

The Design of the Water Supply in the Metropolitan Area of Jakarta

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The goal in this research paper is to analyze the organization model of the water related infrastructure in Jakarta in order to identify possible weaknesses in the efficiency. For the analysis, we carry out a literature review. The study is making the conclusion that the public private partnership is already the best approach in Jakarta's water supply. However, a stronger regulator than the Jakarta Water Supply Regulatory Body needs to appear to guarantee enough incentives for the private water companies to operate the infrastructure site but also to prevent market failure. In general, the local authorities need to better communicate to avoid slow decision-making and the lack of initiatives.

1. Introduction

This work is dealing with the fresh water supply in the Indonesian capital city Jakarta. To survive, the human body needs a certain amount of water each day, which is absorbed through food and drinks. Furthermore, water is used and consumed for personal hygiene, washing, cooking and flushing the lavatory. It becomes obvious that water is an essential commodity and one of the most basic human needs.

The danger of not having access to clean drinking water and hygienic facilities is that people become infected with avoidable maladies, such as grace skin irritations and diarrhea related diseases caused by germs, viruses and other organisms that live and multiply in polluted water. To avoid these diseases, a certain effort must be done to supply clean drinking water and hygienic sanitary facilities. However, barely any effort was made for a long time, and therefore Jakarta's poor population cannot provide their families with the daily needs such as clean drinking water.

Politicians, experts and authorities of communities in Indonesia and most of South-East Asia had generally been avoiding the topic, as it is considered taboo to talk about sanitary issues. However, the government could benefit from discussing this issue as it has been shown that "Clean Water, sanitation and hygiene is a proven cost-effective investment that will reduce health budget spending and increase economic productivity and education levels", see UNDP (2009). According to Gaede, the economic loss in Indonesia through diseases is estimated at US\$ 3.3 Billion until now and could be reduced with actions that aim for a better supply of clean water and sanitary facilities. Any effort towards improvement of the population's health could result in less work disrupting illnesses and would allow adults who might otherwise be home caring for sick children to remain at work. And not only would the economy benefit from better productivity, but most importantly the Indonesian people themselves.

In this work, we want to analyze the current water situation to identify possible causes for water supply issues in Jakarta. We do so by first examining the current status quo of the water supply in Jakarta. Then the ownership model will be identified. Later, the actual supply contract will be analyzed in order to lay the foundation for final suggestions of possible improvements of the water distribution system.

2. Jakarta's water situation

Jakarta has experienced a tremendous growth in the past decades, from 435,000 people in 1930 to 9.61 Million residents in 2010, and even 27.9 Million residents in the greater metropolitan area of Jakarta, see

Firman (2011). Still, this statistic is not including the huge waves of migration during the day for work. Jakarta also has the highest density of all Indonesian cities with 15,342 residents per km². Many residents in Jakarta live in precarious living conditions: 20-25 % live in temporary housing (partly illegal, or semi-legitimate status) and four to five percent live scattered on river banks or similar places, see Varis et al. (2006). The majority of the population in Jakarta is considered low or lower middle class Bakker et al. (2006). Jakarta is also the economic center of Indonesia, with annual growth rates of six percent.

Concerning the water supply, there are estimations that say that in the first half of the 21st century, the “public service provided by the city’s administration can only fulfill the needs of 15-20 percent of Jakarta’s daytime population“, see Brown (2009). Looking at the map of Jakarta, the city has 13 rivers and several canals. However, none of all the waterways in or around Jakarta are rated as clean. The Jakarta Environmental Management Agency reports that 71 percent of Jakarta’s waterways are rated as ‘heavily polluted’, 20 percent is ‘partly polluted’ and nine percent is ‘lightly polluted’. 85 km South East from the city there is the Jati Luhur dam with two Billion m² clean water. It is supplying 82 percent of Jakarta’s fresh water, see Brown (2009) and Bakker et al. (2006). But even before it reaches Jakarta, the water is already brackish, see Primanita (2010).

