Development of Infrastructure in the Kingdom of Cambodia: Export of Water Technology by Kitakyushu

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Abstract

Cambodia's infrastructure has been severely damaged by decades of conflict and civil war. Re-establishing systems of infrastructure has become the highest priority so as to develop the country and improve its people's quality of life. The city of Kitakyushu in Japan has been engaged in reconstructing Cambodia's water systems and developing its human resources since 1999, as part of its international cooperation work. As a result, the Phnom Penh Water Supply Authority has undergone remarkable recovery and growth, and most people in the city now have access to clean, safe water. This outstanding result is recognized as "The Miracle of Phnom Penh." This paper provides a summary of the efforts of Kitakyushu's development and water specialists in Cambodia.

Introduction

Infrastructure building is essential to social and economic development, including education, human rights, industry, and human life in general. Weak and failing infrastructure perpetuates poverty and is a serious obstacle to both welfare and to a country's development. Therefore, improving infrastructure is regarded as a top priority in breaking the cycle of poverty, and countries cannot be expected to develop without it.

The Kingdom of Cambodia is a Southeast Asian nation that, due to a long civil war that lasted until around 1990, is substantially less developed and poorer than its neighboring countries [1,2]. Owing to the chronic violent conflict, infrastructure such as water supply, electricity, and roads deteriorated to an extremely poor condition [3,4]. For example, in 1993, only 20% of Phnom Penh's residents had access to piped water. Lack of infrastructure was, and still is, one of the main factors stalling the country's development.

The city of Kitakyushu, located in the western part of Japan, is known as one of the biggest industrial areas in Japan. However, the city's remarkable industrial

development brought with it severe pollution. In the 1960s, several rivers and the Dokai Bay were highly contaminated by industrial and domestic wastewater [5]. In order to restore the health of the environment, Kitakyushu's city government implemented their own technologies, with support from local companies and universities, such as sewage maintenance management systems and industrial wastewater treatment technologies [6]. These efforts re-established Kitakyushu's safe natural environment.

Through this experiment of overcoming its own serious pollution, Kitakyushu's city government has long-standing ties with cities across Asia and has continued to provide support to water and environmental technologies. For example, in 2009, Vietnam introduced biological contact filter (BCF) purification, which is a technology patented by Kitakyushu, and Kitakyushu's city government also held a training program regarding capacity building of sewage facility managers in the city of Huhehaote, China [6].

As a result, Kitakyushu's technologies are highly acclaimed not only in Japan but also overseas. Furthermore, Kitakyushu was chosen by the Organization for Economic Cooperation and Development (OECD) as a "Green Growth Model City" of the world that is maintaining both economic growth and environmental sustainability [7]. Since the 1990s, Kitakyushu's city government has also pursued endeavors to export water infrastructure relating to international technical cooperation. Today, Kitakyushu's water technologies have already been used in many Asian countries, such as China, Vietnam, Saudi Arabia, and Cambodia. However, this road has not been an easy one.

In the course of preparing this paper, I investigated the current water infrastructure situation in Phnom Penh and explored how to create infrastructure in developing countries. In August 2013, I interviewed Kitakyushu's water experts, the director of the Department of Potable Water under the Ministry of Industry, Mining, and Energy (MIME) of the government of Cambodia, the Director General of the Phnom Penh Water Supply Authority (PPWSA), the First Secretary of Embassy of Japan in Cambodia, and a project formulation advisor of Japan International Cooperation Agency (JICA) in Phnom Penh. They described the wide variety of problems they had faced and the knowledge gained throughout the learning process. This paper summarizes the findings of my survey in Cambodia.

An important issue that became evident is that effective water supply requires excellence, specifically in the areas of human resources and management, as well as in technology and hardware. One reason for the success of the water supply in Phnom Penh was appropriate investment and cooperation in both of these areas.

Tracks of development of water infrastructure

Phnom Penh's infrastructure was severely damaged by more than 20 years of civil war that began in 1970. The water supply dissemination rate in Phnom Penh was 20%, and, before 1993, water was only available for 10 hours per day. Consequently, people were forced to perform the long, arduous work of collecting water. In order to solve this serious problem, in 1993, a new director was appointed to the PPWSA: Mr. Ek Sonn Chan. Chan initiated a thorough reform of the water agency, utilizing international development funding and expertise [8,9]. JICA accepted this request and offered funds to improve the water supply facilities. JICA provided a grant of $25 million in support of the PPWSA in 1995 and gave over $21 million in additional grant money in 1997. The PPWSA also received financial support from the World Bank and Asian Development Bank starting from 1997; however, these were not grants, but loans [10].

