Integrating Official and Traditional Flood Hazard Management in Malaysia

CHAN NGAI WENG, *Professor, Geography Section, School of Humanities, Universiti Sains Malaysia, 11800 USM Penang, Malaysia*

NOR AZAZI ZAKARIA, *Director, River Engineering and Urban Drainage Centre (REDAC), Universiti Sains Malaysia, Engineering Campus, Seri Ampangan, 14300 Nibong Tebal, Penang, Malaysia*

AMINDUDDIN AB GHANI, *Deputy Director, REDAC, Universiti Sains Malaysia, Engineering Campus, Seri Ampangan, 14300 Nibong Tebal, Penang, Malaysia*

TAN YEN LIAN, *Postgraduate Student, School of Humanities, Universiti Sains Malaysia, 11800 USM Penang, Malaysia*

ABSTRACT

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 In terms of flood management, Malaysia's predominant official strategy is based on a technology-centred approach emphasising the application of new technologies in flood control, forecasting, warning and evacuation systems. 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, significantly reducing flood loss. 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 that are far from being infallible. With both official as well as traditional systems working in tandem, flood-loss reduction can be maximised.

This paper discusses how traditional flood management mechanisms that have been developed and used for centuries can be integrated into official flood management strategies for greater overall effectiveness in the management of flood hazards in Malaysia.

Keywords: Traditional Flood Management; Official Flood Management; Flood Warning; Public Participation; Structural Flood Measures; Non-Structural Flood Measures; Flood Loss; Malaysia.

1 Introduction

Malaysia has a long history of flooding, the country being exposed to monsoon winds

and heavy convectional rainfall all year round rendering more than about 10 % of the country being flood-prone. In the rural areas where farming is the main economic activity, the rainy season and seasonal flooding is in fact good for padi cultivation. Flood plain occupants in such areas are well adapted to floods. However, the occurrence of flood hazards in urban areas, especially flash floods, is considered a sign of unsustainable development. This is largely due to rapid development (often haphazard) of urban floodplains such as those in Georgetown, Kuala Lumpur and Kota Bharu (Chan, 1995a). The replacement of natural forests with impervious urban areas result in almost all the rainfall entering the rivers in a shorter time. This reduces the capacities of most rivers to drain away excess water. Rivers in urban areas are very constricted and development literally comes to the rivers' doorstep, i.e. up to their banks. There is no buffer zone or river reserve leaving rivers no room to manoeuvre. Hence, reducing their drainage capacities. Furthermore, rapid urbanisation of urban floodplains and upstream development of hill land have changed surface characteristics and altered the hydrological cycle, particularly the time in which rain drops enter the rivers and the volume of runoff. Hill land development is a form of unsustainable development which often results in accelerated soil erosion and landslides, two forms of environmental hazards. Soil erosion leads to sedimentation and siltation of rivers, contributing to increasing flood hazards of more severe magnitudes.

Malaysia is a rapidly developing country. Science and technology are eagerly employed in all fields. In the area of flood mitigation, new technological innovations are routinely used and the Malaysian official approach to flood mitigation has always been in line with a technological approach via 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. For example, remote sensing technology using satellite pictures, radar imageries and aerial photographs is being applied to monitor and predict floods. High-tech computer modelling is also employed in this area. Undoubtedly, such developments, if applied properly can effectively reduce loss of life, livestock, crops and property damage. However, the application of high-tech solutions is only one side of a coin. These technologies can only be successful if the other side of the coin, i.e. the public/victims respond effectively to flood warnings and react positively. Often, sophisticated (imported) flood warning and evacuation systems (FWESs) are alien to the public who are accustomed to traditional FWESs. Hence, if the public are not properly coached and briefed about the new FWESs, then there are bound to be scepticism, confusion and even inappropriate responses. This will eventually lead to lack of confidence in the costly new technologies, rendering them utterly useless (Chan, 1995b). In many cases, such confusion and mistrust of the new systems have even led to greater flood loss as in several cases of mistrust of the solar sirens in Georgetown (Penang State) and Kampong Dato' Keramat (Kuala Lumpur). In contrast, traditional FWESs 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 (Chan, 1999).

