The Impact of urbanization on river channel pollution

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Abstract. Nowadays, with the developments of human civilization. The urbanization processes happened all over the world. During the processes, human beings gain the benefits but the problems appeared can also deeply harm the both the nature and the human beings. One of these serious problems is the river channel pollution. Many cases had been used as examples and the targets of the analysis. From the analysis, the result is that the urbanization can truly cause negative impacts to the river channel by discharging waste water, releasing domestic animals and human excrement directly into the river and also throwing garbage into the river channel. Also, the governments' neglect and poor city sewer construction can also cause river pollution. The essay's main purpose is to fill a vacancy about the relationship between the urbanization and the river channel pollution. Also, showing people how serious the river channel has been polluted under the expanding of urbanization.

Keywords: urbanization, river channel pollution.

1. Introduction

Nowadays, urbanization has already expanded a lot and many areas around the world have been deeply affected by this process in the population structure, economy, politics, local environment and also many other regions. The meaning of urbanization is to transform the way of living from a rural way to an urban way [1]. From ancient times to the modern times, the big civilizations were always near the rivers, these civilizations are the oldest urbanizations around the world. For instance, the ancient Egypt was originated from the Nile. The river born the ancient Egypt, due to provide them sufficient water to them. However, during the processes of urbanization, the activities of human beings increased with a significant figure. With human activities, the pollutions cannot be totally avoided as well as the river channel pollution.

Undeniably, river water pollution can be a negative impact with caused by the processes of urbanization. In the past, due to the local governments' negligent management in the water management also some factories and some residential zones released wasted water with toxic materials directly to the natural water bodies. In 2001, after testing seven major water system within China, about 29.5% of water's quality accorded with third water grades' quality which was confirmed to the water supply's requirements. While the ratio of poor fifth water's quality was 44%. Furthermore, about 50% of China's shallow groundwater areas polluted to different extents, and in the urban area, over half of the groundwater has been polluted. With the reckless releasing of industrial polluted wastewater, the polluted water deeply polluted the surface water system and the ground water system, with 80% of them has been polluted [2]. Water supports all the lives on our planet. But the pollution of the rivers was so serious and from the research, the water pollution directly caused the water shortage, damaged the water cycle system in the natural system in China. The phenomenon also conducted negative impacts to the agriculture system and urbanization can be a contributory factor of the water pollution crisis.

Under this condition, the Chinese government took plenty of actions to solve the river pollution issues. With no question, governing the river channel pollution is one of the main parts of the Chinese government's water purification plan. In year 2022, the Chinese government will invest about 4.6 billion RMB into the river channel governance and the punishments of illegally damage the natural river by any method became more tougher [3]. From the river pollution example of China, the negative effects of river pollution and from Chinese government's actions, the river channel pollution is a quite important issue and it is not an easy problem to be solved.

The relationship between the urbanization and the river channel pollution can be quite clear and until now, there are some efficient methods which can reduce the rate and the negative effect of river channel pollution that caused by the urbanization. With an example that from 2008, the Chinese government started to deploy 'river managers' to the rivers and these 'river managers' are mainly responsible for protect the river channel. They analysis the pollution condition of the river channel, provide plans of purify the river, also they need to supervise the river channel [4]. Their appearance strongly protects the river from the surgery urbanization rate in China.

However, from the author's view, the river channel protection is not totally spread in China and the method of river channel purify is not good enough. For instance, the author lives near by a river, but the river is smelly all the time, even every week the river manager drives a boat to clean and purify the river channels. This phenomenon represents that the methods of purify the river channels in some regions are not helpful at all.

Overall, this article is mainly about investigating the relationship between urbanization and the river channel pollution. Some cases will be used in the essay to help analysis this relationship. In the following paragraphs, the examples of river channel pollution caused by urbanization processes in both China and foreign countries (some examples will be well developed countries, some of them will be low developed countries) will be listed in the article and then investigating the sources of the river channel pollution in the examples. these examples' urbanization processes will be analyzed, their urban river channel managements' methods will be analyzed, also their methods' advantages and disadvantages will be analyzed. Furthermore, many famous specialists' opinion about the urbanization caused river channel pollution will be reviewed and analyzed.

