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# PRELIMINARY SURVEY OF WATER ENVIRONMENT PROBLEMS IN HCMC

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## KEYWORDS

Groundwater, Ho Chi Minh City, nitrate, Saigon-Dongnai River, water pollution, water supply

## INTRODUCTION

Ho Chi Minh City (HCMC) is located in the center of the southern region of Vietnam. It has 0.6% of the total area and 6.6% of the total population in Vietnam. HCMC is the economic center, which produces 1/3 of total GDP in Vietnam. With its rapid economic and social development, water demand is increasing rapidly. The major source of water supply to HCMC is surface water taken from Saigon-Dongnai River systems, but small households and people living outside of the piped supply still depend solely on groundwater and rainwater harvesting. Although HCMC has rich natural reserves of groundwater, unregulated uses of groundwater lead to water table drawdown and possible future depletion of groundwaters. Salt water intrusion is yet another concern to be caused by extensive groundwater uses. Contaminated surface water infiltrates into groundwaters, but the monitoring activities in HCMC are still limited. The aquifer profile implies that the major aquifers in HCMC are not completely separated and the unconfined aquifer is connected with river beds, in which wastewaters are discharged from households and industries. Problems concerning water environment in HCMC are multi-faceted and difficult to prioritize without scientific understandings of the water systems. This study aims to analyze the extent of current water environment problems in HCMC in order to help leading its water policy towards a sustainable future.

## MATERIALS AND METHODS

Presently existing documents and data on water uses and water quality in HCMC were summarized. Our research group visited a few times to the groundwater wells and private houses that use groundwater as the only source of water supply. Water samples were taken for analysis from these households.

## RESULTS AND DISCUSSION

### Rivers and canals in HCMC

Ho Chi Minh City (HCMC) is located in the center of the southern region of Vietnam, with a population of over 6 million and is a metropolitan city. City produced 22 per cent of the national GDP (HCMC Statistics Year Book, 1997). HCMC has an administrative area of 2,079 km<sup>2</sup> that encompasses 17 urban districts of 440 km<sup>2</sup>, and five semi-urban districts. Ho Chi Minh City has a tropical climate and is under the influence of monsoons. Its main climate features are: *consistent and high temperature* (average 27.4 °C), *high humidity* (average 77.2%), and *heavy precipitation* (annual average 1,929 mm).

There are three large rivers that run through HCMC, namely, Saigon, Dong Nai and Vam Co Rivers. Saigon and Dong Nai Rivers flow together in their downstream areas, forming Nha Be River, which also receives the water from Vam Co River (WB, 2001c). The Saigon River is a third tributary of Dong Nai River; it runs through the southwestern region of HCMC and joins Dong Nai River at Cat Lai. The Saigon river has a total length of about 280-km, a catchment area of 5,400 km<sup>2</sup>, and a discharge capacity of 2,200 m<sup>3</sup>/s at Thu Dau Mot.

A major hydrological project, Dau Tieng Dam, was built on Saigon River and commissioned in 1984 for irrigation purposes. The discharge rate from Dau Tieng Dam into Saigon River is 10-20 m<sup>3</sup>/s during the dry season and 15- 40 m<sup>3</sup> /s during the rainy season. The Dam is located 135 km from the mouth of the Saigon River and has a catchment area of 2,700 km<sup>2</sup>. The Saigon River has 3 main tributaries: (1) Thi Tinh River, flowing into Saigon River at Thu Dau Mot; (2) Rach Tra River at Thuan An; and (3) Ben Luc River at Khanh Hoi Ward, District 4. The section of the Saigon River that runs through HCMC has a width of 225-370 m and a maximum depth of 20 m.

HCMC has a dense network of rivers and canals. The drainage canals in the city are grouped into 5 basins in which the main canals have a total length of 55.6 km. Secondary canals (draining into the main canal) have a total length of 36.4 km. Major canals in HCMC are: Nhieu Loc-Thi Nghe, Tan Hoa-Lo Gom, Tau Hu-Ben Nghe-Doi-Te, and Tham Luong-Ben Cat. Most of these canals had their depth and length reduced due to encroachment by illegal houses and buildings, dumping of garbage and other debris, sediment buildup from wastewater loading, and lack of regular maintenance.

### **Water Supply in HCMC**

The Water Supply Company (WSC) is responsible for provision and maintenance of privately financed water treatment plants with build-operate-transfer (BOT) scheme. The WSC has a total workforce of about 1,800. The number of house connections with meters are approximately 300,000, out of which 80% are individual households, 15% industrial uses and 5% service users. This low number of customers relative to the total population of the city is due to the fact that more than 30 per cent of the city's area has limited or no access to tap water. Metered water is charged according to a progressive tariff structure (after adjustment in March 2000) as follows:

- Up to 4 m<sup>3</sup> per person per month: 1,700 VND/m<sup>3</sup>
- Up to 6 m<sup>3</sup>: 2,500 VND/m<sup>3</sup>
- Up to 10 m<sup>3</sup>: 3,200 VND/m<sup>3</sup>
- Above 10 m<sup>3</sup>: 4,000 VND/m<sup>3</sup>

Some 200 meter-readers are hired by the WSC to manually record the meters. Encoding is performed at the four local branches, and data processing and bill printing at WSC main office, using a minicomputer networked with personal computers. The total company revenue in 1999 was about VND 370 billion (ca. US\$ 26.5 million). This included water surcharge of about VND 100 billion a year (now removed) to pay for infrastructure development. Table 1 shows the sources for HCMC water supply systems being operated by WSC.

Table 1. Current water supply sources for HCMC operated by WSC (WB, 2001a).

