water resource carrying capacity

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Strategic Framework for Optimizing Water Resources Carrying Capacity as a Basis for Sustaining Urban Development
(A Case Study of Bekasi Urban Area in Indonesia)

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Abstract

Bekasi has altered to an urban area driven by rapid urbanization and industrial growth. The consequences of this change are the risen in population and land use changes which need to supported by sustaining water supply. The purpose of this research is to develop a strategic framework for optimizing water resources carrying capacity as a basis for sustaining urban development in Bekasi. Currently, some of the water demand for the urban activities is supported by the surface water from the outside through the Citarum Barat Water Supply System. Most of the water demand is pumped from ground water. Those two Bekasi water resources might not be available to support the future needs. Hence, this study is aimed to find another alternative of water resources of the Bekasi. The study found that Bekasi has unused its own potential water resources that is surface water of the Bekasi River. However, the quality of this water resources has poorly degraded since the river is used for the urban drainage system. The poor quality of the river is caused by water pollution comes from domestic and industrial waste. It is also identified that land uses in urban area and urban activities related to surface water pollution. Surface water pollution has affected river self purification, then, it has resulted the quality of rivers water is not sufficient for water supply. The paper identifies the possibility of the Bekasi River as the new water resource in term of its quantity, continuity and its quality to fulfill the need of water supply for the future development. The methodology used in this study is the description analysis with mathematical approaches to examine the factors which are influences the quantity, the continuity and the quality of water resources. Finally, the study found that the quantity of water resources is sufficient to support the growth of urban activities but still needs a strategic framework to maintain its continuity. On the other hand, the quality of the Bekasi River needs to improve. One of a strategic framework for optimizing the quality of water resources is to reduce pollutant loading from domestic and industrial waste. The reducing of pollutant loading can be achieved by determining a waste minimization system of domestic and industrial waste.

Keywords: Strategic Framework, Water Resources, Water Quantity, Water Quality

I. Introduction

City plays economic and social roles as the center of manufacturing industry, and or of public services. As the center of manufacturing industry, the linkage between cities and

between a city and its hinterland is growing mostly related to the production process. The linkage would exist between the area where the raw materials are produced, processed, packaged and marketed. Meanwhile, as the center of public services, a city provides the services that facilitate not only for its inhabitant but also the people surroundings.Though the existences of cities have significant roles for the economic and social growth of regional even national scale, in fact, cities are not self sustaining. Moreover, they are usually use resources inefficiently compared to rural areas. A city is a complex system that greatly dependent on outer resources. In order to sustain city's life, it takes air, water, energy, food and other resources and produces wastes from those resources used.

One of the most important resources to support city's activities is water. People, plants, and animals need water to stay alive. Water provides essential wildlife habitat, enables crops to grow, and it is used for almost every human activity, such as bathing, cleaning clothes and appliances. Fresh water is also needed for virtually every manufacturing process of industry.

Water is a renewable resource that is replenished through the hydrological cycle. It can be supplied from groundwater and surface water (stream and lake), but especially for groundwater, is basically nonrenewable because it takes about 300 years for groundwater to recharge. According to urban sustainability, water supplies are the most important element in determining urban carrying capacity and the limits to population and economic growth. Effective water supply planning and implementation will be crucial to sustaining livable communities.

Bekasi is one of the city in Indonesia which has altered to an urban area driven by rapid urbanization and industrial growth. Urbanization mainly comes from Jakarta Metropolitan City which is known as a highest density population in Indonesia, Bekasi is located very near to Jakarta, and it becomes a hinterland of Jakarta to fulfill the needs of

settlement and industrial area. As the consequences of this role, Bekasi is now facing great challenges from rapid population growth increasing demands for water in agriculture, industry and domestic life.

Currently, some of the water demand for the Beaksi activities is supported from the outside by the surface water of Citarum River. The water from Citarum River is flowed by Saluran Induk Tarum Barat canals, and the water is treated by PDAM - Bekasi to provide clean water. But this water supply system can only cover 20% of Bekasi water demand, and 80% of the water demand still covered by pumping the ground water. Those two Bekasi water resources might not be available to support the future needs. Hence, this study is aimed to find another alternative of water resources of Bekasi. In order to achieve this aim, it is necessary to identify the hydrological system related to Bekasi to find the potential water resources comparing with all the activities which reflects the demand of water. The methodology used in this study is the description analysis with mathematic approaches to examine the factors which are influences the quantity, the continuity and the quality of water resources.

II. The Existing Water Suplly and Demand of Bekasi

Bekasi uses around 1,825,000 m^3 per day of water for irrigating agricultural, residential and industrial purposes. As it explained before, the water supply from City Water Supply System (PDAM Kota Bekasi) can only cover 20% of the water demand. About 1,483,000 m^3/year, comprise 80% of water demand supplied from the groundwater. The dependency on the ground water supply will increase in line with the increase of population and the intensity of activities in Bekasi while the capacity of the City Water Supply System has not been significantly improved.

