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Water pollution and control measures

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LIAONING WATER POLLUTION & CONTROL MEASURES

I. Water situation in China

With her more than one billion people, almost one quarter of the world's total population, China is the most populous country, but her social and economic development is uneven due to the historical reason.

Comparing with U.S.A., China's population density is higher. There are more than twenty cities with population of more than one million in China, but in contrast there are only six cities with populations of more than one million in U.S.A. Urban population varies from about 6% in the remote provinces to more than 67% in others. The density of population varies from less than 2 persons per sq.km. (Tibet) to more than 1900 (Shanghai). Ninety percent of the total population living on only 17% of the land.

Concerning natural conditions, China is similar to U.S.A. on the geography and climate, annual precipitation ranges from more than 1600 mm in the southern coastal areas to about 600 mm in central area of the country to less than 200 mm in the northwest. China ranks among the lowest of nations in surface water resources per capita.

(see Table 1)

Among 0.8 billion rural population in China, only 0.3 billion have access to safe water supply, of which 15% is piped. The other 0.5 billion of rural population have problems with drinking water, including 45 million people who are supplied with water containing excess flourides, 60 million who depend on brackish waters, 150 million who draw on polluted surface water that are not adequately treated and 50 million who do not have adequate source of water.

Due to the high density of the population, uneven economical development, deficient water source and population control, water borne infectious diseases such as dysentery and hepatitis which are common in developing countries are also common in China.

So the deficient water source has already obstructed the development of industry, agriculture, economics and resident's health, especially in some rapid developing metropolis like Shanghai, Beijing, Tianjin, Shenyang and Dalian.

II. General description of Liaoning Province

A. Population and economics. Liaoning is a coastal province in the northeast of China with a total population of 36.29 million persons living in an area of 145,700 sq.km. with a density of 249 persons per sq.km., it is amongst the most heavily urbanized provinces.

(See Table 2)

There are four super size cities with over one million people among the 22 in the whole nation.
Liaoning's industrial base was developed in the early 20th century and preceeds much of China. It is the site of the well-known steel works in Anshan and coal mine in Fushun. Its foremost contribution is in heavy industry (output value RMB 437 billion in 1986) ranking it first among all provinces in heavy industrial output. It also ranks first in power generation, iron ore reserves and iron and steel production. Total industrial output was RMB 66,439 billion ranking it third in China after Jiangsu province and Shanghai metropolis.

B. Environment. Much of the urban environment in Liaoning province's highly industrialized cities is marked by severe pollution of air, earth and water. Episedoes of health-threatening levels of air pollution occur frequently; surface waters contaminated by industrial wastes pollute ground water which is used as a sources of drinking water; and crops irrigated with industrial waste water because of water scarcity have become contaminiated by toxics and rendered inedible.

C. Water environment. Liaoning province is situated between 39 and 43 deg.N latitude and between 119 and 126 deg.E longitude. It has a temperate continental monsoonal climate with a hot rainy summer; a long cold winter with little snow and a short windy spring. There are only 130-180 frostfree days. The average annual precipitation is 400-1000 mm decreasing markedly from southeast to northwest.
There are 16 rivers with over 1000 sq.km. catchment among the total 221 rivers in Liaoning province. There are 19 reservoirs which have capacity over 0.1 billion cub. m.
Although there are plenty of rivers and reserviors water resources are still deficient due to the uneven precipitation, high evaporation and the improper control measures. Annual water resources per capita is 987 cubic meters which is much lower than the national standard.

(See Table 3)

The table shows the worst center area with shortage of water supply and heavy pollution.

(See Table 4)

The Hunhe-Taizi river basin, running southwest through the heartland of Liaoning province is the focus of water resource concerns because of it's urban, industrial and agriculture pre-eminence in the province. It has located in or near it some of China's largest heavy industries and major sources of coal and iron ore and economically important cities of

Anshan, Benxi, Fushun, Liaoyang, Shenyang and Yingkou. The cities have a combined population of 9.7 million and account for about 58% of Liaoning's industrial output. However the surface water can't meet the need of rapid development of urban water demand which had been increased 10 times since 1949 to 1985.

Most of liquid wastes generated in the province are discharged without treatment to the river system through industrial outlets, combined sewers or irrigation channels. So the polluted surface water even ground water can no longer be used.

D. Health impact. The greater part of these wastes containing the toxic and hazard pollutants as oil, phenol, cyanide, benzopyrene, entered the Hunhe and Taizi river basin, most of these wastes reappear in the supply of down stream users.

