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Impact of Land Development on Water Quantity and Water Quality in Peninsular Malaysia

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ABSTRACT

The steady population growth in Malaysia has been responsible for the usage of relatively large volumes of water. Even though water quality has begun to attain some prominence, its relation to water quantity and to water system operation has been largely overlooked. Human activities frequently challenge the quantity and quality of water in Malaysian water resources. These include activities that use river water directly - such as irrigation and land-based activities that generate nutrients and pollutants, while also changing the runoff patterns of their catchments. A growing population with growing expectations places increasing pressure on our water resources, stretching their ability in maintaining the standards of water quantity and quality.

Key words: population growth, human activities, water resources, water quantity, water quality, Peninsular Malaysia

ABSTRAK

Pertumbuhan penduduk yang tetap di Malaysia telah menyebabkan penggunaan air yang relatif banyak. Walaupun kualiti air telah menjadi bertambah baik, pertaliannya dengan kuantiti air dan operasi sistem air telah agak terabai. Aktiviti manusia sering memberikan cabaran terhadap kuantiti dan kualiti air dari sumber air Malaysia. Ini termasuklah aktiviti yang menggunakan air sungai secara langsung – seperti penggunaannya untuk pengairan dan aktiviti berasaskan daratan yang menghasilkan nutrien dan bahan pencemar, di samping mengubah pola larian air dalam kawasan tadahan. Pertambahan penduduk dengan pertambahan jangkaan telah meletakkan tekanan yang bertambah terhadap sumber air, dan menyebabkan keupayaannya untuk mengekalkan standard kualiti dan kuantiti air tercabar.

Kata kunci: pertumbuhan penduduk, aktiviti manusia, sumber air, kuantiti air, kualiti air, Semenanjung Malaysia

INTRODUCTION

The quality of freshwater at any point on the landscape reflects the combined effects of many processes along water pathways. Human activities on all spatial scales affect both water quality and quantity. Alteration of the landscape and associated vegetation has not only changed the water balance, but typically has altered processes that control water quality. Effects of human activities even on a small scale are relevant to an entire drainage basin. Furthermore, local, regional, and global differences in climate and water flow are considerable, causing varying effects of human activities on land and water quality and quantity, depending on location within a watershed, geology, biology, physiographic characteristics, and climate. These natural characteristics also greatly control human activities, which will, in turn, modify (or affect) the natural composition of water.

One of the most important issues for effective resource management is recognition of cyclical and cascading effects of human activities on the water quality and quantity along hydrologic pathways. The degradation of water quality in one part of a watershed can have negative effects on users downstream. Everyone lives downstream of the effects of some human activity. An extremely important factor is that substances added to the atmosphere, land, and water generally have relatively long time scales for removal or clean up. The nature of these substances, including their affinity for adhering to soil and its ability to be transformed, affects the mobility and the time scale for removal of the substance. Water applied to landscapes, over and above consumptive use, has the potential to degrade the quality through runoff, mixed with organics, fertilisers and undesirable constituents s which presents threat to future water quality. Some may not realize the magnitude of the problem and the long range decisions which must be made soon or they will be made for us. Population increase cannot be stopped and the demand for water will greatly increase. Even, if the population does not increase at the projected, water demands are substantial right now and must be dealt with.

WORLD WATER STATUS

In 2006 the United Nations World Water Development Report termed the state of water on our plant as a "crisis of governance." While the world appears to have enough of a fresh water supply today, the issue is one of governance, as in distribution, management and quality control practices. Due to mismanagement, limited area resources and environmental changes, some caused by climate change, almost one-fifth of the planet's population still lacks access to safe drinking water and 40 per cent lack access to basic sanitation. Access to water is further restricted by national and governmental entities that regulate where the water flows, to who has access and for what purpose the water is used.

Water is also used as an economic, health and environmental weapon by the "haves" over the "have-nots." Governments "determine who gets what water, when and how, and decide who has the right to water and related services," said the report authors. Its availability is also related to a range of issues intimately connected to water, from health and food security, to economic development, land use and the preservation of the natural ecosystems on which the water resources depend on.

