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Sustainable management of rivers in Malaysia: Involving all stakeholders

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ABSTRACT

All over the world, including Malaysia, management of rivers is a central issue in this 21st Century. While government has always been traditionally entrusted with the responsibility of managing rivers, increasingly, the public, NGOs (Non-Governmental Organisations), industrialists, farmers, and other stakeholders are playing a greater role. Sustainable management of rivers involves cooperation between countries and states sharing the same river basin, and cooperation between government and all stakeholders. Internationally, countries need to negotiate and use rivers as the basis for peace rather than conflict. In Malaysia, the Federal Government can initiate policies and remain in charge of governance of rivers, in consultation and cooperation with state governments. However, government must relinquish some of its responsibility on river management to all other stakeholders, viz. industrialists, entrepreneurs, farmers, communities/squatters, NGOs, educational institutions, fishermen, conservationists, tourists, the general public, etc. All stakeholders need to start taking proactive actions, even sacrifices, to manage, protect, conserve and restore our rivers so that their resources can be sustained for future use. This is where people from all levels ranging from politicians, policy makers, private companies, NGOs to individuals can play crucial roles. River management and related river issues need to involve NGOs and the people as these issues happen at the local level. Decision-making regarding solutions should be carried out at the lowest appropriate level, ideally involving all stakeholders ranging from government to the private sector, NGOs, the local community and schools. People should be the focus both in decision making as well as active "workers" involved with restoration work. The motto of "Malaysia Boleh" (Malaysia Can) involves all Malaysians.

This paper discusses how all stakeholders can contribute by working together in smart-partnerships with government towards effective and sustainable management of rivers in Malaysia.

Keywords: Non-Governmental Organisations; sustainable river management; government-industry-NGO partnerships; public participation; environmental conservation; drought and flood management; political-economy of rivers.

1 Introduction

Rivers are the cradles of civilisation as major civilisations have developed on river banks, estuaries and flood plains. Rivers have always held a prominent place in human society. It is at the banks, confluence, estuaries and floodplains of major rivers that many great civilisations emerged. The majority of the world's major rivers have survived the vicissitudes of time, witnessing the rise and fall of great civilisations on their banks. In Egypt, historical records indicate that not only do Egyptians worship the Nile but they also worship Hapi, the presiding spirit of the Nile (Butzer, 1976). In ancient Mesopotamia, the Babylonians worshipped the Euphrates and the Tigris as gods, both with practical value (irrigation and water resources) as well as their spiritual role (Ponting, 1991). In India, the Ganga River is sacred so much so that pilgrims make pilgrimages there to cleanse themselves (Das, 2001). In China, the Hwang Ho and Yangtze Rivers are not just the foci of civilisations but also the "sorrows" that bring massive destruction (Zhang *et al.*, 2000). Malaysia is no different. During historical times, rivers were the hub of life with not only the major settlements lining the banks but rivers also play an important role in the economic and social life of the people (Nik Hassan Suhaimi Nik Abdul Rahman, 1998a and 1998b). Despite their vital importance, humans have largely neglected, abused and mismanaged rivers all over the world. According to Ismail Serageldin, Chairman of the World Commission on Water for the 21st Century, more than one-half of the world's major rivers are being seriously depleted and polluted, degrading and poisoning the surrounding ecosystems, thus threatening the health and livelihood of people who depend upon them for irrigation, drinking, washing, recreation and industrial water (www.worldwatercommission.org). All over the world, overuse and misuse of land and water resources in river basins (both in advanced industrial countries and developing countries) is the main reason for the degradation of rivers, contributing to about millions of environmental refugees in 2001.

For many reasons, rivers are sources of life, providing water supply for the people, irrigation for agriculture, cheap and efficient transportation, rich sources of food, hydro-electric power, and water use for industries. Rivers are also the natural habitats for riverine and aquatic flora and fauna and the river environment supports a rich biodiversity of life forms (Keizrul bin Abdullah and Mohd Fadhillah bin Hj. Mahmood, 1998). In Malaysia, settlements have historically sprung up along river banks and river estuaries as major agricultural zones are established near rivers. Unfortunately, however, rivers also provide a convenient means

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of drainage, and is used for the discharge of domestic, commercial, industrial and agricultural effluents resulting in severe pollution (Keizrul bin Abdullah, 2002). Malaysia has developed very rapidly over the last three decades, coupled with equally rapid urbanisation. Coupled with this, agriculture expansion and industrialisation have also rapidly changed the land use from one of mainly forest and food crops to one of estates (cash crops), urban, commercial and industrial centres (Government of Malaysia, 2001). Opening of new land, be it for agriculture, logging, housing, industry or other human land uses, has given rise to excessive levels of soil erosion and river sedimentation (Douglas, 2002). These have increased landslides and water pollution hazards manifolds, endangering lives and property (Chan, 1998a). All these developments have encroached upon rivers and overstressed river systems.

To exacerbate matters, since colonial times until now, the authorities have been adopting a technocratic approach (structural management) of rivers employing a top-down method. Such an approach can never be totally successful simply because it does not involve people (Chan, 2003). Government can provide all the necessary technical know-how and build all the mitigative structures to control rivers, but if people do not cooperate, then its overall success is limited. Year-round dredging of rivers is a futile effort if people keep dumping garbage into rivers. This is the case of the Sg. Kelang which after decades of dredging, is no where as deep or clean as it was before. To make matters worse, there is always the friction between federal and state governments over rivers, and institutional issues are also major stumbling blocks for effective management of rivers (Chan, 1998b). Consequently, a combined result of politics, haphazard rapid development and urbanisation, together with ineffective management, have plunged many rivers in Malaysia into a sorry state. The Drainage and Irrigation Department (DID) has acknowledged that many river basins in the country have actually reached their limits of water supply and are now susceptible to water stress and droughts. The occurrence of low flows is exacerbated when rapid development has produced great amounts of human wastes as well as wastes from all of man's activities, including agriculture, industrial, commercial and transportation wastes. This has resulted in a large number of polluted rivers, some to the extent of being not rehabilitable (Keizul bin Abdullah, 2002). The irony is that the government is spending millions of Ringgit cleaning up rivers each year. The buzzword now is "River Restoration" – a term that somehow vindicates local authorities and those in charge, but restoration is at once a difficult and expensive task. Restoration requires time, money and effort. Once restored, rivers have to be managed sustainably in order to stop them from reverting to their old self (Tamai, 2003).

Currently, there have been some fragmented efforts from the authorities for river restoration and rehabilitation (Chop and Juhaimi Jusoh, 2002). The Drainage and Irrigation Department has initiated a program to clean up the Kelang River, i.e. to clean the river of solid waste and silt, to improve water quality to Class III (recreational purposes without body contact) and to beautify strategic stretches of the river for recreational purposes (Keizrul bin Abdullah, 2002). So far, it has had mixed results. Some stretches in the cities are showing good results as more attention has been focussed there but elsewhere the river is as dirty as ever. It is also a top-down approach that did not involve much participation from the local communities. Hence, they were often met with scepticism and resistance. To substantiate the point, many urban river improvement and flood mitigation works were stalled mainly due to the resistance of riverine squatters who refuse to cooperate. Consequently, the whole approach to river restoration needs to change from this top-down approach to a more participatory one. More and more, the public and environmental NGOs (Non-Governmental Organisations) have to be involved in all levels of river management, be it in planning, operation, education or restoration (Parish, 2003). For any river project to be effective and successful this end users and those directly affected, viz. the local communities residing besides the river must be involved. Many recent studies indicate that river restoration and rehabilitation can only be successful with a combined effort between government, NGOs and the local communities working together to ensure the cleanliness of the rivers (Chan, 2003; Low, 2003).

Based on the above introduction, it is the opinion of the author that in order for river management to work most effectively, in general for most countries and in particular for Malaysia, the following ingredients are necessary:

P – Public participation (NGOs, NPOs, Statutory Bodies, Semi-Government Agencies, etc);
E – Environmental Conservation;
O – Ordeals (Management of Floods and Droughts);
P – Politics and Pollution Management;
L – Learning, Education and Awareness; and
E – Equity and Economics.

2 Public participation

Since independence in 1957, Malaysia has not only developed rapidly from a rural economy based on agriculture and tin mining to an export based manufacturing economy. Over the last three decades, the transformation has been unprecedented with very rapid urbanisation and industrialisation. All these developments have overstressed river systems. As a result, many river basins have reached their limits of water supply and are now susceptible to water stress and droughts, most notably the 1997/98 water crisis (Chan, 1998c). The occurrence of low flows is exacerbated when rapid development has produced great amounts of human wastes as well as wastes from all of man's activities, including agriculture, industrial, commercial and transportation wastes. This has resulted in a great number of rivers that are very polluted, some to the extent of being not rehabilitable. Yet, the irony is that millions of Ringgits are spent each year on improving and cleaning rivers. Consequently, this has led the authorities to a change of mindset by loosening their grip on river management. More and more, the authorities are now inviting NGOs and local communities to play an active role in river management (Low, 2003). Yet, many are not totally convinced that the authorities are whole heartedly relinquishing their traditional

functions to the public, and see this as a form of "greenwash" (Chan, 2003). Nevertheless, genuine or not, it is clear that the authorities have little choice but to work hand in hand with the public as despite all the years when rivers were solely under their "control", things have not vastly improved. In many river basins, things have even become worse. Recently, the Prime Minister remarked that Sg Pinang used to be very clean when he was a kid growing up in Penang. However, the same river has degraded so much that a frog would not survive if he threw one into the river today. This was again confirmed by Penang State Local Government, Environment and Traffic Management Committee chairman Datuk Dr Teng Hock Nan who lamented that the public is largely to be blamed for perpetuating filthy drains and rivers, which can led to epidemics and other health problems (The Star, 10 December 2003). Hence, when people are not involved or properly educated, they become the culprits that contribute to the deterioration of rivers. Thus, it makes good sense to involve people as government would be seen to be people-friendly, sensitive and accommodating to the public, has to spend less on human resources, and most of all reduce the number of culprits that contribute to pollution. It is therefore imperative that people play a vital role in river conservation and management. Government must not view NGOs as enemies (though admittedly, there are some irresponsible politically-driven NGOs with ulterior motives) but should view NGOs and the general public as "partners" in the country's development and involve NGOs as much as possible, especially in water conservation and management. NGOs form the link between government and people as well as between government, industry and consumers.

