Chapter 12
Impacts of Disasters and Disaster Risk Management in Malaysia: The Case of Floods

Ngai Weng Chan

1 Introduction

As floods are the single most severe of all disasters in Malaysia, the chapter specifically focuses on flood disaster management. This is followed by an emphasis on ex post and ex ante analysis of the past and potential socioeconomic impacts of flood disasters in Malaysia. This chapter then reviews and assesses the effectiveness of the Malaysian government's flood disaster management system with respect to risk identification, emergency preparedness, institutional capacity building, risk mitigation, and catastrophe risk financing. A detailed discussion on the current constraints that prevent people from engaging in post-disaster supports follows. Finally, the chapter ends with policy recommendations for reforms at the national level and explores the prospects for regional cooperation framework in disaster management.

1.1 Overview of Disasters in Malaysia

Malaysia lies in a geologically stable region which is free from earthquakes, volcanic activities, and strong winds such as tropical cyclones which periodically affect some of its neighbors. It lies geographically just outside the "Pacific Ring of Fire." It also lies too far south of the major typhoon paths, although tail-ends of tropical storms have occasionally hit it. However, that does not mean Malaysia is totally "free" from natural disasters and calamities, as it is often hit by floods, droughts, landslides, haze, tsunamis, and human-made disasters (Parker et al. 1997). Annually, disasters such as floods account for a significant number

N.W. Chan (✉)
Universiti Sains Malaysia, Pulau Pinang, Malaysia
e-mail: nwchan@usm.my

D.P. Aldrich et al. (eds.), *Resilience and Recovery in Asian Disasters*, Risk, Governance and Society 18, DOI 10.1007/978-4-431-55022-8_12

of casualties, disease epidemics, property and crop damage and other intangible losses (Chan et al. 2002a).

In the past few decades, the country has experienced various extreme weather and climatic events, including El Nino in 1997 (which led to severe droughts), La Nina in 2011 and 2012 (which brought floods), freak thunderstorms almost every year (which brought wind damage, flash floods and landslides), monsoonal floods (which brought about heavy losses, including loss of life in many parts of the country exposed to monsoon winds), and haze (which brought about poor air quality, extreme heat and drought). Monsoonal floods are an annual occurrence which varies in terms of severity, place and time of occurrences with a recent 2010 flood in Kedah and Perlis being among the worst flood ever experienced by the country. The total economic loss and the financial burden on the government were enormous. When two or more of these events coincide such as the "Terrible twins" (La Nina and the monsoon season) that hit the federal capital of Kuala Lumpur and Selangor in December 2011, the damage is compounded (The Star 2011). The haze phenomenon in 1997/1998 also caused significant problems due to losses in tourist income, health effects and hospitalization costs, and mitigation losses (Kunii et al. 2002). More recently, the 2005 haze episode in Malaysia was a week-long choking haze (at its worst on August 11) that affected mostly the central part of Peninsular Malaysia. The air quality in Kuala Lumpur was so poor that health officials advised citizens to stay at home. The event also led to crisis talks with Indonesia and caused widespread health effects and inconvenience (Ahmad and Hashim 2006). The Asian Tsunami which hit in December 2004 was also very severely felt on the coasts of Peninsular Malaysia, most notably in Penang, Kedah, Perlis and Langkawi (Chan 2009). Due to Malaysia's wet equatorial climate regime with frequent heavy rain storms of high rainfall intensities, landslide disasters are common. In recent decades, landslide disasters in the Klang Valley Region and elsewhere have caused significant loss of life, property and infrastructure damage, environmental destruction and anxiety (Chan 1998a; Periasamy 2011).

Arguably, of all the disasters in Malaysia, floods are most frequent and bring the greatest damage annually. In 1996, floods brought by Tropical Storm Greg in Keningau (Sabah State), claimed 241 lives, caused more than USD 97.8 million damage to infrastructure and property and destroyed thousands of houses. In 2000, floods caused by heavy rains killed 15 people in Kelantan and Terengganu, and caused more than 10,000 people to flee their homes in northern Peninsular Malaysia. The December 2006/January 2007 floods in Johor caused 18 deaths and USD 489 million in damage. In 2008, floods occurred in Johor again, killing 28 people and causing damage estimated at USD 21.19 million. In 2010, the floods affected transportation in and around Kedah and Perlis, shutting down rail, closing roads including the North-South Expressway (The Star 2010c) and the airport in Kedah's capital city of Alor Setar leaving helicopters as the only mode of aerial transport into Kedah and Perlis (The Star 2010d). Water supply in Kedah and Perlis was contaminated, forcing these two states to seek supplies from their neighbor Perak (Bernama 2010a). Kedah and Perlis are the "Rice Bowl" of Malaysia, and the floods

destroyed an estimated 45,000 ha of rice fields with the government pledging USD8.476 million in aid to farmers (in both states (Bernama 2010c).

1.2 Literature Review

1.2.1 The Top-Down Government-Centric Model

Historically, disaster management in Malaysia has commonly been considered as a government function and is largely based on top-down government-centered machinery (Chan 1995). At the very top, the government agency responsible for disaster management (all sorts) is the National Security Division (NSD) under the Prime Minister's Department. The NSD is therefore responsible for coordinating activities related to the preparation for, prevention of, response to and handling of disasters, basically referring to natural and technological disasters. Currently, the handling and resolving of disasters in Malaysia are managed via the Committee System which emphasizes the concept of coordination and mobilization of agencies involved, in an integrated and coordinated manner. At the highest Federal level, the National Disaster Management and Relief Committee (NDMRC) is in charge of managing and handling national-level disasters. State-level disasters are managed by the State Disaster Management and Relief Committee (SDMRC). At the third level, district-level disasters are managed by at the District Disaster Management and Relief Committee (DDMRC). At the lowest village level, village-level disasters are managed by the DDMRC with inputs from the village committee.

All these committees at various levels are integrated via "Vertical Coordination" (e.g. between FDMRC and SDMRC) as well as via "Horizontal Coordination" (e.g. between the State Police Department and the State Drainage & irrigation Department). The above disaster management mechanism has been widely applied in flood disasters which is the major type of disaster affecting the country (Chan 2011). Before the country went through modernization and industrialization, there were also meteorological disasters, strong winds, rain-induced monsoon floods, and other natural disasters. However, since independence in 1957, other kinds of disaster have been experienced, such as fires, explosions, structural collapse, landslides, biological/disease-related disasters, flash floods and landslides caused by slope disturbance resulting from human activities. According to Yusof (n.d.), Malaysia has transformed radically from an agrarian economy to a modern industrialized nation. This rapid process of development and transformation has given rise to the occurrence of a range of man-made disasters that are considered as "landmark" disasters whereby various safety and emergency acts and regulations were proposed, amended or formulated, resulting also in the formation of specialized teams in disaster management. This government-centric approach is employed to address both the physical/natural (Sham 1973) as well as the human aspects of flood management (Leigh and Low 1983).

1.2.2 The Technocentric Model

In terms of flood disasters much of the relevant research literature reflects a technocentric approach which strongly emphasizes the use of structural/engineering methods in addressing floods (Chan 1995). Consequently, it is not surprising to find that the bulk of the literature on flood studies in Malaysia is largely focused on the field of engineering and hydrology. Some notable examples are Volker (1971), Drainage and Irrigation Department (1973, 1974, 1976), Japan International Cooperation Agency (1989, 1991), Syed Mohammad et al. (1988), Julien et al. (2010) and Ab. Ghani et al. (2012). Such an approach is central within the "Society over Nature" school of thought, or technocentricism, which asserts that science can solve all flood problems. This cannot be further from the truth in an ever-changing world, especially in the context of rapidly developing Malaysia. Despite the fact that technology plays an important role in flood hazard management, it is a fallacy that it can provide the means of total protection against all floods. In fact, Jones (1991) has observed that technology can increase vulnerability to floods.

1.2.3 The Natural Science Perspective

Against the background of the technocentric approach is the "natural science perspective," which is essentially the natural scientist's explanation to the occurrence of flood hazards. Alexander (1993) states that this approach focuses on how natural processes in the "Earth-Atmosphere System" create hazards. This approach also takes into account the importance of society in altering the physical processes, but the flood hazard is principally attributed to the natural causes (e.g. monsoon winds and rains). Some good examples of the natural scientist's approach to flood hazards in Malaysia are Chan (1998b) and Lim (1988). The natural science perspective is essentially a "tech-fix" approach, although in recent years it has incorporated ecological, biological, environmental and sustainability considerations. Because of its emphasis on technology as a means of alleviating hazards, it has often been criticized as being too narrow an approach. No field of science can predict the occurrence of hazard events with any level of certainty. Studies by others have also shown that disasters occur because of other factors such as the misapplication of technology, institutional ineffectiveness, warning ineffectiveness, and hazard generating socio-political systems (Winchester 1992).

