ECOHYDROLOGY
ASIA - PACIFIC
REGION

Proceedings of
Asia-Pacific Workshop
on Ecohydrology,
Indonesia, 2001

# TRANSFORMATION OF 'TRADITIONAL' WATER USE TO CONJUNCTIVE MANAGEMENT, A NEED FOR SUSTAINABLE DECENTRALIZATION PRACTICE

**P.E. Hehanussa**
Indonesian Institute of Sciences
Cibinong 16911, Indonesia
phnussa@indosat.net.id

## ABSTRACT

*The importance of water sector as an engine of national economic development was well understood since late 1960's. A major milestone was achieved in 1983 i.e. the self support of rice production, an activity that consumed 78% of the national water supply. Unfortunately this was not a sustainable success. Environmental problems are soil toxicification, groundwater drop, increasing rice pests, water pollution, and salination to the fertile soil are increasing. The social and economic effects are the widening gap between rich and poor, between head and tail enders in irrigation systems, and between farmers and money lenders and middlemen. A possible strategic change to divert this trend is a better practice of ecohydrology.*

*This could be done through changes in bureaucratic perception from looking into water as a limitless resource into considering water as part of the ecosystem. To implement changes, consider the water use in Indonesia that has evolved through several parallel transformations. From traditional use where water is considered free and limitless into water that has a social and economic value; from purely exploitation practices into sustainability; from water into water resources; from water supply as a project into water for people; from differentiated authorities of surface, groundwater, and rain water into a conjunctive management; from a centralized governance into a decentralization.*

*Economic valuation of water may increase water use efficiency although water pricing for most people (farmers) are not easy in the implementation; water exploitation in the past are the result of poor coordination between departments and sectors; project oriented of water supply has its root in the centralized bureaucratic planning and imple-*

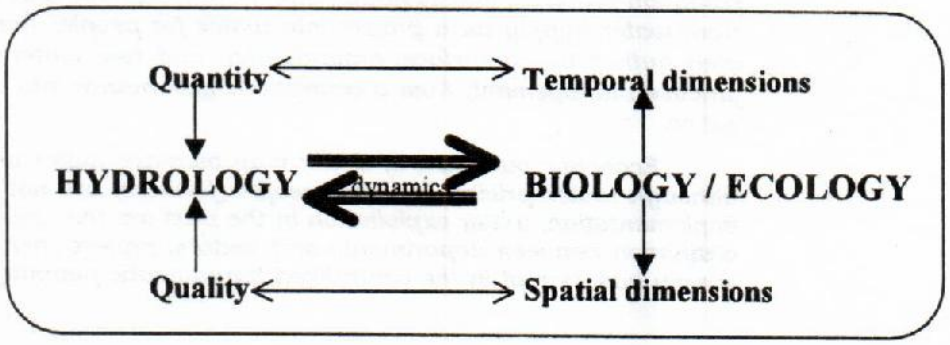
*mentation; conjunctive management is absolute in areas where water use has exceed 25% of the water availability. Decentralization should be interpreted as having a multiple meaning, not only in the governance sector as stated in the law UU No.22/ 1999 but also in the changing role of government from provider to enabler, in participation of stakeholders and NGO's, as well as farmers, forestry, fisheries, health sector, plantation associations, and participation of the larger community in the water planning and management.*

**Key words:** water use; conjunctive management; decentralisation

## 1. INTRODUCTION

The earth was considered as the blue planet, the human body consist of over 70% of water, such that water has been considered as 'the first resource'. The World Bank predicted that over the next 40 years, every year 90 million people will be added to the world population. The world population will grow from 6-billion today to 8-billion in 2030 to 10-billion in 2050. Availability of clean water, more food, and new urban areas will increase ecological stresses to the environment, other than problems such as additional pollution, health problems and spread of water borne diseases, landuse changes, and decreasing forest cover. To face and unite initiatives for solutions to these huge problems UNESCO has lately decided to declare the year 2003 as the year of clean water.

The changing trend between humanity and its environment is influenced by how people understood their (fragile) relation to the ecosystem. Out from complications of these problems, ecohydrology has grown into a new branch of knowledge that has fused several disciplines into a more comprehensive and interrelated science to build a better base for understanding to manage our resources. Ecohydrology is the science that deals with hydrological processes and its inter-relation to the dynamics of biology (ecology) in spatial and temporal dimensions.