There are many examples of government-people partnerships that have worked. In the area of restoration, rivers can be restored and rehabilitated given the right kind of efforts. Some of these are discussed below. River conservation and restoration is not the sole responsibility of government. In order for rivers be conserved and managed effectively, the role of NGOs and ordinary citizens are becoming increasingly important (Rasagam and Chan, 2002). As a good example of a model for community participation in the management of rivers, WWP is currently carrying out "The Sg Kluang Neighbourhood Park". The Sg. Kluang is an important river which passes through the residential areas of Bayan Baru and Bukit Gedong as well as the Bayan Lepas Industrial Zone before it drains into the Western Channel near Pulau Jerejak. WWP is going into partnership with the DID, the Penang Development Corporation (PDC) and the local residents to develop a riverside park that will cater for the recreational needs of the Bayan Baru population as well as provide a mechanism for community participation in river management. The project consists of providing minimum landscaping, basic recreational amenities and a cycle track within an approximately 4 km stretch of the drainage reserve of the river. An administrative mechanism for community support and management of the park is also proposed which requires the support of the DID and PDC. Benefits expected from this project are much needed park and recreational facilities in Bayan Baru, considerable enhancement of the river landscape and improved access for river maintenance and a reduction in the amount of waste thrown into the river along this stretch. Other benefits include a cycle and jogging track linking Sg. Ara to the coastal sea front which can also be connected to the new residential areas in the north such as Bayan Bay and the Gold Coast development. Future phases can include extending the proposal upstream to improve the water quality of the river through a catchment management programme. So far, all parties appear enthusiastic about the project as it is probably the first time such a project is jointly undertaken by government, statutory body, NGO and the public.

Another example of NGOs working effectively on river-related conservation in Malaysia is the Global Environment Centre (GEC) which is implementing the River Basin Initiative (RBI) and related water management projects by the Danish Government via DANIDA (http://genet.cjb.net/). This project, though funded by DANIDA, would not be successful if there is no close co-operation between GEC, the MPPJ and local communities. GEC has chosen the Sungei Penchala as a pilot study for community river basin management, drawing upon local communities such as resident associations, Malaysian Angling Association (PEMM), schools and others. GEC has also launched the RBI News, which is the biannual newsletter of the River Basin Initiative. It is currently distributed free to all RBI members and partners. The RBI News brings to partners the latest news and development of the Initiative, river basin projects not only in Malaysia but also around the world, as well as useful river basin and water resources links, publications and events. With the kind of funding GEC is getting from international funding agencies, the RBI is expected to be a huge success. However, much work still needs to be done. GEC is also spreading its expertise in RBI into other states. In Penang, GEC is embarking on the Sg Pinang RBI, a joint effort with WWP. It is envisage that GEC will also link up with other NGOs in this line of work in other states. Already there are links between GEC and PEMM, and between GEC and Environmental Action Committee (EAC) of Sabah. Under the "Community Participation in River Management, Malaysia" project, a grant of RM1.4 million is provided by the Danish Government (via DANIDA) over three years. Co-funding for the community demonstration project is also provided by UNDP-GEF and the Canadian High Commission, as well as the Petaling Jaya Municipal Council (MPPJ). The local press has also helped in publishing feature articles on the project.

WWF Malaysia, though a relative newcomer to the Malaysian NGO scene, has been hogging the limelight on "green" issues in recent years. It has probably overtaken the MNS and is now considered the prime NGO on environmental conservation in Malaysia. This is possible largely because of its international reputation and substantial overseas funding. Unlike the MNS and WWP, both of which are member-based organizations run by voluntary (non-salaried personnel), WWF Malaysia is run by paid professionals. However, WWF Malaysia is not "pure" water NGO in that its aims are diverse, involving itself in almost all environmental issues with a main focus on flora and fauna conservation. In the area of water management, WWF Malaysia's "Forests for Water, Water for Life" (FWWL) programme represents only one of many of its projects. The FWWL project aims to change the way Malaysians think about, use and manage

water. The project intricately links water to water catchments (i.e. forests), emphasizing that in order to protect water supply, one must first protect the forested catchments. FWWL embarks on a step-by-step approach aiming to heighten awareness, promote action and sustain long-term efforts in water management (http://www.wwfmalaysia.org/projects/forests.htm#fwwl). The FWWL programme appears to have some form of success but has not been evaluated. Despite its diverse background, WWF Malaysia has often been asked by the water authorities to coordinate NGOs in the area of water management, mostly because of its high profile and reputation in the global arena. WWF Malaysia has also compiled a white paper on capacity building in water management amongst communities and NGOs.

Realising the advantages and benefits of public participation in river management, the authorities have formed an NGO called the Malaysian Water Partnership (MyWP) (http://didnet.moa.my/mywp/). Though this is strictly not a river management body, it is nevertheless very closely related as many of its activities deal with rivers. MyWP was officially registered with the Registrar of Society Malaysia on 7 January 2003. MyWP is the national consultative body on the water sector and was formed out of a recommendation made at the National Consultation on Integrated Water Resources Management (IWRM), which was held in Kuala Lumpur on November 29, 1997. MyWP is made up of nine core national agencies, viz. DID, EPU, DOE, MWA, UPM, FMM, Wetlands International Asia Pacific (WIAP), Federation of Malaya Consumers Association (FOMCA), and Indah Water Consortium Sdn. Bhd.(IWK). The total institutional membership of MyWP is 67, comprising of government agencies, private sectors, water user groups, non-governmental organisations and research institutions. There are many individual members from the NGOs and the public. From what is documented on its website (http://didnet.moa.my/mywp/), MyWP has conducted a series of many national consultations, conferences, and workshops among all stakeholders (both public and private) involved in the water and environment sectors. Participation in these meetings were encouraging and average around 150 to 200 comprising policy-makers, professionals, academics, NGOs, water users, consumers, service providers. Some of the more prominent activities include: (i) Water sector mapping and vision in collaboration with GWP SEATAC, which contributed to the identification of gaps and the needs for strategic assistance in IWRM and the National Water Vision (June 28, 1999); (ii) A consultation to deliberate on the drafts of the four main sectoral vision that is, Water for People, water for Food and Rural Development, Water and Nature, and Water in Rivers (December 18, 1999); (iii) From vision to action; to formulate the framework for action to realise the vision. The representatives from the "Water in Rivers" and "Gender and Water", also addressed the meeting (February 18, 2000); (iv) Gender analysis in the water sector to address the gender disparities in access and control of water and the contribution of women in water resources management. The meeting was led by Ms Kusum Athukorala, the Gender Ambassador from the World Water Vision to South East Asia and South Asia (Febuary 21, 2000); (v) Dialogue on Water, Food and Environment – Sector Level – 6 March 2003; (vi) Regional Forum on Capacity Building for IWRM in Southeast Asia – 10 December 2002 to 14 December 2002; and (vii) The National Dialogue On Effective Water Governance In Malaysia was organised from 6 to 7 October 2003 in Kuala Lumpur. This involved stakeholders from all areas of water management. NGOs were invited not only to participate but also to present papers.

The authorities have made a good move when forming MyWP. MyWP has projected a positive image of the authorities (at least in terms of water and river management). The authorities are now viewed as open to public feedback and inputs as well as being accommodating the public (and NGOs) in a participatory approach towards water and river management. Perhaps MyWP can now be extended to include a sub-section on river management. Perhaps, a MyRP (Malaysian Rivers Partnership) can also be registered with the Registrar of Society Malaysia solely for the purpose of managing rivers via a comprehensive participatory approach. As mentioned by Low (2003), government can still play a pivotal role and responsibility in setting the overall policies and laws for river development and management, but it is inevitable that people must be involved.

3 Environmental conservation

There is no denying that Malaysia is committed to environmental conservation. Obviously, it would be perfect and politically correct if both the environment is protected and the economy prospers. Unfortunately, this is not always possible as development takes priority over environment and people take priority over rivers. The river environment needs to be conserved in order to enable the river to perform all its natural functions as drainage conduits, flood control, and as a habitat for riverine flora and fauna. In their natural undisturbed condition, rivers play an important role in maintaining the ecological balance of the river basin. Through its self-purification abilities, the river is able to absorb and cleanse itself of wastes and impurities, thus maintaining a threshold of river water quality that is able to enrich the natural beauty and to support an abundance of flora and fauna (Keizrul bin Abdullah, 2002).