1.2.4 The Organizational Perspective

Another flood disaster management approach is that of the organizational perspective, originally an approach used by organizational analysts in explaining hazards. This approach focuses upon the ways in which organizations such as government agencies, private companies, NGOs and other civil society voluntary bodies tackle

hazards. Disaster managers in the field of economics, geography, systems analysis, planning and sociology who are concerned with "collective behavior" and "collective decision-making" are probably responsible for this perspective (Parker 1992). The role played by organizations cannot be underestimated because they are powerful and influential. The argument is that organizations may contribute in one way or another to the creation or worsening of hazards. Turner (1978) examined hazards arising out of organizational inefficiencies. Reasons for failures include organization inefficiencies (within and outside), existence of organizational "sub-cultures" which lead to "collective blindness" to the hazard, "organizational exclusivity", poor information dissemination and others. Handmer and Parker (1991) have documented the tendency for organizations to "groupthink," resulting in the narrowing of options, and noted the existence of a high level of secrecy amongst the bureaucracy of government organizations, all of which hinder emergency planning. In Malaysia, the organizational approach has been studied by Chan (1997a), who found that organizations tend to protect and safeguard self-interest rather than expose their weaknesses.

1.2.5 The Vulnerability Model and the Structural Paradigm

Vulnerability to flood disasters in Malaysia is another approach (Chan 2000). The study of disaster vulnerability originated from the "Structural Paradigm" in which disasters were believed to be subject to cultural, social, economic and political forces (Torry 1979). In developing countries and poor countries, it was discovered that broader structural forces (local and national) were more powerful and pervasive than local factors in affecting the outcome of hazards and disasters (Wadell 1983; Hewitt 1983). This radical view gave a new insight that went beyond the conventional geophysical cause of hazards and disasters. More recently, the recognition that structural forces at the international level can strongly affect local vulnerability has resulted in an expanded version of the structural paradigm, known as the "political economy paradigm" or the "political ecology perspective of hazards" (Blaikie et al. 1994; Varley 1994). All these approaches to disasters are essentially "structuralist" views that link social relations to disasters and are rooted in Marxist political economy. In Malaysia, Chan (2000) has used this paradigm to study flood hazards, and has proposed measures to reduce the exposure of people to flood hazards and also to reduce people's vulnerability to floods. Chan (1996) has found that vulnerability to flood disasters in Malaysia is not solely influenced by poverty, but more importantly by awareness, perception, attitude, experience, length of residence and social relations (Jamaluddin 1985).

2 Flood Disaster Risk in Malaysia

Malaysia is a country very prone to flood risks, mostly by nature of its physical (e.g. topography and drainage) as well as its human geography (e.g. settlement and land use patterns). The combination of natural and human factors has produced different types of floods, viz. monsoon, flash and tidal (Chan 1998b). Malaysians are historically a riverine people, as early settlements grew on the banks of the major rivers in the peninsula. Coupled with natural factors such as heavy monsoon rainfall, intense convection rain storms, poor drainage and other local factors, floods have become a common feature in the lives of a significant number of Malaysians. Monsoon and flash floods are the most severe climate-related natural disasters in Malaysia, with a flood-prone area of about 29,000 km^2 affecting more than 4.82 million people (22 % of the population) and inflicting annual damage of USD 298.29 million. With annual heavy monsoon rains averaging more than 3,000 mm and such a large flood-prone area, flood risk is indeed high, most notably in riverine areas and coastal flat lands. With such a large population living in flood-prone areas, flood exposure is high as well. Because of such high flood risks and exposure, the Malaysian Government is forced to spend a huge amount of its annual budget to mitigate against floods.

According to Hj Ahmad Hussaini, the Director General of the Drainage and Irrigation Department of the government of Malaysia, there are two major water-related problems affecting this country. These are excess water (floods) and water shortage (droughts). Both these problems have disrupted the quality of life and economic growth in the country and can result in severe damage and loss of property, and occasionally loss of human lives, as can be seen in the December 2006 and January 2007 floods in Johor (Hussaini 2007). Floods occur annually in Malaysia, causing damage to property and loss of life. It is useful to distinguish "normal" from "major" flood events. "Normal floods" are seasonal monsoon floods (November to March) whereby the waters do not normally exceed the stilt height of traditional Malay houses. Thus, people living in stilt houses in the rural areas are well adapted to normal floods. It is the major floods, which are "unusual" or "extreme" events that render people helpless. These floods are extensive, severe and unpredictable and result in significant loss of life, damage to crops, livestock, property, and public infrastructure (Winstedt 1927). In a major flood, people's coping mechanisms are totally ineffective and they are forced to rely on government relief for recovery. During major floods, a flood depth of 3 m is not uncommon, and hundreds of thousands of people are often evacuated. Historically, Malaysia experienced major floods in the years 1926, 1963, 1965, 1967, 1969, 1971, 1973, 1979, 1983, 1988, 1993, 1998, 2005 and most recently in December 2006 and January 2007. Recent urbanization amplifies the cost of damage in infrastructures, bridges, roads, agriculture and private commercial and residential properties. At the peak of the most recent Johor flood, around 110,000 people were evacuated to relief centers, and 18 people died. (Hussaini 2007).

In the past, natural causes such as heavy intense rainfall (monsoon or convective) and low-lying flat terrain were the main causes of flooding. However, deforestation reduces the role of forests as natural flood attenuation systems (Chan 2003; Chan et al. 2002b). As a result of deforestation, a very high proportion of rainfall becomes surface runoff, and this causes breaching of river capacity resulting in floods. Yet development has continued unabated. In more recent years, rapid development within river basins has further increased runoff and reduced river capacity, resulting in an increase in both flood frequency and magnitude. Urban areas are the most susceptible to flooding, and with more than 60 % of the Malaysian population now urban, flash flooding in urban areas has become a very serious problem (surpassing the monsoon floods) since the mid 1990s. This is reflected in flood frequency and magnitude, social-economic disruption, public outcry, media coverage and the government's escalating allocation of funds for flood mitigation.

3 Socioeconomic Impacts of Flood Disasters

Among all disasters, floods cause the most damage in Malaysia. The annual costs incurred by the Malaysian Government in rescue and flood relief operations, as well as rehabilitation of public works and utilities, are substantial. It is estimated that the costs of damage for an annual flood, a 10-year flood and a 40-year flood are USD 0.98 million, USD 5.87 million and USD 14.34 million respectively. The 1926 flood was perhaps the biggest flood in living memory in Malaysia. During this flood most parts of the country were affected. The 1971 flood was so serious that it was declared a national disaster by the Prime Minister. Total flood loss was estimated at USD 65.2 million then and there were 61 deaths. The 1967 flood damage estimated for the Kelantan River Basin alone was USD 25.43 million.

The socio-economic impacts of floods in terms of flood damage vary. However, there is now a considerable volume of literature on flood damage assessment (Chan and Parker 1996). Flood damage in terms of losses can be direct or indirect, and both categories include tangible and intangible losses. While the assessment of tangible losses is fairly straightforward, the evaluation of intangible losses can be problematic. Despite this, there have been attempts to quantify intangible flood damages so that they can be included in cost-benefit analysis (Green et al. 1988). In Northern Peninsular Malaysia, the 2004 flood resulted in tidal flooding that caused considerable damage to residential and commercial properties located on or near the eastern and northern coasts of the area. While the damage in rural areas was largely confined to residential properties (largely farms and fishermen's properties) resulting in the loss of livestock and crops, farm machinery, fishing vessels and equipment, and damage to building structure and contents, tsunami flooding in coastal urban areas involved damage to residential and commercial properties, vehicles, materials, machinery, goods and loss of business. And because of the high density of residential and commercial properties, infrastructure and public

utilities in urban areas, the urban damage toll is expected to be much higher than in the rural areas. Though commercial properties suffered much greater damage in monetary terms, the households suffered the most in terms of damage in kind (intangible losses) and affected members of households are usually the victims that carry with them the trauma and mental damage for life. Jamaluddin (1985) suggests that victims need to respond positively and appropriately to flood disasters if they hope to have any chance of quick recovery.

In the flood damage assessment literature, damage or losses have been categorized as direct or indirect. Such damage is further categorized as tangible or intangible (Parker et al. 1987). According to Chan (1995), tangible flood damage refers to those effects of flooding which can be assigned monetary values. They can be direct as in the case of damage to building structures or indirect as in the case of the loss suffered as a result of drop in business volume. Direct flood damage results from the contact of flood water and its contents (sediment, oil etc.) with buildings and their contents, vehicles, livestock and crops, humans, memorabilia, etc. For residential properties, the pressure and contact of flood water may give rise to adverse effects on building structure (walls, floors, stilts etc.), damage to garden and house contents such as furniture, electrical appliances, household utensils, carpets, wiring systems and sockets, etc. In the case of commercial properties, additional effects may include damage to shop fittings, goods, raw material, machinery, etc.