The potential role of ecohrdrology in future planning and better management practice of decentralization in Indonesia which became law since 1st of January 2001 will be shortly discussed. An enrichment of decentralization meaning other then what was currently understood from the law No.22/1999 will be discussed. This paper discuss in broad terms how the environment react with antropogenic changes induced by human activities and how can we try to better conserve our environment and its sustainability.

## 2. TRADITIONAL PRACTICES

The Indonesian regions can be divided into three 'wetness' regions based on the discrepancy between monthly precipitation and evaporation rates. Two regions that cover the major part of Indonesia are 'wet' or surplus with precipitation ranging between 1800 to 6000 mm/year. The third region has a much smaller area consisting of Nusa Tenggara, the southern part of Irian Jaya, and a narrow coastal area in the northern coast of Jawa that has low monthly precipitation surplus compared to evaporation. Most of the Indonesian population occupy the wet regions where surplus of precipitation or water availability are in the mind of people, the perception that water is limitless if not plenty. This background condition does not left any stress to the mind people on a need for the planning of water management.

Three decades of economic developments during the last century has brought significant changes. Surrounding the 'growth centers' especially in Jawa island are new urban areas that has grown to such a large size that the average per capita availability of water has gone far below the national average. Several figures on the water availability based on provincial figures are : the Jakarta metropolitan that has an area of 578 $km^2$ and 12 million population can provide only 55 $m^3$/person/year, Yogjakarta province has only 1022 m3/person/year, and East Jawa can provide 1460 $m^3$/person/year. These figures are very low compared to national level. The second group of low per capita water availability are Central Jawa and Bali province that can provide only 2008 $m^3$/person/year and West Jawa province with 2337 $m^3$/person/year. The other 26 provinces (Indonesia consist of 32 provinces) have a water availability that exceed 4000 $m^3$/person/year. Irian Jaya has a low population but large area so that it has a surplus with a water availability of over 54000 $m^3$/person/year, see table 1.

Traditional water sources in the urban areas and villages in Indonesia are direct from rivers, spring, seepage, dug well, rain water harvesting, artesian water, caves, and galleries. At the break in slopes of the many volcanoes of the Indonesian archipelago are rich areas with clusters of springs. At uplifted coral reef islands in east Indonesia it is common to extract water

Table 1. Water availability in 26 provinces of Indonesia.

| PROVINCE | Water availability *m3/person/year* | PROVINCE | Water availability *m3/person/year* |
|---|---|---|---|
| DKI Jakarta | 55 | West Sumatera | 23 741 |
| DIY Yogyakarta | 1 023 | South Sumatera | 24 106 |
| East Jawa | 1 461 | Aceh | 25 933 |
| Central Jawa | 2 008 | Southeast Sulawesi | 28 124 |
| Bali | 2 008 | Jambi | 38 351 |
| West Jawa | 2 337 | Riau | 39 812 |
| West Nusa Tngra | 4 018 | Bengkulu | 43 830 |
| Lampung | 7 620 | Central Sulawesi | 48 943 |
| North Sumatera | 10 592 | Maluku | 57 344 |
| South Sulawesi | 12 783 | West Kalimantan | 101 904 |
| North Sulawesi | 15 706 | East Kalimantan | 175 685 |
| South Kalimantan | 18 993 | Central Kalimantan | 222 802 |
| | | Irian Jaya | 543 492 |

Source: Dept. of Public Works, 1991

from dugged galleries and from caves located at the boundary between the underlying impermeable rock and the overlying limestone. In many small islands it is also common practice that women used small canoes to transport water between islands. In the coastal areas of the smaller islands it is common practice to tap (ground)water that emerged after the first hour of change between high to low tide. Dry coastal areas has practiced rainwater tapping from the roof with simple can or plastic bucket or some community has build ferrocement containers.

Traditional knowledge used in agriculture practice has wisdom that sometimes are forgotten and considered 'not modern'. The 'subak' in Bali is a system of water supply consisting of canals, drains, and distribution gates that is managed by honest religious leaders and head of the village. The amount of water is distributed based need as discussed in village meetings. People of Bali treat water especially the springs as a sacred resource in their practice of religion. This tradition has a strong root to the people life and has been practiced until now. In the Toraja region in central Sulawesi there is a traditional relation between planting a certain rice species in their agriculture practice. The fat water buffaloes plows the sawah and their deep feet penetration into the mud are natural tubes for the nitrogen to enrich the soil. During rice plantation water level in the field is high so that fish can grow in the rice field. They use only green fertilizer, the fish consume the pest that attack the rice stem and eat the growing young grass

sprout. In Jawa island it was called mina padi. This mutual symbiosis is good for nature including people who benefit from the tradition.