River conservation inevitably involves conservation of water catchments in its source area. If we take a water catchment such as the Belum Forest Reserve (BFR) in Perak, the overall combined value of environmental conservation is enormous (Davison, 1995). Results form the many expeditions have noted that the BFR is invaluable for a variety of vital ecological and environmental functions: It is firstly important as a biodiversity reservoir, conserving thousands of flora and fauna species over time (it is probably one of the oldest forests in the country); It is also important as a source of traditional herbs and medicine (not forgetting that the forest is the only food source of the orang asli communities who live there); At the headwaters of the Perak River (the main waterway which serves a variety of functions as well), the BFR is a vital source of water catchment; The BFR also houses the Temenggor Dam and any large-scale deforestation is bound to increase sedimentation of the dam, hence reducing its efficiency and ultimately its usefulness; The BFR acts as an

important control for soil erosion and landslides. Without the trees to hold the soils together, soil erosion will be accelerated beyond control, weakening the steep slopes in many parts of the forest, hence increasing the risk of landslides which will endanger the orang asli communities living there (We should remember the Genting landslide and Pos Dipang episodes as warnings of what disturbed forests and slopes can wreck on the human species). Given the current threat of the La Nina phenomenon, any large scale clearing of the BFR would greatly exacerbate soil erosion and increase the incidence of dangerous landslides, thereby endangering the lives of a significant number of orang asli communities living in the vicinity of the area. The BFR is not located in a rain-shadow area but is exposed to the Northeast Monsoon (which blows from November to March). With a 30–40% expected increase in rainfall due to the La Nina, the erosive power of the rains would be greatly increased. Hence we need the protective cover of the forest more than ever now; Logging would also lead to the pollution of water sources (rivers, lakes, dams and underground sources) due to sedimentation and the high concentrations of suspended solids; Finally, deforestation would greatly increasing the risk of downstream flooding as the rainwater reaches the rivers in double-quick time as a result of loosing the absorptive "sponge" effect of the forest. Hence, urban catchments which are almost devoid of vegetation (e.g. the KL Metropolitan area and the Sg Pinang catchment centred around Georgetown) are extremely prone to flash-flooding in comparison to vegetated/forested catchments. Inevitably, flood hazards are a deterrent for tourists and have negative impacts on tourism.

Conservation of the river environment must necessarily involve the concept of Integrated River Basin Management (IRBM). This is a commonly used buzzword in Malaysia for river management authorities. However, politics and legislation have been a major hindrance to its implementation. Theoretically, the river basin covers the entire area demarcated by its natural hydrological boundaries (usually along mountain ridges) such that rain falling in the basin will all flow first into the river's tributaries and finally into the main river. Thus, all activities within the basin will impact on the river. For example, upstream activities such as logging and industries will produce pollutants that eventually impact upon the quality and quantity of the river water at downstream stretches. Hence, the deforestation for housing, agriculture, logging, industry and mining, amongst others, will impact negatively on rivers. Industries located near to rivers will inevitably degrade water quality in the river, unless they have good effluent water treatment facilities. As rivers flow into towns and cities, they also pick up a lot of pollutants, both point and non-point. Hence, urbanisations and developments and townships need to be properly planned to preserve the natural beauty and functions of the river. Integrated river basin management (IRBM) is the holistic approach to managing the river basin with the objective of protecting and preserving the river and its ecosystem. (Keizrul bin Abdullah, 2002.)

Environmental conservation of rivers is important in the sustainable development of the river basin. Without conservation, river resources will not be sustainable. As human society puts increasing pressures on river resources, unsustainable use will

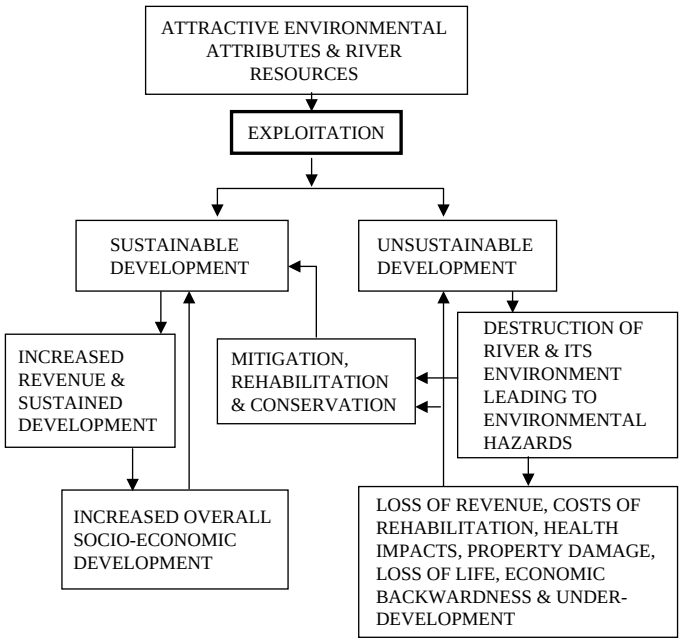

Figure 1 A model of sustainable river management.

jeopardise both river ecosystem and human society. Ideally, the use of river water and its resources has to be able to support a prosperous human society and yet not having to undermine the integrity of the river's regime or the ecological systems in the river basin that depend on it. According to Keizrul bin Abdullah (2002), human society must strike a balance by keeping the demands on the river basin within its "carrying capacity" as failure to do so will ultimately impact on Man's future and his sustainable use of these resources. Figure 1 is an interactive model linking river management, development and environmental conservation. In this model, the benefits of sustainable river management will be enormous and sustained when the development is prudently planned in a sustainable manner. On the other hand, if the push is for rapid exploitation, little forward planning and environmental protection, then the results would be disastrous not only for the river environment and the river system but also for human society.

A conference of experts, government officials, consultants, NGOs, academics and the general public recommended that rivers and their environment needed protection, conservation and rehabilitation (Chan, 2002a). The conference recommended the employment of the "Living River System Concept" to protect rivers (Ramadasan *et al.*, 2002). In addition, it also proposed the protection of highlands and catchments (upstream areas and sources of rivers). Hence, forests, water catchments, hill land and hill slopes, river reserves, wetlands and natural characteristics and attributes of rivers should be protected, conserved and rehabilitated. Land use change in these environmentally sensitive areas such as dam construction, urbanisation, logging and removing of swamp/mangrove forests, and river diversions should be strictly controlled. Conservation of wetlands are important for flood protection. Environmental conservation of upstream areas are needed to control sedimentation, which is a major river management issue (Douglas, 2002). Environmental conservation of highlands is vital as the effects of agriculture can be devastating

on the rivers. This is the case of Cameron Highlands where water sources are polluted and soil erosion due to excessive land clearing and bare soil on steep slopes (Chan, 2003). Hence, there is a need to development of a National River Restoration Plan for all polluted and degraded rivers. Many developed countries are "Freeing Rivers" from damming, channelling, embankments, barriers and other artificial structures as these disturb and change river flow and other characteristics. The Sg Kelang Cleanup Program demonstrated that dirty rivers could be revived/ cleaned via rehabilitation (Chop and Juhaimi, 2002).

Conservation of the river environment is not the sole responsibility of government. Many NGOs and local communities are involved and can be mobilised. The MNS is the oldest NGO in the country and it has always been at the forefront fighting to save the environment and its resources. However, its agenda goes beyond conserving rivers. Others concerned with environmental conservation are WWF, CAP, ERA, WWP etc. (see below) Another particular NGO using proactive local community-based work aimed at environmental conservation via raising environmental awareness is the grass roots community organisation (REACH) that has been established in the Cameron Highlands area. REACH (the EXCO has many WWF Malaysia employees) is concerned over rapid development and its undesired effects in Cameron Highlands, including illegal land clearing, and subsequent effects on rivers and their water. REACH has conducted extensive research on rare plant species and have documented them for the push towards environmental conservation. REACH has managed to generate heightened public concern and commanded national attention, highlighting the important role of highland forests as water catchments and sources of river flow. Other NGOs doing similar conservation work on rivers are Water Watch Penang (WWP), Malaysian Nature Society (MNS), WWF Malaysia and others. WWP is concerned about catchment conservation in Penang Hill, Teluk Bahang Hills and the Ulu Muda Catchments. MNS is a national organization and is concerned with catchment conservation throughout the country. WWF Malaysia has its "Water For Life" programme and part of this programme concerns conservation of forests, water catchments and rivers.

4 Ordeals: management of floods and droughts

According to Chan (2002b), water hazards are the only major hazards and disaster affecting Malaysia. In fact, Keizrul bin Abdullah (2002) points out that the two most significant natural hazards in terms of economic losses are water related, that is floods and drought. The DID estimates that about 29,000 sq. km. or 9% of the total land area in Malaysia is flood-prone, and most of these areas are located in the riverine, estuary and coastal areas exposed to the North-east monsoon. The DID further estimated that about 12% of the population or nearly 3 million are frequently exposed to floods. Malaysia represents one of the "Tiger Economies" of Asia that is rapidly developing, industrialising, and urbanising. However, like all other Asian economies, the country is plagued by seasonal environmental hazards (mostly floods) that significantly reduce its GDP and deplete its annual budget on development. Flood loss has not only caused loss of life but also resulted in enormous economic. The DID has confirmed that significant costs have been incurred in rescue and flood relief operations and rehabilitation works, and whilst the total flood damage suffered varies from year to year, the average annual flood damage has been estimated to be RM100 million at 1980 price levels (Figure 2).

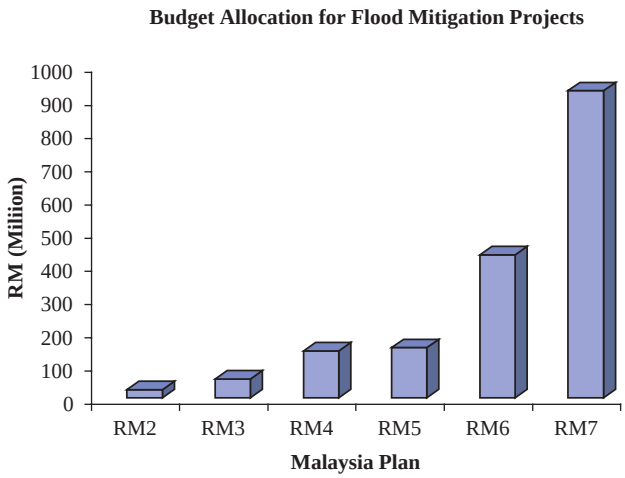

Figure 2 Budget allocation for flood mitigation projects under various Malaysia plan periods (Source: Keizrul, 2002).

