

# **HOW CAPABLE ARE LOCAL RESIDENTS AND LOCAL GOVERNMENTS AT COPING WITH AND ADAPTING TO FLOOD DISASTERS IN MALAYSIAN CITIES? A case study of two cities from Johor state**

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## ***Abstract***

To understand how well local residents and local authorities coped with and adapted to the 2006/2007 floods in Malaysian cities, this research presents the results of interviews with affected residents in the towns of Kota Tinggi and Segamat.

The first large flood was a surprise to almost everyone. As a result, many people were unable to save their belongings. In subsequent floods, by contrast, they were able to save at least their important documents. Their main coping strategy was to flee their homes and live with friends and relatives during shallow floods of short duration. For more serious and sustained floods, they moved into school shelters.

After experiencing the 2006 floods, some residents in Segamat took adaptive measures. District disaster committees began holding meetings before each new flood season, and stored basic supplies and materials in strategic locations. But this “coping and adapting” approach has a number of weaknesses. Local residents still deal with flooding issues individually, rather than by collaborating with their neighbors; this limits the effectiveness of their efforts. At the same time, the local authorities’ capacity to warn and rescue flood-affected residents has proven limited. Meanwhile, their zoning has not been revised to show flood risk areas or prohibit new development in flood-prone ones. Finally, authorities have not adequately engaged and educated local residents as to how to cope with, and adapt to, flood disasters.

## ***Introduction***

Floods account for about 90 percent of the natural disaster-related damages in Malaysia (Pradhan, 2009). They affect an average of 4.9 million people every year (Mohit & Sellu, 2013) with average annual property damage reaching US\$100 million (Pradhan, 2009). Many regions

of the Malaysian Peninsula experienced heavy monsoon rains and severe floods in 2006 and 2007 (Tam, Ibrahim, Rahman, & Mazura, 2014). Kota Tinggi and Segamat were among the towns in Johor state hardest hit by the flood (Shafie, 2009). The towns are the headquarters of the Kota Tinggi and Segamat districts of Johor state, with populations of 52,746 and 69,821, respectively.

From mid-December 2006 to early January 2007, huge floods that normally would occur once every 50 years, on average, occurred twice in the town of Kota Tinggi. Thousands of residents were evacuated, and property worth millions of ringgit was damaged (National Hydraulic Research Institute of Malaysia, 2012; Sulaiman et al., 2012). Flood-control dams failed to contain the flood water that was generated by this unexpected and unprecedented rain (Shafie, 2009).

Although the timing is of course unknown, similar failures can be expected in the future. This is consistent with earlier findings that engineering or structural approaches alone are unable to deal with flood uncertainty (Liao, 2012; Morss, Wilhelmi, Downton, & Grunfest, 2005; Simonovic, 1999; Tam et al., 2014). Therefore, both communities and flood-control agencies should enhance their capacity to cope with and adapt to the rising trend of flood incidents (Bolin & Stanford, 1998; Joyeeta Gupta et al., 2010).

In Malaysia, however, the focus is more on structural measures, flood modeling, and hydrological analysis, and less on enhancing the ability of residents and local authorities to cope and adapt (Asmara & Ludin, 2014; Ayog, Bolong, & Zakaria, 2005; Ismail, 2015; Lim & Lye, 2003; Mah, Putuhena, & Lai, 2011; Water and Energy Consumer Association of Malaysia, 2013; Wing, nd). Asmara and Ludin (2014) and Ayog et al. (2005) attempted to understand local coping and adapting capacities in some Malaysian cities; however, their studies did not focus intensively enough on how individuals and local governments coped and adapted to flood disasters.

This research attempts to fill some of these gaps. It explores the capacity of local residents and local governments to cope with and adapt to flood disasters in Kota Tinggi and Segamat towns in Johor state of Malaysia, and what we can learn from their experience. Toward these ends, residents and local officials in both towns were interviewed.

The paper is organized as follows. First, it presents a literature review, in the process defining coping and adapting capacity, presenting flood experiences from the developing world, and explaining how vulnerability influences coping and adapting capacity. Second, it explains research methods and their limitations. Third, it introduces urban flooding in Malaysia and the structure of flood disaster management governance, with special reference to the towns under study. Fourth, it presents results on the coping and adapting capacity of local residents and local authorities. Fifth, it lays out what approaches cities and towns in the global

south should consider for coping with and adapting to future flood disasters; and finally, it offers some conclusions.