2. The typical examples about water channel pollution

2.1. An example in the developing country

For the example in the developing foreign countries, Brazil can be a good example. Brazil is located at the South America and the country's urbanization rate is quite high and this rate is continuing increasing. The urbanization processes started in the big cities in Brazil like St. Paul, Rio de Janeiro, Brasilia and Bell Horizonte and most of the urban population was gathered in these cities. According to the World Bank's data, the urban population rate (portion of total population) in Brazil increased from 47% in 1960 to 87% in 2020. In 2016, the Olympic Games raised in the Rio de Janeiro and during that time the figure was 86% [5]. But even before the Olympic Games, the river channels and other waterbodies' pollution was quite serious. The Associated Press tested the water quality at several venues where aquatic events were held during the 2016 Olympic Games. The consequences showed that swimming or boating in these places is not safe, and the total number of germs in the water was even comparable to untreated sewage and the Associated Press reported that Olympic athletes competing in these waters was equivalent to direct contact with viruses that can easily cause disease. There were still more than 50 tributaries of the river that fed into Guanabara Bay contain untreated garbage and human waste [6]. From the garbage and the human waste appeared in the river channels and linked with high urbanization rate in Rio, the issue can be firstly the garbage collection system in Rio was not enough to deal with such a high number of urban population's garbage. Secondly, the city river channels' supervision level was low, people can throw rubbish to the river channels with no control. With no question, the serious river channel pollution was mainly caused by the fast urbanization processes, high the urban population in Brazil and the government's nonfeasance. Figure 1 shows the serious river channel pollution caused by the urban civilians who live at the upper stream dropping garbage directly to the river channel.

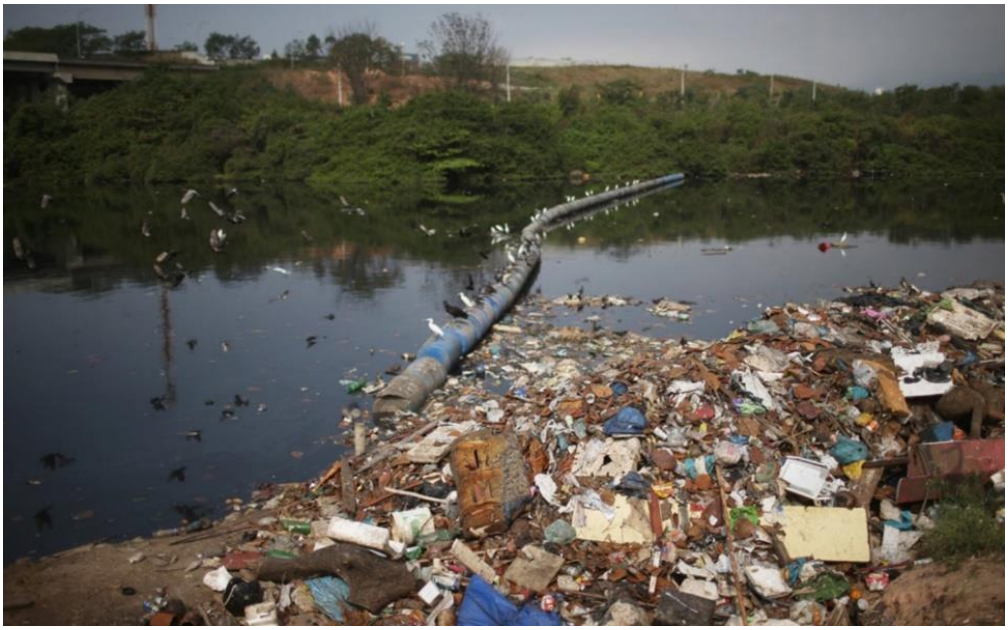

Figure 1 One of the tributaries that feeds into Guanabara Bay [7]