For example, over 120 sq.km. land and more than 30 drinking water wells are polluted by nitro-compound with concentration of 0.5 - 2.6 mg/l.

300 teenagers (polluted water drinkers over 10 years) were checked and heinz body in their blood were found, even higher than 12%, where as the rate was zero in another non-nitrocompound area (Shenyang).

The death rate of malignant tumour of the residents drinking the polluted water for longer period is 110.62 per 0.1 million, but only 72.26 per 0.1 million in areas with safe water, a 52% higher incidence rate.

The river water is heavily polluted by domestic wastes containing E-coli 4650/l; total bacterium 0.15 billion/l; chloride 500-1375 mg/l. The incidence of dysentery is 502.56/0.1 billion, typhoid fever, paratyphoid 2.51/0.1 billion, virus hepatitis 86.96/0.1 billion respectively among the residents drinking the polluted river water.

Shen-fu district farmland is irrigated by untreated waste waters from refinery plants which result oil content 338-410/100g soil and benzopyrene 226.5-500mg/100g soil. Oil content in water is 0.33-0.48mg/l, phenol 0.0042-0.005mg/l, benzopyrene (Bap) 0.025-0.08 ppb. Bap content in rice reaches 0.16-1.44ppb. The death rate of stomach cancer is 45/0.1 billion persons, but only 12/0.1 billion in another comparable but less contaminated district. Malformation foetus rate is 3.06/1000 and congenitial malformation reaches 8.28/1000 which is 2-3 times higher than the other districts.

Fluoride content in some ground water is over 16mg/l which poisons 0.43 million of residents, among them 0.396 million are suffering from yellow stains on the teeth and 3000 from bone fluorisis. The total patients of above mentioned diseases are 31,000.

III. Control measures

A. Cofinanced urban study. With the Chinese governmental approval, and Australian-funded Urban Renewal Study is being carried on in Liaoning Province at the present period.

On the water issue the study objects are as follows:

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

(b) 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.

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

(d) To propose an action-oriented program for the orderly development of water resources and the return of used water to the environment. The program should address all major issues inlcuding:

(i) industrial waste discharge policy;
(ii) institutional reform;
(iii) regulatory, pricing and policy issues;
(iv) water resources development and allocation;
(v) program of physical works and non-physical action including measures to:
- improved efficiency of use by industry and agriculture
- pre-treatment of industrial waste as appropriate
- establishment of municipal waste water treatment works (including line treatment for agriculture re-use), and oxidation ponds
- development of augmentation of water resoures and reuse of treated water for the augmentation of low season river flows and achievement of water quality goals.

(vi) to identify and evaluate significant projects (e.g. water supply, river control, flow augmentation or waste water treatment) that are essential to the overall strategy, so that they may proceed to independent feasibility studies, financial approval, funding and design construction decision prior to finalization of total strategy.

Additional reserviors and possibly water transfer schemes, combined with improvements in the efficiency of water use and a reallocation among users, will be required to maintain adequate waste assimilation capacity of the river system. The basin, the water user and the waste producers would be viewed as parts of a common system, and plan construction and non-construction measures in a comprehensive integrated and basin wide way so water supply and water quality objectives can be achieved at least cost.

B. Regulations and Laws. The Environmental Protection Bureau of Liaoning Province (EPB) 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 promulgated in 1983. Essentially the system acts as a pollution "tax" and industries have the option of investing in treatment facilities or paying the tax.

At the national level the following policy measures are emerging to promote conservation and reduce pollution:

(a) Increase the water resources tax payable by industry.

(b) Impose quotas on industrial consumption based on production and technology type, and tax quota exceedance.

(c) Regulate to force water reuse.

(d) Strengthen "pollutions pays" policy measures.

(e) Devote more attention to non-point pollutant sources.

(f) Employ rational policy for promoting treatment: require pretreatment for selected pollutants but in general require municipalities to build regional treatment facilities.

(g) Finance for capital works will come from national or provincial governments but municipalities will pay for operation and maintenance.

(h) Sewer department will be self-financing and will apply tariffs accordingly.

C. The way ahead. We have focussed on Liaoning's growth prospects and the concommitant 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 service, especially water supply. Recognising the need of sizable investments the National Government has agreed to more equitable cost sharing arrangements than in the past. Liaoning and it's municipalities will better mobilize financial resource through taxation, borrowing and increased reliance on user fees.