The contamination of the rivers is not the only water supply concern in Jakarta. In Jakarta, there are two different geological layers in which groundwater can be found: They vary between almost zero and 30-40 m in the ground. The closer the groundwater is to the surface the more contamination is found. Still 70 percent of Jakarta’s population uses groundwater as a source for water, even though it is neither drinkable nor healthy for the personal hygiene, see Anon (2011). As so many people in Jakarta use the groundwater, it is already in a state of depletion: too much water is taken before it could regenerate, see Figure 1. Due to the depletion two problems occur: The first problem is salinization, as the seawater intrusion is taking place making the water useless for the people in Jakarta. The second problem is land subsidence because the groundwater recharge rate with 10.5 m³ per second is lower than the extraction rate with 15.5 m³ per second as reported by Cochrane (2010). The consequence is that some areas drop up to 25 cm a year. If this trend continues, the shoreline will dramatically extend to the South and with it many settlements will drown.

2.1 Why Jakarta’s water is polluted

The water in Jakarta is polluted for several reasons. One is the strong growth of the primary and secondary sector in Jakarta. Bowo (1999) describes that the water that is used for the production of goods is not treated before it is discharged into the rivers and canals. The second issue is the behavior of the population towards its waste, see Figure 1. 1,400m³ of waste is thrown into the waterways daily. 400 m³ will be taken out, 600m³ are jettied into the sea and 400 m³ stay in the rivers and waterways, see Anon (2010). The third difficulty is the handling of the wastewater. Less than three percent of the city has a sewage connection at all, including all types of uses such as living, offices or malls. That is the second lowest coverage in whole South East Asia.

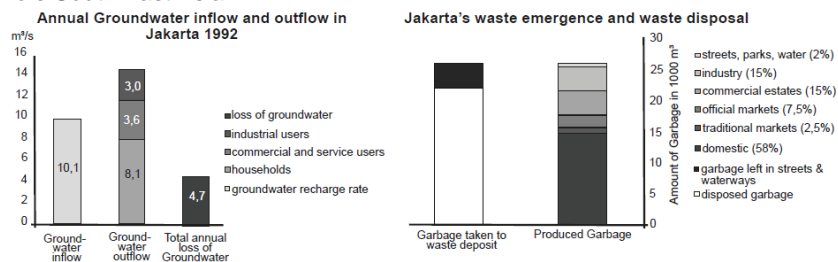


Figure 1: Annual Groundwater Recharge Rate, extraction rate, the loss and use of Jakarta’s Groundwater (on the left) and Total Waste Emergence and Waste Disposal, waste makers and the garbage that was left in the streets in 1997 (on the right)

Adding up to the direct pollution of the waterways, the bad condition of the existing infrastructure also adds up the lists of polluters. First of all, there are not enough sewage treatment plants in Jakarta, only one in 76 L of wastewater is purified, see Hendry (2010). Thus, way more wastewater is discharged than purified water is produced. Second, the wastewater pipelines often have leaks and are not functioning properly anymore, so that the microbial contamination is reaching the ground and the groundwater. Also damaged fresh water and wastewater pipelines are often right next each other. This way the fresh water that goes into the households is often directly contaminated with dangerous germs from sewage. But pollution is not the only problem that comes from the leaks, they are also the main reason for the loss of the fresh water in combination with accumulation in the pipes, low pressure and heat. The fresh water pipelines themselves can become a perfect breeding ground for germs according to Giles and Brown (2002). This issue is also

an important matter in the fresh water supply as the water quality suffers under these conditions. Facing all these difficulties there is no doubt that the water in Jakarta is polluted. The Frame for Economic Designs for the Water Supply

A change from public to public-private or private infrastructure business came when many countries went under financial pressure in the late 1970s and early 1980s due to recession and sinking commodity prices. Because of these events the idea came up that the private sector could be involved in financing infrastructure. At the same time developing countries were browbeaten as the donor nations forced them to reduce their debts and granted no new indebtedness. These circumstances led to a privatization of the infrastructure. It was expected that through privatization the efficiency would rise, and with the better infrastructure the country itself would become more interesting for investors. The economic growth would then again contribute to the reduction of poverty in terms of the trickle-down effect. As the idea of Governance became very popular and the developing countries could not solve their budget problems on their own, the developing world experienced a big wave of privatization in the late 1980s and early 1990s. Indonesia became one of the new 'markets'.