Inflation and other reasons (viz. urban expansion and the escalation of land and property values) have probably increased the annual flood damage significantly. Chan (2002b) demonstrates that flood losses (tangible and intangible, as well as direct and indirect) can be severe (Table 1).

In terms of flood management, Malaysia's predominant official strategy is based on a technology-centred approach emphasising the application of new technologies such as the use of remote sensing in flood forecasting and telemetry and automatic warning gadgets in flood warning and evacuation systems (Chan, 1995). Undoubtedly, such developments, if applied properly can effectively reduce loss of life, livestock, crops and property damage. However, the application of high-tech solutions can only be successful if the public/victims respond effectively to flood warnings and react positively. Often, sophisticated (imported) flood warning and evacuation systems are alien to the public who are accustomed to traditional systems. This will eventually lead to lack of confidence in the costly new technologies, rendering them utterly useless. In many cases, such confusion and mistrust of the new systems have even led to greater flood loss. In contrast, traditional methods have been employed for centuries and the locals understand them well as they are used to them. Because of their long adaptation, locals respond effectively in times of flooding via traditional systems in much the same way as the human body's immune system responds to an alien strain of virus. Take away this traditional system and replace it abruptly with a completely new system will do the victims more harm than good, as it will probably endanger their lives. The majority of flood-prone victims living on the flood plains have developed some flood mitigation and flood-loss reduction methods. The amount

Table 1 Estimated flood loss in Malaysia.

Flood Event		Flood Loss* (RM million)	Death	Number Evacuated
Year	Place			
1886	Sg Kelantan & Sg Besut	Hundreds of square kilometers of forests & nature destroyed	NA	NA
1926	Nearly the entire Peninsular Malaysia	Erosion & Environmental Destruction	NA	NA
1931	Perak-Kelantan Border	NA	NA	Thousands
1947	Kerian, North Perak	Padi Crop destroyed	NA	NA
1954	Johor & Terengganu	Hundreds of Acres Padi	2	Thousands
1957	Kelang Valley	NA	NA	4,000
1965/66	Kelantan & Terengganu	> 30, 000 acres of Padi	NA	Thousands
1967	Sg. Kelantan	221.8	38	320,000
1967	Sg. Perak	171.9	0	280,000
1967	Sg. Terengganu	44.7	17	78,000
1971	Sg. Pahang	103.6	24	153,000
1971	Kuala Lumpur	94.2	24	NA
1981	Kelantan	NA	8	2,740
1982	Peninsular Malaysia	NA	8	9,893
1983	Peninsular Malaysia	0.6	14	> 60, 000
1984	Sg. Batu Pahat	22.6	0	8,400
1988	Sg. Kelantan	36.7	19	36,800
1988	Other areas in Peninsular Malaysia	NA	37	> 100, 000
1991	Peninsular Malaysia	NA	11	NA
1991	Georgetown	1.2	0	42
1992	Peninsular Malaysia	NA	12	NA
1993	Sabah	NA	5	5,000
1995	Alor Setar, Kulim & Baling	NA	0	2,250
1995	Pulau Pinang	5.4	0	1,240
1995	Shah Alam & Kuala Lumpur	222.6	4	7,000
1995	Other Peninsular Malaysia	NA	4	14,900
1996	Pos Dipang, Perak	> 100 Houses Destroyed	44	Thousands
1996	Sabah	300.0	241	23,000
1998	Kuala Lumpur	NA	5	0
1999	Sabah	NA	9	4,481
2001	East Coast of Peninsular Malaysia	Millions of acres of padi & RM2 million of books	9	Thousands
2003	June – Kuala Lumpur	Millions of Ringgits of vehicles damaged, Loss of Business & Property Damage	0	Hundreds
2003	Kedah and Pulau Pinang	RM32.1 million (Bridges, Roads, Infrastructure, 600 Pigs costing millions, RM3 million in Flood Aid, etc)	2	25,777

NA = Not Available.
* = Does not include flood losses in the private sector, although it was reported in the news that many factories in Penang and Kuala Lumpur suffered significant losses. (*Sources*: DID, National Security Council and Newspapers.)

of loss-reduction accruing from the use of traditional methods of flood mitigation can be significant. Often, the amount of loss-reduction can determine whether or not a farmer can recover fast enough to resume planting the next season's crop. Families not taking pro-active flood loss-reduction often end up being plunged into greater depths of debts which they may take a long time to repay. This underlines the importance of traditional flood mitigation strategies being used vis-à-vis the official strategies. People do count and they must be involved sufficiently to ensure that they do not over-rely on the government schemes which are far from being infallible. With both official as well as traditional systems working in tandem, flood-loss reduction can be maximised.

Obviously, it is not possible to protect people completely from floods. Equally, flood managers should understand that floods cannot be controlled. Despite the DID acknowledging that absolute control over floods is rarely feasible nor physically or economically viable, the majority of the flood mitigation measures being undertaken in the country (going by the amount

of money spent over the various Malaysia Plans and the approach taken by the authorities), is heavily lopsided towards "Structural Measures". These measures involve large scale construction of dams, embankments, river diversions and other improvement works, urban drainage canals, flood retention ponds and other large structures. Though partially successful in some areas, they are not the panacea to flood control. Building of structures is a top-down approach that does not involve a vital ingredient, viz. the flood victims or floodplain occupants. Without co-operation and inputs from the people, overall flood management effectiveness is limited. For example, the best flood forecasting and warning system would be rendered useless if people do not heed the warning and refuse to move. Effective flood management in many developed countries involves employing both engineering and non-engineering measures. Engineering (structural) measures must be complemented by non-structural measures such as legislation and enforcement, watershed management, land use planning controls, community participation, education and awareness campaigns, control of runoff at source, etc. Since the government is currently actively encouraging public participation in almost all areas, including river management, it is timely that flood management should also be opened to public participation.

5 Politics and pollution management

In Malaysia, almost every issue is a political issue. Rivers have always been the bone of contention between the Federal and State Governments. While the Federal Government oversees regional development, it is not able to control development of rivers and their adjacent land by State Governments since land and rivers belong to the States. Other than this problem, it is also obvious that there are currently too many government agencies (at the Federal, State and Local levels) that are either directly or indirectly concerned and involved with river management. The Director General of the DID, Dato' Keizrul bin Abdullah (2002) acknowledges that there is no formal mechanism to integrate and co-ordinate activities within a river basin and this is one weak point that has to be addressed if river management is to be improved. He stresses further that there are currently many ministries, departments and agencies having functions related to the river or impacting on the river. Often, each of these agencies may be carrying out their own agendas without consultation with others, and some agencies may even have conflicting objectives. Although it is widely accepted that the DID is the authority on rivers, there is still no single agency entrusted with the function and authority (and more importantly the jurisdiction) of managing fully the river covering all the related functions of river in an integrated and holistic manner. Consequently, it is not surprising that this situation has given rise to a lot of politicking and disputes between the various levels of government, viz. Federal, State and Local.

Perhaps the importance of politics is even more obvious in the States of Kelantan and Terengganu which are run by opposition parties not linked to the National Front of the Federal Government. It is not surprising that many development projects and the funds for flood mitigation schemes have not been reaching these two states as fast as they ought to. Nevertheless, there may be other reasons for the economic backwardness of these two states. The point is, politics do play a significant role in flood management. Many states depend heavily on the Federal Government to fund their development projects, especially the large-scale mega projects which are Federally funded. Hence, it should perhaps be not that surprising to note that in carrying out the duties and responsibilities, a state's effectiveness largely depends on Federal funding. Without Federal funds, states (especially poorer states) would find it hard to carry out Federal policies and strategies, and implement the planning and oversee the operation of projects, as well as maintain and manage rivers. The effectiveness of river management schemes, including the extraction of river water, the discharge of effluents into rivers, the issuing of licences to businesses and industries along rivers, the formulation of rules and regulations, and the enforcement of Federal regulations and laws, all depend on politics. Because of the impact of floods on millions of people, tackling floods is an important agenda for politicians. This is manifested by the commitment of the Government in addressing floods in the country. Over the various Malaysian Plan periods, it can be seen that the amount of development expenditure on flood management has increased significantly from a mere RM16.5 million in the Second Malaysia Plan to a 60 fold increase of close to RM 1 billion in the Seven Malaysia Plan (Keizrul bin Abdullah, 2002). Over the period from 1971 to 1995, a total of RM 930 million has been spent on flood mitigation programmes, mainly for engineering measures. The amount spent over the Eight Malaysia Plan is expected to be increased many folds, but the question remains whether merely spending more money on expensive large-scale structures (e.g. a dam or a giant flood diversion canal) is the smart way to solve our flood woes or spending it wisely on more economical, more people-friendly, more quickly implemented non-structural measures.

Another significant river issue is that of pollution. It is a known fact that Malaysia is richly endowed with a lot of rain, about 3,000 mm per year, giving about 990 billion cubic meters (BCM) [1 BCM = 1 million Megaliter]) of water a year. This gives rise to about 150 river systems which form the main water supply of the country. Theoretically, after deducting evapotranspiration, the country still gets about 556 BCM per year. This is translated to a per capita renewable water availability of about 20,000 cubic meters per annum. Compared to many African countries where the corresponding values are less than 1,000 cubic meters per capita per year, Malaysians are considered fortunate. Yet, we have water problems, chief of which is water pollution. River pollution adversely affects the riverine environment and renders river water either unfit for use or too expensive to be processed. The main sources of organic water pollution are domestic and industrial sewage, effluents from agro-industries and animal husbandry. In several urban and industrial areas, organic pollution of water from both point and non-point sources have resulted in environmental problems and adversely affected aquatic lives. Rivers which pass through urban areas suffer the worst degradations and are subjected to heavy solid and liquid waste disposal from squatter settlements, drainage effluents from commercial area, food

Table 2 Quality of river waters, 1987–2002.