Traditional wisdom in scarce water availability areas used water from dug wells that is regulated by tradition. There are regions such as in Nusalaut island where water from a village dug well can be used only until a certain quantity and for a certain utilization. The head of the village or bapa raja determine this limit and is obeyed by the people. There are also regions such as in Banda islands where water from a dug well may be used only at a restricted period which is just after maximum high tide and two hours before the low tide. These water use practice although considered as a taboo or sacred by the people but has its wisdom in the natural cycle of the water cycle.

A good example of ecohydrology practice is the so called 'shifting cultivation' agriculture in Kalimantan and Sumatera islands. This is a wise traditional interaction between people and forest. The food need for a family are cultivated from a piece of land in the forest area that is utilized for about two years. They will then prepare another piece of land by clearing and burning them from shrubs and small trees for the next year. The selection of slope of a piece of land, the time of cutting down, and wind direction during burning is considered based on 'tradition'. With a rotation period of 15 to 20 years before coming back to the location this has create harmony between people and the forest. Three decades ago they introduce the mega-deforestration companies that scoop multi-million dollars of log-wood from the Indonesian forest pushed away this traditional shifting cultivation practice and forced them to shorten their cycle to less then seven years. This shorter 'rest' for the forest ecosystem has damaged the soil profile and water infiltration capacity that was pointed as the scape goat for environmental degradation in the area.

## 3. WATER AND RELATED POLICIES

Water availability in a region has sometimes been misunderstood, even by those who has received high education levels. As an example, in a high level national meeting a governor proudly announced that his province will never suffer water shortage, he claimed that they are ready to export water to Singapore. It turn out that the figures he used was that all the water, 100% of all water availability in the province is for the use by the population. This is a misinterpretation that has repeatedly occurred because people has put themselves at the center and the ecosystem that support human life has been put aside or even away. Normally not more than 25% of water availability in an area can be used for human needs and the rest is to support the ecosystem needs for its sustainability. The ecosystem means the environment that support human life a/o. the forest, the soil moisture, the trees, fish, grass, birds, animals, the fruits, flowers, rice, the microclimate, the lakes, the rivers, the wetland, etc. A diversion of these figures

may be the arid regions of the world that used up to 50% of its water availability, but then the ecosystem support to life has incomparable balance to the more humid areas.

The 'rice sustainability' was a success story repeatedly told by representatives of department of public work in the early 1980 to mid 1990's. The government policy for rice sustainability has been interpreted by the implementing departments in a narrow meaning of just provide more water, a program that has neglected long term social and environmental factors. To support the program greater attention was given to build new irrigation structures that is heavily based on loan. It turn out that many of the structures has low O&M funding and need repair even in its very early stage after construction that has absorb more funding. From the above experiences it was learned that sustainability by the government at that time has been meant as only for the rice consumers but has neglected the farmers and the environment

The framework of the system is government will provide irrigation, type of rice to be planted, timing of plantation, subsidize fertilizer and pesticide. To support the system are national programs such as inmas (intensifikasi massal), bimas (bimbingan massal), and insus (intensifikasi khusus). The farmers has not much choice and was not asked to take part or reject the program. From quantitative figures it is true that rice production per hectare has increased, but a second question is whether the income of farmers has also increased and what are the impacts to the environment. At the end the farmers has a great burden to pay for the pesticide and fertilizer, then given credit, that many times they can not pay back. It also turn out that during planning stage, water was not considered (by the engineers) as part of a hydrologic cycle or the ecosystem. The resulting non point source pollution that intensify, soil toxicity that increased, and various biotic degradation that occurred were blamed to the farmers. From the above experience it can be concluded that ecohydrology could become an alternative way to come out with better bases for management practices.

## 4. DECENTRALIZATION AND WATER RELATED ISSUES

Decentralization is a major change in the governance style in Indonesia. As stated in law No.22/1999 there is a shift from a centralized government into (kabupaten) district level. Surface water in the past was managed centrally by the department of Public Works, groundwater by the department of mining and energy, and climatic observation by the department of transportation. With the new law they all goes to the kabupaten level which is a major change that need good coordination with activities related to forestry, agriculture, fisheries, and health. From the ecohydrological point of view the concern is the interpretation of these changes, how do we do plan not damage our environment more.