TABLE 1

SURFACE WATER DISTRIBUTION

COUNTRY	WORLD	USSR	JAPAN	CHINA	LIAONING
surface water (m^3) / capita	12,700	18,900	4,796	2,700	987

TABLE 2

AREA / POPULATION	TIANJIN (M)	LIAONING (P)	BEIJING (M)	SHANGHAI (M)	JIANGSU (P)	GUANGDONG (P)	TIBET (A)	XINJIANG (A)
TOTAL (millions)	8.08	36.86	9.60	12.17	62.13	62.53	1.99	13.61
URBAN	5.65	24.82	6.40	7.49	15.96	180.77	0.21	5.85
URBAN PERCENTAGE %	69.9	67.3	66.7	61.5	25.7	30	10.6	4.3
RANK (URBAN %)	1	2	3	4	24	20	29	9

NOTE: M=Metropolitian P=Province A=Autonomy region

Map of Administrative Districts of Liaoning Province in China

TABLE 3

WATER RESOURCE DISTRIBUTION IN LIAONING

	EAST	SOUTH	WEST	CENTER	
GROUND WATER	0.149	0.371	1.490	5.454	BM^3
	2%	4.97%	19.96%	73.07%	%
SURFACE WATER	12	5.835	4.467	11.2	BM^3
	35.82	17.41	13.33	33.43	%

TABLE 4

URBAN INDUSTRY/DOMESTIC WATER COMSUMPTION IN LIAONING

TOTAL	EAST	SOUTH	WEST			CENTRE							
	DAN DONG	DA LIAN	JIN IHOU	FU XIN	CHAO YANG	SHEN YANG	FU SHUN	AN SHAN	LIAN YANG	BEN XI	YING KOU	TIE LING	OTHER
776.3	34	37.3	27.4	17.1	3.9	131.3	104.9	107.5	64.4	98.7	19.3	25.7	

SESSION V
HOUSING, ROADS AND OTHER SERVICES

Chairman: Amran Hamzah
Department of Town & Country Planning
Faculty of Architecture
Universiti Teknologi Malaysia

PAPERS PRESENTED

Professor N K UPADHYAYA and Mrs P UPADHYAYA
Disposal and utilization of steel plant waste

C KARIYAWASAM
Disposal of excreta and sullage

MOHD WARID HUSSIN and KAMSIAH MOHD ISMAIL
Polypropylene reinforced cement sheets

Dr J C SRIVASTAVA
Technologies of women's low-income housing needs

MEGAT JOHARI MEGAT MOHD NOOR and AZLAN ABDUL AZIZ
Soil-cement for low cost roads

Dr R M BRADLEY
Squatter area upgrading in Malaysia

A G WRAY
Urban project development trends - Philippines

Dr ANDREW COTTON and RICHARD FRANCEYS
Services for urban low income housing

Professor CHE XIANXIN and BAI YONGJIU
Liaoning water pollution and control measures

DISCUSSION

Professor N K UPADHYAYA

1. Mr LANE asked if the waste materials described in the paper were sorted by hand and if so what were the health effects of exposure to large quantities of such materials.

2. Professor UPADHYAY said the materials were sorted by hand. There was a positive health hazard in doing so due to dust pollution from which health related problems could develop.

C KARIYAWASAM

1. Dr BRADLEY commented that the low priority of improved excreta disposal facilities was also found in squatter areas in Kuala Lumpur where only 5% of those surveyed considered it an essential upgrading measure. In all ongoing USAID projects in Sri Lanka community participation in the selection of sanitation facilities was based on organizing the community to elect family health volunteers (each representing ten to fifteen families). The volunteers first received health education and then educated the community in sanitation/health linkages etc. This process took about one year. After this the community chose which type of upgraded excreta disposal system it would prefer and could afford.

2. Mr GHOSH asked Mr KARIYAWASAM what he meant by community participation and suggested he meant health education. He also wished to know which was the target group for communication; was it women or adult males? Was there any connection between habits/attitudes and economic growth? What were the toilet designs in rural areas?

3. Mr KOLSKY commented that the author had noted that 80% of the possessors of flush toilets did not use them. He asked if they had installed them themselves or if they were already installed before they came into possession of the home.

4. Mr KARIYAWASAM said that the flush toilets had been installed by the owners of the homes as they were considered to be a status symbol.

Mr AZLAN ABDUL AZIZ

1. Mr KOO HOCK SONG asked how cement and laterite were mixed in the field and could this method be used in hilly regions.

2. Mr AZLAN explained that cement and laterite were mixed by ploughing the surface and raking in the cement powder. Difficulties had not been experienced wherever a tractor could operate.

3. Mr LANE commented that it might be interesting to try reducing the cement percentage and increasing the rice husk ash content instead, as the latter was cheap and widely available.