In the case of residential properties, indirect damage includes the cost of alternative accommodation, costs of transportation (of family members and household contents), loss of income through disruption to work, costs of treatment for illness resulting from floods (especially children and the elderly being exposed to the cold waters), loss of schooling and subsequent costs of extra lessons to catch up with the syllabus, etc. Intangible flood damage refers to those effects of flooding to which it is not currently possible to assign acceptable monetary values (Pearce 1976). The only common property shared by "intangibles" is that they cannot be evaluated for one reason or another (Parker et al. 1987). As with tangible damages, it is possible to have both direct and indirect intangible damages. The damage of historical buildings by flooding is a direct effect but it would be difficult to evaluate the loss in monetary terms. This is then an intangible direct loss. On the other hand, the inconvenience caused by a flood is difficult to measure in monetary terms. This is then termed an intangible indirect loss.

According to findings by Green et al. (1988), the non-monetary (intangible) impacts of flooding are far more important to the households affected than the cost of the damage done. Physical damage to buildings and their contents are the most visible but not always the most serious effects of flooding (Green et al. 1983). Among the notable intangible damage is disruption to the household's life caused by a flood and the stress of the flood event itself; subsequent health damage; loss of memorabilia or of other irreplaceable and non-monetary goods; and possible evacuation. Furthermore, stress and worry about the risk and consequences of future flooding may also damage a person's health. Chan and Parker (1997) have evaluated the socio-economic aspects of flood disasters in Peninsular Malaysia and found that non-monetary and intangible effects are just as significant as monetary impacts.

4 Flood Disaster Risk Management

4.1 Background

In Malaysia, the Drainage and Irrigation Department's Flood Mitigation Policy and Strategy consists of both structural measures (for example dams and embankments to control flood flows) and non-structural measures (for example land use planning and flood forecasting and warning systems to mitigate the impact of flooding). Hence policy guidelines for implementing flood mitigation measures include the following: (i) implementation of structural flood mitigation in terms of engineering and socio- economic environment; (ii) implementation of complementary non-structural measures; (iii) implementation of non-engineering measures where there is no engineering solution; and (iv) continuation of strengthening flood forecasting and warning systems (Hussaini 2007).

In terms of flood mitigation and management, Malaysia conducted a National Water Resources Study in 1982 on structural and non-structural measures for flood mitigation and management (Japan International Cooperation Agency 1982). The government also conducted a number of flood mitigation projects but these were mostly structural mitigation measures such as canalization of rivers, raising river embankments and the building of multi-purpose dams. Interestingly, despite their high costs compared to non-structural measures, structural measures continue to this day to be favored. The financial allocations for such projects have consequently increased significantly in every one of Malaysia's subsequent five yearly development plans. Such escalating expenditures put a heavy strain on the government, and there have been suggestions that strategies be re-examined with the objective of developing a more proactive approach in finding ways and means to address the flood disasters in a holistic manner. The current government machinery allows the Economic Planning Unit of the Prime Minister's Department to coordinate all aspects of planning, design and implementation of water resources (including flood management) in the country.

4.2 Malaysian Flood Disaster Relief and Preparedness Machinery

The Malaysian Flood Disaster Relief and Preparedness Machinery (MFDRPM) was set up after the disastrous flood of 1971 when the National Disasters Management and Relief Committee (NDMRC) was formed. This committee was entrusted with responsibility for planning, coordinating and supervising relief operations during floods. Unfortunately, this was an entirely top-down approach as most of the organizations in the committee were governmental departments/agencies and social organizations that are able to provide shelter, rescue, food and medical supplies. Through the various government levels, the NDMRC, SDMRC and DDMRC

committees coordinate between government departments and various voluntary organizations. In terms of early warning, the Flood Forecasting and Warning Systems have been upgraded (Chan 1997b).

The Department of Irrigation and Drainage Malaysia is responsible for providing flood forecasting and warning service to the public. It has established an Internet-based National Flood Monitoring System known as Infobanjir (http://infobanjir.moa.my), enabling rainfall and water level data can be collected for the whole country. The government has been working closely with the Canadian government to establish the GEOREX Monsoon Flood System for the Kelantan River Basin, a flood monitoring system integrating remote sensing, hydrological modeling and geographical information systems (GIS). This system allows the merging of hydrological data, such as river water levels and potential flooded areas, with geographical data on demography and transportation infrastructure.

Flood management activities undertaken include the following: (i) the National Water Resources Study; (ii) development of infrastructure for flood forecasting and warning systems; (iii) "Infobanjir" (the National Flood Monitoring System); (iv) "Flood Watch" (a flood forecasting and warning system); and (v) the Urban Storm-water Management Manual for Malaysia (MSMA) (Hussaini 2007). All these flood management activities are basically a combination of structural methods aimed at "controlling" floods and non-structural methods aimed at reducing flood impacts. One famous example of a structural method is the Storm-water Management and Road Tunnel (also known as the SMART Project), developed by the Drainage and Irrigation Department to alleviate flash flood problems in the Federal capital of Kuala Lumpur (Umar 2007). The 9.7 km long, 11.83 m diameter tunnel integrates both storm water management and a motorway in the same tunnel. In contrast, an example of a non-structural method is the flood forecasting and warning system (Drainage and Irrigation Department 1988).

In Malaysia, disaster management is almost entirely based on a top-down approach. At the very top is the NDMRC running a National Crisis and Disaster Management Mechanism (NCDMM). According to Chia (2004), this machinery was established with the objective of co-coordinating relief operations at the Federal, state and district levels so that assistance can be provided to flood victims in an orderly and effective manner. In the case of floods, the NCDMM would be called the National Flood Disaster Relief Machinery (NFDRM). The NFDRM is basically a reactive system, as it reacts to major floods when they occur. The coordination of flood relief operations is the responsibility of the National Flood Disaster Management & Relief Committee (NFDMRC), headed by the Minister of Information with its secretariat at the National Security Council (NSC). The committee is empowered, among other things, to declare any district, state or even the whole nation to be in a state of disaster so as to be eligible for financial assistance from the Federal Government. Members of this committee include government departments/agencies and social organizations which provide shelter, rescue and food supplies in case of disaster.

The NFDRM is theoretically responsible for all operations at the national, state, district, *mukim* and village levels. In reality, however, it coordinates operations at

the national level and overseas operations at the state level. Much of the activity in each state is left to be run by the respective state authorities. Its main task is to ensure that assistance and aid are provided to flood victims in an orderly and effective manner from the national level downwards. As a result, its approach to disaster mitigation is largely reactive (Chan 1995). For example, this body meets annually just before the onset of the northeast monsoon season to organize flood disaster preparedness, evacuation and rehabilitation work. It is also more of a welfare body than it is a flood management organization. The Disaster Relief and Preparedness Committee (DRPC) coordinates all relief operations from the Malaysian Control Centre in Kuala Lumpur. At the state level, there are 13 State Disaster Relief and Preparedness Committees (SDRPC) for Malaysia. Each state is given funds by the Federal Government every year to enable it to run its own disaster relief operations. At the district level, there are several district committees under each state, depending on the number of districts in a particular state.

Each district will have its own District Disaster Relief and Preparedness Committees (DDRPC) which receives funds and directives from the SDRPC. Below the district level, there are several *mukim* Disaster Relief and Preparedness Committees (MDRPC), again depending on the number of *mukim* in each district. Each MDRPC is headed by a penghulu (County Head). Finally, there are many Village Disaster Relief and Preparedness Committees (VDRPC) under each *mukim*. Each VDRPC is headed by a ketua kampong (village Head). The National Disaster Response Mechanism (NDRM) is basically a system responding to disasters, as its name suggests. As such, its approach towards disaster management/reduction is largely reactive. Because Malaysia's main type of disaster is flooding, the NDRM is largely targeted at handling monsoon flooding. Consequently, this mechanism is less than effective and should be re-modeled into something more pro-active. There is also a serious lack in terms of stakeholder participation, although the authorities have recognized the important role of NGOs, particularly that of MERCY, the Red Cross, the Red Crescent and other NGOs. This is likely due to heavy the dependence of communities on government, and the reluctance of government to relinquish responsibilities to the public. Public apathy may also be a reason for low public participation in disaster management. Capacity building is therefore necessary. NGOs and other stakeholders should be involved right from the beginning, from pre-disaster preparedness to rescue and reconstruction. NGOs would be particularly effective in creating awareness and education on disasters. The disaster management mechanism should also adopt more non-structural measures, use state-of-the-art technology and cooperate internationally with other countries for addressing transboundary disasters.

