

# Sustainable Development of Atmosphere and Water Resources: A Case Study of the UK

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## ABSTRACT

Nowadays, the air and water resources are seriously polluted, and achieving sustainable development is particularly important. This paper will introduce the historical and current situation of atmosphere and water resources in Britain and their sustainable development strategies and provide some inspirations for sustainable development strategies for China's atmosphere and water resources. By analyzing past strategies of air and water pollution control in the UK, there were many mature sustainability strategies that could be learned by China. However, the sustainable development of the atmosphere and water resources still needs to be improved. Taking the study of the British atmosphere and water resources as an example, people can get enlightenment and future development direction in air and water pollution control. Meanwhile, more research is needed on future water pollution (acidification and eutrophication).

**Keywords:** *The UK, Atmospheric resources, Water resources, Sustainable development, Strategies*

## 1. INTRODUCTION

From the perspective of historical development, developed countries have faced the problems of air pollution and climate change during their original accumulation and development of industrialization. The UK was the first country to start and complete industrialization. It was also the country with the most serious air pollution and more greenhouse gas emissions. Through continuous exploration and practice, the UK has formed a development path of effective coordinated management of air pollution and climate change. Today, the UK's air pollution problem has been effectively alleviated, with CO<sub>2</sub> emissions continuing to fall since their peak in 1973 and reaching 56.6% of their peak in 2019[1]. On the other hand, Britain's water resources also need attention. Nitrate levels in groundwater, which provides a third of Britain's water supply, have been rising in recent years, making it costly to treat water or develop new sources[2]. Therefore, the existing water treatment technology needs to be further improved to improve efficiency and reduce cost. This paper will introduce the distribution and utilization status of atmosphere and water resources in The UK, and analyze how to realize the sustainable development of atmosphere and water resources. These studies are

conducive to the sustainable use of atmospheric and water resources.

## 2. ATMOSPHERIC AND WATER RESOURCES USE IN THE UK REGION

### 2.1. Development and Utilization of Atmospheric Resources

After the poison fog incident in London in 1952, the British government began to pay attention to air pollution. Britain is known as the "foggy city", mainly because of the rapid population growth and the heavy use of coal. According to statistics, when the toxic fog occurs, the level of sulfur dioxide in the air increases seven times, and the soot increases three times. Every day, about 1,000 tons of soot particles, 2,000 tons of carbon dioxide, 140 tons of hydrochloric acid and 14 tons of fluoride, and 370 tons of sulfur dioxide converted into 800 tons of sulfuric acid are discharged into the air of London[3].

In terms of utilization, during the Industrial Revolution, the massive use of fossil energy such as coal and oil made the air pollution problem prominent when Britain was moving toward industrialization. Then, in the 1970s and early 2000s, the widespread use of

natural gas largely alleviated the UK's air pollution problem. Since the beginning of the 21st century, the UK has encouraged new energy industries to reduce greenhouse gas emissions.

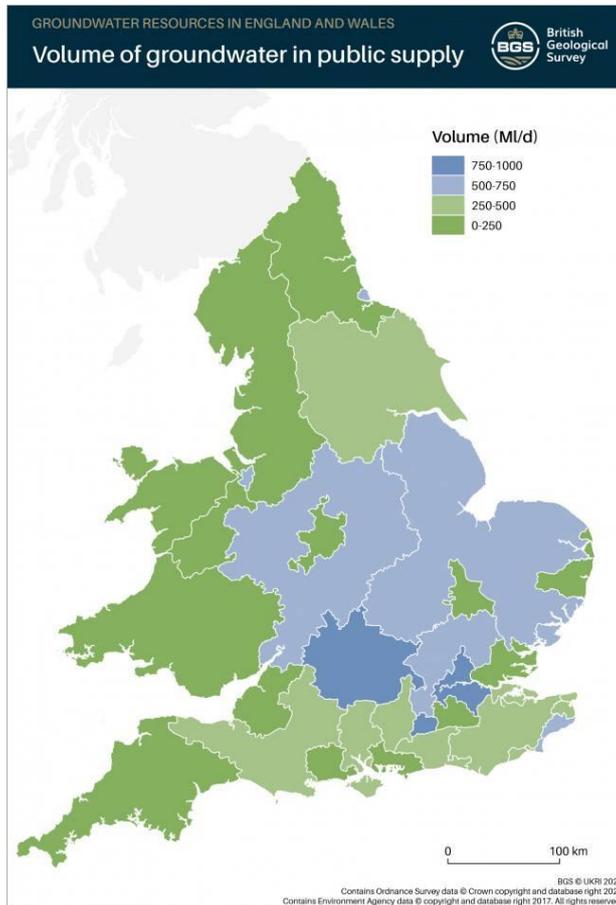
**2.2. The Distribution and Utilization of Water Resources**