Year	No. of rivers monitored	Clean	Slightly polluted	Very polluted
1987	91	43	45	3
1988	91	48	40	3
1989	91	45	43	3
1990	90	48	35	7
1991	87	37	44	6
1992	87	25	55	7
1993	116	30	75	11
1994	116	38	64	14
1995	115	48	53	14
1996	116	42	61	13
1997	117	24	68	25
1998	117	33	68	13
2002	120	30	68	22

(*Source*: Department of Environment Malaysia)

centres and wet markets, residual hydrocarbon from urban traffic and workshops, and excessive silt loads from land clearings (Keizrul bin Abdullah, 2002). In the Klang Valley, 80 tons of solid wastes end up in the Sg. Kelang daily. Table 2 shows just how polluted our rivers are.

Sources of river pollution are many. According to Douglas (2002), sedimentation is a major pollutant and a major river management issue. Malaysia has experienced rapid economic growth during the last three decades of the 20th Century. The country has been transformed, first from forest to agriculture and then from agriculture to industries. Now, urbanisation has developed rapidly. There has been large scale and widespread changes in landuse throughout the country. Almost all urban areas have experienced expansion with rapid build up of commercial and housing areas. In rural areas expansion of plantation agriculture has depleted large areas of natural jungle. Mining operation, housing and road development, logging and clearing of forest are major causes of high concentration of suspended sediment in downstream stretches of rivers. Chop and Juhaimi Jusoh (2002) have documented that the lower stretches of our rivers are characterised by heavy silt loads especially after heavy rains. In urban areas, this is the direct consequence of large numbers of land clearings for projects such as housing, industry and highways and the subsequent strong erosion caused by heavy rains. Studies have shown that in urban areas 90% of sediment load to rivers come from land cleared for construction. In the Klang Valley, it has been estimated that erosion averages 2,950 tons/sq. km/yr for the whole catchment, equivalent to about 3 mm of soil loss a year. In some upstream areas of the Sg. Batu catchment, extreme erosion rates of up to 50,000 tons/sq. km/yr have been calculated. All these figures are very high when compared with the rates for undisturbed forest catchments of around 10 to 100 ton/sq. km/yr. One consequence of these changes is a tremendous strain on our natural waterways, and excessive silt loadings on the river systems.

Another major source of river pollution has been determined to be squatter settlements along river reserves and in some cases built over the river itself. The river corridor is an accessible and convenient locale for the less fortunate and the poor to reside. Lacking access to basic water and sanitation facilities, residents in many such settlements turn to the river both as a source of water as well as a means of waste disposal. The inhabitants of squatter settlements provide a sizable portion of the workforce especially in supporting industries and service areas. Given that many food vendors reside and prepare their wares under these conditions, there is a need to relocate them to better habitation. The exact number of families living in such settlements is constantly changing and difficult to estimate, but for the Sg. Kelang alone, there is an estimated 40,000 families. Unless the squatter issue is addressed, river pollution will not be effectively controlled. Similarly, unless land use controls are effectively enforced and culprits severely dealt with, pollution will continue to maim our rivers and render their resources useless. Many urban rivers are affected by squatters who continue to pollute rivers (Figure 3: Left).

Deforestation and rapid land use change due to accelerated economic growth have destroyed the natural forest cover replacing it with exposed or partly exposed surfaces (Figure 3: Right). Other activities that have had a similar effect on the land use are mining operations, construction of housing, logging and clearing of forests, highway construction, agriculture estates, quarrying and urbanisation (Chan, 1999a). All these have caused high concentrations of suspended sediment in downstream stretches of rivers. Typically, the lower stretches of Malaysian rivers are characterised by heavy silt loads especially after heavy rains. For urban areas, Keizrul bin Abdullah (2002) demonstrates that 90% of sediment load in rivers are derived from land cleared for construction. For example, in the Klang Valley alone, it has been estimated that erosion averages 2,950 tons/sq. km/yr for the whole catchment, equivalent to about 3 mm of soil loss a year. In many upstream areas where forest clearance has been rapid, erosion rates of more than 50,000 tons/sq. km/yr are not uncommon (Wan Ruslan Ismail, 1995; Chan *et al.*, 2000). In comparison, the rates of erosion for undisturbed forest catchments are only of the magnitude between 10 to 100 ton/sq. km/yr. Hence, pollution via sedimentation is a serious problem for Malaysia rivers and a major river management issue (Douglas, 2002).

The most serious kind of river pollution, however, is the pollution by heavy metals and hazardous chemicals discharged from the thousands of factories in industrial zones, especially those located upstream of rivers (Chan, 1999b). Privatisation of treatment of industrial wastes has made such treatment expensive, and there are a significant number of factories not treating their wastes. Some have even been caught dumping their wastes illegally. The economic slowdown in recent years has exacerbated this problem as there are more and more been incidents of illegal dumping of toxic wastes and leakages of waste products from improperly constructed containers as well as accidental spillage. This has caused serious pollution, especially to the rivers. Based on the current large volume (which is increasing alarmingly) of pollutants of all sorts, rivers can no longer perform their self-purification function. Consequently, river pollution monitoring by the Department of Environment (DOE) has shown a drastic decline in water quality of rivers. For example, out of the

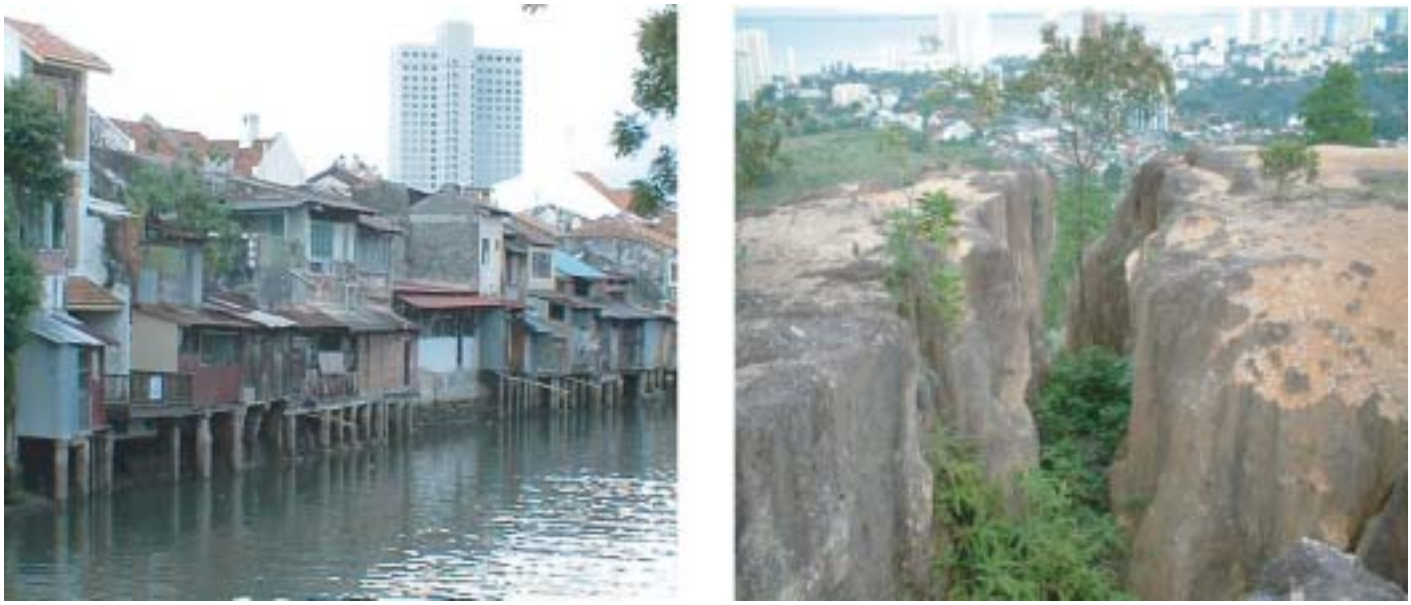

Figure 3 Left – Squatter houses along the Melaka River, Malaysia. Right – Deforestation caused by land development in the Penang Hill in Penang State, Malaysia.

117 rivers monitored in 1997, 24 were rated as clean, 68 slightly polluted and 25 polluted. The situation improved slightly in 1998 but the conditions of rivers deteriorated again in 2002. In terms of heavy metal contamination, 55 rivers have been found to exceed the maximum limit of 0.001 mg/l for cadmium, 44 rivers exceeded the iron limit of 1.00 mg/l, 36 rivers exceeded the lead limit of 0.01 mg/l and 24 rivers exceeded the mercury limit of 0.0001 mg/l (Keizrul bin Abdullah, 2002).

The DID has an elaborate project to tackle pollution in the Kelang River (Figure 4). The Klang river is located in the Klang river basin, one of the most densely populated areas of the country housing 3.6 million people (about 18% of Malaysia's population) (Chop and Juhaimi Jusoh, 2002). The Klang River passes through major urban centers of Ampang, Kuala Lumpur, Klang, Shah Alam, Subang Jaya, Petaling Jaya, Kajang, Ampang Jaya and Selayang. Hence, it is not surprising that the Klang River has been notoriously known as the "Most polluted river in the country". The river flows through one of the most densely urbanized regions in the country, passing through the urban conurbation of the Federal Territory (Kuala Lumpur)-Petaling Jaya-Shah Alam-Klang. The proposal to clean up the river was first made in 1988 with the Department of Irrigation and Drainage (DID) heading a team of government agencies. However, due to bureaucracy, the program was not formalized until 1992 (Chop and Teh, 1993). The three main objectives were:

(a) To clean up the Klang River and its major tributaries from rubbish and silt;
(b) To improve the water quality of the Klang River and its major tributaries to a standard minimum of class III standards (WQI = 60) (i.e. suitable for recreational purposes without body contact); and
(c) To beautify the riverine areas with a view to provide and upgrade recreational facilities within the city.

