PROCEEDING

Faculty of Landscape Architecture
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Jakarta, Indonesia

IDRC CRDI MercyCorps

INTERNATIONAL SEMINAR on

SUSTAINABLE URBAN DEVELOPMENT

20-21 August 2008

at Campus A of Trisakti University,
Building D, 8th Floor,
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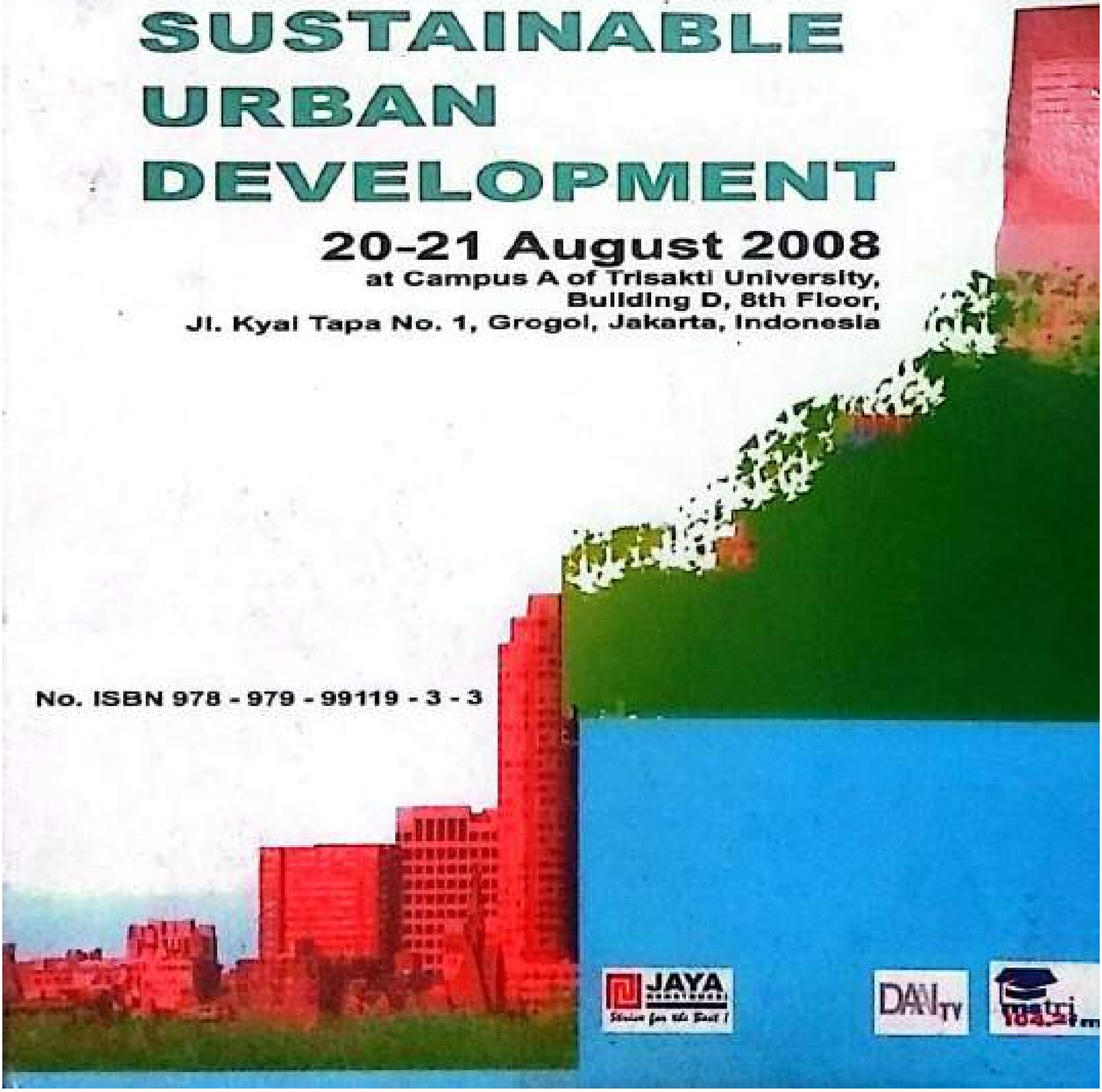