Water quality is declining in most regions of the earth. Regional over population, increased industrialisation, absence of proper waste water treatment are all contributing to the emerging crisis. "Poor water quality is a key cause of poor livelihood and health. "An estimated 1.6 million lives, directly or indirectly connected to water quality issues and their related diseases, could be saved annually by providing more access to safe drinking water, sanitation and hygiene to the world's poorest regions.

Access to water is not only a Third World or emerging nations' issues, droughts in the Southeast of United States and quantity issues in the Southwest and in California have brought conservation, control and distribution issues to the public's attention in the past few years. Water in the United States is a key factor to residential and commercial development, economic stability and job growth all issues which effect local and regional communities' economic well-being. The Editors of Accountability Central work to bring the many facets of water issues, especially quality and quantity into focus with news, commentary and research. Education, public discussions and concerned communities can help bring about real and positive changes and sensible and fair solutions to the problems at hand and perhaps these forums can help in some small way.

Rapid economic growth in many developing countries especially from the late 1980s to 1997 has led to deforestation, agricultural expansion, urbanization and industrialization which have had negative impacts on the environment. However, economic development has a role in providing a better human existence against a background of increasing population growth. Many countries especially in Asia had been seriously intensifying their industrial sectors and

food industries and this had placed tremendous stress on their water needs. In 1999, the world population reached 6 billion. The growth of population decreased the water tables in many countries, for example water tables under the North China lain had fallen by 1.5m per year. While in India the pumping of underground water estimated to be double the rate of aquifer recharge from rainfall (*NSTP* 2002). This problem has caused millions of people facing water shortage for their basic needs. In most developing countries, population growth has been very rapid and this puts pressure on resources including land. As a consequence, land-use will change and this will, in turn, affect hydrologic processes and also have long term effects on soil. The National Water Resources Study 2000-2050 projects that water demand for Malaysia between 2010 and 2050 will be twice the population growth rate. Meanwhile, according to the Malaysian Water Industry Guide 2001, in 1999, the water supply capacity in Malaysia was approximately 10,729 million litres per day as compared to the demand of about 9,028 million litres per day.

POPULATION, DEVELOPMENT AND WATER NEEDS

In recent years, the importance of environmental functions of rivers in urban areas has been increasingly recognised. For instance, river water quality tends to deteriorate in accordance with growth of economic activities and urbanisation, and the river itself faces problem especially during droughts when there is no enough water to dilute the materials disposed in discriminately into the rivers and hence, water pollution problems arise to the fore. Rivers become exceedingly polluted and it is either too costly to treat them or the technology to do so is not available. In particular, increases in population density and the expansion of urbanised areas and the creation of a higher density of built areas, become the most important influences on changes in hydrological processes such as the increasing of water resources development and water demand and increases the quantity of waterborne pollution which then affects the water quality of the river.

In a developing country like Malaysia, the increasing pressure of human and livestock population on the land, forest and water resources has led to misuse and neglect of the land, over-exploitation of forests and overgrazing (Tejwani 1993). Population concentration into urban areas and expansion of existing development areas became global phenomena particularly after the 1950s. Malaysia in particular has experienced a rapid and intensified urbanisation since its independence, through a period of high economic growth. Douglas (1983) stated that urbanisation brings with it many alterations of nature including site transformations, such as river channel diversions, changes to the functioning of local ecosystems and altering the natural flows of energy, food and materials. Apparently the land clearing in upstream has washed sediment downstream, raised the levels of silt and reduced the river storage capacity. With this in mind, the study by Drainage and Irrigation Department (DID) estimated that only 10 percent of the nation's annual rainfall in the reserve is available for use. It seems that Malaysia will face big water crisis because 97 percent of raw water supply comes from river system. At the global level, the United Nation Committee on Natural Resources reported that 80 countries, or 40 percent of the world population, are already experiencing serious water shortages.