In Malaysia, the government is expected to be the sole provider of flood protection. However, centuries of experience of living with floods have made the majority of

Malaysians "flood-wise". Hence, the majority of flood-prone victims living on the flood plains have developed some forms of flood mitigation and flood-loss reduction methods (Chan, 1995a). Chan and Parker (1996) have also shown that the amount of loss-reduction accruing from the use of traditional methods of flood mitigation can be significant. Often, the amount of loss-reduction (i.e. money saved) can determine whether or not a farmer can recover fast enough to resume planting the next season's crop. Indeed, in many poor families, successful loss-reduction may mean quicker recovery and hence a better standard of living. In the case of unsuccessful loss-reduction, a farmer or trader may be plunged into greater depths of debts which he/she may take a long time to repay. Hence, many families without sufficient traditional knowledge of flood loss reduction never really recover from the effects of a severe flood (Parker, et. al., 1997). This underlines the importance of traditional flood mitigation strategies being used vis-à-vis the official strategies.

2 Official Flood Mitigation Measures Versus Traditional Measures

In Malaysia, official flood management is predominantly focused upon flood control measures classified as "Structural Flood Mitigation Measures", i.e. mostly on construction of large artificial structures to control floods. Unofficially, however, the public have evolved traditional measures to reduce losses as well as adaptation to floods. It is recognized by the flood authorities that a comprehensive method employing both structural and non-structural measures would be hugely beneficial. However, politics and economic considerations often significantly reduces the application of non-structural measures and this has limited overall effectiveness (Chan, 1999).

2.1 Official Structural Measures

Chan (2002) has discussed in detail the many structural measures currently employed by the flood authorities in Malaysia. These include: *River Improvement* involving regularly dredging and deepening major river channels, preventing the dumping of rubbish into the rivers and clearing of rubbish and other obstacles such as tree trunks, boxes and oil drums in the rivers to ensure smooth and swift flow. Year-round channel improvement of certain stretches of major rivers which are flood-prone is also necessary. This includes channel deepening, widening and straightening. The construction of *Embankments* is used to control bank erosion (Figure 1). River meanders exposed to severe erosion are protected by the construction of walls of bamboo/wooden tree trunks or cement/concrete walls. This reduces rates of river bank erosion which contribute towards siltation and the reduced discharge capacities of rivers. Currently, the town of Teluk Intan which is located on a meander of the Sungai Perak, is somewhat protected by such a measure. *Tidal Gates* are effective on smaller rivers and can serve both as a barrier to high tide as well as to assist in irrigation. Tidal gates in Malaysia are used extensively across many river mouths and are effective for controlling tidal flooding.

Figure 1 River embankments along the Sg Kelang.

The improvement of *Urban Drainage* in urban areas such as towns and cities have reduced flooding in urban areas. Additionally, clogged drains are periodically cleared to ensure no blockage of free flow. Furthermore, the drainage capacities of urban drains in cities and towns are improved by widening, deepening and enlarging the existing network. There is also a need to construct more storm drains/monsoon drains in frequently flooded areas. *Diversion/Relief Channels* are constructed upstream of frequently flooded locations. These channels can be closed at normal flow but opened during high flows to siphon off a substantial amount of discharge elsewhere. Relief channels allow excess water to be drained away, thus averting flooding. Such channels can drain a substantial volume of discharge and relieve pressure on main rivers. The use of *Underground Drainage* has worked in cases where surface drains are inadequate or where the improvement of surface drains are not feasible should not be overlooked. This is the case in Georgetown where the low elevation and already constricted river and artificial drains are inadequate for effective flood control. *Retention Ponds* are commonly constructed along flooded rivers as low-lying areas along rivers can be easily converted into retention ponds which siphon off excess discharge during high flows, thus reducing the probability of floods. During normal times, the retention ponds can be used as playing fields (when dry) or maintained as scenic shallow lakes which contribute to the aesthetic aspects of river corridors (Figure 2). The *Installation of Water Pumps* has been successful in highly flood-prone areas, water pumps can be installed at strategic points along a river stretch. These pumps can be activated either manually or automatically when the river rise to certain pre-determined critical level. In critical localities such as large urban centers which act as administrative and commercial, permanent pump houses need to be constructed at strategic locations. Such pump houses should be connected to pipes which drain directly into the sea.

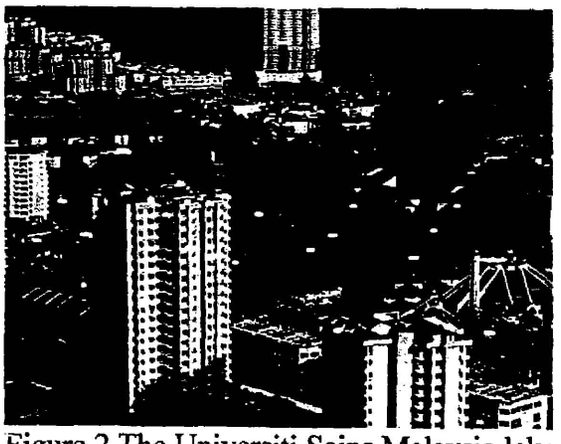

Figure 2 The Universiti Sains Malaysia lake is an example of a flood retention pond.