This condition of water supply system of Bekasi is essentially not sustainable because high dependency on the ground water supply will reduce the availability of the water which needs very long time to recharge. The rate of recharge depends on the texture and composition of the soil, underlying rock strata, depth of water table, the slope of the land, the amount of vegetative cover, and impervious surface area. The higher proportion of impervious surface, the longer time needed for the groundwater to recharge. If the condition is overdraft or the rate of ground water consumption is faster than the rate of the recharge, in the future the availability of the ground water would deplete.

The availability of groundwater in Bekasi depends on the aquifer of Karawang-Bekasi Aquifer, in which the area has been characterized as built area. The aquifer area and the rainfall intensity might be large, but the rate of recharge to the aquifer is low as consequences of rapid population growth and development. In 2006 population of Bekasi was 2,071,444 with 3.73% population growth rate per year. The economic activities with high water consumption are manufacturing industry, agriculture, trade centers and public services. According to this fact, Bekasi should not over dependent on the ground water to fulfill the water demand for its inhabitants. Hence, Bekasi should try to find another potential water resource.

III. Identification of an alternative water resource in Bekasi

Bekasi is located in the north of West Java and it has an area of 210,49 km^2. The area of Bekasi is covered by three watershed, they are Sunter Watershed, Cakung Watershed and Bekasi Watershed with their specific river system (see Figure 1.). The river system of each watershed is shown in table 1.

Tabel 1. The River System of Bekasi

No.	RIVER SYSTEM	RIVER CATEGORY	AREA (km^2)	LENGTH (km)
1.	**SUNTER**		**33,490**	
	Sunter River	Main River		56.10
2.	**CAKUNG**		**14,170**	
	Cakung River	Main River		39.68
	Cibaru River	Tributary		20.30
3.	**BEKASI**		**144,000**	
	Bekasi River	Main River		132.50
	Cikeas River	Tributary		138.60
	Cileungsi River	Tributary		

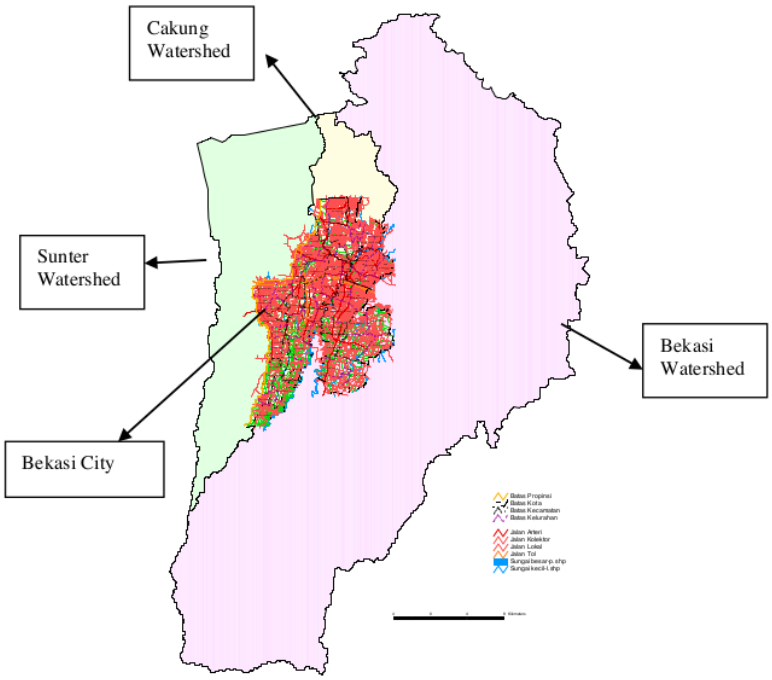

Figure 1. Bekasi and its Watersheds

The figure 1. and the data in table 1 show that Bekasi Watershed covered almost 2/3 part of Bekasi Area. The main river of Bekasi Watershed that is Bekasi River, has the potential availability of water that can supply about 2.5 billion m^3 per year. Meanwhile, the demand of water in Bekasi is about 1,825,000 m^3 per year. It can be proven that Bekasi River is potential to be used as an alternative water resource in terms of its quantity. However this

potential water should be analyzed whether it is suitable for potable water in terms of its quality.

The local government officials had identified a serious surface-water pollution come up in Bekasi River by domestic sewage and industrial discharge. The concentration of same contaminants has exceeded The Drinking Water Quality Standard (see Table 2).