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ORGANIZING COMMITTEE REPORT

Dear all participants,

The International Seminar on Sustainable Urban Development, ISOSUD 2008, is conducted by Faculty of Landscape Architecture and Environmental Technology, Trisakti University and in cooperation with Mercycorps. The aims of this seminar is to share and to discuss all ideas, experiences, concepts and regulations on sustainable urban development amongst researchers, practitioners, and decision makers.

Within two days, we will listen and discuss with some keynote speakers, they are Prof. Suma Jayadiningrat from Indonesia, Prof. Winter from Karslruhe Universitat Germany, Prof. Takao Yamashita from Hiroshima University Japan, Prof. Mustafa Kamal from Universiti Putra Malaysia, Dr. Rolf Baur from Technische Universitat Dresden Germany as Director of CIPSEM UNEP/UNESCO, Dr. Jusna J.A. Amin from Trisakti University Indonesia, Dr. Haryo Winarso from ITB, and Dr. Sujana Royat as Deputi Menko Kesra. Beside that, there will be 6 class room of presentation in each day. The presenters are come from many institutions and many countries. The local institutions including universities, like Trisakti University, ITB, UI, UGM, UNDIP, ITS, UNPAS, ITENAS, Univ. Malahayati, Univ. Islam Sultan Agung Semarang, Univ. Islam Indonesia Yogyakarta, Univ. Muhamadiyah Surakarta, UNPAD, IPB, UPN Surabaya, UNTAR, Univ. Negeri Semarang; research boards, like BPPT, LIPI, LAPAN; governments like Public Work Dept.; Donors like World Bank; and NGO's, like UN Habitat, Bali Fokus, LPPSE, and Mercycorps. International presenters are come from Malaysia, Thailand, Taiwan, Japan, and Germany.

We are very grateful to Rector of Trisakti University; Dean of Faculty of Landscape Architecture and Environmental Technology; Head of Environmental Engineering Department; Head of Landscape Architecture Department; Head of Urban and Regional Planning Department; the member of Steering Committee, Peer Reviewer, and Organizing Committee that very supported and helpful within the preparations and conduction of the seminar. The seminar is supported by Mercycorps, IDRC, and PT Jaya Konstruksi; also MS Tri Radio and DAAI TV as media sponsorships.

Thank you for your participation and hope you enjoy the seminar.

Jakarta, August 20th, 2008

Chairman of Organizing Committee
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SUB – THEME ENVIRONMENTAL MANAGEMENT

Session II Class Presentation
August 21.2008

Environmental Management				
Time (WIB)	Code	Topic	Presenter	Chairman
13.15-13.40	OP.EM-05	Strategic Framework For Optimazing Water Resources Carrying Capacity As A Basis For Sustaining Urban Development (A Case Study Of Bekasi Urban Area In Indonesia)	**Setyo S. Moersidik [1], Endrawati Fatimah [1,2], Masni Dyta Angreani[1], Maika Nurhayati[1]** [1] Environmental Studies Program, Post Graduate Program, University of Indonesia, Jakarta, Indonesia [2] Department of Regional and City Planning, University of Trisakti, Jakarta, Indonesia (For correspondence: Address: PSIL – UI, Jalan Salemba Raya No. 4 Jakarta, Telepon: (021) 31930251, Facsimile: (021) 3146662, E-mail: psil_ui@link.net.id	**Dr. Widyatmoko**
13.40-14.05	OP.EM-06	Developing A Model Of City's Land Resources Carrying Capacity	**Endrawati Fatimah [1], Setyo S. Moersidik [2], M. Putri Rosalina [2]** [1]departement Of Regional And City Planning, University Of Trisakti, Jakarta, Indonesia [2]environmental Studies Program, Post Graduate Program, University Of Indonesia, Jakarta, Indonesia (For Correspondence: Address: Psil – Ui, Jalan Salemba Raya No. 4 Jakarta, Telepon: (021) 31930251, Facsimile: (021) 3146662, E-Mail: psil_ui@link.net.id, indo_googolendra@yahoo.com	
14.05-14.30	OP.EM-07	Using Geographic Information Systems In Flood Prone Area Management For Sustainable Development	**Ir. Yanti Budiyantini, MdevPlg** Department of Urban and Regional Planning, Institut Teknologi Nasional (Itenas) budiyan@itenas.ac.id	
14.30-14.55	OP.EM-08	The Application of Participation Conservation Model In The Catchment Area of Wonogiri Dam, Bengawan Solo River Basin	**Pardino, MM, Drs. FX. Hermawan K, M.Si** Research and Development Center for Social, Economic,Cultural and Community Role, Board of Research and Development, Ministry of Public Works fxhermawan@yahoo.com	