The rapid development in Malaysia through the economic growth and land development process in the last few decades has had significant impacts on the environment including water quality deterioration in urban river basin areas such as in Klang's Valley and Langat's Valley near Kuala Lumpur. For instance, in 1998, the country faced a serious problem when the Langat River, one of Klang Valley major water supply arteries was badly polluted and reduced the supply of water as 100 million litres of water per day. It was reportedly caused by several agricultural projects, construction sites, riverside settlements, factories and animal farms located along the river (*NSTP* 2001). The pollution level in this river is a major cause for concern as it is an important source of water supply in the Klang Valley especially for

economic development and domestic usage. As a consequence of this water crisis, export oriented industries especially the semi-conductor sector have lost USD 3.4 million for each day of shutdown due to water cut. This water crisis urged government to take more structured approaches in order to make sure it will not hit the Federal Capital and the highly industrialised Klang Valley in future. In fact, this crisis has showed the lack of effectiveness of the law and the efficiency of the relevant authorities to undertake remedial measures.

Economic development also has been connected with the rise of other environmental problems in river basins in Malaysia. Some of the problems associated with factors such as urbanization, diminishing of forests, and rapid changes in the catchments land use, include soil erosion, rivers sedimentation, floods, and imbalance in the water supply. For instance, the extensive deforestation within the catchment area of Malacca's Durian Tunggal Dam (south of Klang Valley) in the 1980s is a classic case of major water crisis in Malaysia where the dam was closed/dried for about nine months (*NSTP* 1998). According to Drainage and Irrigation Department (DID) study, Malaysia have an annual rainfall of 990 billion cubic metres, of which 360 billion cubic metres will return to the atmosphere. Surface runoff accounts for another 566 cubic metres, while the remaining 64 billion cubic metres seep into the soil as ground water. Further, the study warns that despite having an abundant runoff, there are water deficiencies in west coast of Peninsular Malaysia unless the government have a proper approach of water management in river basin. The variation in rainfall has a direct influence on the flow and amount of surface water where as during dry season the runoff decreases and in the wet season it become flood water.

As a consequence, additional problems may arise, for example shortage of clean water, pollution of water bodies, urban flood disasters and deterioration of environment surrounding river or catchment areas as it is happened in Klang Valley in 1998 which affect 1.5 million residents for about six-month and cost about RM55.4 million for water rationing exercise (*NSTP* 1998). These environmental problems arise when proper consideration for environmental concerns is not taken when planning of large land development projects for urban and rural development, infrastructure and industrialization. In case of Klang Valley water crisis, there is a high price to pay for extensive land clearing and the sitting of waste discharging factories and housing estates with malfunctioning sewage treatment systems within the water catchment area of the Langat River (*NSTP* 1998). More recently however, respective authorities such as Local Authority (Local Government) and Department of Drainage and Irrigation (DID) have urged for environmental issues to be considered at the planning stage and have produced guidelines to help promote more sustainable urban development planning in the country. However, the efficiency of these approaches which relate to legislative matter is still a subject of debate (Dani 2001). Adequate provision for all types of land development should be made in order to achieve the balance between public interest and natural environment preservation.

The Langat River, Linggi River and Bernam River basins in Peninsular Malaysia have all faced environmental problems from deforestation and agriculture since land development started in the 1970s. It is now believed that due to the development spillover from Klang Valley to these areas and State Government of Selangor, Negeri Sembilan and Perak aggressive program to locate real estate development and labour intensive manufacturing industries, there are bound to have severe environmental consequences in the basin area, as large area of the natural forest and vegetation are being cleared (Department of Urban and Rural Planning, 1995). The clearing of forests/lands are creating imbalance to hydrological regime of the basin which may cause water problem in future. Forests are important to water conservation as they form part of hydrological cycle. The quantity of the water ends up into the rivers and groundwater is depends on protected extend forest. During wet seasons, act as a sponge absorbing runoff into the earth with their complex root systems. Conversely, during dry season the stored water is gradually release into the ground water system that ultimately fine its way to the rivers. This is why, under normal condition during a dry spell, rivers continue to flow.