### ***Literature: Coping and adapting capacity and vulnerability***

#### ***Coping and adapting***

Strong coping and adaptive capacity promotes city resilience—the ability to recover from stress and thrive (Bermann, Quinn, & Paavola, 2012; Joyeeta Gupta et al., 2010). Without these two capacities, resilience in response to climate change and disasters is difficult to achieve (Intergovernmental Panel on Climate Change, 2012; Liao, 2012). “Coping” is defined as survival in the face of immediate, unusually significant stress (Few, 2003; Islam, Hasan, Chowdhury, Rahaman, & Tusher, 2012; Ben Wisner, Piers Blaikie, Terry Cannon, & Ian Davis, 2004). A city with high coping capacity that experiences stressful impacts is able to continue normal functioning within a short period of time, without permanent damage to livelihoods, health, or well-being (Johnson & Blackburn, 2014). Going through various coping experiences generates useful knowledge for long-term adaptation (Berry, 2005).

Adaptive capacity is a long-term “learning by doing” process (Berkes & Ross, 2013). It is the ability to respond to a disruption by adjusting to a changing situation, and thriving (K. M. A. Chan et al., 2012). Every flood, for example, involves something new—for example, debris deposition at unexpected locations. By understanding new phenomena and making the necessary adjustments, incident by incident, the city incrementally increases its adaptive capacity. Overall, coping focuses on the moment, and survival; adapting (in terms of human responses) focuses on the future, where learning and reinvention are key features, and short-term survival is less in question, although it remains inclusive of changes inspired by already-modified environmental conditions (Intergovernmental Panel on Climate Change, 2012).

A flood-resilient city is defined by strong coping and adapting capacity on the part of both of its individual citizens and its organizations (J. Gupta et al., 2010). Most urban citizens are ineffective at coping and adapting to floods, primarily because of their individualistic living styles, their limited social capital with their neighbors, and their heavy reliance on government (Ayog et al., 2005; Khailani & Perera, 2013). Our survey of residents in flood-prone Surat city in India, for example, revealed that nearly two-thirds of the surveyed residents had no coping strategy at the time of the severe floods of 2006 (Bhat, Karanth, Dashora, & Rajasekar, 2013). Most city residents were unaware of the risk associated with rapid urbanization around riverbanks and coastal areas. When water levels rose in the area, about 27 percent of the residents moved to upper floors and terraces, while the rest went to shelter in friend’s and relative’s home (Bhat et al., 2013). Others went to schools, temples, and hospitals.

After the flood incidents, it should be noted, residents had taken some adaptation measures. Some had raised the plinth levels of their residential and commercial buildings (Bhat et al., 2013). Others had started using their ground-floor spaces only for parking. Many residents had built higher shelves and lofts in their houses to keep their valuables safe when flood waters again begin to rise in the area (Bhat et al., 2013).

Closely connected rural communities and urban slums show relatively high coping and adaptive capacities. In rural Bangladesh, for example, Paul and Routray (2010) found that villagers had create raised bamboo platforms to survive the rainy season. As the flood rises, they keep their possessions on these bamboo platforms, and—if necessary—transport them by boat to a safer place. They stockpile food supplies, and put sandbags around their homes in response to the rising waters. When necessary, they move temporarily to higher ground until the water recedes. Since these are rural farmers who face flooding in rainy seasons every year, and who have no choice other than to live in the flood zone, they cope and improve coping while facing the upcoming flood. In this situation, the line between “coping” and “adapting” tends to get blurred.

In Korail, one of the largest informal settlements in Dhaka, Jabeen, Johnson, and Allen (2010) found that during a flood, most residents slept on tall furniture and used a portable cooker for food preparation. Many shared toilets with their neighbors who were unaffected by the flood. In cases of longer flooding, some of them shared food with their neighbors, and some borrowed money to meet their needs. These residents were active in preventive and impact-minimizing efforts during the flood (Ben Wisner, Piers Blaikie, Terry Cannon, & Ian Davis, 2004). Families susceptible to flooding—but living away from the water’s edge—constructed five-inch barriers at the door to stop water at to a certain level from coming into their rooms (Jabeen et al., 2010). Many raised the height of the furniture by up to 9 inches to protect goods from flooding. Those living near the water built their houses on stilts, and after the flooding was over, raised house plinths and changed roofing and partition materials.