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OP.EM-05

STRATEGIC FRAMEWORK FOR OPTIMIZING WATER RESOURCES CARRYING CAPACITY AS A BASIS FOR SUSTAINING URBAN DEVELOPMENT (A CASE STUDY OF BEKASI URBAN AREA IN INDONESIA)

Setyo S. Moersidik [1], Endrawati Fatimah [1,2], Masni Dyta Angriani[1], Maika Nurhayati[1]

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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 fulfil 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.

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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 fulfil 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.

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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		

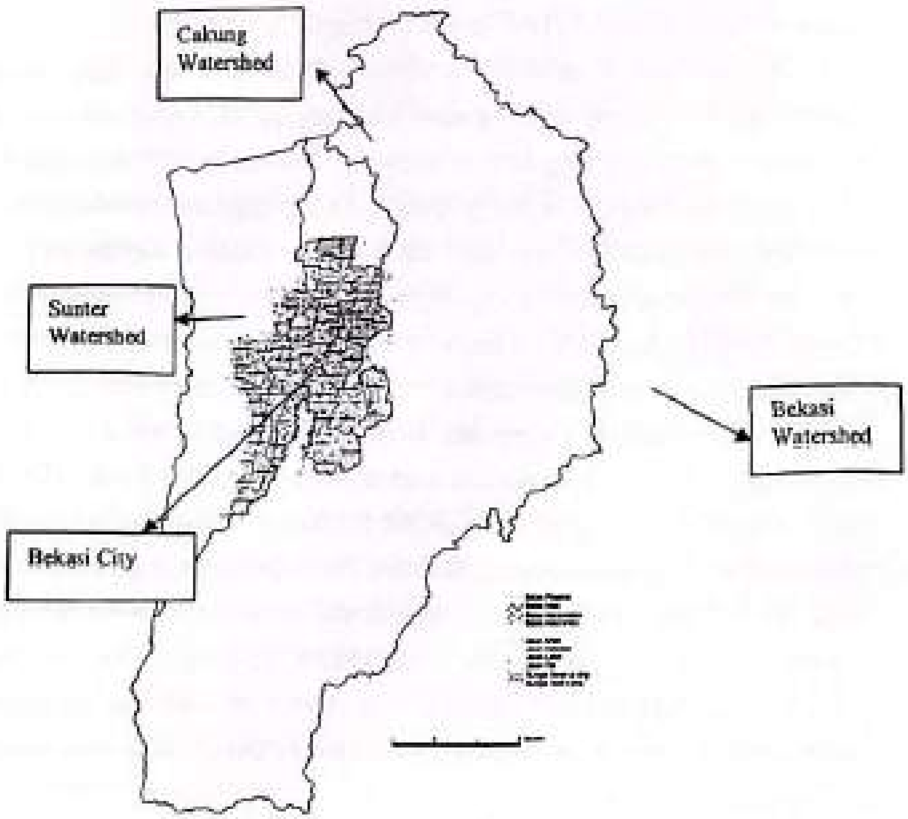

Figure 1. Bekasi and its Watersheds

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.