Figure 4 The Klang River runs right through the Federal Capital of Kuala Lumpur, one of the most urbanised and densely populated regions in the country.

A sub-programme is aimed at relocating about 2,650 squatters' families which now live in colonies along the banks of the river. This job is headed by the Federal Territory and Klang Valley Development Division of the Prime Minister's Department. Unfortunately, relocation is a messy and expensive exercise (Chan, 1997). Up to 1999, only 310 squatter families had been relocated. The major reason for the limited success of the relocation programme is the inability of local authorities to provide alternative low cost housing to the squatters. Nevertheless, both the Selangor State Government and DBKL are committed to see a "Squatter free" Klang Valley by the year 2005. Whether or not this is realised remains to be seen. Often, despite the presence of many laws which protect rivers in one way or another, enforcement is a problem (Meenakshi Raman and Mageswari Sangaralingam, 2002). Hence, another sub-programme is that of enforcement headed by the Department of Environment Malaysia (DOE). The DOE is supported by all Local Authorities and state

Department of Environment offices. It is responsible for monitoring water quality and inspecting factories for their wastewater discharges. It is also responsible for charging the polluters. The DOE has also set up a GIS database for the Klang River basin. However, while the GIS database expedites the work of the DOE, monitoring and enforcement have always been problems. Lack of staff and "problematic" factories have reduced the effectiveness of this sub-programme.

6 Learning, education and awareness

Education is often the key to almost everything. Without education, people will not behave responsibly and cooperate with the authorities on conservation issues. For example, conservation campaigns should show riverine communities the severe effects of their negative actions on their own health and their families. The DID has a "Love Our Rivers" Campaign but it is run only periodically, with certain rivers selected on a one-off basis. The continuity of the programmes depends on the availability of funds, and when funds are lacking there is little continuity. One of the weaknesses of the above programme is that it is run by DID officers or DOE officers, all of whom are government officers who are well qualified as engineers or environmental/science officers. They are not qualified as facilitators or campaign workers in the field of mass communication, advertising or education. Hence, not surprisingly, despite their eagerness and enthusiasm, these officers do not do justice to the campaign. Ideally, this important countrywide campaign should be run by professionals and not any government or an agency which has no expertise on public relations. Conservation campaigns would need positive inputs from NGOs who should provide constructive criticisms and work closely with government agencies. There is a need also to educate politicians and government servants involved with the management of river about the conservation aspects of rivers.

For example, the work of WWP, the only water NGO in Malaysia, is a good example. One of WWP's river conservation activities is the "*Sg Pinang River Walk – Caring For Our Rivers Campaign.*" This is targeted at the general public. For example, on 13 March 1999, a clinic on the importance of looking after our rivers was conducted. The objective is to instill awareness and love for our rivers. The event was well received as about 20 participants with ages ranging from 3 to 60 took part. The president led the group in the "River Walk" along the banks of the Sg Air Terjun (a tributary of the Sg Pinang) (Figure 5).

The group was instructed on the importance of water conservation and hence the need to keep our rivers clean. They were then treated to some basic water monitoring exercises where participants conducted themselves in the river. The kids as well as adults enjoyed this exercise tremendously. The objective is to get the residents living in the vicinity to adopt that section of the river and monitor its "Health" via simple indicators such as the physical characteristics (velocity and discharge, cross-section area of river channel, temperature, colour, turbidity, presence of rubbish, smell/odour, flowing or stagnant water), the biological characteristics (presence of aquatic weeds, fish, and other aquatic wildlife) and the chemical characteristics (pH, Dissolved Oxygen and Conductivity). Because participants actually get into the river to perform various tasks, they really enjoyed themselves. Hence there is potential in this sort of activity. This activity was repeated in several other localities with different communities. On all occasions, it was well received. It appears that WWP's message on loving rivers was passed on. WWP's Education Programme for School Children and Website – WWP's main aim is to educate the young to love and monitor the health of our rivers. Hence, a Sungai Pinang "experience" was held for school children on 15th May 1999. This is one of WWP's major thrusts towards instilling love for our rivers amongst our future generations. The idea is to target school children and educate them about river cleanliness. School children are taught about the cleanliness of rivers, water resources of rivers, flora and fauna depending on rivers, river pollution, factories pouring untreated effluents into rivers and bad habits of humans dumping rubbish into rivers etc. The students are taught some basic water monitoring tests and allowed to do it hands on in the river itself. About 30 students from Tanjong Bungah School took part. Students were briefed on the importance of water conservation and hence the need to keep our rivers clean. The group was then taught some basic water monitoring exercises in which they conducted the exercises themselves in the river. WWP hopes that this school will adopt this section of the Sg Air Terjun so that the students will monitor its "Health" by testing simple indicators such as the physical characteristics (velocity and discharge, cross-section area of river channel, temperature, colour, turbidity, presence of rubbish, smell/odour, flowing or stagnant water), the biological characteristics (presence of aquatic weeds, fish, and other aquatic wildlife) and the chemical characteristics (pH, Dissolved Oxygen and Conductivity).

When the students had finished their exercises at this location, they were then taken by bus to downstream Sg Pinang (at the Patani Road Bridge). Here, they conducted the same exercises and to their disgust, they found the huge contrast in river cleanliness between the two sites. Many refused to get into the river at the second site! The results of the exercises confirmed the vast difference in the quality of the river at the two different locations. The president then rounded up with a discussion as to the reasons for the change in water quality and cleanliness. Students

Figure 5 Teaching the local community to monitor and love their rivers – case of the Sg Air Terjun in Penang, Malaysia.

were asked to recommend ways and means of cleaning up the second site. WWP will then help the school adopt the Sg Pinang as the school's "River". From then on, the school children will continue to monitor the cleanliness of the river. They then enter the data into their school's internet site (which is linked to WWP's internet site at http://www.greenfield.fortunecity.com/leo/184) via computer. WWP will do the same for other schools and all the students from the participating schools will be able to log on to their computers and view each other's data, talk to one another about river conservation, have discussion groups linked to their school subjects, ask WWP questions, plan further river projects, etc.).

Another NGO, the Global Environment Centre (GEC) is also actively involved with awareness and education. GEC has organized several water/river management meetings/seminars, one of which was the East Asia Regional Seminar on River Restoration (13–15 January 2003) co-organised with the Drainage and Irrigation Department (DID) and various other bodies. GEC's RBI is also impressive. The RBI aims to work in partnership with national and international organizations through their ongoing and future activities at local and river basin level. Its objectives include: (i) Developing a cross-sectoral partnership with participation at local, country and international levels to advance integrated management of biodiversity, wetlands and river basins; (ii) Establishing a Knowledge Sharing Network to share experiences and good practices across sectors and between partners in a cost effective manner; (iii) Enhancing awareness on options for integrated river basin management; (iv) Strengthening capacity in selected countries and agencies; (v) Analysing and synthesizing information for input to biodiversity, wetlands and water resource related meetings and dialogues. The RBI's expected results are: (i) Forming a networking partnership between water, biodiversity and wetland sector agencies at national and international levels; (ii) Building an internet-based reference collection and active information exchange network with discussion forums; (iii) Establishing pilot projects/sites demonstrating integrated river basin management; (iv) Producing awareness materials, campaigns and training courses to promote best-practices of river management; and (v) Publishing manuals and review documents providing guidance to governments and practitioners. So far, RBI is already in its Initial Operational Phase (August 2001–December 2003) whereby the main activities are: (i) Establishment of the partnership mechanisms and support cross-sectoral dialogue; (ii) Initiating information sharing activities; (iii) Developing/disseminating awareness and training materials; (iv) Establishing and operating and Internet-based knowledge sharing system (a website has been launched – http://genet.cjb.net/); and (v) Implementing pilot activities at demonstration sites/basins.

Wetlands International Malaysia's training programmes focus on providing training to protected area managers and development planners, using techniques ranging from community facilitation processes to teaching technical aspects of natural water purification process (WWF Malaysia *et al.*, 2001). Water and wetlands are inextricably linked. In fact if wetlands are managed well, then needless to say that water resources will also be inevitably managed to the same degree. Wetlands International – Malaysia has assisted in setting up both the Nature Interpretation Centre at Taman Wetland in Putrajaya and the Tasek Bera Visitor Centre, Pahang with exhibits and interpretative materials. The Malaysian Nature Society (MNS) has the distinction of being the oldest NGO in the country. Established in 1940, the Malaysia Nature Society is the oldest scientific and non-government organisation in Malaysia dedicated to nature conservation and appreciation. Though its aim is wide, water resources conservation is one of its many aims. Amongst its many programmes related to water is a water forum in 2000 which focussed on raising awareness among local communities targeting resident associations and other grass root organizations. Essentially a member-based organization, the MNS works alongside other NGOs and government officers to complement each other's efforts rather than duplicating them (http://www.mns.org.my/). Again, the MNS is not an organisation entirely devoted to water issues. It's main mission is "To promote the study, appreciation, conservation and protection of Malaysia's Natural Heritage, focusing on biological diversity and sustainable development". So, to the MNS, water is merely a sub-issue under its many diverse concerns. The MNS aims to (i) Motivate the appreciation and care for the Malaysian Natural Heritage; (ii) Get people involved in nature and healthy outdoor pursuits through various activities; and (iii) Promote realization of the need to sustain and conserve this gift from Mother Nature for our future generation. Under its many Education Projects Program, which are the life blood of the society lies many community related projects (some of which are related to water) that rely on its voluntarism (from its members numbering in the thousands). To date, MNS boasts that it is actively involved in many such projects which benefit directly the targeted communities concerned. Unlike the WWF which has a section on water, the MNS does not even have a section on water. Nevertheless, the MNS is a reputable organization and receives significant foreign and local funding. The MNS is also highly respected amongst government departments, and this is reflected in it being invited into many government panels on environmental issues, EIA, evaluation of development projects, environmental hazard assessment, etc. The MNS, has a permanent office with paid staff. Most significantly, the MNS has 12 branches (mostly states) throughout Malaysia, served by a secretariat in Kuala Lumpur. Altogether there are about 5,000 members. Activities are both organised by the MNS headquarters as well as the branches Special-interest Groups (Pathfinders, Marine, Birdwatching, Photography, etc). The secretariat has a Science and Conservation Department, an Education Department, a Park's Unit, a Publications Division and a shop offering books and Merchandise but no water department. The society also manages a number of nature education centres and park's. The MNS has a good partnership with the Selangor State Government, as its office in Jalan Kelantan (Kuala Lumpur) is leased from the Selangor State Government. Unfortunately, this puts the society in a fix when it comes to criticizing environmental issues and development projects involving the Selangor State Government.