4.2.1 Limitations of the Malaysian Flood Disaster Management Model

As a country which is almost annually affected by flooding, Malaysia employees countless measures and strategies to reduce floods. While many of these strategies 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 an outdated reactive approach based on evacuation, relief and rehabilitation, the low salience of floods on government agendas, the lack of interaction and cooperation amongst government agencies dealing with floods, the bureaucratic nature of government agencies, and the victims' reluctance to relocate. In fact, floodplain encroachment has even exacerbated flood hazards, as more and more people are forced to occupy floodplains due to the shortage of land, high rents and rural–urban migration. Urban floodplains have also extensively developed as a result of rapid urbanization leading to greater flood damage potentials (Chan 1996; Chia 2004).

In Malaysia, flood forecasting and warning systems have also not developed as quickly as expected (Drainage and Irrigation Department 1988). Currently, two flood forecasting models have been developed and used by the Drainage and Irrigation Department Malaysia, viz. the Linear Transfer Function Model (LTFM) at Pahang River and the Tank Model at Kelantan River (Umar 2007). The agencies involved in flood relief have used information from the models to decide when they should mobilize their staff and equipment to the areas that are potentially to be hit. The flood warning system consists of dissemination systems such as automatic warning sirens, the Short Messaging System (SMS), telephone, fax and the website (http://infobanjir.water.gov.my, Accessed 16 May 2012). The current system being used is not state-of-the-art technology, as it does not have radar or satellite rainfall forecasts as inputs into computer models. Rather, it uses river levels as inputs. The number of automated telemetric rain gauges and river level recorders is also short of the required number. As a result, the advantages of flood forecasting and warnings have not been maximized and the current system appears cumbersome and ineffective. This has led to a lack of confidence amongst floodplain users and flood victims in flood forecasts and warnings (Chan 1997c). While every effort is made by relevant authorities to improve formal (official) FWESs, there has been little attempt to incorporate traditional (informal) FWESs into them. Traditional FWESs are an integral part of the Malaysian cultural heritage and are closely knitted into the fabric of rural societies. Due to years of responding to flood hazards, traditional FWESs are based on practical knowledge of adaptation and have served people well. As such, the authorities should incorporate them into formal FWESs in order to maximize the effectiveness of overall flood warning and evacuation response from the people.

As a developing country, Malaysia's flood mitigation policy can be described as commendable. Since the First Malaysia Plan (1971–1975), the country's expenditure on flood mitigation has increased substantially. From a mere USD 4.56 million in this plan, it has shot up to a massive USD 228.2 million for the Sixth Malaysia Plan (1991–1995), a 50-fold increase over a 20 year period. During the 10th Malaysia Plan, the budget allocated for flood management was USD 1.17 billion, a 256-fold increase. Even after discounting inflation, the real increase is still substantial. With the many structural and non-structural measures being implemented for flood control and for flood relief, the country is moving in the right direction towards a comprehensive program of flood mitigation. Yet, there are many areas which can still be improved. While the total number of telemetric

stations for rainfall and river flow in the country seems large enough, a closer scrutiny would expose the inadequacies of uneven distribution. Most telemetric stations are located in populated areas while the sparsely populated areas, especially highland watershed areas, do not have enough telemetric stations. The Malaysian Meteorological Department and the Drainage and Irrigation Department have also not utilized remotely sensed rainfall (i.e. using radar and satellite systems) as an input in its forecasting models.

Legislation related to flood control is indirect as there is no flood legislation. Existing legislation is also sector-based and outdated. While there are currently some laws governing the regulation of river use and have some bearing on flood mitigation, they are not sufficiently clear or forceful enough as measures for flood mitigation. These laws were formulated mainly for the purpose of regulating and managing single sectoral water use. More stringent and clear-cut laws must be passed to enable the authorities to have direct control in all aspects of water use which may affect flooding. This includes laws that clearly specify water rights administration, water resource development, flood plain management and all aspects of flood mitigation. Alternatively, the existing laws should be updated with a stronger emphasis on flood mitigation.

Finally, flood hazard management in Malaysia has not kept up in the context of its rapid development. Malaysia is a newly-industrializing country in which the pace of social, economic and political change is fast, as is the pace of physical and environmental change. Other things being equal, these are the contexts in which flood hazards can be magnified and mismanaged. The contexts themselves are also changing, and changing physical systems have given rise to increased risk, exposure and vulnerability to flood hazards. Other contexts, largely structural, such as persistent poverty, low residential and occupational mobility, landlessness, and ethnic culture have also contributed to increased vulnerability to flood hazards amongst specific communities, mainly the poor. Thus, in order to better manage floods and move towards greater flood loss reduction, flood management must be given a higher salience on official agendas. In a country where poverty reduction and income equity amongst all races are targets of policy, the reduction of flood losses appears to be an important vehicle towards achieving those targets. This is because the poor are the most vulnerable to flooding in Malaysia, and any substantial increase in flood protection and flood loss reduction will reduce the income gap between the rich and the poor. The government should also adopt a more pro-active and dynamic approach towards flood management, rather than adhere to a reactive approach.

Finally, the current flood management model lacks a multi-disciplinary approach that should include a well balanced mixture of structural and non-structural measures. In this respect, the employment of legislation to control floodplain encroachment, the development of hill land, and urbanization is vital if Malaysia is to successfully develop at a sustainable pace and yet protect and conserve its environment, and at the same time 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 as a newly industrializing country (NIC) by the year 2020 (Chan 2011).

5 Constraints in Post-Flood Disaster Supports

5.1 Politicization of Flood Disasters

Notwithstanding the limitations and weaknesses in the current Malaysian flood disaster management system, there are other constraints which hinder the effectiveness of the system. In Malaysia, almost all facets of life, be it political, social, economic or cultural, are closely linked to politics. Hence, it is not unusual that disaster management is also closely linked to politics. Yusuf (n.d.) calls this linkage "the politicization of disasters." Disaster managers have been cautioned that future disasters will be best depicted as a context for framing and blaming, as politicians with some skill may turn disaster from a threat into an opportunity/political asset (Boin et al. 2009). In the case of Malaysia, politicians are quick to politicize disasters. This is all the more apparent when the Federal Government and State Governments are formed from different political parties. Disaster management research has largely ignored one of the most pressing challenges the ruling government is confronted with in the wake of a disaster, viz. how to cope with what is commonly called the blame game. In order to ensure an effective response to any disaster, political leaders must understand opposition parties' responses in pointing fingers and blaming the ruling government for mishaps in the disaster. It is vital that leaders properly manage the political aspects of disasters and their inquiries. On 12 April 2012, an opposition party leader led some 200 Klang residents to stage a protest in front of the Selangor State Secretariat building, demanding that their flood damage compensation money to be increased to USD 260.8. The group claimed that the USD 163 received from the Selangor government was far too little to compensate for the damage residents suffered in the recent floods. While this claim was beneficial for the flood victims, one cannot hide the fact that previous Selangor State Governments had not previously paid flood victims any compensation at all. This case is in fact a example of the politicization of floods.

In another incident in 2007 when Johor was ravaged by floods, Johor *Mentri Besar* (Chief Minister) Datuk Abdul Ghani Othman had claimed that the devastating floods (18 deaths, USD 0.49 billion damage and 110,000 people evacuated) may have been caused by Singapore's land reclamation at its Pulau Tekong island in a narrow sea lane between Malaysia and Singapore. The *Mentri Besar* blamed Singapore based on its land reclamation at the island which had effectively plugged the mouth of the Sungai Johor, resulting in the river overflowing its banks and inundating the town of Kota Tinggi (The Star 2007). In another incident, Selangor United Malays National Organization (UMNO) deputy chief Datuk Seri Noh Omar has blamed the Selangor State's ruling Pakatan Rakyat's (PR) poor flood mitigation

works for the recent spate of flash floods in the state (Chieh 2012). Respondents in the study by Chan (1995) also mentioned that political parties had their own agendas, as they helped only those flood victims (in their constituencies) who supported them. For example, the UMNO Member of Parliament would pay more attention and channel more aid to the Malay majority areas. Similarly, the Malaysian Chinese Association leaders would give priority to help the Chinese victims, and the Malaysian Indian Congress would favor helping the Indians. More recently, floods have triggered further political fallout. The Federal Minister for Housing and Local Government and Alor Setar MP criticized the Kedah State government (led by the opposition Pan-Malaysian Islamic Party (PAS), an opponent of the MP's National Front coalition) for what he considered a slow response to the floods and the government's inexperience (Bernama 2010b; Foong 2010). Deputy Prime Minister Muhyiddin Yassin then claimed the State government had a responsibility to assist victims of the flood (The Star 2010a). In response, Kedah's Chief Minister Azizan argued that his government's response had been "quick" and that 300,000 ringgit in aid had been committed to the affected areas (New Straits Times 2010). Fortunately, Kedah's Sultan Abdul Halim called publicly for politics to be set aside for the purposes of dealing with the floods (The Star 2010b).

