changed from agricultural to industrial and domestic pollution. Urbanization promoted the improvement of the industrialization process, making the secondary industry in the industrial structure, mainly the proportion of industry, increase significantly, thus driving the vigorous development of township enterprises. At present, the farmland around the lakes in remote urban areas of Hubei province was being developed gradually, and the lakeside buildings were becoming more and denser. The sewage outlets leading to these lakes were increasing day by day. The industrial wastewater and domestic sewage discharged into the lakes by enterprises and residents around the lakes are increasing day by day. At the same time, urbanization will also lead to the gradual development of roads along the lake, vehicle emissions and vehicle body corrosion would also increase lake pollution. In addition, with the increasing attention and strengthening of urban environmental pollution control, many enterprises that cause serious pollution would make use of the opportunity of urbanization construction to realize the transfer of water pollution to the remote urban areas, which would undoubtedly make the lake pollution crisis in the remote urban areas face a serious threat.

3.3. The destruction of wetland ecosystem in Hubei province was intensified and the ecological advantage was gradually lost

With the speeding up of the process of urban construction, local water conservancy construction in Hubei and other lakes activities also increased, these measures of the original intention was based on reducing flood disaster, prevention and cure of lakes for coastal erosion and other purposes, but at the same time it also destroyed the river network system, caused serious damage of lakeside zone, which destroyed the lake own self-cleaning pollution resistance system, weakened the lakes self-protection
ability, destroyed the lake ecological system, influenced the remove nutrient and pollutants from surface water and groundwater treatment and biomass and oxygen production, caused pollution aggravate and difficult to control. The destruction of lake ecological balance system often made the original ability to regulate the dynamic balance of water resources worse than before, thus the lake ecological advantage in Hubei gradually lost.

3.4. In the urban planning, the ecological protection of lakes in the far city of Hubei province was far from enough

Under the influence of national policies, farmland and other grain land would be the key control objects in urban planning, but the ecological protection of lake land in the far urban areas was often ignored. Urbanization construction under urban planning would bring significant increase in urban population and land use, which would make the contradiction between people and land become increasingly prominent, and the environmental pressure in planned areas would naturally increase. At present, most of the planning in Hubei province focused on forest vegetation and water areas in densely populated areas, and the potential threat to the lakes in the remote urban areas was often ignored, and other ecological benefits may be obtained at the expense of the lake ecology in the remote urban areas.

4. Countermeasures and suggestions

Many scholars have made in-depth and thorough studies on the control of lake pollution in the main urban areas, and the control measures obtained are mainly focused on regulations, technical means, planning and guarantee, etc. Lakes in the far urban areas of Hubei province can also learn from these effective experiences to restrict the ecological impact of urbanization on them.

4.1. We need to improve the rules and regulations for lake management in remote urban areas of Hubei province

At present, the state has formulated relevant laws and regulations on lake protection, and cities have also formulated corresponding local laws and regulations on lake protection according to their actual conditions. Although the lake protection law system has been established, the protection of lakes in different regions has not been differentiated in the law system. At present, most of the laws and regulations still focus on the lakes in the central urban areas, and far from enough attention has been paid to the lakes in the far urban areas of Hubei province. In view of this situation, different laws and regulations should be applied according to the geographical characteristics of the distribution of lakes in different cities. With the acceleration of the implementation of the urbanization policy, it is urgent to establish the management system of lakes in the far urban areas which are greatly affected by urbanization.

4.2. We need to establish effective cross-domain governance mechanisms

Unlike lakes in the main urban areas, lakes in the far urban areas of Hubei province often involve a wide range of basins, which may span different administrative regions. The enthusiasm, initiative and consideration of measures for water pollution control in different regions are closely related to their own interests. The effectiveness of water pollution prevention and control depends to a certain extent on the interests of different stakeholders in water pollution prevention and control game. In order to establish the effective management mechanism of the lakes in the far urban areas, it is necessary to improve the inter-basin management mechanism. The improvement of cross-domain governance mechanism requires the introduction of cross-domain governance theory, as well as the ideological mobilization, communication and coordination of administrative subjects in different administrative regions, the comprehensive use of the government and the market, combined with a variety of governance tools to complete the overall plan.

4.3. We need a water environment monitoring system which was used to record the magnetic characteristics of lake sediments

The protection of lake ecological environment is inseparable from effective technical detection means. In view of the current situation of lakes in the far urban areas of Hubei province, the monitoring system should be established by combining the practical but low-cost technical means. According to the research of scholars, the environmental changes brought by industrial production and human activities around the lake can get a sensitive response from the magnetic variation characteristics of
lake sediments. Due to the large area and wide scope of lakes in the remote urban area of Hubei province, it is difficult to monitor many latent ecological impacts, so it is necessary to monitor the ecological changes of lakes in the remote urban area regularly by using rapid and effective environmental monitoring technology with low cost. In other words, the magnetic record of the response of lake sediments in the far urban area of Hubei province to the urbanization of the surrounding areas should be established to conduct rapid and accurate dynamic monitoring of the ecological impact caused by urbanization[6].

4.4. We need to must give equal importance to lake ecological protection in the far urban areas of urban planning in Hubei province

To take environmental protection and sustainable development as the central idea in urban planning, we must find a green urbanization road that ensures coordinated development of economic, social and ecological benefits. In the development of town planning, the ecological protection of lakes in the far city of Hubei should be given the same importance as other ecosystems. When selecting relevant town planning parameters, we should, on the basis of respecting the law of nature, appropriately introduce the protection concept of lakes in the far urban areas, so as to nip in the bud[7]. For example, the planning application for the lake-view real estate around the lake in the far urban area of Hubei province can be appropriately restricted. For the town planning of the downstream of the lake in the far urban area, the natural law of river network evolution should be considered[8], and the existing river system should be kept as far as possible to achieve the harmonious coexistence of human and water environment and the sustainable development of the whole large ecosystem[9].

5. Conclusion and discussion

5.1. Conclusion

Based on the basic characteristics of the lakes in remote urban areas of Hubei province and the experience of lake management in the main urban area, the following ecological restriction mechanisms are proposed from the four perspectives of rules and regulations, governance mechanism, monitoring system and town planning:

(1) With the acceleration of the implementation of the urbanization policy, it is urgent to establish the management system of lakes in the far urban areas which are greatly affected by urbanization.

(2) It is necessary to improve the inter-basin governance mechanism.

(3) The ecological impact of urbanization can be dynamically monitored quickly and accurately by means of a variety of technologies.

(4) It is urgent to construct the urban planning system to realize the harmonious coexistence of human and water environment and the sustainable development of the whole ecosystem.

5.2. Discussion

Based on the characteristics of the lakes in the remote urban area and the experience of controlling lake pollution in the main urban area, this paper puts forward the corresponding restriction mechanism, which is of certain practical significance for the overall consideration of the long-term development needs of lakes in the remote urban area of Hubei province and the acceleration of the realization of the sustainable development of social economy. However, due to the shortage of data collection, this paper fails to conduct a more in-depth and thorough analysis based on the actual data, which will be the direction and research focus of the author's next step.

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