2.2. An example in the developed country

For the example in the developed countries, USA can be a typical example. According to the World Bank, the urban population rate (portion of total population) increased from 70% in 1960 to 83% in 2020. The urbanization rate was high but the speed of urbanization was not fast during the last 6 decades [8]. In the late 19 century in USA, due to the surges in the industrialization and urbanization, the river channel pollution was quite serious and threatened people's lives. Chicago as the most typical example in the USA, it afforded the boosts of the urban population and the development of industry. Before the sewerage system was established in the 19th century, the only way for the residents to deal with the waste water was to dump it on the earth, so the water existed on the ground can only be directly absorbed by the soil or be evaporated Chicago is located on shallow sandy ground, which is underlain by a layer of impermeable clay, so that in Chicago, the ground of thew city was like a swale, often in a sludgy state. This type of land status poses quite great safety hazard. When the tap water and sewer system were scarce, people generally used wells with shallow depths. The impermeable surface on the road can allow sewage to flow back into these shallower wells, affecting the quality of the well water and acting as a vector for infectious diseases. During the summer, when there was plenty of rainfall, the garbage that accumulates on the road is also easily washed into these wells by rainwater, leading to further contamination. So, the problem of water contamination in the Chicago city is thought to be one of the contributary factors of the high prevalence of Cholera and Dysentery during the 19th century. Furthermore, many factories established in the Chicago in around 19 centuries due to it is not only for these factories to transit their finished goods by shipping, also they can use the water in the lake for cooling, cleaning, and they can even directly discharge the waste water into the Great Lakes. However, the Chicago government realized the river channel pollution's negative impacts can deeply damage the city environment and civilians' health. So, in 1852, Chicago secured drainage by raising the height of streets and buildings to ensure adequate drainage, using gravity to ensure drainage. Lake Michigan was the lake that provided Chicago's drinking water, but at the same time sewage was discharged into Lake Michigan. 1854-1860, nearly 86.9km of sewers were laid in Chicago. The construction of sewer lines increased the amount of sewage discharge, which led to the gradual pollution of Lake Michigan's water. The Chicago government later improved the water supply system by digging a tunnel under the lake to improve the quality of water supply; on the other hand, the Illinois-Michigan Canal was dug deeper to direct the water flow to wash the Chicago River, thus reducing water pollution and improving the drainage system. In the 20 centuries, in 1972, the Water Pollution Control Act (WPCA) was introduced, and the WPCA specified that by

July 1, 1983, the nation's rivers were to be fishable and swimmable [9]. From the report, the original fast urbanization processes strongly damaged the local river channel environment in Chicago. Also, because the urbanization brought the development of the industrialization took placed in the Great Lake zone, the factories had no limits about release the toxic water to the river channels also directly caused the river channel pollution. But due to the later period actions utilized by the Chicago government and the US government, the river pollution in the Chicago city nearly disappeared in the 21 centuries. Figure 2 shows the Chicago river's nowadays appearance. From the picture, the river is pure.

Figure 2 River channel in the Chicago city [10]