5.2 Mediatization of Flood Disasters

Another obvious constraint in effective flood disaster management is that of mediatization. In any account, the media are a potent force. This is a factor that significantly affects disaster management. So powerful is the role of the media that they can either help a nation address a disaster or make the country look bad. According to the Thomas Theorem: "If the media define a situation as a disaster or a crisis, be sure that it will indeed be a disaster or a crisis in all its consequences" (Thomas and Thomas 1928). Yusof (n.d.) contends that mediatization would be one of the driving forces in the world of future disasters. The media can either use a disaster for outright sensationalism, or it can self-impose censorship on the event making it "unimportant". The media can also apply pressure on politicians and decision makers to explain and justify the occurrence and impacts of the disaster to the public.

5.3 Lack of Awareness and Volunteerism

Lack of awareness towards donating and volunteering to flood disasters is another constraint that impedes advancement of disaster management, especially towards engaging the public and giving the public a more active role. Generally, Malaysians are very private people who have developed the conception that disasters are the responsibility of the government. Few Malaysians would volunteer in social work.

This is a constraint that limits the effectiveness of volunteer groups such as MERCY, and the Red Cross and Red Crescent. Asking Malaysians to donate money or even clothes/food to disaster organizations is a difficult task. Malaysians do not donate towards flood disaster aid simply because they feel that is not their responsibility. They feel that it is the responsibility of the government, be it at the Federal or State level.

5.4 Erosion of Social Capital

Aldrich (2010) has found that recovery from disasters is very much dependent on social capital, especially in post-crisis resilience. Hossain and Kuti (2010) similarly highlighted the importance of disaster response, preparedness and coordination through social networks. In the case of flood disasters in Malaysia, social capital as manifested by kinships and family bonds have been found to be a strong factor in helping victims cope with and recover from flood disasters. This factor is all the more important when government aid is not forthcoming to the victims. However, out-migration from families due to the search for jobs in cities has, among other reasons, broken down the extended families. Consequently, families have lost the one thing that protects them from being totally devastated by flood disasters, i.e. the social bonding and self-reliance that has made them resilient in the past. For example, in the 1990s Makcik (Aunty) Mabee never had any problems when her house near the Sungai Pinang in Penang was flooded every month as she could call upon her own children (ten of them) to help her cope with the floods. More than that, she could rely on help from her relatives living in adjacent houses. But now in 2012, she is no longer able to rely on her own children (only two girls have stayed behind) or her relatives as they have all moved out to Kuala Lumpur or other cities looking for jobs.

6 Policy Recommendations: Towards Effective Flood Disaster Risk Management in Malaysia

Disaster preparedness is one aspect of disaster management that clearly needs to be improved, especially in the context of flood disasters. While the NDRM appears to work in the east coast flood-prone areas whereby preparations get under way during the month of October/November just before the monsoon season, residents living on the west coast of the peninsula, in the southern state of Johor and the northern states of Kedah and Perlis are not exposed to this kind of preparedness. That is because in the past the north–east monsoon seldom affected these rain-shadowed areas. In recent years, massive floods are now not affecting the usual east coast states such as Kelatan, Pahang and Terengganu, but have moved south towards

Johor and north towards Kedah and Perlis. The major floods in Johor in 2006–2007 and the massive floods in Kedah and Perlis in 2010 are indications that this trend is happening. Hence, residents in Johor, Kedah and Perlis, or for that matter in Kauala Lumpur (subjected to frequent flash floods) should also be sensitized by exposing them to awareness via flood preparedness campaigns.

Flood Disaster Risk Management in Malaysia has traditionally been over-focused on a top-down government-centric approach. This was workable in the past when population was sparse and the public largely made up of poorly educated citizens, and the role of NGOs and civil society was limited in scope. It is time for a radical change towards a more people-friendly "horizontal" or "bottom-up" approach. People, especially disaster victims, need to be engaged and empowered to be more resilient. If not, they remain highly dependent on government aid and this is not what the Malaysian Government wants. When the public (who are the victims) are actively engaged and involved, their ability to respond to flood or other disasters effectively and appropriately will be enhanced. The general principles of preparedness that should be adopted are as follows: (i) preparedness is a central foundation of disaster/emergency management; (ii) preparedness is not static but a dynamic and continuous process whereby managers and victims learn; (iii) preparedness is an educational activity to increase awareness and understanding; (iv) preparedness is not just about drills but is based on knowledge (which is evolving all the time); and (v) preparedness evokes appropriate actions (from both disaster managers and victims).

Providing disaster services up to international standard should be one of the objectives of disaster managers. The authorities must introduce standards that would serve as the guiding principles for flood disaster managers and other humanitarian workers during disasters. These standards, widely known in the humanitarian sector as the SPHERE Standards, are comprehensive and stress quality as well as quantity in order to achieve the best practice in providing aid during/after a disaster. These standards specify, among others, the minimum amount of uncontaminated water with which a victim should be provided per day (7.5 L), the minimum sizes for shelters, average distances to water distribution points, specifications for toilets, healthcare, etc. in the aftermath of a disaster (www.sphereproject.org, Accessed 15 May 2012).

Other policy recommendations proposed for the Malaysian Government are as follows: (i) Develop disaster/emergency plans which are reviewed and updated regularly. Ensure that early warnings reach and are understood by the most vulnerable people as they need to know what to do, where to go, and how to protect themselves. Hence, the plans must include education and preparedness; (ii) Constantly improve existing flood forecasting and warning systems. Incorporate traditional systems into the official systems so that people can make the adjustment quickly. Employ state-of-the-art technology in such systems; (iii) Provide flood-prone areas/communities with emergency materials such as torch lights, batteries, water purification tablets, stretchers, chain saws, plastic sheeting, first aid supplies, generators, etc.; (iv) Identify and gazette more emergency sites/shelters such as community halls, schools, mosques, etc. and assembly areas such as parks or fields

when evacuating people; (v) Construct shelters/houses and infrastructure to withstand future disasters (for example, the Malay stilt house has stood the test of time but this unique flood-proof architectural design is fast disappearing due to changing needs); (vi) Healthcare centers such as hospitals and clinics should be made flood-proof (for example, the ground floor can be used only as a car park or recreational space), roads should be built on the highest ground, water supply mains should be waterproof, and electricity wires should be on high poles; (vii) Relocation should be used as a last resort, considering its negative effects on people. However, if need be, relocation should be carried out and people should be well compensated for it. Alternatively, people should get alternative housing nearby, not in an alien place that is far away from their social networks. During relocation or temporary resettlement, social networks should be preserved; (viii) Government should provide livelihood opportunities, introduce victims to suitable alternatives, and where possible, help people to be responsible for their own reconstruction; (ix) Subsidies in the form of cash or food vouchers can be provided, not as a long term subsidy but as a short-term aid. Cash is a suitable choice as it allows people to purchase their own needs rather than receive items in kind which they might already have; (x) Government must ensure that evacuation centers are always safe and well maintained. A crumbling structure may precipitate another disaster; (xi) Government must consider gender differences when giving out aid and support, as disasters often affect men and women differently.

7 Emerging Threats of Disasters at the National Level

At the national level, many factors impinge on the success or failure of flood disaster management. One of the most influential factors is politicization. In Malaysia, almost everything is political. For example, the issue of water is politically motivated (Chan 2011), river management is politically inclined (Ujang 2010), the business sector has political influence (Chooi 2012) and even education is not free from politics (Tneh 2011). It is therefore no surprise that disasters are also political. The floods in Kedah State in 2010, for example, triggered immediate political fallout. The Federal Minister for Housing and Local Government (National Front Coalition) criticized the Kedah State government (led by the opposition Pan-Malaysian Islamic Party) for what he considered a slow response to the floods and the government's inexperience (Bernama 2010a, b). Deputy Prime Minister Muhyiddin Yassin claimed the State government had a responsibility to assist victims of the flood (The Star 2010a). In reply, Kedah's Chief Minister Azizan argued that his government's response had been "quick" and that 300,000 ringgit in aid had been committed to the affected areas (New Straits Times 2010). Fortunately, the politicization was stopped when Kedah's Sultan Abdul Halim called publicly for politics to be set aside for the purposes of dealing with the floods (The Star 2010b).

Alarmingly, disasters in the modern world are a complex mixture of natural and human-made inputs. Often, when two or more disasters collide, they change into "Compound Disasters" or can evolve into a totally different category of disaster. A good example is when the Asian Tsunami not only flooded the west coast of Penang but also caused contamination of water supplies. This is a challenge that the Malaysian Government needs to be aware of. Related to this is the mutation of disasters, as if disasters were something "alive." Disasters mutate in form in response to population growth and urbanization, economic growth, globalization of commerce, and technological advancement. The challenge is how to contain individual disasters and stop them from evolving and mutating.