In 1999, Kitakyushu's city government also accepted Cambodia's request that they dispatch waterworks experts to Phnom Penh to develop water infrastructure and to train local staff. At that time, the non-revenue water rate, which is defined as the difference between the amount of water put into a distribution system and the water billed to consumers, was more than 70%. Such losses are mainly caused by leakage and water theft. Reducing the lost water was a serious problem for Cambodia, and the successful management of the PPWSA was considered a virtually impossible task.

The water and sewer bureau of Kitakyushu introduced the Zone-Monitoring System, which was developed uniquely by Kitakyushu, to address the water loss issues [11]. Since it is difficult to pinpoint the locations of leakage or water theft, the water supply network is split into a number of blocks with a water meter installed for each block. This system allows blocks in need of repair to be immediately identified. As a result, it can efficiently specify the precise locations of leaks or thefts, compared to the conventional method, and it successfully reduces the amounts of non-revenue water.

Figure 1 illustrates the reduction in the amount of non-revenue water in Phnom Penh from 1993 to 2010. This diagram shows a year-by-year decrease in the amount of non-revenue water; the amount of leakage was

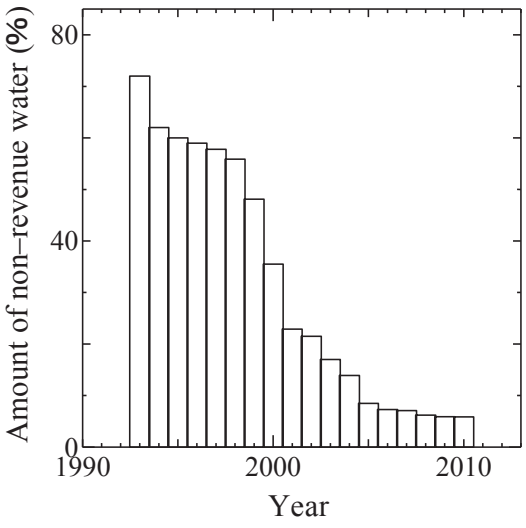

Fig. 1 Amount of non-revenue water in Phnom Penh

dramatically reduced from 72% to 6% or less, which is on par with developed countries.

Moreover, prior to Kitakyushu's provision of technical support, only 20% of people had access to piped water. Through the implementation of this cooperation, 90% of Phnom Penh's residents gained access to clean, safe water. Another outstanding result was that it became possible to drink water directly from the tap—a rarity in the world. In Asia in particular, such water is available only in Japan and Phnom Penh. These achievements have been lauded as a "miracle" and certainly provide an excellent model for other cities [12].

Phum Prek Water Treatment Plant

There are four water treatment plants in Phnom Penh. Among them, Phum Prek Water Treatment Plant, which is located next to the PPWSA, has the capacity to produce 150,000 m^3/day of potable water. The water supply is fed by the Mekong River, which flows from north to south through Phnom Penh to Vietnam.

Figure 2 depicts the facilities of Phum Prek Water Treatment Plant; the picture was taken during the author's research survey in Phnom Penh. This plant's water treatment mechanics are as follows:

1. Receiving and chemical dosing (Fig. 3)
The reception well intakes raw water and doses it with the chemicals calcium oxide (lime), polyaluminum chloride (PAC), and chlorine. This area also conducts the rapid mixing of chemicals in water.

2. Flocculation basin (Fig. 4)
Small flocs (flocculent masses) are joined together to make big flocs in order to facilitate quick setting.

3. Sedimentation basin (Fig. 5)
Big flocs are set at the bottom of the basin, and settled waters flow to the end of the basin.

4. Rapid sand filter (Fig. 6)
Small substances and flocs are filtered out, producing cleaner water.

5. Dosing chlorine (Fig. 7)
Chlorine is added to the filtered water to disinfect it.

This treatment method makes it possible to remove the brownish color from river water and eliminate harmful components such as arsenic and lead.

Figure 8 depicts the plant's control room, which monitors and controls the plant 24 hours a day. Initially, Japanese experts from Kitakyushu created the plant's standard operating procedures and instructed the management on how to run the plant. However, the staff of the PPWSA are highly skilled, and they manage the plant independently now. Moreover, the PPWSA staff are transferring their skills to other water engineers at various provinces in Cambodia.