The nations' and cities' infrastructures were an attractive business for private companies. But as the water sector is often too complicated and too cost-intense it did not experience as much PPI as the communication and energy sector.

3. The theoretical design for the water supply

Three main concepts dominate the organization for water infrastructure sites (infrastructure in general):

- Public Operation: The infrastructure is owned and operated by the municipality / state.
- Private Operation: The infrastructure is owned and operated by private partners.
- Public-Private Partnership: The term sums up all the categories of cooperation between public authorities and private companies concerning the operation of infrastructure.

The participation and responsibility levels may vary between the parties in a Public-Private Partnership (PPP). In PPP both private and public property can be found, see Gusenbauer (2009). The target is to gain more efficiency by granting one or several value-added step(s) and to hence gain more profit, see Prasad (2006). The following PPP models are named after their private involvement of the infrastructure site: Service and Management Models; Transfer of Operation Models (TOR) with the Leasing and Concession Models; and the Build Operate Transfer Model (BOT). We focus on the Concession Model as one form of the TOR, as this is the kind of partnership the city of Jakarta has with private partners.

With a TOR the state is giving a license to a company for a certain period of time to completely run the infrastructural site and provide service. It is serving the consumers directly and can therefore cover the expenses with the taken revenue. With this model, the company is having all responsibility and has to share the commercial risk for the service offering. The role of the government usually is to monitor the tolls by allowing competition and or regulating fees. Usually the public authorities would only chose companies with experience so that they could entrust this big task a competent partner, but the government can also protect itself with performance-bonds in case the company is not fulfilling the contract (well), see JWSRB. There are two types of TOR: The Leasing Models and the Concession Models.

The main attributes of the concession model of the TOR are the public property of the infrastructure site, the public financing of the up-front investment, private financing of expansion investments and the private business management, see Aetra (2012). In this model, a public task is handed over to the concessionaire who is responsible for the management of the infrastructure site. The government again is the concession giver and the company the concession taker. The concession model is relevant in the countries where private companies or foreign investors are not allowed to own infrastructure sites by law, but where know-how and investment for the infrastructure site and management is needed. The concession taker has to pay concession charges. However the business is still attractive to the companies if the difference of the concession charges and the income through the users' fee is sufficiently large. At the same time excessive yields could result in not having enough incentives for the concession takers to maintain the site and provide sufficient service. That could happen if the conditions 'fit' according to Bakker et al. (2006).

4. The design of Jakarta's water supply

4.1 Initial situation and targets

The city of Jakarta made a concession contract with two private companies, granting them the concession right of the water supply infrastructure sites for 25 years. Therefore the economic design of Jakarta's water supply can be classified as the TOR-Model. That means that the ownership is public, the financing and operation is private, see Bowo (1999). In 1998 the contract was closed. The Contract is called a Cooperation agreement.

The stakeholders that are directly involved in the concession contract are the owner of the infrastructure site, PAM Jaya, and the two concessionaires Palyja (serving West Jakarta) and Aetra (serving East Jakarta). Indirectly involved are the government as the regulator and the residents as consumers.

The infrastructure site is in the ownership of the city, PAM Jaya, but they are run by the two operators. Palyja is gaining most of the water for the production from the Jatiluhur Dam, which is treated in water treatment plants with a capacity of 5,000 l per second. The remaining needed water is mainly bought as Bulk Treated Water from PDAM Tangerang, of which the source is the Cisdane River, see Iwanami and Nickson (2008). Aetra is also using raw water sources from the Jatiluhur Dam and they are treating the water in three Water Treatment Plants with a total production capacity of 6,500 l per second.

In the contract it was settled that the profit of the companies is not linked directly to the revenues of the infrastructure site, but that the private companies would receive fees from the government. These fees depend on the volume of water that is delivered to the distribution network.