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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	8.2	69.2
8	COD	10	mg/l	31.8	10.3	115.3
	BIOLOGY					
9	Fecal Coli	1000	mpn/100 ml	85,800	88,500	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.

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OP.EM-06

DEVELOPING A MODEL OF CITY'S LAND RESOURCES CARRYING CAPACITY

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Abstract

One of the most popular and widely applied method of the environmental carrying capacity assessment is the Ecological Footprint–Biocapacity Account (EF-BC Account). The ecological footprint is defined as the amount of biologically productive land or sea area required to renew the biological resources consumed and to absorb the biological wastes produced, by a given human population or activity. The biocapacity measures the amount of useful biological resource production and waste absorption within a defined geographical area. A such area can be defined as an ecological deficit if the ecological footprint amount is exceed its biocapacity. It means the carrying capacity of this area is exceed.

EF-BC account has some advantages such as it has a single figure indicator that is easy to understand and to make comparison among other period in the same area or among other areas. However, this method has some disadvantages such as it only covers natural capital calculation and not suitable for assessing carrying capacity at the local level, especially for assessing carrying capacity of a city. By using this method, carrying capacity of any city would be exceed, since a city is characterized as an area with limited natural capital, especially land resource. Land available in the city is very limited and constant in amount. Moreover, the land in the city is usually used for housing and other buildings for socio-economic purposes and not as biologically productive land. This fact would make the biocapacity of a city is small, while the ecological footprint is very wide in line with its high population and high consumption of resources per capita. By using the EF-BC method, the result of assessing carrying capacity of city would be biased.

Therefore, this paper would discuss and develop a model of land resources carrying capacity for a city by considering not only its natural capital but also other community capitals that are human capital, social capital and built capital. The model developed can be used to assess the land resources carrying capacity in terms of the quantity and of the quality of land resources available in the city. The methodology used in developing the model is the description analysis with a mathematical approach as well as spatial analysis. The model of city's land resources carrying capacity is a functions of all the community capitals. This model would be useful for government to make the planning which focuses on achieving the sustaining city.

Keywords: *Carrying Capacity, Sustaining City, Land Resources.*

Introduction

The environmental problems around the world is accelerating in line with the population growth and the increase of resources consumption per person. In the early 1990s, half of the world's urban population was located in 394 cities, each containing over half a million inhabitant. The population of urban areas is currently growing at 2.4

percent annually, over three times as fast as the 0.7 percent rate for rural areas, affecting over 60 million people are added to urban populations each year. In 1997, United Nation predicted that by the year 2030, 61 percent of the world's population will live in cities and towns and an estimated 90 percent of this increase will occur in cities of developing countries (Leitmann, 1999). At the same time, urban areas are more and more the engines of national and regional economic growth, following their functions as the centre of manufacturing and services. Consequently, the cities become the biggest consumers of resources and generators of waste. This fact brings the important of exploring on how to achieve sustaining cities.

By use of the carrying capacity approach, Wackernagel et al constructed a method to measure the sustainability that is called Ecological Footprint and Biocapacity Account (EF-BC Account). This method has been globally used and became one of the most popular method. However, this method has more appropriate to be used for global and national level, since it assumes that the resources consumed in the region can or must not be imported from outside the region. Meanwhile, according to Graymore, 2005, unlike the global sustainability, small region do not necessarily have to remain within the region's carrying capacity in terms of the resources that are available, since much of what is consumed may be sourced from outside the region. If this idea of ecological footprint and biocapacity method was used for small regions, the fact many of the resources consumed in the region are imported would suggest that the area is not sustainable as the population is living outside its own carrying capacity.