However, when there is uncontrolled deforestation activities and opening of land for urbanization and industrialization without proper land use planning, they can spoil rather than boost the economy. It is important to know that forests are vital component in sustaining the water supply. Despite the incident in Durian Tunggal Dam, other forests have also been cleared to make way for industrial estates, golf courses and housing estates. For instance, between 1978 and 1994, the Malaysian Government had degazetted forest reserve as the size of Terengganu to other land uses. Peninsular Malaysia has 4.7 million hectares of forest reserves which 2.8 million hectares are categorized as production forests and the remaining 1.9 million hectares are protected forests. In fact, of the 1.37 million hectares of forests reserve in Peninsular Malaysia classified as water catchment forests, 0.87 million hectares or 63.5% of the total, are in the production forests (NSTP, 1998). In order to minimise the impact of logging activity to the river pollution, government should ensure that loggers comply with the stipulated conditions.

With the rapid increase in urban populations and the creation of large urban areas in Klang Valley (population of 1.5 million in 1998 to 1.8 million people in 2000) and Langat basin, the pressure on land resources and space becomes apparent. For these reasons, the government has taken proactive steps by extending the development programme to include areas outside Kuala Lumpur which are also strategic for foreign investment, industry, commerce and business. The Bernam basin which is situated 73 kilometres north of Kuala Lumpur is one of the river basins which are subject to extensive land development planning proposals by governments and the corporate sector in Malaysia. Development in Bernam area have started in 2000 and it is expected that various environmental problems will result especially on water quality if the managers do not consider issues of environmental sustainability. This is because part of the Bernam area is situated in a sensitive area of the main range which supplies most of Peninsular Malaysia's water needs as 90 percent of the river systems originates from highland forests which acting as natural water towers to help meet the needs of domestic, agricultural and industrial use. In order to minimise environmental degradation similar to that experienced in the Langat and Linggi basins, developers/managers need to apply the concept of sustainable development.

The natural ecosystem of river a basin is also an important asset to the stimulation of economic growth as it provides numerous facilities such as physical environment itself, human resource and capital. However, the over emphasis towards on land development has been producing various events of degradation and interference to ecosystem which risk the quality of life such as shortage water resource and clean water, air pollution, haze, flash floods, and sedimentation. Regarding water quality, the situation in the various river basins in Malaysia shows serious deterioration in the majority of rivers over the monitoring periods of 1986 to 2000 (see Table 1).

These value is based on Malaysian Water Quality Index comprises sixth parameters which are Biological Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, pH, Suspended Sediment and Ammonia Nitrogen. In terms of index classification, value 0-59 is class as a polluted, 60-80 as slightly polluted and 81-100 classified as a clean river. As indicated in Table 1 and Figure 1, both the number and percentage of slightly polluted and polluted rivers increased after 1990, leaving around 30% of the rivers ranked as clean rivers in the most recent years. It is showed that proper river basin management needs to be taken earlier in order to minimise the future impact on water yield and water quality due to development projects which have already been planned.

Table 1. Water quality trend in Malaysia: 1986-2000

Year (No. of Rivers)	Clean Rivers	Slightly Polluted	Polluted
1986 (91 rivers)	49 (54%)	37 (41%)	5 (5%)
1987 (91 rivers)	43 (47%)	45 (49%)	5 (3%)
1988 (91 rivers)	48 (53%)	40 (44%)	3 (3%)
1989 (91 rivers)	45 (49%)	43 (47%)	3 (3%)
1990 (91 rivers)	48 (53%)	35 (39%)	7 (8%)
1991 (87 rivers)	37 (43%)	44 (51%)	6 (7%)
1992 (87 rivers)	25 (29%)	55 (63%)	7 (8%)
1993 (116 rivers)	32 (28%)	73 (63%)	11 (9%)
1994 (116 rivers)	38 (33%)	64 (55%)	14 (12%)
1995 (115 rivers)	48 (42%)	53 (46%)	14 (12%)
1996 (117 rivers)	42 (36%)	62 (53%)	13 (11%)
1997 (117 rivers)	24 (21%)	68 (58%)	25 (21%)
1998 (120 rivers)	33 (28%)	71 (59%)	16 (13%)
1999 (120 rivers)	35 (29%)	72 (60%)	13 (11%)
2000 (120 rivers)	34 (28%)	74 (62%)	12 (10%)