Coping and adapting capacities are important, but in the case of major floods, may not be sufficient. In such cass, external assistance from local authorities may be necessary (Paul & Routray, 2010). Most local authorities, however, are too weak to respond effectively to major floods. In Kurnol town, Andhra Pradesh, India, for example, local authorities were ill prepared to deal with one of the worst floods that had occurred in a century or more (Ramachandraiah, 2011). They failed to issue early warnings about the flood. To prevent electrical grounding and short circuits, the authorities shut off the local power grid; as a result, people had to escape the area in the dark (Ramachandraiah, 2011). The batteries of the cell phones of the district authorities died just when those phones were most needed, and there was no power to recharge them (Ramachandraiah, 2011). Finally, they were far too slow to set up relief camps and provide much-needed relief supplies.

During a recent flood in Chennai city, India, more than 270 people died and 4,000 people were stranded (Zachariah & Thangavelu, 2015). The local authorities failed to warn people about the flood in advance, and their rescue efforts were notably slow (Zachariah & Thangavelu, 2015). Notably, local governments in some countries refuse to assume flood-related responsibilities. In Norway, for example, local authorities insist that managing large-scale flooding is the responsibility of the national government, rather than theirs (Næss, Bang, Eriksen, & Vevatne, 2005).

In some cases, politics and prejudice have affected the coping and adapting capacity of local residents. In Indore city in India, for example, some local leaders provided relief supply only to those areas where their loyal voters lived (Bahadur & Tanner, 2014). In Kurnol town, Andhra Pradesh, India, some leaders offered help only to people from their own caste or group (Ramachandraiah, 2011).

### *Vulnerability*

Vulnerability is the relative exposure of a group or individual to stress, due to unanticipated social and environmental change (Adger, 1999). It reflects the degree of coping and adapting skills that are needed to respond to a particular disaster in a particular geographical location. Exposure, in turn, is the “presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.” (Intergovernmental Panel on Climate Change, 2012).

This research focuses on “vulnerability” in the context of negative impacts of a flood disaster on an individual or group. That vulnerability often results from the development of human settlements in floodplains, and often in urban areas. For example, the rapid urbanization of Bangkok expanded in vulnerable and inhabited flood plains. As a result, when a huge flood ravaged the entire city in 2011, it caused huge social and economic losses (Haraguchi & Lall, 2014). Over half of the new development between 1986 and 2002 in Warri town in Nigeria occurred in flood prone lands (Odemerho, 2014). The Surat city in India—which experienced major flooding in 2006—is expanding in the coastal zone. There are as yet no land-use regulations to prevent development in high flood risk zones in India (Bhat et al., 2013). In fact, the coastal areas—highly vulnerable, in many cases—have become the hottest locale for private real estate development (Bhat et al., 2013).

### ***Research method and limitations***

As noted, this research studied the 2006/2007 flood impacts on the residents and local governments in the towns of Kota Tinggi and Segamat. The study area was located in the urban fringe residential area. Most of the residents living in the area were lower middle-income people working in department stores, small businesses, ice cream shops, transportation, and port industry. This study comprised interviews with ten flood-affected

residents in each of the two towns to understand how they coped and adapted to the flood.

The flood hit residential area chosen for interviews was Taman Kota Jaya (TKJ). By talking with local residents, we identified three residential streets in TKJ that were hard hit by floods: Jalan Duku, Jalan Mangesh, and Jalan Sakun. Prior to selecting these three streets, brief interviews with two residents in Jalan Bilinjal and Taman Kuso area were carried to test the relevance of some interview questions. Similarly, in Segamat town, three streets hard hit by flood in 2006 were identified for the purpose of interviews: Taman Segar, Kampong Abdullah, and Taman Pelangi.

Home visits were made, and those adults who were available at home were interviewed. In Kota Tinggi, the chief village head, one irrigation engineer, and a town planner were interviewed to provide background on key flood issues in the town. One professor from the University Technology of Malaysia (UTM) who was involved in managing nationwide grants for flood research was so that we could gain his perspective regarding flood disasters in Johor state.

