

CRITICIZING THE CONVENTIONAL PARADIGM OF URBAN DRAINAGE

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Introduction

Water is a vital needs for human beings. The human daily needs for water is very much, such as for drinking, bathing, washing and other activities. Not surprisingly, then appears a term that equated water with gold. The term is blue gold. However, water is often regarded as resource that will not be exhausted due to a recurring cycle, so the human desire to maintain water quantity, quality and distribution in both space and time are still very low.

The Issue of World Water Crisis

Water crisis is one of the most popular issue in this century. This is related to the fact that in the 1990's there were 300 million people around the world have difficulty in accessing clean water. In addition, some studies indicate that the water crisis is predicted will be occurred in 2050 which led 2 / 3 of world population will have

difficulty in accessing clean water (Pawitan, 2002). FAO in *Food Production: The Critical Role of Water*, which is published in 1996 categorizes Indonesia into countries which are not vulnerable to the water crisis. However, in 2002, research from Hidayat Pawitan from Bogor Agricultural University (IPB) mentioned that 15 counties and cities in Indonesia have water crisis problem, while more than 50 counties and cities in Indonesia are categorized as regions that guard against water crisis. One of those counties and cities is Yogyakarta.

Some factors that caused water crisis are increase of demand for water, increase of polluted water, and decrease of sources of water because of disruption of the hydrological cycle. The increase of water demand caused by population growth and increase in the number of industry that use water and increase in the number of human activities that use water. Water pollution especially in urban area was caused by industrial waste and household waste. While the disruption of the hydrological cycle can caused by less water percolate into the soil so the water flows directly into the river.

Development of Urban Population and its Impact to Urban Environment

Population growth is strongly associated with the needs of resources such as water and land. Population growth will cause land settlement become larger it can replace another landuse. This causes the city become more dense and more space to absorb water is lost.

Table 1. Population Density in Some *Kelurahan* in Yogyakarta and Surrounding in 1990 and 2000

Category of Population Density (people/km ²)	Yogyakarta (45 <i>kelurahan</i>)		Urban Fringe Area (14 <i>kelurahan</i>)		Rural (379 <i>kelurahan</i>)	
	1990	2000	1990	2000	1990	2000
<500	0	0	0	0	87	80
501-1,000	0	0	0	0	140	140
1,001-1,500	0	0	0	0	87	80
1,501-2,000	0	0	4	0	42	45
>2,000	45	45	10	14	23	34
Total	45	45	14	14	379	100

Source: Kirono, 2005

Table 2. Population Growth Some *Kelurahan* in Yogyakarta and Surrounding

Category of Population Growth	Yogyakarta (45 <i>kelurahan</i>)	Urban Fringe Area	Rural (379 <i>kelurahan</i>) (14 <i>kelurahan</i>)
<i>Low</i>	1	0	42
<i>Medium</i>	42	14	334
<i>High</i>	2	0	4
Total	45	100	100

Source: Kirono, 2005

Soerjani, et al (2008) mentioned that the needs of the population to the water related with four issues, those are the increase of population which means that water needs become increased, increased need for food, increased industrialization and protection of ecosystems to technology. Water crisis problems occurred because of human water needs are increasing rapidly, while the amount of water is almost always same due to the cycle. the temporal distribution of water has been changed due to disruption of the hydrological cycle, this will cause water in the rainy season is available in large amount, but in the dry season there is a shortage of water.

Development of the Cities and Hydrological Cycle

The development of the city is identical with the change in land cover/land use in the earth's surface which are dynamic and constantly. Developments that occurred in urban areas of Yogyakarta caused changes in land use from agricultural land (non-built land) into built land, such as settlement and industrial land. Rapid population growth and high levels of urbanisation consequences also on changes in cover / land use in the suburbs. This larger land use change will have an impact on the degradation of environmental quality, including water quality degradation.

Yogyakarta region experiencing the most rapid expansion of urban properties to the north and the west, (see Figure 1.3). Suryantoro (2002) states that the most common land use conversion in Yogyakarta from 1959 are decrease of agricultural land (10.24 ha / yr) and increase in settlement area (7.75 ha / yr) (see Table 1.1). *Urban sprawl* in Yogyakarta city rose 135.05 ha / yr (1970-1987) and 225.09 ha / yr (1987-1996). Significant land use conversion causes

changes in the land cover and the ability of the earth's surface to absorb water as groundwater affix.