Moreover, if the EF-BC Account was used for a city which is characterized as a small region with a limit of land resources, the result would suggest that all city in the world is not sustainable since the land available in a city is used for non agricultural purposes. The fact, the city has a regional economic function as the centre of manufacturing and services, and there is no other way, so most of resources consumed for the population is imported.

Hence, the main purpose of this research is to develop carrying capacity assessment method that is appropriate and effective as a tool to measure the sustainability of a city. This model will focus on the sustainability of land resources which are quantitatively limited in the city and cannot be imported from the outside region. The model developed would be based on the approach used in EF-BC account that is carrying capacity approach that assesses the demand and the supply of land resources for sustaining the city development.

Firstly, the paper reviews the Ecological Footprint – Biocapacity (EF-BC) Account as the base approach for developing the model. Then, it follows by the review of the city's function and the consequences to the land use pattern in order to understand the characteristics of a city on using the land resources. The methodology used in developing the model is the description analysis with a mathematical approach as well as spatial analysis approach. The mathematical approach will be used especially to assess the quantity aspect, while the spasial analysis approach will be used to identify the quality of the land available.

E F – BC Account as the Method of Carrying Capacity Assessment

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Generally, a city plays economic and social roles as the centre of manufacturing industry, and or of public services. As the centre of manufacturing industry, the linkage between cities and its hinterland is growing mostly related to the production process. As the centre of public services, a city provides the services that facilitate not only for its inhabitant but also the people surroundings. There are three categories of services provided: 1) Consumer Services; 2) Production Services.; 3) Public and Goverment Services.

Though the existences of cities have significant roles for the regional growth even national scale, in fact, cities are not self sustaining. They are usually most use resources inefficiently compared to rural areas. A city is a complex system greatly dependent on outer resources (Figure 3.1.). In order to sustain city's life, it takes air, water, energy, food and other resources and produces wastes as these resources used. Most of these resources is imported from near and distant farmlands, forests, mines, and watersheds. Most of wastes produced is also discharged into or end up in air, water and land outside the boundaries.

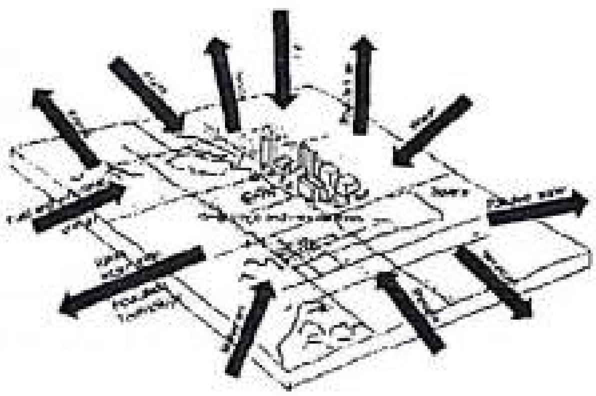

Figure 3.1. Crude model of major inputs and outputs of an urban area
(Source: Miller TJ., 1990)

Though some resources need for city life could be imported to the city, there is only one resource that cannot be imported and is confined within the city boundary. In line with city's population growth, the land available is becoming scarcity. Meanwhile, affecting by the push factors as well the pull factors of a city, the city's population growth cannot stop to increase, then it becomes overcrowded and or expands upward. Then, the environmental problems will arise when the existing population and its activities

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exceed the maximum load that can be supported by ecosystem, in other words, the city carrying capacity has exceeded. Therefore, the land resource carrying capacity is necessary to identify and to use as the base of making city planning decision.

As mentioned before, the land available in a city is usually very limited and relatively finite in quantity. However, the city's life is very dynamic, in all aspects, demographic, social and economy of inhabitants as well development policies, by which they will affect the land use changes. Basically, the availability of land in the city can be divided into two category, protected areas and usable areas. Protected areas include unsuitable areas for development such as sloppy land, flooding areas, etc., and areas that have ecological functions such areas surroundings lake or pond, areas along riverside, areas along coastal line, etc. All the protected areas can not be used for any development purposes. The total protected areas exist in a city is influenced by the physical condition of that city that is constructed naturally depend on the form, structure and condition of the watershed in where that city is located. The hydrological interrelation between a city and the watershed in where that city is located reflects the natural capital of that city.