Facilities	Intake Location	Capacity (m <sup>3</sup> /day)
Thu Duc Water Treatment Plant	On Dong Nai River at Hoa An 10.8 km northeast of Thu Duc WTP	650,000
Binh An (Malaysian BOT) Water Treatment Plant	On Dong Nai River at Binh An, 200m upstream of the Dong Nai Bridge	100,000
Hoc Mon Groundwater Field		40,000
Various wells		40,000
Binh Tri Dong Groundwater Plant		12,000
Total		842,000

The water supply system in the basin is old and inadequate. Leakage and other components of water losses are high (approximately 40%), mainly due to leakage in the distribution network. Per capita water use varies from about 270 litres per capita per day (LPC) for households with high quality toilets, to about 30 LPC for households who share a neighbor's water connection. Customers in low-pressure areas supplement the public supply with water from private wells, drilled to a depth of 30 to 40 m, some of which are polluted.

There are over 3,000 industrial establishments that cause pollution. Many of them are of private small-scale workshops, operating illegally due to their unacceptable pollutant levels. DOSTE has compiled a "Black Book" listing about 700 worst polluters in the industry sector, many among them are state-owned enterprises. The City policy of relocating polluting industries out of the urban core has not been carried out

### Groundwater resources in HCMC

The groundwater resources in Vietnam are abundant – with the total potential exploitable reserves of the country's aquifers estimated at nearly 60 billion m<sup>3</sup> per year. The availability varies from abundant resources in the Mekong River Delta to somewhat limited resources in the North Central Region. HCMC and the surrounding North-East region of the Mekong River is reported to have an exploitable groundwater resource of 3.8 billion m<sup>3</sup> per year. Although this estimated is huge amount of water, equivalent to 10 million m<sup>3</sup>/d, over abstraction causes rapid drawdown of groundwaters in HCMC. Land subsidence and salinity intrusion are also being reported in HCMC, as well as in the Mekong River Delta.

Groundwater is emerging as an important source of water for domestic, industrial, and agricultural uses. While the quality of ground water remains good, there are some pockets of contamination. There is evidence of pollution –from poorly maintained septic tanks, garbage dumping, and industrial effluents and overexploitation in parts of HCMC and the Mekong River Delta. In addition nitrogen and iron levels above the admissible standards are found both in Mekong River Deltas. *Salinity intrusion*- a pressing issue is the salinity intrusion, taking place in the HCMC and Mekong River Delta. In order to deal with groundwater problems, Government has established the national policies and strategies for water quality management, the Law on Water Resources (1998), TCVN 5944 (1995) for Ground water quality standard. The Agency of Geology and Minerals (Ministry of Natural Resources and Environment-MONRE) is responsible for groundwater monitoring and maintains a National Groundwater Monitoring Network with 310 regional monitoring stations and more than 600 observation wells across Vietnam. Compared with

the huge groundwater sources and extensive use of groundwater, this monitoring network is still insufficient.

Figure 1 shows our experimental results on anion analysis. Both nitrate and chloride ion concentrations are high in the depth between 30-40m. This contamination of shallow aquifer clearly indicates intrusion of contaminants from surface waters. It is to be noted that at depths between 70 to 80m, and between 120 and 160m, chloride and nitrate concentration also increased. These results are not easy to interpret. There may be different mechanisms of groundwater contamination, but further studies must be carried out to verify any models.

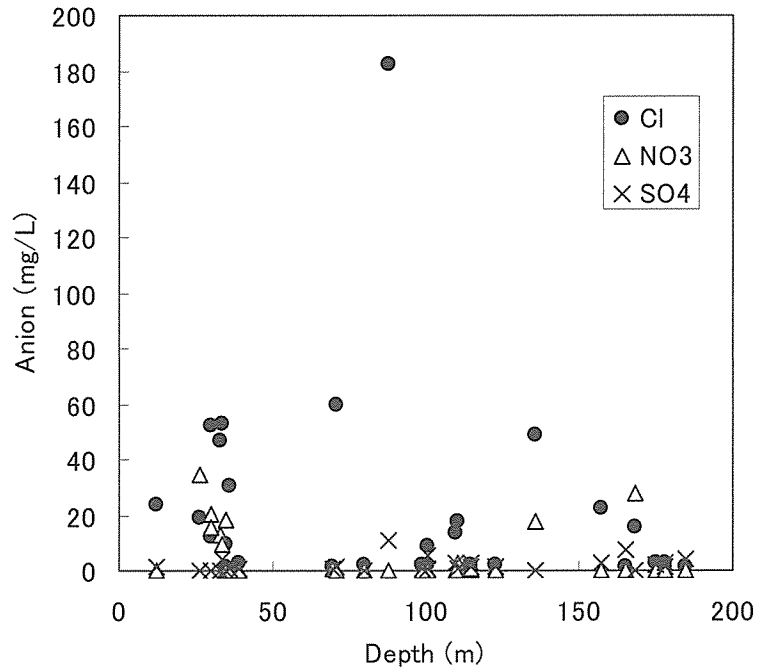


Figure 1. Anions in groundwaters.

## CONCLUSIONS

Water sources, water uses and some of the water quality problems were summarized with literature review, as well as field visits. Data and information that are available are still very limited. Salt water intrusion is considered to be the major threat to the aquifers, but the rates and mechanisms of salt water intrusion have yet been well elucidated. Nitrate intrusion into the aquifers is a future threat to the groundwater uses, which must be dealt with before the problem becomes widespread. Regulations on groundwater abstraction, as well as regulation on land use, will be an important future policy in HCMC, but there must be scientific data that help us to understand the rate and mechanisms of groundwater depletion.

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