The UK has a high degree of industrialization. The development and utilization of water resources mainly aim at improving the living water use of urban and rural people and developing industry, inland river shipping, aquaculture and water tourism. The total annual water consumption in the UK is 11.511 billion cubic meters, of which public water accounts for 47.3%, irrigation water accounts for 0.3%, and other industrial water accounts for 52.4%. Daily water consumption in urban and rural areas was 322 liters per capita. Groundwater supplies about a third of Britain's public water, particularly in Wales and Scotland[4]. Here is some

information extracted from the Water Management Plan published by England and Wales Water in 2019 to understand the current situation of water use in the UK.

In terms of current groundwater use, the amount of groundwater used for public supplies in England and Wales is shown in Figure 1 each day. Some of the water supply regions are large, such as the area supplied by Anglian Water. The data cover the entire region, thus showing those areas that are more dominated by groundwater supplies (in the case of Anglian Water, this is mainly from the Chalk aquifer), and those that are more dominated by surface water(e.g. Rutland water, River Trent and Grafham Water reservoirs).

Groundwater provides about 5% of public water use in Scotland. Northern Ireland does not currently use groundwater for public water supplies. Groundwater supplies (for domestic, agricultural and industrial use) are of great importance to Britain.



**Figure 1** Groundwater deployable output, MI/d, 2019. Source BGS © UKRI

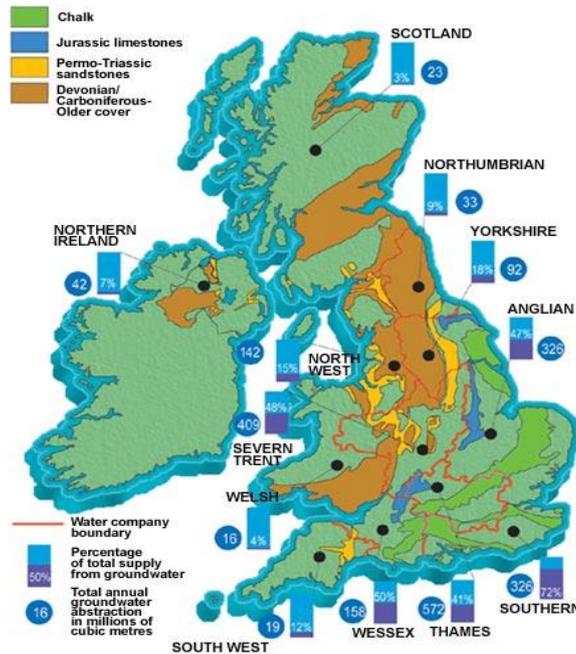


Figure 2 Groundwater use statistics in the United Kingdom, 1998, BGS © NERC [8]

Figure 2 shows how the proportion of public water supplied from groundwater has changed across the UK. Because of the large population and relatively good groundwater resources, most groundwater is extracted in the Midlands, east and southeast of England.

### 3. STRATEGIES ANALYSIS OF SUSTAINABLE DEVELOPMENT OF ATMOSPHERIC AND WATER RESOURCES

#### 3.1. Measures to Reduce Air Pollution in the UK

The government is the leading force in air pollution control, and laws, regulations and policies are the main means of government control. Faced with severe air pollution, the British government quickly enacted a series of laws and regulations, among which the representative ones were Clean Air Act of 1956 and Pollution Control Act of 1974.

The specific contents of laws and regulations are as follows:

Establish smoke-free areas. A smoke-free zone is an area where all emissions of smoke and fumes are prohibited[5]. Companies must use clean energy to meet government standards for emissions; Residents must use anthracite or electricity, gas, etc. State and local public organizations will subsidy, and fines will be imposed for non-compliance.

Measures to be taken in urban construction mainly include reducing urban population density, industrial relocation, urban greening, and so on.

In the 1930s, the London government found the pollution problem brought by the dense population and excessive industrial enterprises in the city, it began to take measures to promote the diversion of population and industry, to divert some serious polluting industrial enterprises to the suburbs and reduce the environmental pressure in the central city.

Industrial enterprises are a major source of air pollution in London. After the toxic fog incident, London accelerated the pace of industrial relocation. The new satellite city attracted a large number of enterprises with low corporate taxes and moderate government subsidies. At the same time, London's urban function gradually transformed from the original industrial manufacturing center to the financial, commercial and service center.