Also the contract contains certain performance indicators, to assess the concessionaire's activities. Most of these targets were also clearly defined. By the year 2008, ten years after the contract with the concessionaires, the following targets were postulated, see Bakker et al. (2006):

- Volume of water sold: from 181 Million m³ to 398 Million m³.
- Reducing the Non-revenue Water from 58 percent down to 25 percent.
- A service Ratio from 43 percent to 75 percent.
- To serve 7.57 Million residents.
- To achieve clean water by the end of year nine and potable water starting year ten.
- Achieve a pressure of 7.5 m in the whole are, by the end of year 10.

And there are service standards expressed which are water quality, that is compliant with clean and potable water standards, water pressure at the consumer's tap, customer care (response time), routine interruption in distribution network (response time), and time for installing new connections, see Lako and Ardhanie.

The contract is considering seven different tariff groups that pay distinct tariffs, concerning their social situation. The tariffs are then again differentiated into three different tariffs by the volume that is sold. Table 1 represents them and compares their charges from year 1998, 2005 and 2010. The prices in Rupiah all belong to the middle tariff for 11-20 m³ water a month (low tariff 1-10 m³, high tariff 21-x m³).

Table 1: Tariff Groups in Jakarta per m³ water. Source: Bakker et al. (2006) and JWSRB

Tariff Number	Tariff Group Description	IDR in 1998	IDR in 2005	IDR in 2010
I	Social institutions and public hydrants	375	900	1,050
II	Public hospitals and very poor households	375	900	1,050
IIIa	Low income households	995	3,900	4,700
IIIb	Middle income households and small-scale business	995	5,000	6,000
IVa	Upper middle income households and government offices	1,660	6,800	8,150
IVb	Large hotels, high-rise buildings, banks	3,650	10,400	12,550
"Special Group"	Harbor	5,200	12,150	14,650

The authorities regulate the concessionaires to prevent welfare losses through natural monopolies. Palyja and Aetra would have incentives to only build connections in wealthy neighborhoods, where people can afford a large volume of water and neglect the urban poor, where it is costly to connect the residents to the water grid and expected profits are very low if any. The regulation is handled by the Jakarta Water Supply Regulator Body (JWSRB). Its task is "to review tariffs and make proposals to the Governor, to monitor the performance of the companies and to mediate disputes between contractual parties and customers".

4.2 Assessment of the situation and targets

In 1999, only 30 % of Jakarta's population was connected to the central fresh water grid. However progress has been made according to JWSRB. In 1998 Aetra had 268,000 connections to households and in 2010 already more than 385,000. The water pipes have been extended from 4,400 in 1997 to 5,928 km in 2011. Also Palyaja is announcing improvement with 10,700 new connections in 2011 and 414,500 connections in total. Aetra and Palyja together have around 800,000 connections. Also they have rehabilitated 950 km of the existing pipe network and extended additional 1,300 km to the grid, see Primanita (2010). Also, the water production is apparently rising with 405 Million m³ in 2008. However not all the water could be sold, as mismanagement still leads to high losses, the non-revenue water is at 51 percent in 2007. Therefore, the water being sold is only at around 258 Million m³, see Iwanami and Nickson (2008) and Varis et al. (2006). The service ratio rose as well up to around 64 percent in 2008.

However this information is biased as the operators state that an average of 7.6 people use one connection, though surveys found out, that the ratio is not more than 5.0. If this were true, only around 43 % of Jakarta's population would be served. Another disappointment is the water quality that did not improve at all. It is still in a very poor condition, and health standards are not met. Also, households with connections can retrieve water for only 18 hours a day on average. That is why the majority of the population is still relying on ground water, even though it is salt affected and polluted with chemicals.

A big achievement by the water operators is the expansion of the water connections and the water grid itself. Other than that, the water operators have not performed good 'efficient' results.

Regarding the regulation, the JWSRB does not have the authority to change tariffs, which is still to be decided by the governor. The study of Iwanami and Nickson (2008) is also revealing that the JWSRB is not effective in improving the water service for the customers. Their research is appreciating the formal existence of a regulatory body, but they are judging their non-efficiency concerning the failure in influencing the water service performance, see Bowo (1999). Also, the JWSRB was not helping making poor neighborhoods a priority for the water operators.