The point of departure for discussions is that the boundaries of regions kabupaten and province are not similar to ecosystem boundaries. For water resources management it has been agreed that 'a water management unit are the river basin (there are about 6000 in Indonesia) or an island in the case of islands that has an area of less than 2000 km$^2$'. From this point of departure we observed that not many boundaries in regions are identical to river unit boundaries. There are lakes with kabupaten boundaries or even provincial boundaries that lies in the lake water. Rivers flow cross kabupaten regions as well as through provincial areas. The Gunung Salak UNOCAL geothermal field although located in the province of West Jawa but its ecological position is at the water devide that let water flows into the Jawa sea in the north and the Indian Ocean in the south. Such diverse composition and utilization need coordination between the upper level (the forests) that provide water and the lower end (cities) that use the water. The mining companies may face even more complications because the ore/oil/mineral rich has nothing to do with regional boundaries as well as ecological boundaries.

These complications can be solved when we decide to use a similar base of departure. Coordination through the national and regional committee is one way. It has also been accepted that there is a major change in the role of government that shift from provider in the past to enabler in the future. This means that the stakeholder with any activity related to water including the mining companies will need more access to the governance. Parallel to this shift is another major change in the concept of water from a social good that is free to have for all as stated in the constitution into a social that has an economic value which mean that there is a price to pay for providing water to a certain place, at a certain quantity, a certain quality, and at a certain time.

## 5. PROPOSED (NEW) WATER LAW

The present law on water management is law No.11/1967. In the 1960's at the time of making this law, water problems are different than what is now faced. Population growth was the initial factor that quickly deteriorated the water availability, to supply more water for people and for food production together with unawareness of the delicate relation between water supply and the environment. They are based on the assumption that water is limitless that has created a false basic vision in the water management, as just exploitation. Another factor is the differentiation in management authority between surface water and groundwater. These has its root in the constitution that was misinterpreted as stating that water is a social good that should benefit all people.

Since mid 2000 there are measures taken by the national planning agency to prepare a new water law. There were optimism that this new law will be determined by the parliament to become law in 2001. The basic

ideas that underlie the proposed law are: build a better coordination, a balance between physical and non-physical developments, a balanced exploitation and conservation; with having in mind of problems such as decentralization, sustainability, democratization, and globalization. In this proposed new law the role of stakeholders (people) are increased, a clear differentiation between central and regional government, a shift of water function from social to a social and an economic value, from exploitation into conservation, and the role of government from provider to enabler. One way of bridging these problems is need of the creation of a national water board, a provincial and a regional water board. Members of the board consist of government officials, stakeholders, NGO's, and from the university and research institutions.

In future decentralization practice, one major change in 'style' that should be firstly put into consideration is the difference between provincial and regional boundaries with the water management boundaries. Water management boundaries are river basins, or islands in the case that the size of the island is less than 2000 km2. Rivers, lakes, and swamps that is flows or located in one region is not a problem. Water bodies that cross two regions will be managed under the policy supervision of the provincial water board but implemented by each region. A water body crossing provinces will have its policy guidance from the national water board but implemented by each province. Water bodies that cross national boundaries will be managed by the central government. Another major change is that water resources should be managed by the region and province from upstream to downstream problems, from the conservation to exploitation, problems related to pollution minimization and technology inputs for more efficient water use.

## 6. ECOHYDROLOGY, A POTENTIAL ANSWER?

Decentralization is the shift of (most) governance authority from the central government to the head of the region or kabupaten and the DPRD. This shift bring along consequences two of them are: first, problems identification and problem solving are at the regional level; and second coordination between offices or dinas that are expected to run better because they are located 'under one roof'. With this background the issue of a sustainable water supply when handled under the umbrella of ecohydrology will become an easier job. To implement this the principles and better understanding of ecohydrology should be disseminated between regional government employees. Second are the stakeholders and people that are the actor in implementations of the program.