Flood disasters continue to impoverish the government coffers. During the 10th Malaysia Plan period (2011–2015), a total of USD 1.17 billion was allocated for flood disaster management. This figure is expected to increase exponentially as it has done so during the last nine Malaysian plans. This is a challenge that the Malaysian Government has to address. Raising tax rates to increase government revenue would not be an acceptable move, given the fact that the citizenry expects the government to foot the bill when it comes to disaster spending. Perhaps a workable alternative would be to involve the private sector and help people become more flood resilient and self reliant. Even so, damaged public structures need to be repaired.

Flood losses are difficult to measure. How much is a life worth indeed? Tangible and intangible losses are complicated by direct and indirect losses. Flood loss profiles are ever changing as a result of population growth, changing needs and changing lifestyles. Technological advancement and the use of sophisticated equipment (for forecasting and warning) may see a drop in the loss of lives, but dense construction may see an increase in property losses and indirect economic losses such as loss of business. These will become major societal vulnerability.

Another major challenge is Malaysia's inability to use new scientific and technological advances to mitigate flood disasters. Currently, the flood forecasting system has just started to use radar and satellite images as inputs in forecasting rains, a necessary input for flood forecasting. Warning systems using short text messages also have problems. Another challenge is that hydro-meteorological hazards are not easily forecastable on an extended time scale, since weather can change abruptly. But today's societies require extended forecasting to increase the time available for evacuation. Sadly, evacuation clearance time has in fact increased due to increased population densities. Hence, road systems need to be markedly improved to ensure swift evacuation.

The pace of engineering advances is not in keeping with their implementation in practice. For example, building codes are not keeping pace with current engineering practice. The Environmentally-friendly Drainage Manual, for instance, is not user-friendly and contractors see it as cumbersome and costly to implement compared to the conventional open drainage system. The challenge here is to educate contractors and house buyers into buying the system.

In the future, floods and other disasters are likely to evolve into new forms yet unheard of. One of the characteristics and conditions of future disasters will be

transnationalisation. For example, the original source of flooding may occur in Malaysia, but the immediate and long term impact of the disaster may be spread into neighboring countries such as Thailand or Singapore. It is therefore imperative that Malaysia and its immediate neighbors come to some sort of agreement and establish cooperation in managing disasters, especially those that can cross borders or are transboundary. Regional cooperation is also needed in the light of the effects of globalization on all countries. For example, disasters are said to have a globalization effect when a country affected by a major disaster can no longer export the goods it exports to other countries worldwide. Thus the Kobe earthquake in 1995 affected a large fraction of Japanese shipping, and forced closures of subcontractors' facilities worldwide, including in Malaysia. This affected world trade and many national economies suffered.

8 Conclusion

After more than half a century of flood management, Malaysia is still subject to severe floods. Indeed, Malaysia will never be flood-free. However, what is avoidable is that Malaysians must not forget past disasters. Past disasters present opportunities for us to learn from past mistakes. Just like mistakes from history which we must remember and avoid, disasters are no different. Once we forget them and let our guard down, they will strike us hard. This is attested by the evolution of various safety and emergency laws, acts and regulations since independence. The current NDRM appears rather outdated as it is based on a reactive approach. This machinery needs to be revamped and repackaged, not just with cosmetic changes but with real changes for the better. Institutional arrangements also need to be vastly improved for effective implementation of the national disaster management program. The NSC needs to be revamped to give it a fresh mandate, more funds to operate, and more qualified personnel. Malaysia is constantly revamping ministries and government agencies. This is where the role of the NSC can be better positioned. Putting the NSC under the Prime Minister's Department gives it more clout, but it also marginalizes it as the Prime Minister has other more immediate agendas. Flood management will not feature highly on the Prime Minister's agenda.

Flood Disaster Risk Management in Malaysia has traditionally been overfocused on a top-down government-centric approach. This was workable in the past when population was sparse, the public largely lowly educated, and the role of NGOs and civil society limited in scope. It is time for a radical change towards a more people-friendly "horizontal" or "bottom-up" approach. People, especially disaster victims, need to be engaged and empowered so as to become more resilient. If not, they will remain highly dependent on government aid and this is not what the Malaysian Government wants. When the public (who are the victims) are actively engaged and involved, this will enhance their ability to respond to flood or other disasters effectively and appropriately. The general principles of preparedness that should be adopted are as follows: (i) preparedness is a central foundation of

disaster/emergency management; (ii) preparedness is not static but a dynamic and continuous process whereby managers and victims learn; (iii) preparedness is an educational activity to increase awareness and understanding; (iv) preparedness is not just about drills but is based on knowledge (which is evolving all the time); and (v) preparedness evokes appropriate actions (from both disaster managers and victims).

Providing disaster services up to international standard should be one of the objectives of disaster managers. The authorities must introduce standards that would serve as the guiding principles for flood disaster managers and other humanitarian workers during disasters. Malaysia should try its best to adopt the new crisis assistance standards in the country. These standards, widely known in the humanitarian sector as the SPHERE Standards, are comprehensive and stress quality as well as quantity.

The Malaysian flood authorities should not ignoring local leadership, as they have rich experience that can be tapped into. Local leaders such as village heads can provide information and cooperation on the ground. Moreover, these leaders can advise the authorities when distributing relief goods, reconstruction material, or other benefits, especially those which help the poor, women, children, and the elderly. Some things to avoid include rushing in with reconstruction without recycling useful materials from the disaster site, bulldozing over what could be valuable building materials, and rushing in quickly to implement ad-hoc plans. For example, establishing new institutions in short time frames or developing complex and inflexible project designs are not encouraged. The authorities should always use familiar disaster management plans and systems with the local officials/leaders. Another thing to avoid is relocation of people away from their jobs and social contacts. This is useless as they would eventually return. In the case of farmers, care must be taken so that they do not miss the next planting season. Hence, distribution of seeds should be timely. The authorities should also be sensitive, for example not imposing grief counseling where it is found to be inappropriate, especially in the context of multi-ethnic Malaysia with multi-cultural beliefs.

Because Malaysia's main disaster is flooding, the NDRM is largely targeted for handling monsoon flooding. Consequently, this mechanism is less than effective and should be re-modeled into something more pro-active. Stakeholder participation is also seriously lacking, although the authorities have recognized the important role of NGOs, particularly MERCY, the Red Cross, Red Crescent and other specific NGOs. These stakeholders need to be involved during every stage of the disaster cycle. Capacity building is necessary. The disaster management mechanism should also adopt more non-structural measures, and state-of-the-art technology, and cooperate internationally with other countries for addressing transboundary disasters.

In terms of flood warning, there are many areas which can still be improved. While the total number of telemetric stations for rainfall and river flow in the country seems large enough, a closer scrutiny would expose inadequacies in terms of uneven distribution. Most telemetric stations are located in populated areas while the sparsely populated areas, especially highland watershed areas, do not have

enough telemetric stations. The Malaysian Meteorological Department and the Drainage and Irrigation Department have also not utilized remotely sensed rainfall (radar and satellite sensed rainfall) as an input in its forecasting models. This could have been deliberately overlooked because of the high cost involved, but real-time flood forecasting cannot be detached from the usage of such techniques, especially in terms of flash flooding.

Legislation related to flood control should also be improved. While there are currently some laws governing the regulation of river use and which have some bearing on flood mitigation, they are not sufficiently clear or forceful as measures of flood mitigation. These laws were formulated mainly for the purpose of regulating and managing single sectoral water use. More stringent and clear-cut laws must be passed to enable the authorities to have direct control in all aspects of water use which may affect flooding. This includes laws that clearly 'specify water rights administration, water resource development, flood plain management and all aspects of flood mitigation. Alternatively, the existing laws should be updated with a stronger emphasis on flood mitigation.

Markets as well as social ties and community could play a role in mitigating hazards. Flood insurance is poorly developed in Malaysia, despite the country been flood-prone. In developed countries, flood insurance is an integral part of overall flood management. The Government should seriously consider introducing an insurance scheme for flood victims to help them get back on their feet after suffering huge losses. In recent years, there have been cases where victims in Johor and Kedah suffered through two major floods and ended up with a total loss twice over. Under a normal scheme to protect properties in Malaysia, insurance companies will not compensate flood victims since it is considered a natural disaster. One could purchase a special flood insurance to protect one's property, but the premium would be very high. Nevertheless, there should be a move by the authorities to introduce an insurance scheme so that the victims can get some compensation.