7 Equity and economics

Equity does not mean equal share of the river's resources between countries, states or people/human communities. Rivers do not belong solely to humans, even though human society use and abuse rivers without consideration for "others" who share the rivers. According to Keizrul bin Abdullah (2002), "Man, being just one of many stakeholders, must accept that his *wants* must not be at the expense of the *needs* of others". The others here refer to the myriad aquatic flora and fauna that inhabit the river and its adjacent environment. Even the river itself has a rightful claim to its resources. For example, over-abstraction of water from rivers has resulted in extreme low-flows and such flows have rendered rivers unable to "cleanse" themselves. Low flows also make pollutants highly concentrated, resulting in poor water quality that will ultimately impact upon human society. Hence, humans need to ensure that rivers get a fair share of its water. The bottom line is that water abstraction must not exceed the minimum level that is required for the river and its inhabitants to function effectively. This minimum level has to be ascertained via extensive research. As is the case with all other natural resources, which hitherto have been monopolised by humans, human society need to fully comprehend the significance of sharing equitably the resources of the river basin, not just amongst all the human stakeholders but more importantly amongst all stakeholders (including the river itself, flora, fauna etc). As Keizrul bin Abdullah (2002) remarks, "…the many components and elements that make up a river basin must be viewed as part of an inter-dependent whole, where no one component or element is superior or inferior to the others".

There should also be equity between the environment (river environment) and economics. For example, when politicians are faced with the hard decision of making a choice between economics and environment, they are more likely to sway towards economics (as they are voted in by people, not by fishes, plants or rivers). A prominent example where there is little equity is the case of the construction of the Sg Selangor Dam. It has been pointed out that the fireflies at the river estuary in Kuala Selangor would perish (due to low flows and salt water intrusion after the dam is completed as this will destroy the Berembang trees on which the fireflies depend for their food). To counter this point, those in favour of the dam went as far as saying that "It was a choice between having water for people or having water for fireflies". Inevitably, the outcome was that humans won hands down.

In terms of economics, it is often difficult to give a value to a river, especially when it is in a deplorable state. Equally, it is difficult to convince the public that a polluted river has economic values, much less convince politicians and policy makers who are development-focussed. In the case of the Sg. Kelang, the high incidence of pollution and flooding has been attributed to rapid and haphazard development of its water catchments in Ulu Kelang and the adjacent areas. Once again, the reason given was that of high demand for land in the Kelang Valley. Understandably, the economic value of a catchment forest (as a flow regulator for rivers) is much less when compared to that of developing the area for housing, industry or even agriculture. To those trying to balance up their accounts, it would appear that if the forest is merely to be kept as a forest reserve, then there would be "zero" income. Surely, in the modern era of environmental enlightenment and greater awareness (due to a more educated and affluent society), one would expect that decision-makers would have at least a basic knowledge that there is a certain economic value attached to the environment and its attributes. For example, the natural environment enriches the quality of life and is considered a major economic asset in many countries. Obviously, in terms of economics, the value of a river is rarely calculated. For example, how much is the Sg Kelang worth? To many, Sg Kelang is merely a convenient drainage outlet conveying the multitude of filth and excess water away from Kuala Lumpur into the sea. There is very little fish and aquatic life in it. It is too shallow to be used for transportation (though some people have toyed with the idea of "water taxis" before). Its water is too polluted to be used for water supply. Even agriculture cannot use it for irrigation. Worse of all, people in Kuala Lumpur hardly ever use the river for recreation. DID has developed many beautiful river parks and walking/jogging paths along both banks in the federal capital but they are hardly used at all. Sadly, Sg. Kelang is often used as a convenient garbage dump.

Elsewhere in Penang, the economic value of the Sg. Muda can perhaps be better quantified as Penang takes 80% of its water supply form this river. If only water supply is taken into account, then a simple calculation shows that the Perbadanan Bekalan Air Pulau Pinang Sdn Bhd (PBAPP)'s annual profit in 2002 was RM50.20 million (http://www.pba.com.my/). Since 80% of its water supply is from Sg Muda, then the value of the water drawn from Sg Muda is about RM40.16 million. Obviously, the other 20% of the water also comes from other rivers since Penang does not use groundwater. This translates to a value worth RM10.04 million for these other rivers. Hence, it was not surprising that the PBAPP and the Penang State Government were extremely alarmed when Kedah State wanted to log the water catchment of the Sg Muda via helicopter logging (The Star, 8 April 2003). According to the Friends of Ulu Muda (FOUM – a loose coalition of NGOs fighting to save the forest from logging), the headwaters of the Sg Muda, viz. the Ulu Muda forest has significant economic values. For example, the economic value of the water resources alone (i.e. water resources generated by the Ulu Muda catchments) could easily total RM1 billion per annum if output generated from the agricultural, industrial and domestic sectors dependent on the water resources are taken into consideration. Water sales in Penang to consumers, 80% of which is sourced from the Sungei Muda, amount to RM100 million for PBAPP Sdn Bhd, with an annual profit of RM50.20 million (in 2002). The Ulu Muda catchment also supplies water to Perlis and Kedah, and water sales in these two states have not been calculated but are expected top be significant as it includes domestic and industrial consumption. The FOUM also estimated that the annual production of rice in the Muda irrigation scheme where the padi planting areas are dependent on water supplied from the Muda, Pedu and Ahning dams, is valued at RM264 million (calculated at 5 tonnes/ha yield for 96,000 hectares at RM 550 per tonne). In addition, the current annual values of fishing and tourism in Ulu Muda are estimated

to be about RM100 million and this significant contribution to the state's economy will be threatened if the logging is allowed to proceed. Sedimentation of the Pedu, Ahning and Muda lakes as a result of logging activities is expected to adversely affect the water quality of the lakes which in turn will jeopardise the livelihood of local boatmen and fishermen. The potential value of eco-tourism activities in the Ulu Muda area is estimated to be much greater in the long-term if the forests are properly protected, compared to the revenue generated from logging activities.

The proposed logging of the Ulu Muda catchment is also a prime example of inequity amongst different stakeholders. Logging would favour the Kedah State Government, but would it be fair and equitable to the Penang State Government, and the Perlis State Government, both of whom also depend on the catchment for water. Even in Kedah itself, the logging would not be equitable to the tens of thousands of padi farmers who depend on the Sg Muda for irrigation. Obviously, logging is likely to result in the loss of forests, fauna and flora. This is not equitable to these environmental attributes.

8 Conclusion

There is no doubt that rivers and their management will be a central issue in the 21st Century, particularly as more than half the world's rivers are "dying". As rivers become more and more polluted, water becomes scarce. This will lead to a dangerous situation whereby countries sharing the same river basin will get into disputes. Already, many countries are fighting over water rights in the Jordan River Basin, the Ganges Basin, the Nile River Basin, the Mekong River Basin, and even within the same countries (fights between states). As this vital resource gets depleted and more polluted, countries may get desperate and even go to war. As such, rivers which are the major suppliers of freshwater for human consumption (including for industries and agriculture), will become central to water availability. As the majority of rivers and their basins are already badly polluted, it is projected that water supply will fall short of demand. This will then put the brakes on future development, especially Malaysia's Vision 2020 to becoming a fully developed nation. Against this background of depleting water resources is the ever looming threat of population increase. All these will lead to more water crises. Malaysia must take stock of this. In fact, many companies have moved into the water sector as they envisage huge water projects and water profits to be earned. The recent WTO meetings were stalled because many developing countries feel that large corporate international water companies will move into their countries to privatise the water sector. In Malaysia, this indirectly means rivers will become important as nearly all our water supply is from surface waters or rivers.

More importantly, we must start taking proactive actions, even sacrifices, to protect, conserve and restore our rivers so that their waters can be sustained for future use. This is where people from all levels ranging from politicians, policy makers, private companies, NGOs to individuals can play an important part. River conservancy and restoration are currently tackled by the authorities. The example of the Sg Klang clean-up programme is encouraging but much needs to be done. For example, Even though the programme had gone through seven years of implementation, there has not been any significant change in water quality in the Klang River as the water for the river is still in class IV. This is where solid waste disposal and rubbish disposal have continued due to poor public response. The government has not really reached the people effectively. The beautification program appears quite successful and is well underway in meeting its targeted objective. Restoration of aquatic life in the river is not encouraging as large stretches remain poor in aquatic life. The authorities have also not tackled the squatter problem effectively although there is this vision by the Selangor State Government and DBKL of not having any more squatters within the basin by the year 2005. Because in-migration from other States as well as from neighbouring countries is expected to increase, squatters are expected to increase rather than decrease in the coming millennium. If we do not tackle the squatter problem and make people more responsible, there is little hope that any clean-up programme will be successful. To restore the Klang River to its once natural state with its full potential, the Government must not work alone. They need to involve NGOs and the people. River pollution and related water problems happens at the local level. Hence, decision-making regarding solutions should be carried out at the lowest appropriate level, ideally involving all stakeholders ranging from government to the private sector, NGOs, the local community and schools. People should be the focus both in decision making as well as active "workers" involved with restoration work. If the people are not involved, they may not co-operate, not because of spite but because they are not aware. The motto of "Malaysia Boleh" (Malaysia Can) is not necessarily limited to the role of government alone.