Urban greening plays an important role in improving urban environmental quality. Green space plays an important role in regulating climate temperature, humidity, illumination, sterilization and reducing air pollutants. In 1991, the public green space area of London reached 17,245 square kilometers, and the per capita public green space area was 140.18 square meters, and the green space coverage reached 42% of the total area of London[6]. London green space plays a positive role in the improvement of urban air quality. The large area of green space promotes air circulation, absorbs and decomposes pollutants in the air, effectively restrains air pollution, beautifies the urban landscape and improves people's quality of life.

The major sources of air pollution in London during this period were industrial emissions, automobile exhaust and soot for home heating. The nature of these issues is energy. Therefore, the British government has

taken measures to improve the energy structure and encourage the use of clean energy such as electricity and natural gas, so as to improve air quality and achieve remarkable results. In the 1950s, coal was the main source of industrial fuel and power. To this end, the government has taken a series of measures to change the energy mix, increase the proportion of clean energy, and replace coal with natural gas and electricity. By the early 1980s, gas and electricity were running entirely in downtown London, and low-sulphur coal, which had been redistilled at low temperatures, was replacing raw coal in rural areas.

The high sulfur content of fuel oil and its derivatives are also an important cause of air pollution. So in the UK, the sulphur content of local fuel oil must not exceed 1% [7]. Since the oil crisis of the 1970s, London has made a smooth transition from oil and solid fuels to electricity and gas as the main energy sources. In 1999, gas accounted for more than half of the energy mix, while electricity accounted for nearly one-fifth.

### ***3.2. Measures to Control Water Pollution in the UK***

The development and management of the water resources environment are long-term, and needs will change with The Times, including water quality standards, the adaptation of needs and changes in social standards. The distribution network of reconstruction is large, and it takes a long time to arrange and manage the new building facilities, and the costs are high. This explains the need for long-term strategic research planning by governments and the water industry. Close cooperation between government, water industry and research groups should be promoted to play a role together.

The water industry needs to supply water in the most efficient way possible, and governments need to set standards, set targets for implementation, monitor industry compliance and develop scientific ideas about the role of aquifer systems. At the same time, the instruments used in the water industry also need to be planned and implemented with a long-term perspective. On acidification: carbon and nitrogen from the burning of fossil fuels lead to acidification from oxides. Therefore, industrial production should pay attention to the protection of water resources.

### ***3.3. The Enlightenment of British Experience in Air and Water Pollution Control in China***

Britain's successful experience in air pollution control has strong reference significance, which is mainly reflected in the following three aspects:

Firstly, a complete and clear system of laws and regulations should be established to lay the foundation

for air pollution prevention and control. The UK's experience in tackling smog shows that comprehensive and clear laws are the foundation for prevention and control.

Secondly, we need to address the root cause of smog, vigorously promote clean energy and gradually replace high-polluting traditional energy sources. Whether it is the traditional "sooty" haze or the modern "compound" haze, its main source is coal, oil and other traditional energy and its derivative products. Therefore, replacing these traditional energy sources with electricity and natural gas is the main way to prevent and control haze. At present, China still takes the coal as main energy, accounting for 70% of its proportion in total energy structure. Therefore, China should draw on the good experience of Britain and vigorously implement clean energy instead of traditional energy policies, but China's national conditions are different from the British. China's motor vehicle emission standards, solving the problems of the development of new energy need a longer time and more effective policy.

Thirdly, formulate a reasonable urban development strategy, curb the development of super cities, actively develop small and medium-sized towns, and strengthen urban landscaping. In particular, the expansion of urban functions is worth learning.

On the other hand, the problems existing in water research in The UK also exist in China and some problems are not highly valued by us, which are worth learning from. Currently, only a small fraction of water sources need to be remedied. As nitrate concentrations continue to rise, water treatment or the development of new water sources is costly. Existing water treatment technologies need to be further improved to increase efficiency and reduce costs. There is also the issue of freshwater eutrophication. The problem is not serious at the moment (only causing problems for recreational water farms and fisheries). Although the mechanism leading to eutrophication has been well understood, there are no effective means to control and solve this problem. This problem still needs to be studied and solved.

To sum up, The UK pays attention to the study of the pollution process and proposes the concept of starting pollution value to evaluate groundwater pollution. Because once groundwater is polluted, it is difficult to treat. It is suggested to take the following measures to strengthen the environmental protection of water resources based on China's national conditions:

(a) Reduce the damage of engineering construction to water resources and the environment.

(b) Take measures to control pollutants from the source and strengthen the collection and harmless treatment of pollutants.

#### 4. CONCLUSION

This paper introduces the basic situation of the atmosphere and water resources in Britain and the strategies analysis of how to realize their sustainable development. At the same time, the UK's experience in controlling air and water pollution is worth learning from. Various strategies are analyzed and further treatment is needed for water pollution control (eutrophication). Future research can focus on eutrophication and water acidification.

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