Another shift of approach is the identification of problems to be solved. Issues such as flood and drought are not 'real' problems, they do occur and are very natural, they should not be fight against, but has to be worked together. Flood control mean to plan

the area surrounding rivers to have minimum damage during floods. Water shortage is fight against by having a better zonation in spatial planning such that pollution to the existing water supply can be minimized or by bringing in technology that use less water. Areas that has less water should not be pushed to plant rice that is famous to consume huge amounts of water (3500 liter to produce one liter rice). Forest fires that occur in the low land areas is an issue that is related to the change in the hydrologic cycle. The root of the tropical forest are such that they have developed a horizontal architecture. Forest clearing in the upper highland in the past has caused significant change in the water budget that cause groundwater drop in the lowland which is a sound condition to start forest fires.

From the above discussions it can be concluded that sustainability of water resources in the decentralization era could be better secured through the practice of ecohydrology. This 'new' approach have amalgamated water exploitation and conservation into one package that is more reliable to guarantee sustainability of developments. Using this approach the upper and the lower reach, between a secure supply and its exploitation, between human and environment, drought and flood control, pollution minimization, recycle and reuse, technology with less pollution are managed under one policy. This will bridge the sectoral approach that in the past has proved less sustainable.

UNESCO act as facilitator through a framework of exchange with similar scientific and technological background that organized meetings, seminars, training, discussion, exchange of experiences, and other activities to increase personal and institutional capabilities. It is the task of the National Committee for IHP that is run by LIPI to facilitate this program, act as a bridge between the institutions, the country, the region, and the world.

## LIST OF REFERENCES

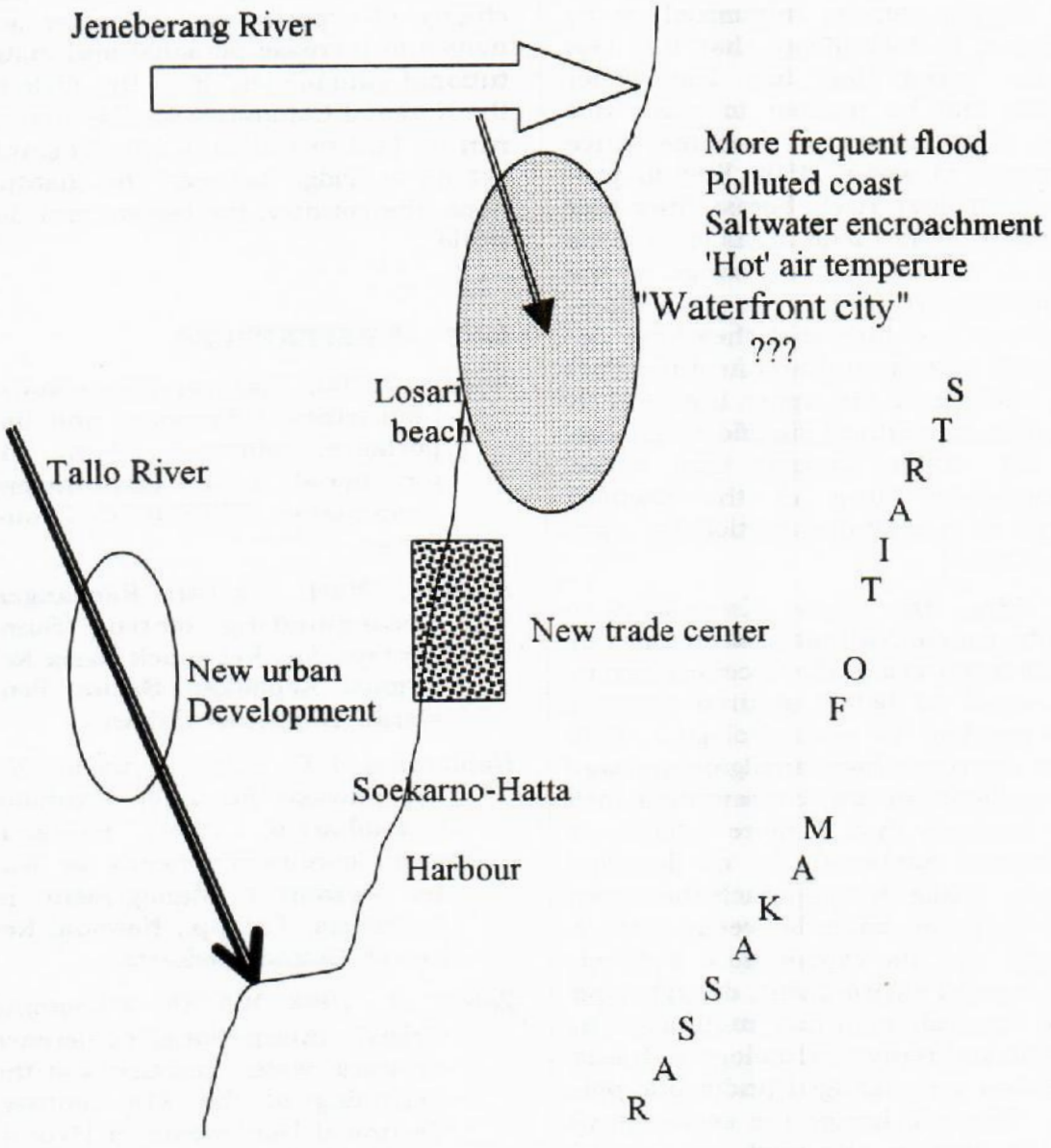
Anonim, 2000, Lakes and Reservoirs, Similarities, Differences and Importance, Volume 1, 24 pp., International Lake Environment Commission, UNEP-IETC, Kyoto, Japan.

