

ENGAGING LOCAL COMMUNITIES THROUGH LOCAL KNOWLEDGE OF FLOOD DISASTER MANAGEMENT IN THE PAHANG RIVER BASIN, MALAYSIA

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Abstract

Natural disasters such as floods and earthquakes impact many parts of Southeast Asia. In Malaysia, recent floods—such as those in 2014–2015—have caused untold damage to property and livelihoods.

Up to that point, flood management had mainly emphasized disaster response, rather than risk-reduction strategies. The aim of this paper is to identify the local knowledge and practices of flood-affected communities along the Pahang River that increase their resilience to flood risks, and to identify the ways in which this knowledge and these practices can be incorporated into flood management going forward. Research was conducted through semi-structured interviews with residents living along the Pahang River who experience frequent flooding, focus group discussions among village leaders, and field observations. The research revealed that the communities possess local knowledge, practices, and social arrangements that, in the past, had increased their resilience to floods. Such knowledge and practices, however, are disappearing. Recommendations include identification of local knowledge, placing value on local knowledge, integrating that knowledge into flood management policy, and sharing that local knowledge globally.

Introduction

Natural disasters such as floods and earthquakes impact many parts of Southeast Asia. Disaster preparedness, however, has been characterized by a top-down approach, with a heavy emphasis on disaster response rather than risk-reduction strategies. Such strategies focus on

managing conditions of hazard, exposure, and vulnerability, which in many cases can prevent losses and minimize the impacts of disasters (Tiefenbach, 2013, Chan 2016).

Because floods occur almost annually, communities have developed adaptive strategies to deal with floods. These strategies are based on local knowledge, practices, and social arrangements, among other sources. But only recently have those practices and that local knowledge been incorporated into the planning and execution of disaster-preparedness activities managed by implementing organizations. Programs that focus on how a society resists, responds to, and recovers from the impact of a natural hazard tend to produce better outcomes, characterized by higher levels of project acceptance, performance, ownership, and sustainability of those outcomes. And by achieving both financial and social goals, such programs may prove cost-effective in the long term (Dekens, 2007).

Using the Pahang River Basin in Malaysia as a case study, this paper identifies the local knowledge and practices of flood-affected communities that have increased their resilience to flood risks, and also highlights the ways in which that knowledge and those practices can be incorporated into current flood management strategies.

Historical context of flood management

Floods cause damage to property, and have adverse effects on people and their livelihoods. Over time, the mortality risk associated with weather-related hazards has declined. The economic exposure associated with floods, however, is on the rise. Mitigation efforts to reduce flood- and weather-related hazards tend to rely heavily on infrastructural development (such as building dams) or on sophisticated and highly technical solutions (such as early warning systems based on scientific data and modeling). Although such solutions may save lives when disasters strike, complementary actions are needed to address underlying social vulnerabilities (Wisner et al. 2011). Toward that end, more proactive approaches—ones that prioritize mitigation and preparedness—are being considered by flood management agencies (World Bank, 2005).

The aim of flood management is to eliminate risk, hazard, and vulnerability. Flood management takes place at both the community level and the institutional level. The historical evolution of institutional-based flood management at the state level can be discerned from, first, the institutional perception of risk management, and second, the concept of “vulnerability” operating at the time.

Incorporating local knowledge and practices into flood management can make significant contributions to disaster-risk reduction and

sustainability. Dekens (2007) suggests multiple reasons for including local knowledge in disaster risk reduction policies:

- Incorporating local knowledge enhances community participation, empowering communities to seek adaptive strategies towards disaster risk reduction.
- Local knowledge can be transferred and adapted to other communities in similar situations, and local knowledge opens avenues to information about the local context.
- The often informal nature of indigenous knowledge dissemination can be used as a model for education about disaster risk reduction.

Only recently, however, have scientists and practitioners given much attention to local knowledge (Mallapaty 2012), and the process for transforming this knowledge into action is still in its infancy. Starting in the 1980s, the social system became an important component of flood management, including considerations of differences in coping capacity and the need for local participation. In many countries, however, mainstreaming community involvement in emergency management and mitigation practices did not begin until the 1990s (UNISDR 2007). Two international frameworks, the Hyogo Framework for Action (2005–2015), and its successor, the Sendai Framework for Disaster Risk Reduction (2015–2030), acknowledged local knowledge and practices as important in flood management (UNISDR 2015).

Flood Management in the Pahang River Basin, Malaysia

The Pahang River is 459 kilometers long, winding its way through the middle of peninsular Malaysia. The climate of peninsular Malaysia is tropical, with heat and humidity throughout the year and annual rainfall of about 2500mm.¹ The east coast of peninsular Malaysia is affected by the northeast monsoon, which brings copious rain in November, December, and January, and causes regular flooding in some parts of the Pahang River Basin.

Communities living within the Pahang River Basin are largely dependent on farming and small industries. They have remained situated along the Pahang River despite the fact that it is prone to frequent flooding. The district of Temerloh, where the growing town of Temerloh is situated, lies at the midstream of the river. The areas of the river most affected by floods are the midstream and downstream parts of the river (Figure 1).

