

Water pollution and control measures in Liaoning Province

by Che Xianxin and Bai Yongjiu

As part of an urban renewal study, control measures are to be proposed for the Hunhe-Taizi river basin of Liaoning Province in China.

WITH HER more than one billion people, almost one quarter of the world's total population, China is the world's most populous country; but her social and economic development is uneven for historical reasons. China's population density is higher than the USA and it has more than twenty cities with a population exceeding a million, in contrast to the USA where there are only six cities of this size. The urban population varies from about six per cent of the total in the remote provinces to more than 67 per cent in others. The density of population varies from less than two people per square kilometre in Tibet to more than 1900 in Shanghai. Ninety per cent of the total population live on only 17 per cent of the land.

Water resources

Annual precipitation ranges from more than 1600mm in the southern coastal areas, through 600mm in the

central areas, to less than 200mm in the north-west. China ranks amongst the lowest nations in a table of surface water resources per person: the USSR has 18 900m³ per person, Japan 4796m³ per person, and China has 2700m³. Liaoning Province has only 987m³.

Of the 800 million rural people in China only 300 million have access to a safe water supply, of which 15 per cent is piped. The other 500 million people have inadequate or poor drinking-water supplies: 45 million are supplied with water containing excess fluorides, 60 million depend on brackish water, 150 million draw polluted surface water that is not adequately treated, and 50 million do not have adequate sources of water.

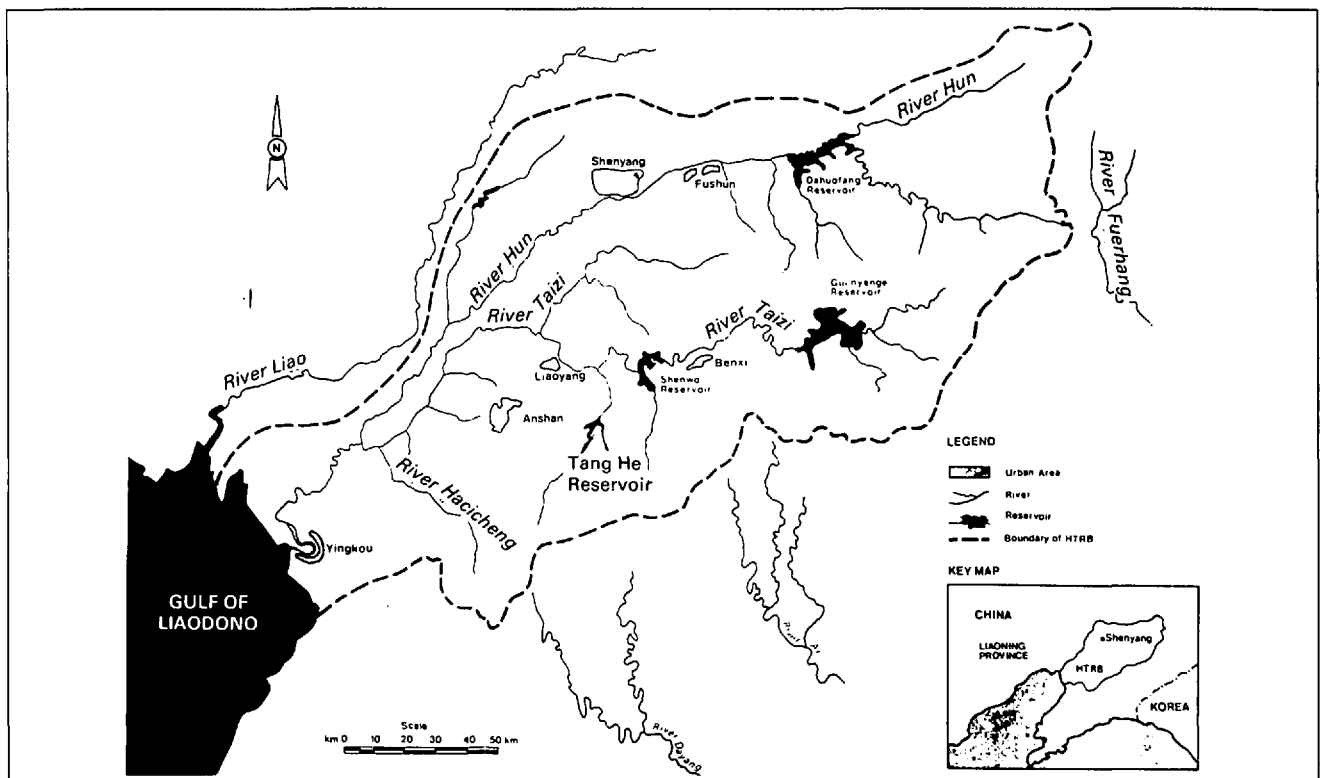
Because of the high density of the population, the uneven economic development and the poor water supply, water-borne infectious diseases such as dysentery and hepatitis are common in China. The

deficient water resources have obstructed the development of industry and agriculture, and impaired residents' health, especially in some rapidly developing metropolitan areas like Shanghai, Beijing, Tianjin, Shenyang and Dalian.

Liaoning Province

Liaoning is a coastal province in north-eastern China with a total population of 36.29 million people living in an area of 145 700 square kilometres (see map). With a density of 249 persons per square kilometre it is amongst the most heavily urbanized provinces. Of the 22 cities with populations greater than one million, four are located in Liaoning Province.