Fig. 2 Phum Prek Water Treatment Plant

Fig. 3 Reception well

Fig. 4 Flocculation basin

Fig. 5 Sedimentation basin

Fig. 6 Filter basin

Fig. 7 Chlorine dosing basin

Fig. 8 Control room

Key to success in infrastructure building

Cambodia's schooling and education system was destroyed during the Pol Pot regime. A large number of people were executed as a consequence of his policies: it is estimated that, out of a population of approximately eight million, about two to three million people perished, and doctors, teachers, and literate people were disproportionately targeted. For this reason, most Cambodian people have had little education.

In order to assist these people with their work, Kitakyushu's experts put particular effort into human resource development at the PPWSA. They instructed local staff not only in the knowledge and technology of water infrastructure but also in Arabic numbers and methods of calculation. The water and sewer bureau of Kitakyushu also provided the PPWSA staff with work uniforms in order to increase their motivation to work and raise their morale. The system of allocating personnel also had a positive effect on the water business management. For example, the PPWSA made efforts to assign jobs according to each staff member's capabilities. Addressing these human resources issues was key to the successful development of water infrastructure in Phnom Penh.

Following these successful programs, many Cambodian agencies have developed a deep level of trust in the experts from Kitakyushu. Kitakyushu's city government now has agreements to provide technical cooperation to 10 Cambodian cities: Siem Reap, Battambang, Kampong Thom, Mondulkiri, Pursat, Kampong Cham, Preah Sihanouk, Kampot, Krong Kep, and Svay Rieng. Many residents of these cities still have no access to clean drinking water, and there is an increasing demand for water driven by population growth. The annual population growth rate in Cambodia is 1.8%, which is about nine times higher than that of Japan [13], and it is estimated that the population of urban areas will double from 2010 to 2030 [14]. Accordingly, Kitakyushu is increasing its efforts to tackle the problem of access to clean water and aims to develop water infrastructure throughout the country.

Conclusion

Since 1999, the water and sewer bureau of Kitakyushu has cooperated with the PPWSA to construct water infrastructure and has provided Cambodia with knowledge and technology to this end. As a result, about 90% of households in Phnom Penh now have access to potable water, and 24-hour stable water services have been made available.

It is clear that the presence of well-qualified people is crucial for any developing country where the construction of infrastructure is an important priority, and development needs to be made with a long-term perspective. In other words, human resource development is vital to developing countries, and the key is to train and secure human resources who can support ongoing development and pass their skills on to others.

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References

[1] O. Hensengerth, Transitions of Cambodia War and Peace, 1954 to the present, INEF, pp. 15-30 (2008).

[2] Z. Zimmer, J. Knodel, K.S. Kim, and S. Puch, The Impact of Past Conflicts and Social Disruption in Cambodia in the Current Generation of Older Adults, Population Studies Center Report (2005).

[3] The Public-Private Infrastructure Advisory Facility and the World Bank Group, Private Solutions for Infrastructure in Cambodia, pp. 7-14 (2002).

[4] M. Sum, Infrastructure Development in Cambodia, ERIA Research Project Report, pp. 32-84 (2008).

[5] H. Tsutsumi, N. Ueda, S. Montani, Proc. of The Twelfth International Offshore and Polar Engineering Conference, pp. 461-464 (2002).

[6] Office for International Environmental Cooperation Environment Bureau of Kitakyushu, ECO, thereby Enhancing Global Partnership, pp. 5-12 (2010).

[7] International Policy Division, City of Kitakyushu, Kitakyushu Bridges, Vol. 38, p. 4 (2012).

[8] B. Das, E.S. Chan, C. Visoth, G. Pangare, and R. Simpson, Sharing the Reform Process, Learning from the Phnom Penh Water Supply Authority (2010).

[9] Institute of Water Policy, Ek Sonn Chan and the Transformation of the Phnom Penh Water Supply Authority (2009).

[10] A. Chiplunkar, K. Seetharam, C.K. Tan, Good Practices in Urban Water Management, Asian Development Bank, pp. 133-143 (2012).

[11] K. Kitahashi, Presentation of Kitakyushu's International Strategy to Empower Japan, p. 31 (2011).
[12] Report of JICA Cambodia Office, Cambodia Dayori, No. 4, p. 3 (2011). (in Japanese)
[13] Population Reference Bureau, 2013 World Population Data sheet, p. 10 (2013).
[14] JICA, Overview on Urban Water Supply Sector in the Kingdom of Cambodia, p. 4 (2012).