Anonim, 2001, Naskah Rancangan Undang-undang tentang Sumberdaya Air, Kelompok Kerja Reformasi Kebijakan Sektor Pengairan, Bappenas, Jakarta.

Hehanussa, P.E., R.M.Tejoyuwono N., Sri Suwasti Susanto, Mardjono Notodihardjo, 1994, Research and Coordination Needs for Water Resources Management in Indonesia, 121 pp., National Research Council, Jakarta.

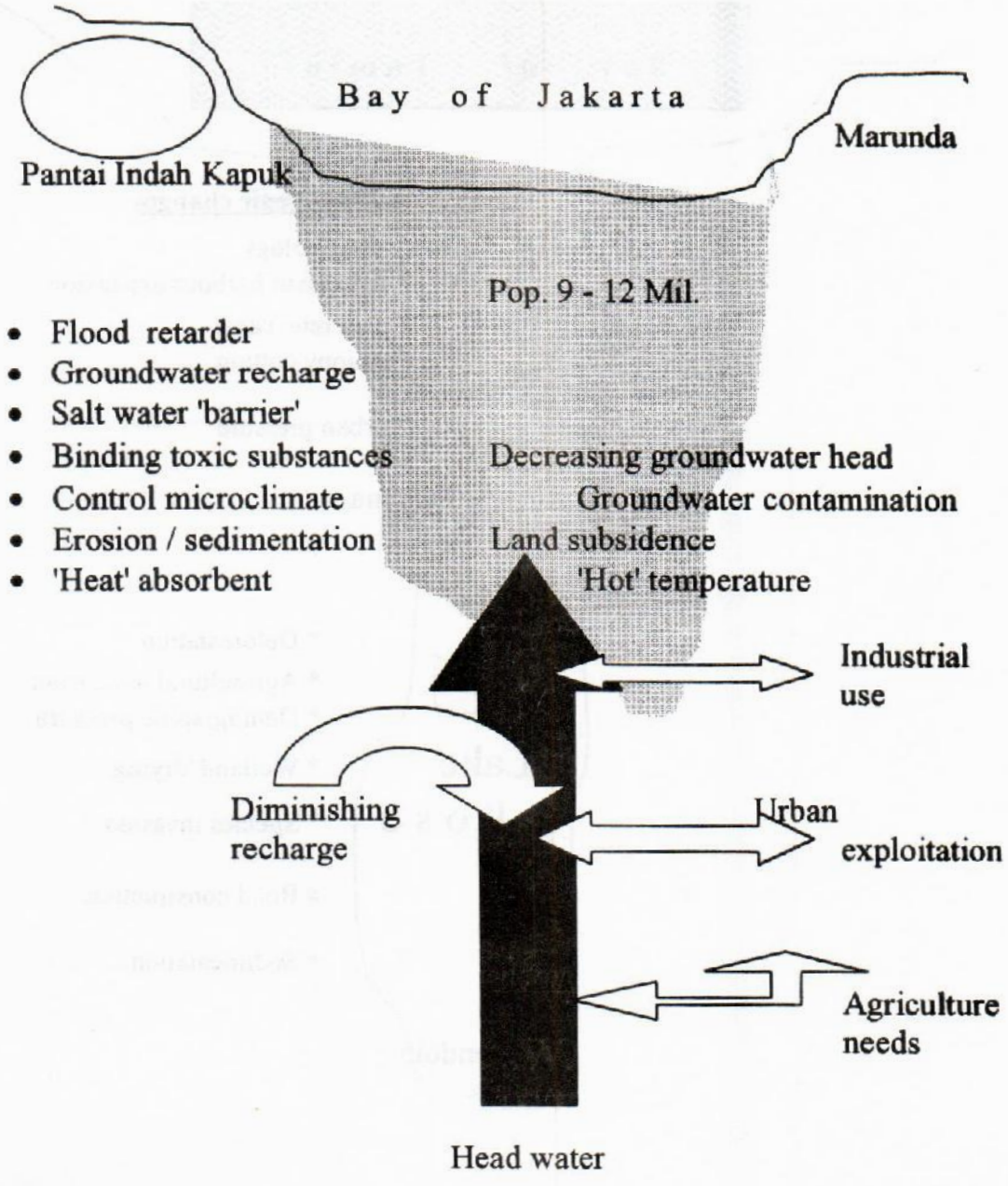
Zebidi, H., 1998, WATER: a Looming Crisis?, International conference on world water resources at the beginning of the 21st century, Technical Documents in Hydrology No.18, Paris.