The real available of land is usable areas that can be divided into existing built areas and un-built areas. The existing built areas comprises the land for all activities purposes such housing, industry, trade, social facilities and public facilities. All building and service facilities existed in a city is the built capital that the city has. The existing pattern of the land uses is influenced by the specific function of a city, the number of population and the social economic level of inhabitant. It means that the need for land per person of a city is reflected by the specific city function (social capital) and the social economic level of inhabitant (human capital).

The un-built area available in a city is the remaining area that can be used for the future development. Simplify, from quantitative aspect side, the land carrying capacity of a city exceeds if the un-built area is not available for any other development. However, the land carrying capacity cannot only be seen from that aspect, it also must be analyzed in term of its quality.

The quality of the protected area is poor when its condition does not function ecologically as it should. Sometimes, that areas are existed in a city, but there are no trees or occupied illegally by some people. In that case, the land carrying capacity of the protected areas can be said as in poor condition. Similarly to that principal, the quality of the usable areas, built and un-built, is poor if their conditions does not reflect comfortable areas for life. The conditions of usable areas can be seen from social economics aspect of inhabitans, the level of crimes, the level of air and water pollution, the crowding index, the availability of public facilities and infrastructures, etc.

Developing the Model

Based on the theoretical reviews, discussed earlier, it can be mentioned that it is needed to develop the land carrying capacity model that is suitable for city environmental characteristics. Systematically, the concept of the model can be seen in Figure 4.1.

Quantitatively, the mathematical function of the land carrying capacity is

$$Y = f(S, D)$$

Where :

- Y = Land Carrying Capacity Status
- S = Supply (Availability) of land which depends on the natural capital and the built capital
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- If S>D = the land carrying capacity *does not exceed*
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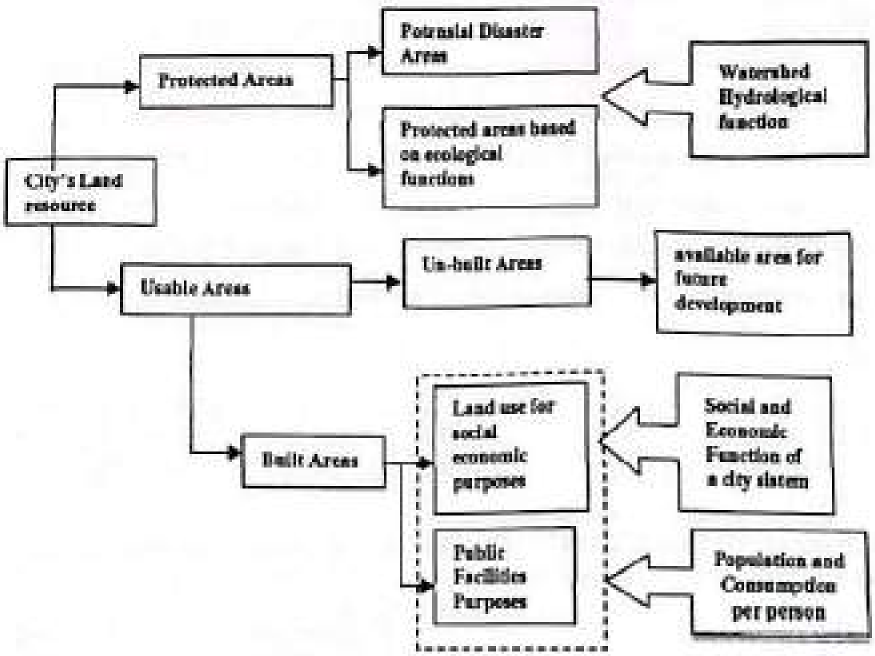

Figure 4.1. Concept of Land Carrying Capacity Model

Meanwhile,

$$S = TA - PA - BA, \text{ and}$$

$$D = HA + SEA + PFA$$

Where:

- TA = Total Area of a city
- PA = Protected Area
- BA = Built Area
- HA = Area needed for the development of housing purpose

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SEA = Area needed for the development which depends on the city function

PFA = Area needed for the development of public facilities purposes

As mentioned earlier, the quality of land available in the city is also needed to be assessed. The assessment of the land quality is needed for identify whether the conditions of area properly supports the functions or not. The method of the land quality assessment is the spatial analysis methods. It is needed to constructs all parameters for each type of land use functions that reflects the adequate standard required to support the functions. After data related to the parameter are collected, they are plotted into a map. This map will show where the area is in poor, moderate or good conditions. If a such of city dominantly has poor areas, it means that in term of land quality, the carrying capacity has exceed. Then, the priority action program of development is not to expand but is to repair and to increase the quality, such as by conducting revitalization, providing more adequate public facilities, etc.

Conclusion

A city has significant roles on the economic and social development of the wider region. The environmental quality of cities must be sustained in such conditions that can optimally support that regional social economic function. That condition can be achieve only if the land carrying capacity of a city does not exceed. In addition, the pattern of land use and the quality of land is appropriate with the function. Hence it can be said that, urban land use decisions are critical determinants of environmental quality.

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by Wisely FALTL

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Developing a Model of City's Land Resources Carrying Capacity

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Abstract

One of the most popular and widely applied method of the environmental carrying capacity assessment is the Ecological Footprint–Biocapacity Account (EF-BC Account). The ecological footprint is defined as the amount of biologically productive land or sea area required to renew the biological resources consumed and to absorb the biological wastes produced, by a given human population or activity. The biocapacity measures the amount of useful biological resource production and waste absorption within a defined geographical area. A such area can be defined as an ecological deficit if the ecological footprint amount is exceed its biocapacity. It means the carrying capacity of this area is exceed.

EF-BC account has some advantages such as it has a single figure indicator that is easy to understand and to make comparison among other period in the same area or among other areas. However, this method has some disadvantages such as it only covers natural capital calculation and not suitable for assessing carrying capacity at the local level, especially for assessing carrying capacity of a city. By using this method, carrying capacity of any city would be exceed, since a city is characterized as an area with limited natural capital, especially land resource. Land available in the city is very limited and constant in amount. Moreover, the land in the city is usually used for housing and other buildings for socio-economic purposes and not as biologically productive land. This fact would make the biocapacity of a city is small, while the ecological footprint is very wide in line with its high population and high consumption of resources per capita. By using the EF-BC method, the result of assessing carrying capacity of city would be biased.

Therefore, this paper would discuss and develop a model of land resources carrying capacity for a city by considering not only its natural capital but also other community capitals that are human capital, social capital and built capital. The model developed can be used to assess the land resources carrying capacity in terms of the quantity and of the quality of land resources available in the city. The methodology used in developing the model is the description analysis with a mathematical approach as well as spatial analysis. The model of city's land resources carrying capacity is a functions of all the community capitals. This model would be useful for government to make the planning which focuses on achieving the sustaining city.

Keywords: Carrying Capacity, Sustaining City, Land Resources.

I. Introduction

The environmental problems around the world is accelerating in line with the population growth and the increase of resources consumption per person. In the early 1990s, half of the world's urban population was located in 394 cities, each containing over half a million inhabitant. The population of urban areas is currently growing at 2.4 percent annually, over three times as fast as the 0.7 percent rate for rural areas, affecting over 60 million people are added to urban populations each year. In 1997, United Nation predicted that by the year 2030, 61 percent of the world's population will live in cities and towns and an estimated 90 percent of this increase will occur in cities of developing countries (Leitmann, 1999). At the same time, urban areas are more and more the engines of national and regional economic growth, following their functions as the centre of manufacturing and services. Consequently, the cities become the biggest consumers of resources and generators of waste. This fact brings the important of exploring on how to achieve sustaining cities.