Source: DOE, Malaysia 2001

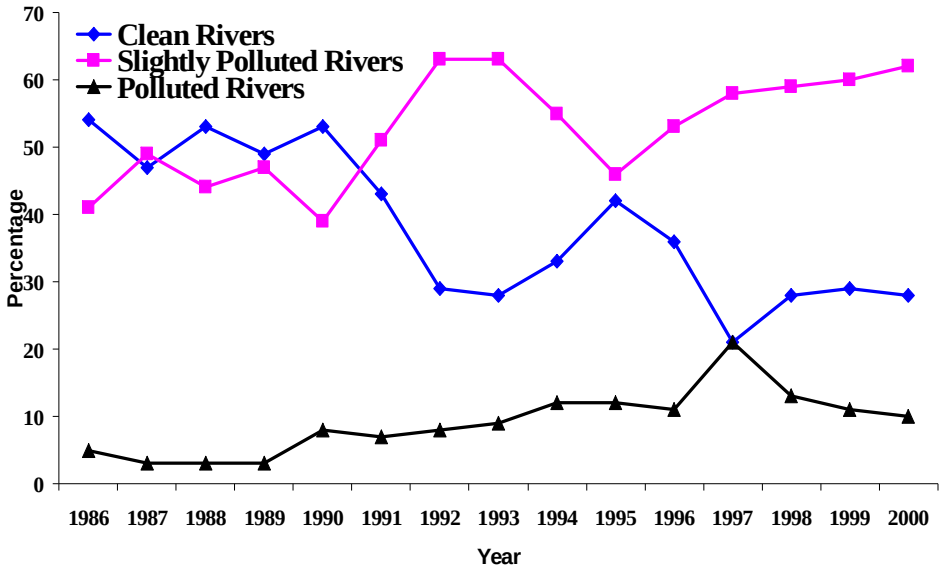

Figure 1. River water quality in Peninsular Malaysia, 1986-2000

CONCLUSIONS

Klang Valley and Langat basins had faced a serious shortage of clean water in 1998 especially due to indiscriminate logging and opening of highlands for housing, diesel contamination originating from quarry near the water treatment plant in the upstream of Langat area and other pollutants from more than 100 factories along the river. This issue getting worse with effects also came from prolonged drought (*El Nino* phenomenon), increasing the non-revenue water loss and lack of resource management. The demand of water in Klang Valley had doubled in the last 10 years from about 1200 million litres a day in 1987 to about 2500 million litres a day in 1997. At this seven percent per annum growth, the water demand in year 2002 exceeded 3,500 million litres a day. Poor maintenance of pipes (leakage/burst pipes) has resulted in annual water lost of 50-60% and will cost about USD 500 million for pipes replacement projects. The government should realise this problem and act quickly with holistic approach to resolve the water distribution management because water demand is expected to rise from the current 2.6 billion cubic metres per annum to 5.8 billion cubic metres in year 2020 (*NSTP* 1998). Typically, Malaysian urban consumers use 200 litres of water a day each, while their rural counterparts account for a mere quarter of it. For that reason, all new land development projects for example in the Bernam basin should take an early prevention measures in order to make sure that the water resources enough for various usages in the future. A part of Bernam basin is actually located at the foot of Titiwangsa Range which functioning as a main watershed for the Bernam River. Therefore all development projects for Bernam basin especially upstream must be well planned in order to sustain clean water supply for various uses such as domestic, industrial, agriculture and recreation following development. The basin must be developed with proper planned, mitigation and environmental friendly procedures; otherwise same environmental problems will occur as it happened in Kelang valley Langat basin.

Clearly, strategies need to be developed to ensure that development does not necessarily lead to severe environmental damage. In this matter, land use development control would be an important aspect in deciding the exposure stage of pollution. The Geographical Information System (GIS) can be used as an effective media and tool to help the water managers or management authorities in preparing the basic information of land use development so that the decision would be rational and objective (Abdul Hadi & Abdul Samad 2000). In Malaysia, the impact of economic development on the environmental quality of the river basin in general and on water resources in particular has not been studied so far in a significant way so that further deterioration can be prevented by implementing appropriate policies in the future. To ensure the sustainability of the water supply, the Federal Government should initiate several long term measures to meet the ever increasing domestic and industrial demand such as introducing water sharing strategy between states as a basis for future development and suggestion to water authorities, the pricing of supplied water should also be based according to its quality.

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