2.3. Example in China

Then focus on the domestic examples within China. China is a developing country with massive number of people. According to the world bank's data, until 2021 Chinese urban population rate (portion of the total population) was 63% [11]. With is not as high as other developed countries like USA (83%) and less developed countries like Brazil (86%). Overall, Chinese government truly did well in river channel management, epically did well in some urban river channel management. For instance, the Suzhou River, Shanghai's mother river. The river runs through the city. In the early 20 century, Shanghai city continued developing like lightning. But the river environment of the Suzhou River was getting worse and worse. The main sources of pollution at that time were the waste water discharged into the river from the residential area and the polluted water from the factories. In 1988, during the first stage of the Suzhou River Environmental Improvement Project was launched, and the project started at the end of 1999 and in January 2003 the project was totally completed, while the second stage of the project started in April 2003. The renovation project is now in its third phase. Overall, the Shanghai government has already invested 14 billion RMB on managing the Suzhou River [12]. Another example is that the river management of Shenzhen-Hong Kong Boundary River. The urbanization rates at both side of the river band are both extreme high. But before the treatment, the river was highly polluted, with serious river water pollution, highly hardened riverbed, degraded flooding function and single ecological species, which seriously affected the ecological environment and quality of life of the whole Shenzhen CBD area and Shenzhen-Shenzhen border area. The comprehensive improvement project of the river in Shenzhen not only solved the problems of serious water pollution, low flood control capacity and poor ecological landscape of the river, but also created a beautiful waterfront landscape, enriched the diversity of biological species, met the needs of the public to get close to nature and enjoy the scenery, and brought new vitality and energy to the development of the whole Shenzhen central area and Shenzhen and Hong Kong. Figure 3 and Figure

4 was photoed by the author, clearly show the river channel pollution in the Huludao city's urban area.

Figure 3 The water pollution in Moon Lake

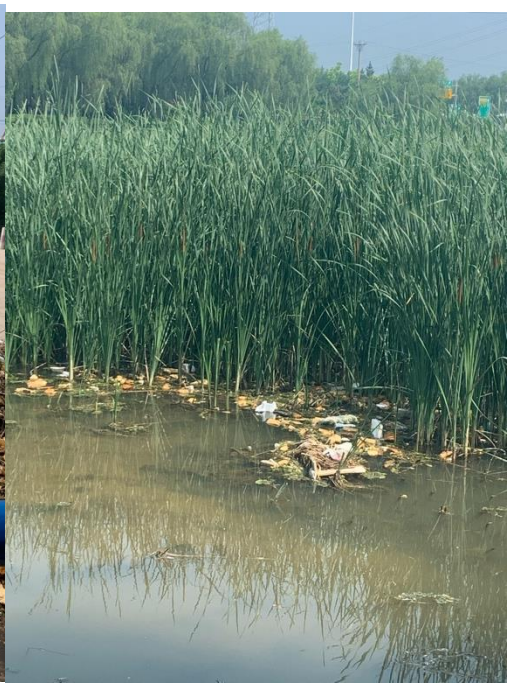

Figure 4 Cleaning the trash at the Moon Lake

From all these examples, urbanization can truly cause river pollution and damage the ecology beside the river channels. Most counties' governments took actions on solving the river channel pollution caused by the urbanization. But some actions are not useful and not efficient. Also, due to the nonfeasance of the local governments, many actions didn't truly apply.

3. The link between the urbanization and the river channel pollution

3.1. A typical example of processes of the urbanization

The example the author chose is the USA. Because the USA's urbanization rate is at a quite high level and making the USA be the example can be more comprehensive compared to other countries' urbanization processes. The development of American cities has been characterized by two successive but distinctive phases. The first stage, from the colonial period to 1920, was the concentration of the population moved from countries to downtown areas, also the progressive developments of cities from small to medium-sized cities and then to large cities. The main form of urban spatial structure was the concentrated development of cities, while the suburbs developed slowly under the lead of cities, which is the traditional urbanization stage. In the second stage, after 1920, suburbanization became the leading force to drive the further development of cities, i.e., the beginning of New Urbanization 0, which constituted a metropolitan area with polycentric, decentralized, and integrated urban and suburban development as the main characteristics. In 1940, almost half of the population of the United States lived in metropolitan areas and became a metropolitan nation; in 1990, more than half of the population lived in large metropolitan areas of more than one million people, and the New Urbanization moved to a higher level [13].