In Segamat, an assistant district officer was interviewed for a perspective on the flood disasters in the area. Students involved in flood issues in both the towns were consulted, giving us a better grasp of the reality on the ground. Discussions were held with the experts from the Iskandar Malaysia Regional Development Authority (IRDA) to gain their insights on flood issues. Local map analysis and field observations were made to conceptualize the geographical context of the area, and relevant international literature was reviewed.

Because this research focused largely on individuals who had personally experienced the floods in the study area, it has strong roots in reality, and therefore a measure of validity. It is possible, however, that some of those interviewed had biases that skewed our findings. Furthermore, because of logistical constraints, our research did not capture the socioeconomic data of each interviewee. We believe that many of the insights revealed by this research can be helpful to urban residents grappling with floods all around the world. But since most flood incidents are situation-specific, not all of these insights may be generalizable. So readers should draw on them as useful, but make their own judgments based on their own unique circumstances.

### ***Urban flooding in Malaysia***

*Urban development and flooding:* Malaysia is a fast-developing country progressing towards industrial development in urban areas. Given the scarcity of land in city and town areas, development is encroaching on flood-prone areas (Ayog et al., 2005). Even though several major floods have occurred in recent years—both as localized flash floods and as basin-wide floods—there are as yet no proper guidelines for development in floodplains (Ayog et al., 2005). Local development plans and zoning

regulations do not document flood-risk areas in cities and towns, and therefore cannot prohibit new development in those areas (Khailani & Perera, 2013). Local development plans are prepared without stakeholder participation and indigenous knowledge. For all of these reasons, there is an absence of “resilience thinking” in the existing local development plan (Khailani & Perera, 2013).

*Structure of flood disaster management governance:* There are three levels of disaster management authorities in Malaysia (N. W. Chan, 2012). They are 1) the National Disaster Management and Relief Committee 2) the State Disaster Management and Relief Committee, and 3) the District Disaster Management and Relief Committee (DDMRC). However, there is often lack of coordination between these three levels of management committees (N. W. Chan, 2012). The DDMRC is chaired by the district officer. Both the towns under this study (Kota Tinggi and Segamat, see Figure 1 below) have their own DDMRCs.

The Kota Tinggi and Segamat DDMRCs are represented by representatives from the Department of Irrigation and Drainage (DID), the Meteorology Department, police, army, and firefighters, and village heads (Penghulus). The district office appoints Penghulus for each subdistrict to collect information regarding flood disasters. For example, in Kota Tinggi district, there is one chief Penghulu and 9 Penghulus for various subdistricts. The DDMRC creates control rooms in each subdistrict for carrying out rescue and relief operations. The DDMRC meets frequently in case of a surge in rain and flooding. The DID provides technical and engineering expertise to the DDMRC, such as information regarding the level and volume of flooding.



**Figure 1.** Location map of Kota Tinggi and Segamat town  
*Source: (Tukiman & Tyszczyk, 2015)*

## ***Findings/results***

*Context and impact of flooding:* For most residents in our two subject towns, the 2006 flood came a major surprise. Because they did not believe that the flood in 2006 would rise so high, they were not prepared for that eventuality. Many residents said that because of the sudden surge of flood water, they had to leave their homes with almost no notice, sometimes at odd times of day—early in the morning, for example, or late in the evening. As a result, they lost most of their belongings that were in their ground floor.

According to one resident from Taman Segar, Segamat, his three cars went under water in the 2006 flood. A woman of Indian origin living in Jalan Durian, Kota Tinggi ran a photocopy and courier shop in the town center.<sup>1</sup> The flood hit the town center at 3:00 a.m., when she was sleeping in her home. All her goods in the shop were submerged, causing a loss of about RM100,000. By 10:00 a.m., the flood also reached her home, and she had to take refuge in her mother's home with a bare minimum of belongings. Later on, her mother's home too was under flood risk, and ultimately she had to go and live in government shelter. One resident from Jalan Duku, Kota Tinggi, said that one of her neighbors had gone for a religious visit to Saudi Arabia for two weeks during the flood incidents; when he returned, he found he had lost most of his belongings.