This condition is also exacerbated by the increasing population in Yogyakarta. The function of the city extends to the suburbs and causing suburban densities become higher. Populations in Yogyakarta has been solid and the only available bit of space. This leads to the increasing of population density in suburbs, where in 1990 there were only 10 *kelurahan* in urban fringe areas have population density more than 2000 jiwa/km² but in 2000, that number had increased to 14 *kelurahan* or whole of the urban fringe areas. (See Tables 1.2 and 1.3).

Tabel 3. Land Use Changes in Some Area in Yogyakarta (Ha)

Land Use	1959	1972	1987	1996
Settlement	1836,87	1922,43	2064,02	2123,61
Commerical	107,62	139,74	176,22	200,63
Services	110,39	137,87	165,59	191,42
Transportation	255,74	267,79	289,88	302,64
Culture	43,47	42,44	43,76	44,66
Sport	20,16	19,47	21,89	24,22
Religious Center	15,99	18,1	23,52	25,82
Agriculture	641,27	538,57	366,97	262,53
Other	216,51	161,61	96,18	72,54

Source : (Suryantoro, 2002).

Tabel 4. The Large of Each Type of Land Use in Yogyakarta Based on The Interpretation of Satellite Imagery Quickbird (Recording Year 2007)

No	Type of Land Use	Large (m ²)
1	Settlement	28221245,14
2	Office	48013,80
3	Shops and service	540971,27
4	Transportation terminal (bus, train, plane)	279054,70
5	Education	21752,68
6	Health service (hospital, puskesmas)	142244,25
7	Universities	167637,62
8	Tourism (museum, zoo, <i>Alun-Alun</i>)	610269,59
9	Traditional market	121558,34
10	Mall	27212,01
11	Industry	272518,42
12	Field	38217,16
13	Green area	1365290,85
14	Rice field	1116107,93

The increase of settlements and decrease in agricultural land or seepage locations will cause the water to percolate become less. This will trigger a decline in the face of groundwater which can lead to subsidence. In addition, the water will flow immediately to the river so the amount of water that can be stored and can be used in the dry season will be less.

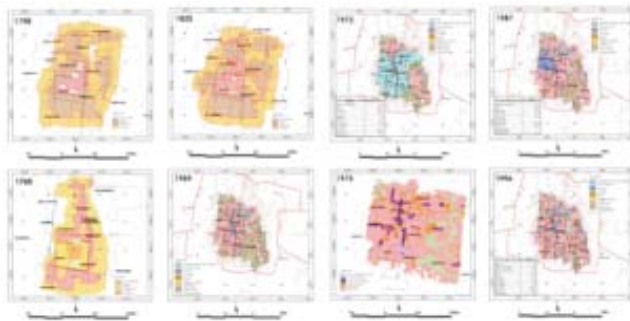


Figure 1. Land Use Changes in Yogyakarta
(Suryantoro, 2002)

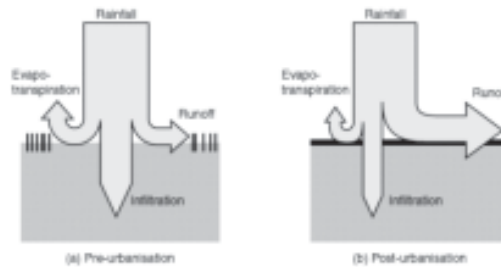


Figure 2. The Impact of Urbanisation to Hidrological Cycle
(Butler and Davies, 2011)

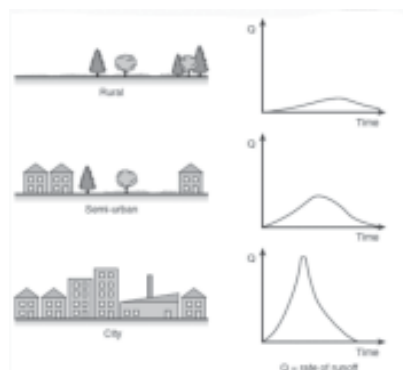


Figure 3. Effect of Urbanisation on Peak Rate of Runoff
(Butler and Davies, 2011)

That condition is aggravated by the presence of conventional drainage. Conventional drainage paradigm defines drainage as a channel which is able to drain the water in someplace immediately. This means that less possibility of water can seep into the soil, and the water flow toward the river become faster, so the peak rate of runoff will be higher. In a large watershed with urban areas in the middle or upstream (eg watershed Solo), it may causes flood in downstream area.