Tabel 2. The Quality of Bekasi River System

No.	Parameter	Standard	Unit	Cileungsi River	Cikeas River	Bekasi River
	PHYSICS					
1	Temperature	Dev. 3	℃	30.7	30.2	33.7
2	TSS	50	mg/l	15	10	50
	CHEMISTRY					
3	pH	6-9	mg/l	7.5	7.1	9.3
4	DO	6	mg/l	4.5	5.6	3.1
5	Fe	0.3	mg/l	0.5	0.5	1.85
6	Mn	0.1	mg/l	0.08	0.08	0.58
7	BOD	2	mg/l	12.9	6.2	69.2
8	COD	10	mg/l	31.8	10.3	115.3
	BIOLOGY					
9	Fecal Coli	1000	mpn/100 ml	65,800	68,500	285,000

The water pollution in Bekasi River mostly generated by domestic and industrial activities which are now can be found along the river bank. It is not only wastewater generated from domestic and industry, but also solid waste or garbage discharge in to the water body, because the lack of solid waste management system in Bekasi.

The land uses along the river bank has generated physical, biological and chemical pollution that reduce river water quality and decrease its assimilative capacity. Water quality is first and foremost a matter of public health. Therefore, the strategic action is required to clean up Bekasi River water and to reduce the pollution load from the activities along the river banks, so the water quality can meet The Drinking Water Quality Standard.

IV. Strategic Framework for Optimizing Potential Water Resource

Many settlements and industries in Bekasi used surface water, especially Bekasi River, as open sewers. Therefore, the local government of Bekasi requires to limit on domestic and industrial discharges to the water body and to stricter the river quality standard. Based on the water quality data of Bekasi River, it can be predicted the source of pollutant and the factors might influence that condition. Then, it can be built some strategic actions to solve the water pollution problems as can be seen in Table 4.1.

Tabel 4.1. Alternative Strategic Action to Optimizing Surface Water Resource

Contaminants	Possible Sources	Possible Influenced Factors	Alternative Strategic Actions
Fe, Mn	Industrial Sites	Industrial Wastewater Treatment System is not properly worked	Improve the aeration rate by increasing the water velocity through restructuring the river form Improve the aeration rate in the industrial wastewater treatment system
BOD, COD	Industrial Sites	Industrial Wastewater Treatment System is not properly worked. The standard of BOD and COD is based on mg/lt	The standard of BOD and COD discharged in water body should be based by their weight Improving monitoring and evaluation of the treatment system Conducting Law Enforcement
		Some industries, especially small scale industries have not used the wastewater treatment system	Introducing communal wastewater treatment system
	Domestic Waste	Poor Sanitary System	Promoting partnership between local government and nonprofit group to educate the public and to clean up the water bodies
		Untreated domestic wastewater	Centralized municipal sewage collection and treatment systems
		Untreated solid waste	Improving the capacity of solid waste management
Facel Coli	Domestic Waste	Poor Sanitary System	Promoting partnership between local government and nonprofit group to educate the public and to clean up the water bodies Centralized municipal sewage collection and treatment systems

Consistent monitoring and enforcement are required and can be done through sampling at established monitoring stations at different times of the year. Some citizen watershed associations monitor river water quality as well. Moreover, the local government should determine the maximum amount of pollution an impaired waterway can assimilate and still meet the drinking water quality standard. The amount of pollution is known as Total Maximum Daily Loads (TMDL). The TMDL process is the key to clean-up of impaired water bodies. Public participation in the process is required. Information on impaired water bodies and pollution sources is needed for the public to be an effective partner in decision making about the type and location of future development.

Industry and settlement should implement some technologies of wastewater treatment to reduce the contaminant in their wastewater or sewage. Wastewater treatment methods include disinfection, primary, secondary and tertiary treatment. These levels of treatment range from the simplest to the most complex, with more polluted water requiring a great.er level of treatment. However, secondary treatment is the minimum requirement for potable water, and nearly all municipal treatment plants treat sewage to this level.

V. Conclusion

The Bekasi River located in the Bekasi City is potential to be used as an alternative water resource in terms of its quantity. However, the quality of that water is poor related to the high contaminants of Fe, Mn, BOD, COD and Feces Coli. To be used as potable water, it is need to conduct some strategic actions to reduce the contaminants up to the level of suitable water for human life. Some technologies can be used to solve that water pollution problems in line with conducting the law enforcement as well improving the public participation on the water management system.

References:

Bekasi City Government, 2006. *Bekasi in Figure 2006*.

Bekasi City Water Supply System, 2006. *Bekasi Water Supply System Report*.

Daniels, T and K. Daniels, 2003. *The Environmental Planning Handbook, for Sustainable Communities and Regions*.,Planner Press, American Planning Association, Chicago Illinois, Washington, DC

Leitmann, J. 1999. *Sustaining cities: environmental planning and management in urban design*, McGraw-Hill Company, USA.

Miller, G.T.J. 1990. *Living in the environment : An introduction to environmental science*, Edisi ke 6, Wadsworth Publishing Company, California.

Riddell, R., 2004 *Sustainable urban planning*, Blackwell Publishing, USA.

Rogers P.P., K.F. Jalal dan J.A. Boyd. 2008. *An Introduction to sustainable development*, Glen Educational Foundation, Inc, Earthscan, USA.

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