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Water Environment Issues of Bangkok City, Thailand: Options for Sustainable Management

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ABSTRACT: Bangkok is a major city, with an area of 1570 km^2 and a population of 10 million inhabitants. Situated 2 meters above sea level, and lacking proper infrastructure and planning, Bangkok faces water management and water pollution problems. Presently, 91% of water demand is supplied from river water and 9% from deep wells. Increased rainwater harvesting would decrease problems of land subsidence, ground water contamination and dependence on surface water sources. Decentralized wastewater management systems would also be useful. Sustainable management of water supply and wastewater reclamation require synergistic interactions among government, private sector and community sectors.

KEYWORDS: Bangkok metropolis, Water supply, Wastewater management, Rainwater, Global warming.

This short article describes the present situation concerning water supply and wastewater pollution in Bangkok city, the capital of Thailand, and proposes some measures to attain sustainable environmental management. Bangkok is one of the world's major metropolitan areas, which has undergone rapid urbanization and industrialization. With an area of 1570 km^2 and situated about 2 meters above mean sea level[1], it has a population of about 10 million inhabitants, but lacks proper infrastructure planning and services. The Metropolitan Waterworks Authority (MWA) supplies piped water of about 4.65 Mm^3/day (equivalent to 91% of total demand)[2] to residential, industrial and commercial sectors using surface water withdrawn from the Chao Phraya River and Mae Klong River, which is treated by conventional processes before distribution. The remaining 9% of the water demand (about 0.5 Mm^3/day) is being met by abstracting from deep wells.

Recently, due to uncontrolled discharges of agricultural runoffs including domestic and industrial wastewaters into the Chao Phraya River and Mae Klong River, the river water quality is deteriorating. The effects of global warming have caused the river flows to be unreliable with too high or too low flow rates during the rainy and dry seasons, respectively. Heavy pumping of ground water has resulted in land subsidence of 2-15 cm/year (BMA, 2004) in most Bangkok areas and ground water contamination with salinity, nitrate, coliform bacteria and volatile organic compounds. Since Bangkok city is expected to continue to grow within the next 10 years, the problems of water supply and contamination of both surface and ground waters would also exacerbate. To respond to the above challenges, some options that Bangkok city could consider to achieve sustainable management of water supply and water pollution control are proposed as follows.

1. Rainwater harvesting. With the average annual rainfall of 1650 mm/year[2] and an assumed 10% efficiency of rainwater harvesting, Bangkok city could utilize 0.7 Mm^3/day of rainwater, equivalent to the amount of abstracted water from deep wells. This practice would help to mitigate the problems of land subsidence, ground water contamination and dependence on surface water sources. If more rainwater could be harvested, it would help to reduce flooding which occurs frequently in Bangkok city during rainfalls. However, depending on locations and air quality, some rain water may be slightly acidic[3] and contain some pollutants which would require prior treatment before usages.

Technology required for rain water harvesting is not complicated and this practice is being implemented with successful results in both developed and developing countries, such as Japan, Korea, Europe, India, and Bangladesh etc. For Bangkok city to reap benefits from rain water harvesting, there should be more campaigns and demonstration projects to increase public awareness and participation. If necessary, some financial and tax incentives should be provided to those who participate in the rain water harvesting programs.

2. Decentralized wastewater management (DWM) systems. At present the Bangkok Metropolitan Administration (BMA) has invested about Baht 17,500 million in the construction of seven central wastewater treatment plants which can treat about 40% of the total wastewater or about 1 Mm^3/day[2] and the treated

effluents are mostly disposed of into nearby water courses. The remaining wastewater, raw or partially treated, is being discharged into nearby storm drains or water bodies. DWM systems can serve clusters of individual homes and/or high-rise buildings with appropriate technologies such as constructed wetlands and membrane bio-reactors, etc. In a constructed wetland system, wastewater is stabilized by bacteria growing on the media surface and using oxygen photo-synthetically produced by emergent plants. Together with other filtration and adsorption mechanisms occurring in the constructed wetland beds, the treated effluents are of high quality suitable for reuses in irrigation and cleansing purposes[4]. The constructed wetland technology has been applied for treatment of domestic and industrial wastewaters in both developing and developed countries. Membrane bio-reactors are an emerging DWM technology applicable for treatment of wastewaters generated from urban high-rise buildings or some industries. Although the investment and operation costs of membrane bio-reactors are still expensive, the treated effluent is of high quality and can be reused as drinking water or toilet flushing water as is being done in Singapore and Tokyo city, Japan, respectively. Benefits to be gained from DWM systems include: reduced contamination of surface and ground water resources and decreased demand on piped water.

3. Stakeholders' participation. Sustainable management of water supply and wastewater reclamation would require synergistic interactions among the stakeholders such as government, private sector and community sectors. The government sector is proposed to act as the facilitator to enhance better development of water supply and wastewater services, as well as to ensure proper enforcement of regulatory framework and implementation of health education. For Bangkok city, since the water supply is being managed by the MWA and the wastewater is being managed by the BMA, there should be good cooperation between these two agencies in order to achieve sustainable management of water supply, water pollution control and wastewater reclamation. In addition, the upstream watersheds of the Chao Phraya River and Mae Klong River need to be properly protected from pollution due to wastewater discharges, as stated earlier. Involvement of the private sector is important in financing the water supply and wastewater sectors as well as in disseminating health education. The private sector may also become involved in providing water supply and wastewater services to some sections of Bangkok city. The involvement of the community in the planning, design and implementation of the water supply and wastewater projects would foster better cooperation from the local people, thus ensuring the project's sustainability. However, the necessary capacity of the community such as skilled personnel must be upgraded in order to carry out the technical work effectively.

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