As for the prices, we can see that they rose over time; the only exceptions were from 1998-2001, 2007 and 2009, when the government decided to freeze the charges. It can be assessed that the poor households pay lower tariffs than the wealthier households or the industry as a cross-subsidy. However this is a challenge for the water operators in a city with a ratio of domestic to industrial customers of 80 to 20, and only a few customers in the higher tariff groups. Many of the costumers are paying tariffs, which are below the production costs. Paljaya states that this is the case for 70 percent of their customers, and for Aetra 76 percent, see Primanita (2010).

The government tried to make it more attractive for the Palyja and Aetra to build new connections in the poor neighborhoods by paying them fees for their water being sold (instead of the water being produced). Yet still three quarters of the connections were built in the wealthier areas of the city. Wealthy residents can afford more water per connection. Therefore the revenues are rising for the operators. The reason why the concessionaires haven't put a priority on poor households is not only reasoned in the volume of water they can sell. Often the poor residents live in informal or semi-formal and very dense areas, where it is more difficult and therefore pricier to provide connections, see Bakker et al. (2006). It can be concluded that the incentives to connect the whole city equally did not pay off. The focus for new connections was set on the wealthier parts of the city.

5. Conclusion

All in all, the private water sector seems to be promising as the companies could work economically and therefore make the quality of the water supply reasonable. Apparently, the Governance Concept is showing results as, regarding all malfunction of the water supply, the private participation helped Jakarta to maintain and extend the fresh water connections.

The general observation is that the advantages of the private involvement in water supply are:

- More financial opportunities to maintain and expand poor infrastructure site, especially when following the Good Governance Principles that are expected from many big loan givers, such as the Asian Development Bank
- Avoiding bad decision-making by the government, as corruption and nepotism are not such a strong issue in private companies
- In case of a good pricing policy the activity of the black market for water can be reduced.

One big disadvantage and fear of involving private companies is market failure: It is difficult to keep the balance between the profit-oriented companies and the needs of the residents. If the market is failing, especially the poor and low-income households suffer from a lack of clean water. What also needs to be taken into account for is that the more actors are involved in a contract, the more confusion and miscommunication can happen, which would result in less efficiency and effectiveness.

The reasons for public involvement in Jakarta's water distribution are:

- Water is stated as property of the State by law
- The government can put a focus on the different interest groups and react on their needs
- The local authorities are able to implement new laws and absolutions when/ where needed.

Therefore the local authorities can directly react on the consumer's needs and prevent them from being disadvantaged, especially in case of the market failure. One more recommendation of the authors is to rethink the role of the JWSRB as the regulator. Many examples from other countries like Guinea or Chile with private participation show that whenever there was no or only a weak regulator, especially the socially vulnerable residents would suffer from the price policies. The example of England is also showing that only with a regulator that has its own authority and several bodies for mutual control, the price policy and

development is balanced. Therefore the recommendation that follows is to give JWSRB more authority to make decisions.

Otherwise, the public involvement also has disadvantages, such as missing finances or an increasing number of 'construction sites' in Jakarta. Also the local authorities often do not have the know-how to operate infrastructure sites. They are set in the administration by the results of an election. Also, the confusion of who is responsible for what and who makes decisions is hindering the successful public involvement of the water supply. Usually it could be expected from the government that they would focus on the needy residents and on the disadvantaged interest groups in general. This paper is assuming this mindset for Jakarta's government which can be seen in trying certain approaches (that may or may not have been realized). However the bad communication between the involved departments poses another real challenge. Furthermore, 'bad governance' is still happening and (former) PAM Jaya workers are using their knowledge to make illegal connections and raise therefore the non-revenue water rate.

Further research on the responsible stakeholders is suggested. A better education about their relations to each other, so that they can combine their knowledge and their resources could be beneficial to the water supply. Also, further studies could be made how far the author's recommendations are maybe already realized or how they could be implemented. We conclude with the words of Varis et al. (2006): „The water issue in megacities is much more than a question of infrastructure“.

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