4. Mr AZLAN said the initial study was to look at the effects of additional additives, ie sand and RHA, on the soil-cement mix. The present investigation looked at a reduction in the cement percentage and an increase in the RHA.

5. Mr NICHOL wished to know the details of size/length of the field trial plot, the duration of the trial and any loading/trafficking of the surface.

6. Mr AZLAN said that the objective of the trial plot was to study the affect of the weather (ie rainfall and temperature) on the performance of unpaved, stabilised, low-cost roads and also to assess the ease of construction. There was no loading/ trafficking applied. The duration of the trial was one year. The width of the trial plot was 4 metres and the length was 12 metres.

Paper No 3 Session 5
Squatter area upgrading in Malaysia

In introducing his paper, Dr Bradley summarised the main findings of the field surveys and emphasised that the upgrading recommendations relating to water supply and excreta disposal were applicable only to the priority areas affecting about 10% of the squatter population. He confirmed that the survey found no evidence of nightsoil buckets being used in squatter areas, this system was in use in legal housing areas.

Dr Bradley presented additional data on parasitic infestation rates from field surveys conducted in Kuala Lumpur in 1982. The results showed that families who used water for anal cleaning and tended to eat food with their fingers had an infestation rate of 38% in sewered areas and 62% in non-sewered areas. Rates in the same areas for families who did not adopt these practices were 19% in sewered areas and 41% in non-sewered areas. These results illustrated the importance of health education and hygiene practices in upgrading the health status of the community.

Dr Bradley concluded his presentation with the latest data (December 1987) for squatter population and nightsoil buckets. The current situation was that the squatter population had now fallen to 145 000, an annual average decrease of about 9% since the end of 1984. This decrease illustrated the success of the mainly privatised squatter area upgrading programme. Nightsoil buckets had also been reduced to about 2000 from 5400 at the end of 1984. Of the 3400 buckets which had been converted in the last three years, about 35% had been converted to sewerage and the remainder to septic tanks or pour-flush latrines.

Dr ANDREW COTTON

1. Dr BRADLEY wished to know the loan terms of ODA to the Government of Sri Lanka and of the Galle Municipal Council to the community.

2. Dr COTTON explained the the loan was made from the ODA to the National Housing Development Authority of Sri Lanka who on-lent to the Galle Municipal Council. The project was in its infancy, but the Galle Municipal Council proposed to look at the repayment of housing loans as an indicator of a particular community's "credit worthiness".

3. Dr BRADLEY asked how many families had asked for additional water and sanitation facilities and what were the most popular improvement requests (roads, power etc).

4. Dr COTTON said that the main concern of occupants of the sites which were to be upgraded was for regularization of the plots and sorting out disputed ownership. There was little indication at present of strong priorities for improved service levels such as a house connected water supply. All householders on site and services schemes were required to take out a loan for a household pour-flush latrine.

5. Mr COFFEY commented that concrete pipe was proposed for small septic tanks. Two 1 metre diameter, 1 metre long pipes on a concrete base with a concrete cover and outlet T-piece would cost M$300. This would represent 30% of the total pour-flush latrine cost (single pit) using raised soakaway mounds, or 15% of the total cost if a seepage pit was used.

6. Mr KARYAWASAM said that private sector organizations were not interested in community participation as it would have no economic benefits. How was it proposed to hand over the development work to the private sector and obtain community participation simultaneously.

7. Dr COTTON explained that community participation did not necessarily imply that the community did the actual construction work itself. The important issue was that the community had control over its destiny; this could be achieved by the community paying a private contractor to undertake work, or by forming their own contracting system.

8. Mr PIGGOTT asked Dr COTTON to elaborate on the success of pit latrines in the densely populated housing areas in which they were being installed. Did he have any operating/performance data.

9. Dr COTTON replied that there was some evidence of pour-flush pit latrines being used in urban areas where the groundwater table was high, and that the rate of sludge accumulation might be quite low. The Sulabh

International Organization in India had achieved great success in the installation of such latrines in very densely populated areas, such as Patna.

Mr BAI YONGJIU

1. Mr LANE wished to know how the money was raised to pay for the anti-pollution measures described in the paper.

2. Mr BAI YONG JIU explained that the general principal was that the polluters paid. Finance was also arranged by the government on different levels (the Environmental Protection Bureau acting as agents) and from industry.

3. Mr COFFEY asked if all the areas in the cities were served by sewers and if not what systems were used in the unsewered areas.

4. Mr BAI YONG JIU replied that sewers were available in all cities but not in rural areas. In these areas excreta was collected by individual householders and used directly to fertilize farmland.