By use of the carrying capacity approach, Wackernagel et al constructed a method to measure the sustainability that is called Ecological Footprint and Biocapacity Account (EF-BC Account). This method has been globally used and became one of the most popular method. However, this method has more appropriate to be used for global and national level, since it assumes that the resources consumed in the region can or must not be imported from outside the region. Meanwhile, according to Graymore, 2005, unlike the global sustainability, small region do not necessarily have to remain within the region's carrying capacity in terms of the resources that are available, since much of what is consumed may be sourced from outside the region. If this idea of ecological footprint and biocapacity method was used for small regions, the fact many of the resources consumed in the region are imported would suggest that the area is not sustainable as the population is living outside its own carrying capacity.

Moreover, if the EF-BC Account was used for a city which is characterized as a small region with a limit of land resources, the result would suggest that all city in the world is not sustainable since the land available in a city is used for non agricultural purposes. The fact, the city has a regional economic function as the centre of manufacturing and services, and there is no other way, so most of resources consumed for the population is imported.

Hence, the main purpose of this research is to develop carrying capacity assessment method that is appropriate and effective as a tool to measure the sustainability of a city. This model will focus on the sustainability of land resources which are quantitatively limited in the city and cannot be imported from the outside region. The model developed would be based on the approach used in EF-BC account that is carrying capacity approach that assesses the demand and the supply of land resources for sustaining the city development.

Firstly, the paper reviews the Ecological Footprint – Biocapacity (EF-BC) Account as the base approach for developing the model. Then, it follows by the review of the city's function and the consequences to the land use pattern in order to understand the characteristics of a city on using the land resources. The methodology used in developing the model is the description analysis with a mathematical approach as well as spatial analysis approach. The mathematical approach will be used especially to assess the quantity aspect, while the spasial analysis approach will be used to identify the quality of the land available.

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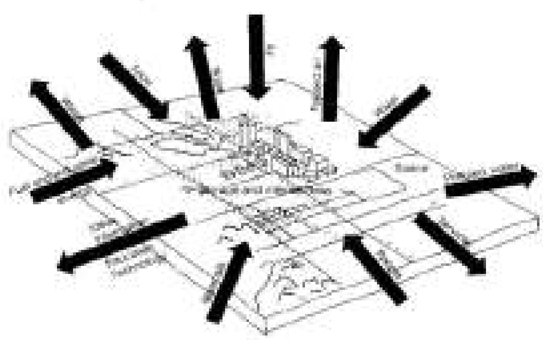

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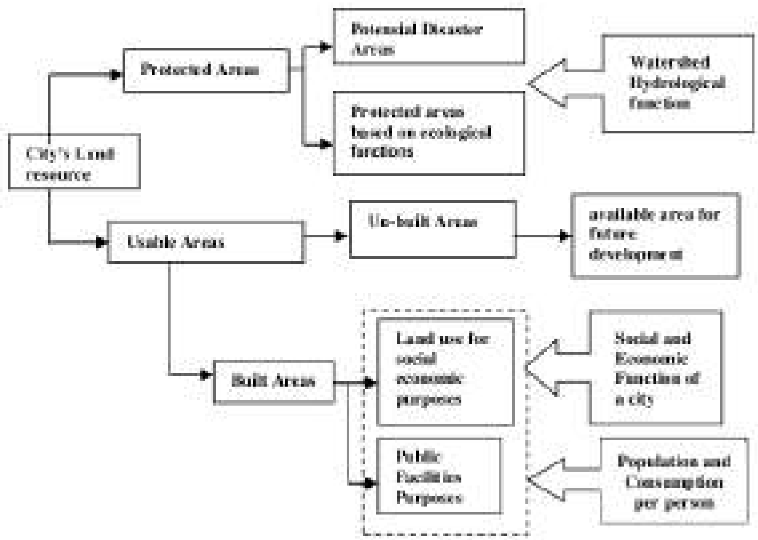

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