Another point is the need to create a data management system (i.e. a database), which would display data spatially and temporally, and underpin a more systematic communication system in flood disaster management (Lawal et al. 2006). This disaster data bank could be managed in a geographical information system environment and be put on the NSC website for all disaster organizations to access. Currently, disaster information is often treated as "confidential" and seldom released to the public. This should not be the case as the public has a right to know all the statistics related to disasters. A case in mind is the holding back of the Air Pollution Index (API) during the 1997/1998 haze episodes. The excuse given was that such statistics may "frighten" tourists and drive them away, resulting in the country losing foreign revenue. But surely the health of its own citizens should be given the highest priority. Here again, the confidentiality of disaster statistics is yet another manifestation of politicization. It must be stressed that politics should not mix with disaster management, or else the disaster will just get worse. Politicians must refrain from using disasters as ammunition. All parties must put aside political differences when it comes to disaster management.

Finally, flood hazard management in Malaysia must be viewed in the context of its rapid development. Malaysia is a newly-industrializing country in which the pace of social, economic and political change is fast, as is the pace of physical and environmental change. Other things being equal, these are the contexts in which flood hazards can be magnified and mismanaged. The contexts themselves are also changing, and changing physical systems have given rise to increased risk, exposure and vulnerability to flood hazards. Other contexts, largely structural, such as persistent poverty, low residential and occupational mobility, landlessness, and ethnic culture have also contributed to increased vulnerability to flood hazards amongst specific communities, mainly the poor. Thus, in order to better manage floods and move towards greater flood loss reduction, flood management must be given a higher salience on official agendas. In a country where poverty reduction and income equity amongst all races are targets of policy, the reduction of flood loss appears to be an important vehicle towards achieving those targets. This is because the poor are the most vulnerable to flooding in Malaysia and any substantial increase in flood protection and flood loss reduction will reduce the income gap between the rich and the poor. The government should also adopt a more pro-active and dynamic approach towards flood management, rather than adhere to a reactive approach. Finally, a multi-disciplinary approach encompassing a well balanced mixture of structural and non-structural measures should be adopted. In this respect, the employment of legislation to control floodplain encroachment, the development of hill land, and urbanization is vital if Malaysia is to successfully develop at a sustainable pace and yet protect and conserve its environment, and at the same time 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.

Acknowledgements The author gratefully acknowledges funding from the Long Term Research Grant Scheme (LRGS) "Project 5 – Economic Model for Flood Disaster Impact Analysis" and to the Economic Research Institute for ASEAN and East Asia (ERIA) for funding the project "Economic and Welfare Impacts of Disasters in East Asia and Policy Responses".

References

Ab. Ghani, A., Chang, C. K., Leow, C. S., & Zakaria, N. A. (2012). Sungai Pahang digital flood mapping: 2007 flood. *International Journal of River Basin Management,* 1–10.

Ahmad, S., & Hashim, N. M. (2006). Kebakaran Hutan Dan Isu Pencemaran Udara Di Malaysia: Kes Jerebu Pada Ogos 2005. *e-BANGI Jurnal Sains Sosial dan Kemanusiaan, 1*(1), 1–19.

Aldrich, D. P. (2010). Fixing recovery: Social capital in post-crisis resilience. *Journal of Homeland Security*. http://works.bepress.com/daniel_aldrich/7. Accessed 28 June 2012.

Alexander, D. (1993). *Natural disasters*. London: UCL.

Bernama. (2010a). *Floods: Perak sends clean water supply to Kedah, Perlis,* Bernama [online]. 5 November 2010. http://www.bernama.com.my/bernama/v5/newsindex.php?id=541097. Accessed 5 November 2010.

Bernama. (2010b). *Kedah government slow in helping flood victims – Chor*, Bernama [online]. 5 November 2010. http://www.bernama.com/bernama/v5/newsgeneral.php?id=541124. Accessed 5 November 2010.

Bernama. (2010c). *For farmers affected by floods In Kedah, Perlis*, Bernama [online]. 6 November 2010. http://www.bernama.com/bernama/v5/newsindex.php?id=541292. Accessed 6 November 2010.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk: Natural hazards, peoples' vulnerability and disasters*. London: Routledge.

Boin, A., McConnell, A., Hart, P., & Preston, T. (2009). Leadership style, crisis response and blame managment: The case of Hurrican Katrina. *Public Administration, 88*(3), 706–723.

Chan, N. W. (1995). *A Contextual analysis of flood hazard management in Peninsular Malaysia*. UK: Ph.D. Middlesex University.

Chan, N. W. (1996). Risk, exposure and vulnerability to flood hazards in a rapidly developing country: The case of Peninsular Malaysia. *Akademika, 49*, 107–136.

Chan, N. W. (1997a). Increasing flood risk in Malaysia: Causes and solutions. *Disaster Prevention and Management: An International Journal, 6*(2), 72–86.

Chan, N. W. (1997b). Institutional arrangements for flood hazards in Malaysia: An evaluation using the criteria approach. *Disasters, 21*(3), 206–222.

Chan, N. W. (1997c). Warnings in the context of flood hazard management in Malaysia. In J. W. Handmer (Ed.), *Flood warning: Issues and practice in total system design* (pp. 115–132). London: Flood Hazard Research Centre.

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.

Chan, N. W. (1998b). Chapter 54 - Flash and monsoon flooding. In S. Sham (Ed.), *The encyclopedia of Malaysia - Volume I environment* (pp. 112–113). Editions Didier Millet: Singapore.

Chan, N. W. (2000). Chapter 29 – Reducing flood hazard exposure and vulnerability in Peninsular Malaysia. In D. J. Parker (Ed.), *Floods volume II* (pp. 19–30). London: Routledge.

Chan, N. W. (2003). Using wetlands as natural forms of flood control. In A. Ali, C. S. Md Rawi, M. Mansor, R. Nakamura, S. Ramakrishna, & T. Mudkur (Eds.), *The Asian wetlands: bringing partnerships into good wetland practices*. Penang: Ministry of Science, Technology and the Environment, Malaysia, Universiti Sains Malaysia, Ramsar Center Japan and Wetlands International Asia Pacific. Penerbit Universiti Sains Malaysia (pp. 909–919), Part VII: Climate change.

Chan, N. W. (2009). *Socio-economic effects of flood losses incurred by residential and commercial properties due to the 2004 Indian Ocean tsunami in Northern Peninsular Malaysia*, Paper presented at the South China Sea Tsunami Workshop 3. Penang: Universiti Sains Malaysia, 3–5 November 2009.

Chan, N. W. (2011). Addressing flood hazards via environmental humanities in Malaysia. *Malaysian Journal of Environmental Management, 12*(2), 11–22.

Chan, N. W., Ibrahim, A. L., Kung, H. T., & Liu, P. S. (2002a). Employing nature to combat floods: Some experiences from Malaysia. In J. B. Ali, A. Rahman, Z. Mohamed, & N. Zainuddin (Eds.), *Disaster management: Strengthening the national security capabilities* (pp. 143–158). Alor Setar: Penerbit Ustara.

Chan, N. W., Ibrahim, A. L., Yusoff, R., & Ismail, N. A. (2002b). The significance of stress and other intangible losses during major flood disasters in Malaysia. In J. Ali, B. A. Rahman, Z. Mohamed, & N. Zainuddin (Eds.), *Disaster management: Strengthening the national security capabilities* (pp. 159–176). Alor Setar: Penerbit Ustara.

Chan, N. W., & Parker, D. J. (1996). Response to dynamic flood hazard factors in Peninsular Malaysia. *The Geographical Journal, 162*(3), 313–325.

Chan, N. W., & Parker, D. J. (1997). Aspek-Aspek Sosio-Ekonomi Berkaitan Dengan Bahaya Dan Bencana Banjir Di Semenanjung Malaysia. In M. R. Agus & F. N. Sidin (Eds.), *Proceedings of*

Persidangan Kebangsaan Kajian Sains Sosial, 29–30 September 1997 (pp. 294–311). Kuala Lumpur: University of Malaya.

Chia, C. W. (2004). *Managing flood problems in Malaysia*. The Ingenieur Bulletin. 22, June-August 2004. Kuala Lumpur: Board of Engineers Malaysia (pp. 38–43). http://www.bem.org.my/publication/juneaug04/F(Flood)(38-43).pdf. Accessed 16 May 2012.

Chieh, Y. H. (2012). *Noh Omar blames Nakatan for Selangor floods*, Malaysian Must Know The Truth Blog Spot [online]. 1 April 2012. http://malaysiansmustknowthetruth.blogspot.com/2012/03/noh-omar-blames-pakatan-for-selangor.html. Accessed 16 May 2012.

Chooi, C. (2012). *Mix of politics with business fuelled economic woes, says Ku li*, Malaysian Insider [online]. 16 February 2012. http://www.themalaysianinsider.com/malaysia/article/mix-of-politics-with-business-fuelled-economic-woes-says-ku-li/. Accessed 16 May 2012.