### *How did the residents cope?*

In Kota Tinggi, most interviewed residents said that they went to live in schools and government shelters. Even those with more than one floor in their homes did not stay in their upper floors. According to one resident, the flood water was so deep that it took many days to recede, and there was no electricity in the area. Their duration of stay in the shelter was one week or more. However, in Segamat, most of those who had more than one floor in their homes stayed upstairs for one or two days, mainly because the flood water was not as deep as that of Kota Tinggi and the water receded fairly quickly. Only those Segamat residents who did not have upper floors to live in sought shelter outside their homes. Some sheltered in nearby tall houses, office buildings, or the house of a friend or relative. None said that they lived in a public shelter. Since the flood did not linger in the area, they didn't feel the need to go to live in the shelter.

Most local residents contended with the flooding individually. None of them said that they discussed with their neighbors about how to respond to the flooding, and none said that they sought help from their neighbors. There were no residential committees formed to mobilize or educate people. Very few of them knew that their homes were located in low-lying areas before the 2006 flood incident. One lady from Kota Tinggi said that she bought her house because of its proximity to school, the hospital, a mosque, the market and her job, and never knew that flooding was a risk in the area. As two residents in Segamat explained, they were

retired, their children had moved to bigger cities in search of work, and they lived in these town centers for proximity to shops, medical care, and other services. One lady from Kota Tinggi said that she was a retired clerk from the Ministry of Health and has been living in the area for 20 years.<sup>ii</sup> Despite knowing the flood risks, she says she wants to continue to live in the area, in part because she has no other options. Still others pointed out that since the big flood occurred only after 30 years, the odds might now favor living in the area.

#### *How did the government do?*

The local authorities' early-warning messages did not reach all the flood-affected areas. Two residents said that they did not receive any early warning in either the 2006 or the 2007 flood. Two others said that they had received a warning through loudspeakers; however, one said that he received a warning in the second case, but not the first. Many government officials—including chief Penghulu, DID engineers, and firefighting officers—had their houses inundated by the flood waters. The chief Penghulu said that the water level around his house reached up to 7 feet. His elderly and paralyzed mother was at home during the flood. He faced a dilemma: rescue his mother, or go to work for public safety? He first called rescue boats to take his mother—who was trapped on the first floor—to the rescue camp, and then went back to work. He said that there was no power, roads were flooded, and food supply was cut. There was a shortage of food, diesel and good sleeping area. There was ever-increasing demand for clean toilets, drinking water, volunteers, and relief staffs. Two residents from Kota Tinggi said that Penghulu come with boats only after the flood kicks in, and that Penghulus are only advisors, and therefore do not have the necessary authority to make decisions related to flooding or mobilize resources.

During the first flood in 2006, the firefighting office was in a rented building in a flood-prone area, although a new office was then under construction.<sup>iii</sup> To protect firefighting equipment, the fire fighters took their trucks and boats to higher grounds. At 3:00 a.m., they received a request from the District Police Office to rescue a pregnant woman from the second floor of a two-story house located at Taman Mawai, a flooded neighborhood. The water level in the area had reached 8 feet above the ground. When they took the rescue boat, the house compound gate was closed, and they had to swim into the water to open the gate and bring the boat closer to the house to rescue the woman.

Next, they received two messages simultaneously. The District Police Office asked them to transfer flood-affected people from Taman Mawai to Kota Kecil (i.e., higher ground). At the same time, however, they received a call to deal with a fire 48 kilometers out of the town. According to the firefighter officer, he sent 6 firefighters and one fire engine to deal with the fire, and 3 firefighters to transfer flood-affected people from Taman Mawai to Taman Kecil, while one person stayed in the office to

monitor communications. Twelve firefighters were supposed to work each shift; at that time, however, they had only ten staff members. Rowing rescue boats through the area was difficult since there were many submerged cars along the way, and they also encountered wild animals in the water. Meanwhile, as noted, some rescue personnel had their own houses submerged in the water, and had to make difficult choices.

Most of the residents were happy with the post-flood government support, such as shelter and food. Some also received cash and clothes from the government. Two residents said, however, that the food in the shelters was not sufficient. A 70-year-old lady living in Taman Jawa at Segamat said that the government provided support only to those close to YB and their relatives, meaning that the relief goods—such as money, building materials, and clothes—were not distributed fairly.<sup>iv</sup> A person from a minority group mentioned that there had been some racial discrimination during the rescue process. He said one of his friends was stuck at home due to the flood, and asked a passing boat to rescue him, but the rescue boat did not stop. He said that the rescuers were Malay, and they gave first priority to Malay people. Several Segamat residents of Chinese origin also expressed their conviction that government support favored Malays over others.