Finally, more efforts and funding need to be injected to sustain the river clean-up programme. Some loose ends also need to be tightened. More importantly, the programme needs to be extended to all other rivers in the country. Government should also explore the option of working together with NGOs and the people in the cleaning and restoration of rivers. WWP and other NGOs offer an option, an extra tool in which authorities can use effectively to curb water demand. Authorities and water companies must get out of their accustomed role of being the sole-provider to being partners with NGOs and people for the benefit of the country. They can continue to play their pivotal role in water supply management but must increasingly employ a significant portion of their strategies on managing the demand side. While the authorities and water companies can build upon their expertise in the fields of basin-wide planning (especially when basins cut across borders), integrated catchment management, inter-state co-operation and water transfers, legislation on water conservation, enforcement of activities that threaten water resources, more effective pricing that encourages water saving and recycling, greater interaction and co-operation of government agencies in addressing water issues, and wider coverage of awareness through educational programmes in the mass media, they must collaborate and involve the available NGOs with a view to greater effectiveness in sustainable management of our water resources.

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References

1. BUTZER, K.W. (1976). *Early Hydraulic Civilization in Egypt: A Study in Cultural Ecology*. Chicago: Chicago University Press.
2. CHAN, N.W. (1995). "Choice and Constraints in Persistent Floodplain Occupance: The Influence of Structural Forces on Residential Location in Peninsular Malaysia," *Disasters*, 19(4), 287–307.
3. CHAN, N.W. (1997). Mitigating natural hazards and disasters in Malaysia: Lessons learnt from tropical storm greg and its aftermath, in K.S. Jomo (ed.), *Proceedings of the First International Malaysian Studies Conference*, 11–13 August 1997, Kuala Lumpur, Produced in CD Rom.
4. CHAN, N.W. (1998a). "Responding to Landslide Hazards in Rapidly Developing Malaysia: A Case of Economics Versus Environmental Protection," *Disaster Prevention and Management: An International Journal*, 7(1), 14–27.
5. CHAN, N.W. (1998b). Institutional issues for water management in Malaysia, in *Selected English Papers of the Asian Conference on Water and Wastewater Management*, Tehran, *2–4 March 1998*. Tehran: PR Committee of Asian Conference on Water and Wastewater Management, pp. 27–42.
6. CHAN, N.W. (1998c). "The Current Water Crisis: What Went Wrong?" *Aliran Monthly*, 18(5), 14–18.
7. CHAN, N.W. (1999a). *Water Conservation, ReUse and Reduction of Water Use.* Paper presented in the workshop on "Sustainable Management of Water Resources in Malaysia", 20 July, Kuala Lumpur. Organised by Global Environment Centre (GEC), Department of Irrigation and Drainage (DID), National Hydraulic Research Institute of Malaysia (NAHRIM), The Malaysian Water Association (MWA), Environmental Management and Research Association of Malaysia (ENSEARCH), and Selangor Waterworks Department (JBAS).
8. CHAN, N.W. (1999b). "Hill Land Development," in Kerajaan Negeri Pulau Pinang 1999 *Penang Environmental Conservation Strategy: Technical Report: Data, Analysis and Tools*. DCT Consultancy Services Sdn. Bhd. Consultancy Report prepared for the Penang State Government, Pulau Pinang, pp. 84–97.
9. CHAN, N.W. (ed.) (2002a). *Rivers: Towards Sustainable Development.* Penang: Penerbit Universiti Sains Malaysia.
10. CHAN, N.W. (2002b). *Pembangunan, Pembandaran dan Peningkatan Bahaya dan Bencana Air di Malaysia: Isu, Pengurusan dan Cabaran.* Penang: Penerbit Universiti Sains Malaysia.
11. CHAN, N.W. (2003). NGOs and Community Participation in Water Management in Malaysia. Paper presented at the *National Dialog on Effective Water Governance in Malaysia*, 29–30 September 2003, Kuala Lumpur. Organised by Malaysian Water Partnership (MyWP) and Drainage & Irrigation Department Malaysia.
12. CHOP, A.K. and JUSOH, J. (2002). The Klang River Cleanup Programme, in N.W. CHAN (ed.), *Rivers: Towards Sustainable Development*. Penerbit Universiti Sains Malaysia, Penang, 378–389.
13. CHOP, A.K. and TEH, S.K. (1993). Cleaning the Klang River, in *Proceedings International Symposium – Managing of Rivers for the Future (Volume II)*, Department of Irrigation and Drainage Malaysia.
14. DAS, M. (2001). of myths and legends – Rivers. *The Hindu, Sunday Magazine* 1 July 2001.
15. DAVISON, G.W.H. (1995). *Belum – A Rainforest in Malaysia*. Kuala Lumpur: Malaysian Nature Society.
16. DOUGLAS, I (2002). Sediment: A major river management issue, in N.W. Chan (ed.), Rivers: Towards Sustainable Development. Penerbit Universiti Sains Malaysia, Penang, pp. 15–22.
17. GOVERNMENT OF MALAYSIA (2001). *Eight Malaysia Plan*. Kuala Lumpur: Government of Malaysia.
18. KEIZRUL BIN ABDULLAH (2002). Integrated river basin management. in N.W. Chan (ed.), *Rivers: Towards Sustainable Development*. Universiti Sains Malaysia Press, Penang, pp. 3–14.
19. KEIZRUL BIN ABDULLAH and MOHD FADHILLAH BIN Hj. MAHMOOD (1998). "River Management – The Way Forward," Workshop on River Management, Kuala Selangor, 30–31 March 1999.
20. http://agrolink.moa.my/did/river/sgklang/klang_basin.html.
21. http://didnet.moa.my/mywp/.
22. http://genet.cjb.net.
23. http://www.mns.org.my.
24. http://www.pba.com.my.
25. http://www.worldwatercommission.org.
26. http://www.wwfmalaysia.org/projects/forests.htm#fwwl.
27. LOW, K.S. (2003). Effective Water Governance in Malaysia – A Synthesis. Paper presented at the *National Dialog on Effective Water Governance in Malaysia*, 29–30 September 2003, Kuala Lumpur. Organised by Malaysian Water Partnership (MyWP) and Drainage & Irrigation Department Malaysia.
28. RAMAN, M. and SANGARALINGAM, M. (2002). Rivers: Issues and problems in relation to local communities, in N.W. Chan (ed.), *Rivers: Towards Sustainable Development*. Penerbit Universiti Sains Malaysia, Penang, pp. 443–450.
29. NIK HASSAN SUHAIMI NIK ABDUL RAHMAN (1998a). The Bujang Valley, in Nik Hassan Suhaimi Nik Abdul Rahman

(ed.), *The Encylcopedia of Malaysia – Early History*. Kuala Lumpur: Editions Didier Millet, pp. 106–107.

30. NIK HASSAN SUHAIMI NIK ABDUL RAHMAN (1998b). The Kinta Valley, in Nik Hassan Suhaimi Nik Abdul Rahman (ed.), *The Encylcopedia of Malaysia – Early History*. Kuala Lumpur: Editions Didier Millet, pp. 108–109.
31. PARISH, F. (2003). A review of river restoration experience in East Asia. *Paper presented at the East Asia Regional Seminar on River Restoration*, 13–15 January 2003, Kuala Lumpur.
32. PONTING, C. (1991). *A Green History of the World – The Environment and the Collapse of Great Civilisations.* New York: Penguin Books.
33. RAMADASAN, K., SALAM, M.N.A. and PERUMAL, P. (2002). Integrated river basin management: A conservative approach, in N.W. Chan (ed.), *Rivers: Towards Sustainable Development.* Penang: Penerbit Universiti Sains Malaysia, pp. 399–405.
34. RASAGAM, G. and CHAN, N.W. (2002). The role of Non-governmental organisations in public awareness and environmental education towards protection, conservation and rehabilitation of rivers: Some examples from the work of water watch penang, in N.W. Chan (ed.), *Rivers: Towards Sustainable Development*. Penerbit Universiti Sains Malaysia, Penang, pp. 470–480.
35. TAMAI, N. (2003). Principles and Examples of River Restoration. Paper presented at the *East Asia Regional Seminar on River Restoration*, 13–15 January 2003, Kuala Lumpur.
36. *The Star*, Various Issues.
37. *The Sun*, Various Issues.
38. WWF Malaysia, Water Watch Penang, Wetlands International Malaysia and Malaysian Nature Society (2001). "Capacity Building in Integrated Water Resources Management (IWRM): An NGO Perspective." Paper presented at the National Forum – *Capacity Building for Integrated Water Resources Management (IWRM) in Malaysia*, 29 October 2001, Kuala Lumpur.
39. WAN RUSLAN ISMAIL (1995). The Impact of hill land clearance and urbanisation on the hydrology and geomorphology of rivers in Pulau Pinang, Malaysia. Unpublished Ph.D. thesis, University of Manchester, UK.
40. ZHANG, X., YU, M. and YANG, G. (2000). Flood in jing jiang reach of yangtze river, in K.D. Nguyen (ed.), *Ecosystem and Flood 2000*. Hanoi: European Commission (DGXII). Natural Centre for Natural Sciences and Technology of Vietnam, and Minsitry of Agriculture and Rural Development of Vietnam, pp. 11–21.