Environmental Friendly Drainage: A Wisdom in the Land of Permanent Rain

At least there are two things that distinguish environmental friendly drainage with conventional drainage. The first is the urban drainage should be separated between the drainage to drain the rain water and drainage to drain wastewater. Secondly, that the drainage of rain water should be able to provide the greatest opportunity for water to percolate into the soil, while the drainage for the wastewater should be connected to the wastewater treatment plant.

Infiltration of water in the rain water drainage can be made by designing drainage to be able to absorb water such as giving the holes are connected to the soil, infiltration wells or city lakes before flowing into the river. The making of city lakes is often regarded require a large space so designing the drainage which can absorb rain water during its flowing in it is one thing that is more possible to be done.

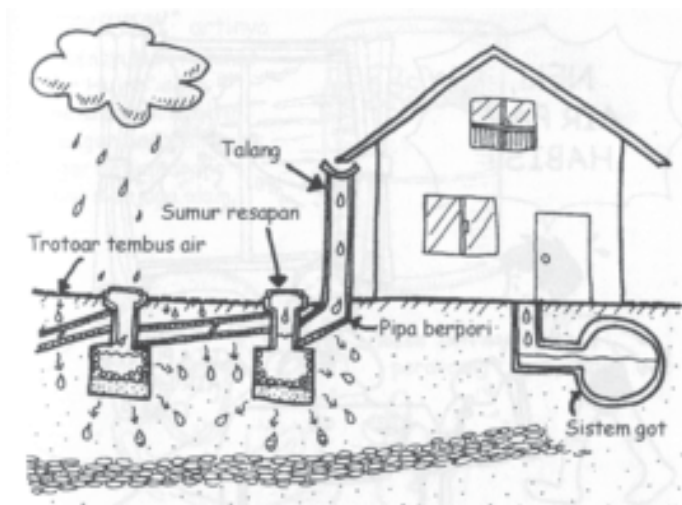


Figure 4. One Design of Separation of Rain Water and Wastewater

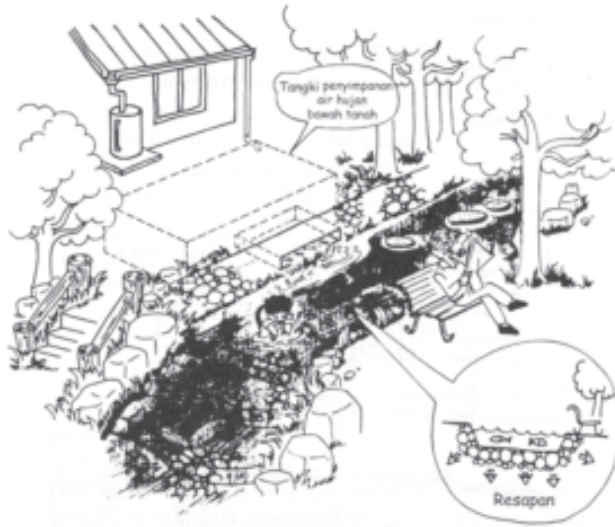


Figure 5. Environmental Friendly Drainase which Able to Absrob the Water

Bibliography

- Butler, David and Davies, John W. 2011. *Urban Drainage*. Third Edition. New York: Taylor and Francis Group.
- FAO. 1996. *Food Production: The Critical Role of Water*. Technical Background Document World Food Summit. Roma, Italia.
- Kirono, Dewi Galuh, C. Sudarmadji, Giyarsih, Sri Rum, Nurjani, Emilya. 2005. "SURF: A Study of Urban influence on Rainfall in Yogyakarta City of Indonesia." *Research Project Report*. USA: START-International Secretariat and Packard Foundation. USA.
- Pawitan, Hidayat. 2002. "Mengantisipasi Krisis Air di Indonesia Memasuki Abad 21." Dalam Nugroho, Sutopo Purwo; Adi, Seno dan Setiadi, Bambang (eds). *Peluang dan Tantangan Pengelolaan Sumberdaya Air di indonesia*. Jakarta: BBPT dan Hanns Seidel Foundation (HSF).
- Soerjani, Mohammad; Ahmad, Rofiq; dan Munir, Rozy. 2008. "Lingkungan: Sumberdaya Alam dan Kependudukan Dalam Pembangunan." Jakarta: Penerbit Universitas Indonesia.
- Suryantoro, A., 2002. "Perubahan Penggunaan Lahan Kota Yogyakarta Tahun 1959-1996 dengan Menggunakan Foto Udara. Kajian Utama Perubahan Luas, Jenis Frekuensi dan Kecepatan Perubahan Penggunaan Lahan." *Disertasi*. Yogyakarta: Universitas Gdjah Mada.