The government's efforts to prepare local residents for floods or to engage them in flood management were minimal. The majority of the residents Kota Tinggi and Segamat said that they had not received any education about floods. They were hardly consulted in drawing up flood-management plans. Very few of them said that the city counselors or YB showed up in the area before the flood. And although the post-disaster relief work of the clubs and NGOs was impressive, those groups came to the community only after the flood.

Also worth noting is that the local planning and zoning regulations do not reflect the flood sensitivity of Kota Tinggi. Most of the areas that were severely flooded in 2006 and 2007 are in residential and commercial use, and the entire downtown and most new residential areas are located in low-lying areas not too far from the Johor River. The floors of most houses are very close to ground level, and are therefore susceptible to any flooding over nine inches above the ground.

Zoning maps do not show flood-risk areas in the town, and the absence of designated flood-risk areas puts planners in an untenable position: trying to stop new development in areas that they personally perceive to be flood-prone. Even recent calamities are not enough to deter inappropriate development. The Kota Tinggi government town planner said that simply on the basis of a big flood that came after 20 years, it is hard to stop people from new development in the area. To address the development pressure and to save himself from the accusation that he issued permits in flood-prone areas, the planner said that he forwards such applications to the higher planning authorities, and seeks comments from 13 different agencies before issuing a permit. Recently, a new

residential development was completed at Jalan KM1, near the town center, at a spot where flood waters rose more than 6 feet above ground level in 2006.

*What did the residents and local authorities learn?*

After the 2006 flood incidents, residents became more vigilant. Most residents from both the towns said that after the 2006 flood, they were able to make better judgments, like assessing the intensity and duration of rain and checking the nearby river water level. If they sensed some risk, they took their car on higher grounds, and many had plans as to where they would go for shelter. This kind of vigilance can pay off. One lady from Taman Jawa, Segamat, saw a rapid increase in the flood water level in her front yard after she finished her evening prayer. She immediately left the house and took refuge in her friend's house, knowing that getting emergency rescue at night would be very hard.

Some adaptive measures were also at work. One resident from Jalan Bunga Raya, Segamat, said that after the 2006 flood incident his family constructed a first floor as a strategy to protect themselves when their ground floor is submerged in water. Another old man living in the same area since 1969 said that he had seen a big flood similar to that of 2006 in the 1970s. He had seen military boats moving around to rescue people. Taking note of those incidents, he had created a small room above his single story home, and this paid off. When floods hit the area in December 2006, he climbed upstairs and spent one night in that room, safely above the water level. A 70-year-old lady owns a single-story home at Taman Jawa, Segamat, and lives alone in that house. After the 2006 flood, she installed a cabinet on her roof to keep her belongings in the event of a big flood.

Some are taking more drastic steps. According to one resident from Kampong Abdullah, Segamat, people in the area are selling their houses and moving to higher ground, such as Segamat Bharu. He said that home prices in Kampong Abdullah have fallen by 30 percent, while housing prices in the elevated areas are rising.

The government, too, is adapting. Local authorities have started having meetings and thinking about flood risks several months before the onset of the monsoon season, generally associated with flooding. The DDRMC started stockpiling relief materials in various strategic locations three months before the flood season, to ensure adequate food supplies during flooding.

### ***Summary of findings***

This research underscores the fact that floods can happen at any time, with little warning, and therefore may leave no time for residents to prepare. As a rule, residents experiencing fewer but larger floods learn to cope, but generally do not learn to adapt like the residents of towns experiencing smaller floods every year. The residents of Kota Tinggi are in

the former category, and by and large, their way of coping was to run to the shelter. In Segamat, by contrast, residents learn to adapt.

As compared to rural communities and urban slums with homogenous socioeconomic characteristics, urban residents living in private residential areas are not well organized among themselves, and therefore tend to take action individually rather than collectively. Many residents were not even aware that their homes were located in a flood-prone area. They considered access to school, market, and town facilities when they were buying a home, and flood risks simply were not among their criteria. The local zoning maps don't show flood plains, most of which are zoned for residential, commercial, or institutional use.

Local authorities failed to have a reliable early flood warning system in place. Many residents said that they did not receive flood warnings. The authorities' approach to flood management is top-down, with little involvement of local residents in flood-related planning. The local authority's ability to supply food and relief materials in flooded areas was weak—for example, firefighters did not have sufficient manpower or equipment to respond to the rescue need, and there was a lack of security forces to protect properties in flooded areas. In some cases, rescue and relief operations were not carried out in a fair manner.