Of all the structural measures, the construction of *Multi-purpose Dams* has been most popular. Dams have been known to be effective as in the case of Kenyir Dam in Terengganu, which has effectively reduced much of the flooding downstream of Sg Terengganu. However, dams are expensive and cause a great deal of environmental problems. They also have a life span and pose serious dangers to downstream populations, both humans and others. More recently, the government has advocated the construction of *Flood-Proof Buildings*, a measure that has been found successful in many countries. Flood-proofing of properties, public and private, is effective in reducing flood loss. In Malaysia, the traditional Malay stilt-house is a good example of a flood-proofed property (Figure 3). Many apartments and flats can be flood-proofed by having a ground floor only for parking. Government buildings can also be made flood-proofed. Finally, *Bunds* (earth, stones, concrete, etc) are used extensively along the coast in Malaysia. Initially, bunds were built to keep out the sea, mostly for reclaiming agricultural land. Increasingly, however, many towns areas need to be protected by bunds. Some notable examples are Pekan and Teluk Intan. Perhaps the most well

known country using bunds (dikes) to protect itself from sea flooding is Holland.

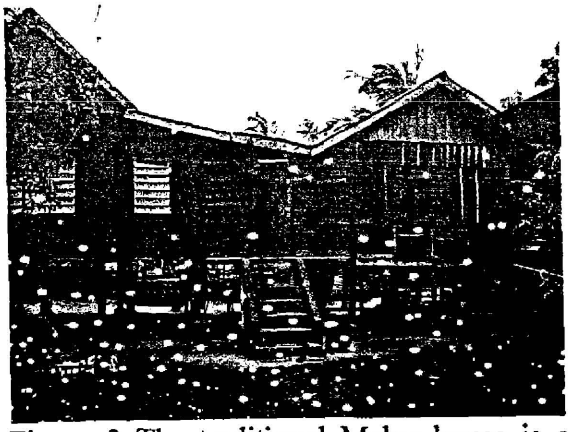

Figure 3 The traditional Malay house is a good example of a flood-proof structure.

2.2 Official Non-Structural Measures

Non-structural solutions to flood reduction are those that do not require the construction of large artificial structures. Hence, they do not involve large-scale concrete structures that are damaging to the environment and natural ecosystems. Because of this, they are less expensive than structural ones (which usually need heavy capital expenditure) and can be used to supplement existing structural measures. Non-structural measures are usually environmentally friendly and are built so that they blend in with the environment and make use of environmental attributes (for example using existing wetlands as retention ponds rather than constructing artificial concrete-lined ponds) can also be quickly implemented as compared to the construction of dams and reservoirs which may take years. In Malaysia, there are many non-structural measures which can be applied effectively.

Legislation can be used to control land use, development and environmental degradation. In Malaysia, while there are many laws relating to flood control such as The Land Conservation Act 1960 (aimed at protecting soil erosion and silting, hence prevents downstream flooding), the Drainage Works Ordinance 1954, Street, Drainage and Building Act 1974, Mining Enactment 1929, Irrigation Areas Ordinance, and the Housing Development Act (Licensing and Control) 1965, non of them deal directly with flood protection or flood control. There is, therefore, a need to pass a new Flood Act, Flood Enactment or a River Law which deals directly with flood protection and control (Hj Keizrul Abdullah, 2002). In relation to flood legislation, Chan (2002) has noted that the Drainage and Irrigation Department (DID) has very little power when it comes to evaluation of development projects that have a flood component. The *Gazettement of Forest Reserves, River Reserves and Parks* is also necessary to control floods. Forest reserves should be enlarged and more gazetted while preserving and maintaining all existing ones. The authorities should also *Freeze All Developments of Hill Land.* Developers are not the only ones who contribute to floods. Squatters and illegal farmers occupying hill slopes are just as much to be blamed. The authorities should impose and enforce a hefty fine for those found to illegally occupy hill slopes, whether for housing, agriculture or other activities. Relocate these people where necessary.