Drainage and Irrigation Department. (1973). Estimation of design rainstorm, *Hydrological Procedures*. 1, Kuala Lumpur December 1973.

Drainage and Irrigation Department. (1974). Rational method of flood estimation for rural catchments in Peninsular Malaysia, *Hydrological Procedures*. 5, Kuala Lumpur 1974.

Drainage and Irrigation Department. (1976). Flood estimation for urban areas in Peninsular Malaysia, *Hydrological Procedures*. 16, 1976.

Drainage and Irrigation Department. (1988). *Flood forecasting and warning systems in Malaysia*. Unpublished paper of the hydrological section, Drainage and Irrigation Department, Ampang Branch.

Foong, P. Y. (2010). *Double-tracking project worsened flood situation in Kedah – Chor*, The Star [online]. 5 November 2010. http://thestar.com.my/news/story.asp?file=/2010/11/5/nation/20101105123917&sec=nation. Accessed 5 November 2010.

Green, C. H., Parker, D. J., & Emery, P. J. (1983). *The real costs of flooding to households: The intangible costs*, Geography and Planning Paper 12. Middlesex Polytechnic, Enfield.

Green, C. H., Turnstall, S. M., Emery, J. P., & Bossman-Aggrey, P. (1988). *Evaluating the non-monetary impacts of flooding*. Flood Hazard Research Centre, Publication 123, Enfield.

Handmer, J. W., & Parker, D. J. (1991). *British disaster planning and management: An initial assessment*. Flood Hazard Research Centre, Publication 202, Enfield.

Hewitt, K. (Ed.). (1983). *Interpretations of calamity, the risk & hazard series: 1*. London: Allen and Unwin.

Hossain, L., & Kuti, M. (2010). Disaster response preparedness coordination through social networks. *Disasters, 34*(3), 755–786.

Hussaini, Hj. A. (2007). *Flood and drought management in Malaysia*, Speech Given on 21 June 2007. Kuala Lumpur: Ministry of Natural Resources and Environment.

Jamaluddin, M. J. (1985). Flash flood problems and human responses to the flash flood hazard in Kuala Lumpur area. *Akademika, 26*, 45–62.

Japan International Cooperation Agency. (1982). *National water resources study*. Unpublished report to the Government of Malaysia.

Japan International Cooperation Agency. (1989). *Study on flood mitigation of the Klang river basin*. Unpublished report to the Government of Malaysia.

Japan International Cooperation Agency. (1991). *The study of flood mitigation and drainage in Penang Island*. Unpublished Supporting Report, Japan International Cooperation Agency for the Government of Malaysia.

Jones, D. K. C. (1991). Environmental hazards. In R. J. Bennett & R. C. Estall (Eds.), *Global change and challenge* (pp. 27–56). London: Routledge.

Julien, P. Y., Ab, N. A., Ghani, R. A., & Chang, C. K. (2010). Case study: Flood mitigation of the Muda River, Malaysia. *Journal of Hydraulic Engineering, ASCE, 136*(4), 251–261.

Kunii, O., Kanagawa, S., Yajima, I., Hisamatsu, Y., Yamamura, S., Amagai, T., et al. (2002). The 1997 haze disaster in Indonesia: Its air quality and health effects. *Archives of Environmental Health, 57*(1), 16–22.

Lawal, B., Shattri, M., Mahmud, A. R., & Ghazali, A. H. (2006). Comprehensive planning and the role of SDSS in flood disaster management in Malaysia. *Disaster Prevention and Management, 15*(2), 233–240.

Leigh, C., & Low, K. S. (1983). Attitudes and adjustments to flood hazard in a mixed ethnic community in Malacca Town, Peninsular Malaysia. *Singapore Journal of Tropical Geography, 4*(1), 40–51.

Lim, T. K. (1988). *Malaysian rivers and floods*. Paper presented at the Seminar Tebatan Banjir, Organised by the Jabatan Parit dan Tali Air Malaysia and Japan International Cooperation Agency, Kuala Lumpur, 14–17 November.

New Straits Times. (2010). *33,000 in shelters: Flood situation very bad in Kedah*, Precarious in Perlis, New Straits Times [online], 4 November 2010. http://www.nst.com.my/nst/articles/33_000inshelters/Article/. Accessed 5 November 2010.

Parker, D. J. (1992). The mismanagement of hazards. In D. J. Parker & J. W. Handmer (Eds.), *Hazard management and emergency planning: Perspectives on Britain*. London: James and James.

Parker, D. J., Green, C. H., & Thompson, P. M. (1987). *Urban flood protection benefits – A project appraisal guide*. Aldershot: Gower Technical Press.

Parker, D. J., Islam, N., & Chan, N. W. (1997). Chapter 3: Reducing vulnerability following flood disaster: Issues and practices. In A. Awotona (Ed.), *Reconstruction after disaster* (pp. 23–44). London: Avebury.

Pearce, D. W. (1976). *Environmental economics*. London: Longman.

Periasamy, T. (2011). *Slope failure hazards: A spatial and temporal study of the Klang valley region, Peninsular Malaysia*. Ph. D., University of Malaysia, Kuala Lumpur.

Sham, S. (1973). The 1967 flood in Kelantan, West Malaysia. *Akademika, 3*, 1–14.

Syed Muhammad, H., & Binnie Sdn. Bhd. (1988). *Feasibility study on flood mitigation and agricultural development projects in the Krian River Basin*. Unpublished Report to the Malaysian Government.

The Star. (2007). *Singapore: We're not to blame for johor floods*, The Star [online]. 2 February 2007. http://thestar.com.my/news/story.asp?file=/2007/2/2/nation/16758525&sec=nation.

The Star. (2010a). *Do not ignore plight of flood victims, says Muhyiddin*, The Star [online]. 6 November 2010. http://thestar.com.my/news/story.asp?file=/2010/11/6/nation/20101106140013&sec=nation. Accessed 6 November 2010.

The Star. (2010b). *Kedah Sultan sad over flood, urges everyone to work together*, The Star [online]. 6 November 2010. http://thestar.com.my/news/story.asp?file=/2010/11/6/nation/20101106173915&sec=nation. Accessed 6 November 2010.

The Star. (2010c). *Kedah and Perlis scramble to send aid to 19,000 hit by floodwaters*, The Star [online]. 3 November 2010. http://thestar.com.my/news/story.asp?file=/2010/11/3/nation/7352766&sec=nation. Accessed 5 November 2010.

The Star. (2010d). *Alor Setar airport remains closed*, The Star [online]. 4 November 2010. http://thestar.com.my/news/story.asp?file=/2010/11/4/nation/7362218&sec = nation. Accessed 5 November 2010.

The Star. (2011). *Terrible twins' La Nina and monsoon to hit KL and Selangor*, The Star [online]. 6 December 2011. http://thestar.com.my/news/story.asp?file=/2011/12/6/nation/10040911&sec=nation. Accessed March 29, 2012.

Thomas, W. I., & Thomas, D. S. (1928). *The child in America: Behavior problems and programs*. New York: Knopf.

Tneh, D. C. E. (2011). *Education and politics in Malaysia*, Malaysian Insider [online]. 26 April 2011. http://www.themalaysianinsider.com/breakingviews/article/education-and-politics-in-malaysia-david-c.e.-tneh/. Accessed 16 May 2012.

Torry, W. I. (1979). Anthropological studies in hazardous environments: Past trends and new horizons. *Current Anthropology, 20*, 517–540.

Turner, B. A. (1978). *Man-made disasters*. London: Wykeham Publications.

Ujang, Z. (2010). *Water mismanagement? The politics of polluted urban rivers*, Paper Presented at the Merdeka Lecture Series. Penang: Universiti Sains Malaysia, 22 October 2010.

Umar. (2007). *Disaster mitigation support and management in Malaysia*. Malaysian Meteorological Department [Online]. www.met.gov.my/files/ClimateChange2007/session1a/. Accessed 16 May 2012.

Varley, A. (Ed.). (1994). *Disasters, development and environment*. Chichester: Wiley.

Volker, A. (1971). *Flood control (West Malaysia)*. UNESCO Archives, 10–24 March 1971.

Wadell, E. (1983). Coping with frosts, governments and disaster experts: Some reflections based on a new guinea experience and a perusal of the relevant literature. In K. Hewitt (Ed.), *Interpretations of calamity, the risks and hazard series: 1* (pp. 33–43). Winchester: Allen & Unwin Inc.

Winchester, P. (1992). *Power, choice and vulnerability: A case study in disaster mismanagement in South India*. London: James & James Science Publishers Ltd.

Winstedt, R. O. (1927). The great flood 1926. *Journal of the Malayan Branch of the Royal Asiatic Society, V*(II), 295–309.