To be fair, the 2006 and 2007 flood did educate residents and local authorities to some extent. The residents learned where to go in case of a flood. Some residents extended one floor up their house to create spaces to protect themselves and their valuable goods. Others sold their properties to move to higher ground. Local authorities and DDMRC began to meet frequently before the rainy season, to make sure rescue and relief plans were in place.

### ***What more needs to be done?***

The capacities to *cope* and *adapt* are the two frames applied by this research to examine how local residents and local authorities deal with flood disasters in urban Malaysia. This section therefore draws a number of lessons from Malaysia for improving the coping and adapting capacity—of both local residents and local authorities—in dealing with city flooding all over the world.

#### ***Coping strategies***

The flood experiences from Malaysia have provided a number of lessons for coping with flood disaster. First, during rainy or flooding season, residents should keep an eye outside their home and remain alert while performing their day-to-day activities, both inside and outdoors. The residents should keep their valuable assets and cars on higher grounds if they begin to experience heavy and continuous rain in their area. If evacuation is necessary, they should go to the shelter during the day, to avoid the need for night-time rescue. Obviously, residents should make sure that the place where they take refuge is safe from flooding.

Residents should consider keeping their important belongings in a safer place if they are planning to go abroad during flooding season. Wherever possible, they should not act alone, but instead should talk to their neighbors and develop joint strategies for dealing with floods. They should seek training and other support from local authorities, and form neighborhood-level flood-response resident committees.

Local authorities should develop an effective early-warning system to alert all residents in advance about a possible flood risk in the area. The authorities should deepen their reserves of rescue equipment, trained manpower, and relief materials. Concurrently, they should train local residents in the basics of flood prevention, coping, and rescue and relief operations. The authorities should involve firefighters in training local residents on how to deal with floods, and should work in concert with local residents and leaders in all flood prevention and recovery tasks. The local authorities should ensure fairness in all rescue and relief operation, and ensure patrolling of flood-affected areas to prevent theft and looting incidents.

Local governments, local leaders, NGOs, mosque, churches, and temples should not only join in post-disaster relief operation, but also should participate actively before the flood to educate residents and develop joint strategy on how to prevent and cope with flooding in each neighborhood. A study of a flood-prone municipality in Puerto Rico, for example, found that communities require support for social learning by building on existing knowledge; stressing the importance of developing a diverse set of flood management options; and promoting effective linkages and collaborations among community members and emergency managers to encourage collective flood management (Lopez-Marrero & Tschakert, 2011).

#### *Adapting capacity*

All homebuyers and renters should make sure that they do not buy or rent homes in flood risk areas. Whenever feasible, residents in such areas should try to sell their properties and move to higher ground.

Ultimately, flood risks will be reduced only if spatial planning regulates land use in flood-prone areas (Böhm, Haupter, Heiland, & Dapp, 2004). New settlements and industry must be kept out of the main risk zones (Böhm et al., 2004). Local authorities must update local zoning maps to show flood risk areas in town. They should prohibit new development in those flood risk areas, and—where possible—relocate and resettle those people living in flood-risk areas. Local building codes should require residents living in flood-prone areas to raise their house plinth levels above the ground, and local authorities should provide incentives to residents to raise those plinths.

## ***Conclusion***

City residents in Johor state of Malaysia experienced huge and unexpected floods in 2006 and 2007. This flood shocked both the residents and local authorities, and made them more alert for future flooding in the region. Their current ability to cope with and adapt to flooding, however, is not adequate. Local residents should further educate themselves regarding what they should do before, during, and after flooding in their neighborhoods. They should work with their neighbors, and seek support from local authorities.

The local authorities, for their part, should improve their early flood warning system, adopt appropriate zoning regulations, and deploy resources to prevent and cope with flooding. They should not act in isolation, but instead, involve local residents in all flood-related planning, and set the stage for taking joint action in the event of a flood emergency.

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## Notes

<sup>i</sup> Personal communication, October 6, 2015

<sup>ii</sup> Personal conversation, October 7, 2015

<sup>iii</sup> Personal conversation with firefighter, October 5, 2015

<sup>iv</sup> Yang Berhormat (YB): an elected representative