# ECOHYDROLOGY OF LAND-HUNGER CITY OF MAKASSAR (SOUTH SULAWESI)

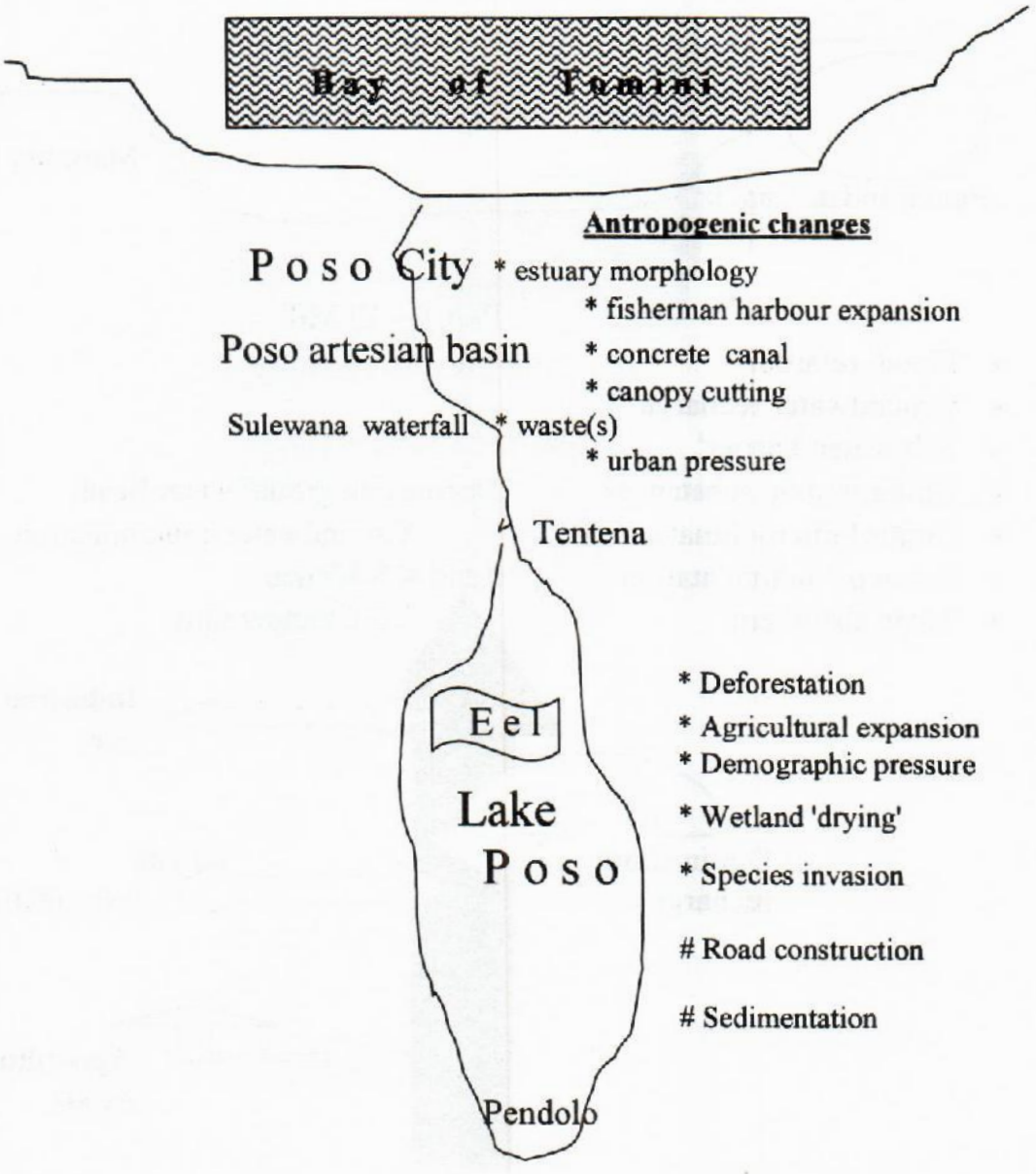



Miss-interpretation of the concept "waterfront city"

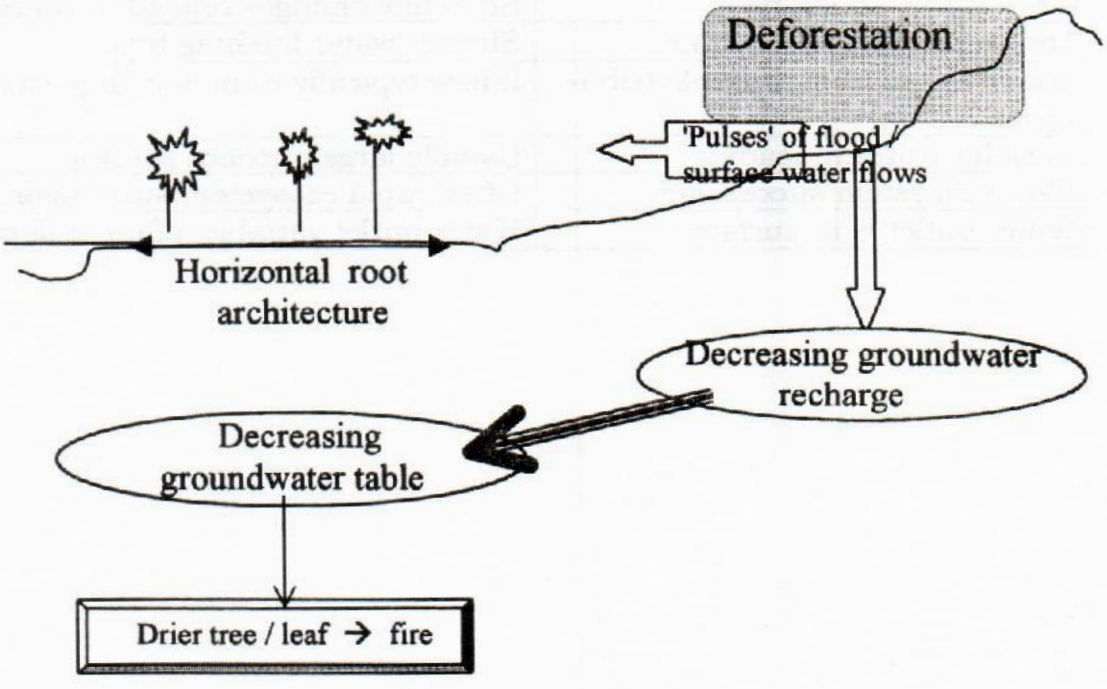
# ANTROPOGENIC WATER CYCLE OF JAKARTA METROPOLITAN



# THE CHANGING ECOHYDROLOGY OF POSO ESTUARY (CENTRAL SULAWESI)



# FOREST FIRES (CENTRAL KALIMANTAN) AN ECOHYDROLOGY HYPOTHESIS



## GENERAL CHARACTERISTICS OF LAKES & RESERVOIRS

| **LAKES** | **RESERVOIRS** |
|---|---|
| Generally located in remote areas | Build near urban/agriculture areas |
| Catchment : surface area < 10 : 1 | Catchment : surface area > 10 : 1 |
| Generally circular water basin | Elongated & dendritic |
| More stable shoreline | Shoreline changes related to volume |
| Longer water flushing time | Shorter water flushing time |
| Water inflow from multiple tributaries | Inflow typically from one large river |
| Variable nutrient loading | Usually large nutrient loading |
| Slow ecosystem succession | Often rapid ecosystem succession |
| Water outlet is at surface | Water outlet variable, often at depth |