Public Education and Awareness Campaigns can help reduce flood losses. The public should be made more aware of warning systems and should be taught to respond effectively to such systems. Even the most sophisticated warning systems would be of little use if flood victims do not heed the warnings. Flood awareness, preparedness, warning and evacuation programmes must be aired regularly, especially just before the rainy season on television to educate the public and teach them how to respond effectively to floods. The government should air public awareness and educational programmes related to flood control over television and radio. Another important measure is the *Relocation of Riverine Communities.* One

of the main reasons why flash floods still occur in many urban centres is due to the long delays in completing flood mitigation works. The acquisition of land, resettlement of affected residents and relocation of squatters have been problematic. Gazettement of *Green Belts* should be made mandatory for developers to plant grass and other cover vegetation in all vacant areas of development schemes, reserving at least 30 % of the developed area for parks and vegetation, irrespective of whether it is housing, commercial, industrial or otherwise. Environmental Impact Assessment has been a problem area to enforce. The use of *Macro EIAs* which covers effects not only in the developed area but also downstream and other adjacent areas is an alternative. The government should encourage the setting up of independent EIA consultants as non-profit organizations.

The authorities should also look at *Improvement of Flood Forecasting*. Currently, the flood forecasting systems employed are not state-of-the-art systems. Admittedly, telemetric rainfall and river level stations are being used more extensively than ever but these can only detect the rainfall once it has reached the gauges or the river. This does not leave enough time to issue effective warning. The objective is to set-up a real-time state-of-the-art Flood Forecasting System employing computer modelling which can use rainfall estimated data via radar and satellite. As such, the rainfall is forecast before it reaches the ground and the river, giving ample time for the issuance of warning. In line with the above, there should be *Improvement of Flood Warning Systems*. Chan (1995c) has shown that existing flood warning systems are largely inadequate and should be upgraded. The current official flood warning and evacuation systems are a form of official non-structural measure, but it is a re-active rather than pro-active tool in disaster management.

3 Traditional Flood Hazard Response Systems

Malaysians living in floodplains are accustomed and well-adapted to floods. Mots riverine and floodplain dwellers have developed traditional adaptations and responses to reduce the effects of flooding. These responses have been effective but their extent is generally limited because they are fragmented and uncoordinated. However, by incorporating these traditional systems into official systems would greatly reduce flood losses. Realising this, the Malaysian government is currently moving towards a comprehensive approach involving the people and incorporating their traditional knowledge and systems into the modern sophisticated systems of flood management.

One of the commonest failures in disaster management concerns the lack of understanding (often by governments) of the social and cultural/traditional mitigation measures of the local community (Davis, 1985). The sociological literature on hazards recognizes the importance of traditional response to hazards (Douglas, 1992). Modes of human response to hazards synthesised by Burton et al. (1993) also recognises cultural adaptation, and suggests that the roots of decision-making in the face of potential hazard may be deeply embedded in traditional formations (Horlick-Jones and Jones, 1993). One's cultural background is, therefore, a structural influence which shapes one's perception as well as behaviour in response to hazards. Often, despite having the most sophisticated and modern response systems, overall disaster reduction is ineffective largely because the people at the grassroot level (i.e. the victims) do not understand these modern systems and hence do not know how to response effectively to them. The saying "You cannot teach an old dog new tricks" is very true as people (especially the older ones) are used to old

ways, and these old ways are often very effective.

The capacity to anticipate, cope with, resist and recover from the impact of flood hazards depends largely on an individual or household's adaptability and resilience. Many Malaysian families have lived on floodplains for centuries and have evolved many responses to reduce and mitigate flood hazards. Generally, the more resilient and innovative ones (in terms of adaptations) are less vulnerable because they have a greater capacity to withstand floods. Adaptation to extreme environments (including flooding) is inherently a human survival trait. Hence, over centuries, Malaysian communities living on floodplains have evolved many adaptations and have learnt to respond positively towards flood hazard reduction. Like their perception, individual response in terms of strategy adoption is strongly moulded by cultural forces. Indigenous Malays, the majority of whom are still predominantly living in areas affected by seasonal floods, are more exposed to flood hazards than other Malaysians who live the cities and towns (Chan, 1997a). Because of higher levels of exposure to flood risks, floods have become and still are an integral part of Malay culture and an accepted part of their lives.