Liaoning's industrial base was developed in the early twentieth century and its main component is heavy industry. There is a steel works in Anshan and a coal mine in Fushun. It also ranks first among Chinese provinces in power generation, iron ore reserves and iron and steel production. Much of the urban environment in Liaoning Province's industrialized cities is marked by severe pollution of the air, earth



The Hunhe-Taizi river basin (HTRB) in Liaoning Province.



Waste water is diluted in a plant like this one in a suburb of Fushun City, and is then used for irrigation.

and water. Surface waters contaminated by industrial wastes pollute the groundwater that is a source of drinking-water. Crops irrigated with industrial waste water (because of water scarcity) are contaminated by toxins, and are inedible.

Liaoning Province has a temperate continental monsoon climate with a hot rainy summer, a long cold

winter with little snow, and a short windy spring. There are only 130 to 180 frost-free days a year. The average annual precipitation is 400 to 1000mm, decreasing markedly from south-east to north-west. Although there are plenty of rivers and reservoirs, water resources are still deficient because of the uneven precipitation, high evaporation, and

improper control measures. Annual water resources, at 987 cubic metres per person, are much lower than the national standard.

Health impact

The Hunhe-Taizi river basin, running south-west through the heartland of the province, is the focus of water resources concerns because of its urban, industrial and agricultural pre-eminence. Located in or near it are some of China's largest heavy industries: the major sources of coal and iron ore and the economically important cities of Anshan, Benxi, Fushun, Liaoyang, Shenyang and Yingkou. The cities have a combined population of 9.7 million and account for 58 per cent of Liaoning's industrial output. Most of the liquid wastes generated in the province are discharged without treatment into the river system through industrial outlets, combined sewers, or irrigation. The surface water cannot meet the urban water demand which increased ten times between 1949 and 1985.

The greater part of these wastes, containing toxic and hazardous pollutants such as oil, phenol, cyanide and benzopyrene, enter the Hunhe and Taizi river basin. Most of these wastes reappear in the supply of downstream users. The death rate from malignant tumours of the residents drinking this polluted water for a long period is 111 per 100 000, a 52 per cent higher inci-



There are plenty of reservoirs, but improper control of measures mean they are often contaminated — sometimes by being used as a swimming pool!



The disposal of domestic rubbish must be monitored to ensure that groundwater is not polluted as a result.

dence rate than the 72 per 100 000 in areas with safe water.

The river water is also heavily polluted by domestic wastes that contain 4650 *E.coli* per litre, 150 million bacteria per litre, and a chlorine concentration of 500-1375mg per litre. The incidence of dysentery, typhoid fever, paratyphoid, and viral hepatitis is high amongst residents drinking polluted river water.

Farmland is irrigated with the untreated wastewater from refinery plants which contains oil, phenol and benzopyrene. The death rate from stomach cancer is nearly four times that in similar but uncontaminated districts. Congenital malformation is two to three times higher than in other districts. Fluoride content in some groundwater is over 16mg per litre, affecting nearly half a million people.

Control measures

With the Chinese government's approval an Australian-funded Urban Renewal Study is now being carried out in Liaoning Province. The goal of the water issues being studied are:

- To prepare a strategy for the development, allocation, use and management of the water resources of the central area of Liaoning Province (catchment of Hunhe and Taizi); the treatment of industrial and municipal used water, and its return to the environment. The strategy must seek to resolve existing or potential conflicts between water use (agriculture, domestic, and industrial) and an improved water quality environment.

- To decide on technically and financially feasible water quality goals (river, estuary, and marine) to be attained step by step over a planned period of time.

- To propose at strategy level non-physical actions and financial investment for works that are required best to meet the competing interests of the water users and the disposal of liquid waste to the environment.

- To propose an action-orientated programme for the orderly development of water resources and the return of used water to the environment. The programme should address all major issues including:

- industrial waste discharge policy;
- institutional reform;
- regulatory, pricing, and policy issues;
- water resource development and allocation;
- a programme of physical works and non-physical action including measures to improve the efficiency of use by industry and agriculture, the pre-treatment of industrial waste, the establishment of municipal wastewater treatment plants, the augmentation of water resources, the reuse of treated wastewater to augment low seasonal river flows, and the achievement of water quality goals;
- the identification of significant projects that are essential for the overall strategy so that they can proceed to independent feasibility studies.

Additional reservoirs and, possibly, water transfer schemes, combined with improvements in the efficiency of water use and a reallo-

cation among users, will be required to maintain an adequate waste assimilation capacity in the river system.

The Environmental Protection Bureau of Liaoning Province has prime responsibility for controlling liquid wastes to rivers and irrigation areas. National standards for licensing discharges were issued in 1973 and new national laws were issued in 1983. The system acts as a pollution 'tax', and industries have the option of either investing in treatment facilities or paying the tax.

The way ahead

This paper has focused on Liaoning's growth prospects and the resulting need for water supply and drainage. Liaoning's industry will be a key element in China's modernization and export drive. Economic and urban population growth is expected to exceed the national average and will occur in the central area of the province. We will have to catch up in the provision of urban services, especially water supply. Recognizing the need for sizeable investments the National Government has agreed to more equitable cost-sharing arrangements than in the past. Liaoning and its municipalities will in future better mobilize financial resources through taxation, borrowing and increased reliance on user fees. ●

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