3.2. The relationship between urbanization and river channel pollution

Making the USA again as an example, from the history of the big cities in the USA. Some of them like New York, Chicago, Detroit. These cities urbanized from a very early time which was due to the economic development and industrialization took places in those cities and continuing attracting

people all over the world live in these cities and work in these cities. In the table below, from 1960 to 2020, the total population in the Chicago city almost doubled. The phenomenon represents the urban population and the urbanization rate increased so fast.

Table 1 The census about the Chicago City from 1960 to 2020. [14]

Census Area	Area Type	2020	2010	2000	1990	1980	1970	1960
Chicago-Naperville-Joliet, IL-IN-WI	Metropolitan	9,618,502	9,461,105	9,098,316	8,065,633	7,869,542	7,612,314	6,794,461
Chicago-Naperville-Joliet, IL-IN-WI	Combined	9,986,960	9,686,021	9,312,255	8,385,397	8,264,490	8,089,421	7,204,198

With more and more immigrants' injection into the city, the urbanization processes developed at a lighting speed and it is continuing expanding. Added the government's cursoriness about the river channel management, during the early urbanization, people directly release the sewage water directly into the Chicago River. In the heavy industry cities like Detroit. The urbanization processes started from the city's industrialization development. Also, during the original industrialization time, the local government didn't take actions on limiting the discharge of waste water from the factories. The factories directly release the polluted water into the Lake Erie and caused serious river channel pollution. However, the local government originally thought that with the large volume of water in the Great Lakes, small amounts of pollutants are diluted to safe levels and self-cleaned by the Great Lakes. But the industrialization of the U.S. and Canada has continued for more than 100 years, and the very low proportion of outflow from the Great Lakes has again made it difficult to discharge the pollutants that have accumulated over time. Fortunately, after the Clean Water Act (CWA) published for several years. Most river channels' water qualities in the USA improved a lot. From the cases, the river channel pollution caused by the urbanization processes can't be totally avoided in the short terms.

4. The main sources of the river channel pollution in the UK during early urbanization and industrialization

At the beginning of the industrialization in the UK (18 century), people used the river flows to generate the machines to operate the production. Almost every factory established in England in the first phase of the industrialization happened there were established near the river. Because building the factories near the river can not only easy for transiting the goods, but also, they can discharge polluted water in to the river. Even the industrialization evolution achieved the steam engine phase. These steam machines also need river water for cooling and cleaning. Behind the industry zone is the residential area. In the residential area, public waste water discharged from this region, this included people and domestic animals' excrement, household waste and detergent [15].

Furthermore, the urban population in England was keeping increasing. In Manchester, the population doubled during 1773 to 1801[16]. Until 1851, the urban population exceeded the rural population in the UK [17]. Also, even the urbanization rate in er eased so fast, but the urbanization level is quite low in the same period. The city construction was lagged compared to that high urbanization rate. Under this condition, the social hygiene is definitely poor whatever in the new cities or old cities. For instance, in 1831 in Manchester, although the city had over 140 thousand people, the city still hadn't pave the formal street and no sewer under the city [18]. Garbage, excrement, polluted water flew through the street and finally injected into the river channels and caused the river channel pollution.

From all of these consequences, the river channel pollution is mainly caused by the poor city sewer construction, poor industrial waste water management, urban civilians had low consciousness about protecting the river channel, they didn't know how harmful they do to the river environment when they are throwing rubbish into the river.

5. Conclusion

The essay has already fully investigated the relationship between the urbanization and the river channel pollution by using examples and analyzing them. From the investigation, urbanization can be a contributary factor of the river channel pollution. And the pollution is mainly from civilians' households (throwing garbage in the river, discharging waste water with detergent). Also, the industry waste water discharge can be one of the factors of the river pollution. With the serious of the research and analyzing, the significance of the essay is to show how serious the urbanization processes can damage the river channel environment. The author hope that the river channel environment can become better can better. Furthermore, with better studies and researches about the river channel pollution under the expanding of urbanization, more and more details about the river pollution will be available. And with these details, the relationship between the urbanization and the river channel pollution can be more definite.

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