Disasters often act as "agents of change", resulting for example, in innovations in hazard-resistant architectural and construction designs (Davis, 1983). In Malaysia, probably the most unique adaptation that has evolved in response to flood disasters is the Malay stilt house. The stilt house originally evolved as an adaptation to the occupation of swamp-land and frequent flooding in riverine/coastal areas (Chan, 1997b). This permanent form of flood proofing is still predominant in the traditional rural areas where frequent flooding is prevalent. Another common form of traditional adaptation is that of "clustered houses" joined by wooden walk-ways which are stronger against fast river currents during flooding.

Rumah Rakit or literally "Raft Houses" are yet another unique form of traditional adaptation to flooding (Figure 4). These houses are built on rivers and rise and fall with the river level. Generally, these houses are safe during normal times and minor floods. However, during severe flooding where rivers currents are strong, the houses can be swept away. Some traditional Malay houses are in fact "portable". In Kelantan State, some villages have wooden houses that can be carried and moved like a sedan chair. During the dry months, these houses are located near to rivers for accessibility but during the monsoon months (November to March), they are moved to higher grounds to prevent flooding. Other traditional forms of architecture built to defend against flooding are as follows: the raising of the floors by successively building higher levels over existing ones; planting trees in front of houses to reduce the impact of river currents during flooding; piling tree trunks along erosive banks of rivers, also to reduce impact of river currents; building annexes and livestock barns (e.g. chicken coops) in the path of river currents; canals are also a form of adaptation; and concrete or cement flood barriers surrounding houses (including thresholds at the doors) can prevent moderate flooding.

Figure 4 Raft houses along the Sg. Kelantan.

The use of the *Sampan* or Malay canoe has probably saved many lives during the course of Malaysian history. This is the predominant traditional mode of transportation in rural villages. It also doubles up as the major means of livelihood as fishermen use them to go out to the river and the sea for fishing. In times of flooding, villagers will use the sampan to bring their family to safety by paddling downstream. Incidentally, sampans have been used as a means of conveying flood warning to downstream villagers when the river level at a certain upstream village has reached a critical level. Now, many sampans are equipped with a motor and this has markedly increased their speed and effectiveness.

In rural villages, especially where padi farming is the main occupation, the locals have double use for their farming lots, i.e. the padi fields. The fields are usually located much lower than the land on which houses are built because wet padi needs to be inundated by water all the time (except during harvesting when water from the fields are drained). Fields are also located on the lowest land for the purpose of irrigation. Hence, when the rivers overflow their banks, padi fields act as a form of retention ponds. School fields, fish ponds and man-made lakes are all forms of traditional retention ponds employed by villagers long before engineers designed artificial retention ponds were used. For example, in Kedah State which is the "rice bowl" of the country, thousands of hectares of padi fields act effectively as retention ponds to reduce the risk of downstream flooding. Irrigation canals along the padi fields also provide a form of diversion and drainage of excess water from the river.

The locals have also used "traditional flood gauges" for river level to make decisions with regard to issuance of flood warning and evacuation notices. In Kuala Krai town in Kelantan State, locals have built a series of steps from the bank of the Kelantan River all the way down to the river. This is now famous as the *Tangga Krai* or Krai Steps (Figure 5). These steps were previously made of clay and hardened sandstone but have now been replaced by more permanent concrete. The villages can read the level of the river simply by noting the number of steps inundated by the river. Through past experiences, a certain critical level whereby flooding is most certain to occur is determined. This step at which this critical level is reached is painted red.

The life saving benefits of timely evacuation before the onset of disasters are well documented (Smith 1992:277-8; Alexander, 1993:413-4). In Malaysia, tens of thousands of people are routinely evacuated during the seasonal monsoon floods which hit many parts of the East Coast every year. An effective Flood Warning and Evacuation System (FWES), therefore, is a pre-requisite for effective flood loss reduction (in terms of lives saved) and increased flood damage savings (in terms of reduced property damage). The overall effectiveness of FWESs depends not only on government official FWESs but also traditional FWESs which have evolved through generations of flooding. This type of informal traditional warning and evacuation mechanism has worked well, mainly because local expertise and self-reliance are employed as important inputs. Supplemented by modern technology such as the telephone and the use of sirens (to warn villagers), informal FWESs are used effectively by many kampungs in the east coast of Peninsular Malaysia. This is because the mechanism is an 'active' system whereby people can actually see the flood and they need little convincing to take responsive action to save their lives and those of their families. Traditional FWESs are also effective because affected people (victims) have used them for generations and are accustomed to as well as have faith in them.

Figure 5 The "Tangga Krai" a flood warning structure.

4 Conclusion

Addressing flood issues in Malaysia is not solely for flood loss reduction. In fact, flood disasters are closely linked to poverty and underdevelopment in many areas in the country. The government is keen to reduce flood loss but the many official responses employed hitherto have been responsible for reducing some of the impacts of flooding, they have not been entirely successful in the overall management of floods. This is largely due to a lop-sided (heavily biased) structural approach based on large-scale artificial measures which are inherently limited in effectiveness simply because they exclude the benefits of other approaches. The majority of the official response is also based on evacuation, relief and rehabilitation, which is a reactive approach. Coupled with the low salience of floods on government agendas *vis-à-vis* economic and industrial development, competition and lack of interaction amongst government agencies dealing with floods and the bureaucratic nature of government agencies, flood hazard reduction has not been as effective as it ought to be.

Admittedly, the Malaysian flood management authorities, viz. the DID is evolving and has become more open to ideas from other fields. In recent years, the DID has developed what is in fact the opposite of its flood management approach. It is now advocating retention of rainwater at source in contrast to its previous "drain as fast as possible" motto. By this, the DID has taken a proactive step by introducing a New Urban Drainage Manual known as Storm Water Management Manual for Malaysia (MSMA). The MSMA is based on the concept of "Retention of rainwater at source" by controlling stormwater via encouraging natural retention by vegetation and infiltration. This method not only reduces the quantity of runoff but also maintains the water quality of the runoff. The MSMA will help ensure that the drainage capacity of receiving rivers is not exceeded during rain storms. It should be noted that the MSMA is not a large-scale artificial or structural method. Rather, it is a soft-engineering method which is built into the surrounding landscape and environment. It is also environmentally friendly and safe (as there are no open drains). As such, the MSMA can even be considered as a combination of semi-natural non-structural measure, even though some minor construction of underground drainage and retention ponds are carried out.

As a complement to the MSMA, the River Engineering and Urban Drainage Research Centre in Universiti Sains Malaysia has introduced the innovative the "Bio-Ecological Drainage System (BIOECODS)" (Nor Azazi Zakaria et al., 2004; Aminuddin Ab Ghani et al., 2004). The USM Engineering Campus is built with the BIOECODS and is used by the DID as an example or a pilot project of an ecologically sustainable development highlighted in the MSMA. Results indicate that the BIOECODS is highly successful in flood mitigation as the campus was not flooded in several flood events when neighbouring areas were totally inundated. As recognition of this highly successful innovation, BIOECODS was awarded the CIDB Merit Award in 2001.

Obviously, merely relying on structural and non-structural measures to address floods would be limiting. The flood authorities should also address the issue of flood management policies, socio-economic aspects of flood management, flood loss estimation, and improve both flood forecasting and flood warning systems, as Chan (1995) has demonstrated that the occurrence of floods is not necessarily due to causes inherent in the natural system but is in fact due to a negative interaction between the human use system and the natural system. Flood management needs to be cross-disciplinary and comprehensive. Flood hazard management in Malaysia can only be tackled effectively via a comprehensive approach incorporating structural and non-structural flood mitigation methods, as well as integrating traditional flood adaptation strategies into the official system. In this respect, other experts in the design and use of traditional housing (especially Malay houses with stilts) can be extremely useful to alleviate flood losses. This is where the CIDB and local authorities (for example PDC and PKNS, two local agencies that build houses) can institute building codes into new houses that include rainfall harvesting and the MSMA drainage system. Addressing floods, a water hazard, is vital if Malaysia aims to move forward in other areas of development. If not, flood hazards will continue to put a tremendous strain on the country's economy, exacerbate poverty and income inequity, and delay the country's target of becoming a developed country by the year 2020.

Finally, the fact that the authorities have not totally exploited the usefulness of a rich variety of traditional flood reduction mechanisms which they can incorporated into official systems. This has led to, among other things, the reluctance of flood victims to cooperate and respond effectively to official FWESs. Comprehensive flood hazard management in Malaysia can only be tackled effectively if the victims themselves are convinced that official response systems really work. More importantly, traditional systems in which the victims are used to must be incorporated into official systems for it to work. Effective flood hazard management requires a more "pro-active" or preventive approach whereby both modern and traditional mitigation strategies (both structural and non-structural) are employed side by side. This is vital if Malaysia is to successfully manage flood hazards effectively. If not, flood hazards will continue to put a tremendous strain on the country's economy, exacerbate poverty and income inequity, and delay its efforts in becoming a newly industrialising country (NIC) by the year 2020.

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