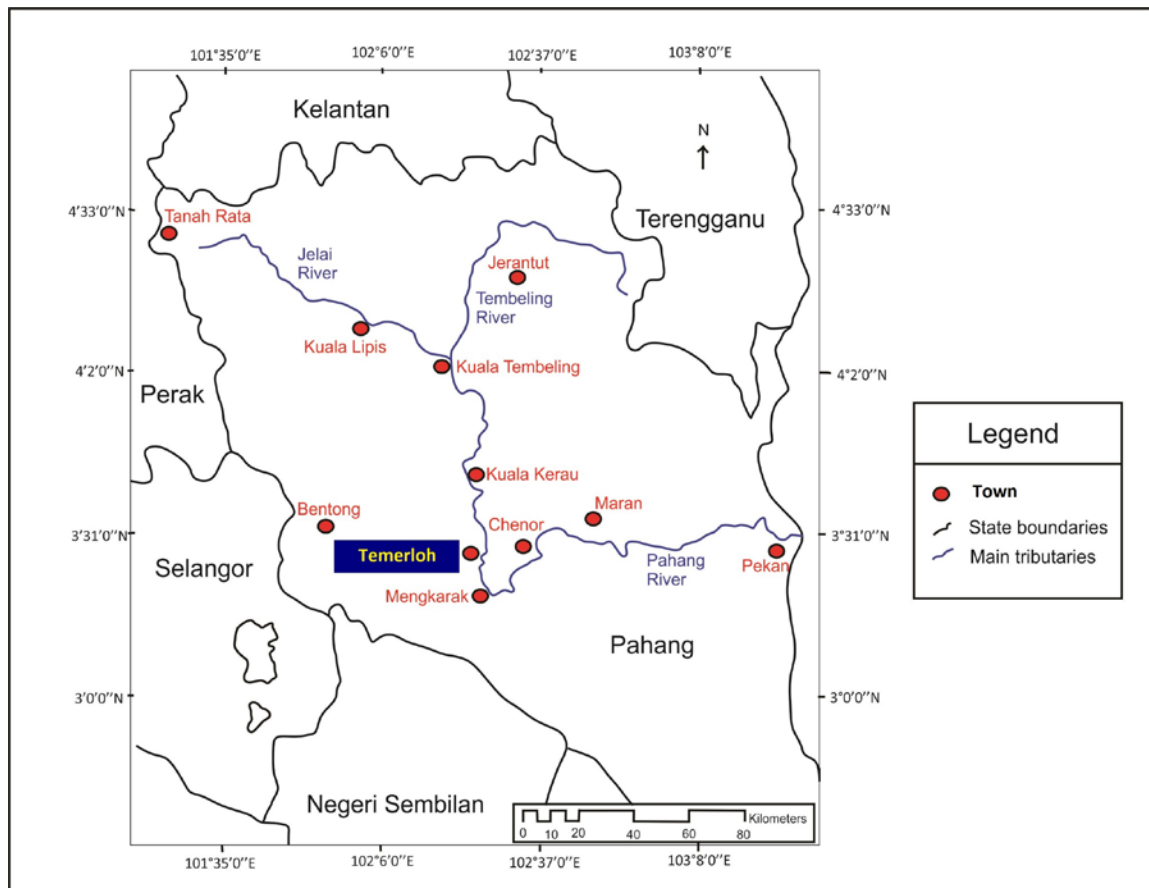


Figure 1. Map of the Pahang River

At the federal level in Malaysia, the newly formed National Disaster Management Agency (NADMA) coordinates the disaster management system. At the community level, the District Officer heads the disaster management team, with the District Police Officer, the District Fire and Rescue Department Officer, and various other governmental departments and agencies.²

There are many reported issues with the current disaster management program in Pahang. Many of the designated shelters within the Pahang River basin do not meet internationally recommended standards for shelters, such as the Sphere Project (Anizan et al 2015). Community capacity-building to reduce flood risks has been minimal (Chan, 2016; Keithley, 2014; Sim, 2016; Leman 2016). Although non-structural measures such as resettlement, development of flood forecasting, and warning systems have been taken to reduce flood risks (Chan, 2016), there is little information as to how the Malaysian government has incorporated community participation, indigenous knowledge, and social arrangements that support disaster risk reduction

into planning. True, Malaysia's Hyogo Framework Interim report cites awareness and counseling programs in schools in flood-affected areas as part of its current strategies (National Security Council Malaysia, 2012), but those efforts appear to be the exception, rather than the rule.

Literature Review

The Asia-Pacific region has a wealth of indigenous knowledge related to floods and other disasters. Mercer (2009) listed literature that explains the benefits of, and the need to incorporate, local knowledge in management related to various fields. As previously mentioned, Dekens (2007) suggested that incorporating local knowledge into formal flood management enhances community participation, promotes transfer of local knowledge, supports development of local information channels, and empowers communities to embrace disaster risk reduction. Local knowledge, when complemented with knowledge from external sources, has greatly aided communities to manage crises that may be natural hazards, economic, or political in nature (Ellen 2007). Such knowledge, however, is rapidly disappearing in the face of modern lifestyles and challenges.

Local knowledge and practices shape risk perception and preparedness for action. Wachinger et al. (2013) proposed that the two most important factors in determining risk perception and preparedness for action are experience and trust. Other factors, such as social and physical attributes, act as modifiers or amplifiers of the effect of experience and trust on risk perception.

Studies of flood-affected communities in Pahang found those communities to be vulnerable due to lack of flood warning, landlessness, unstable housing, and food insecurity (Chamhuri, 2016). In the wake of a flood, they tend to face numerous health challenges, as evidenced by the high number of people who experienced poor physical and psychological states. This combination of factors indicates a low level of empowerment to adapt to floods within the community (Sharifah Ezat et al 2015).

Methodology

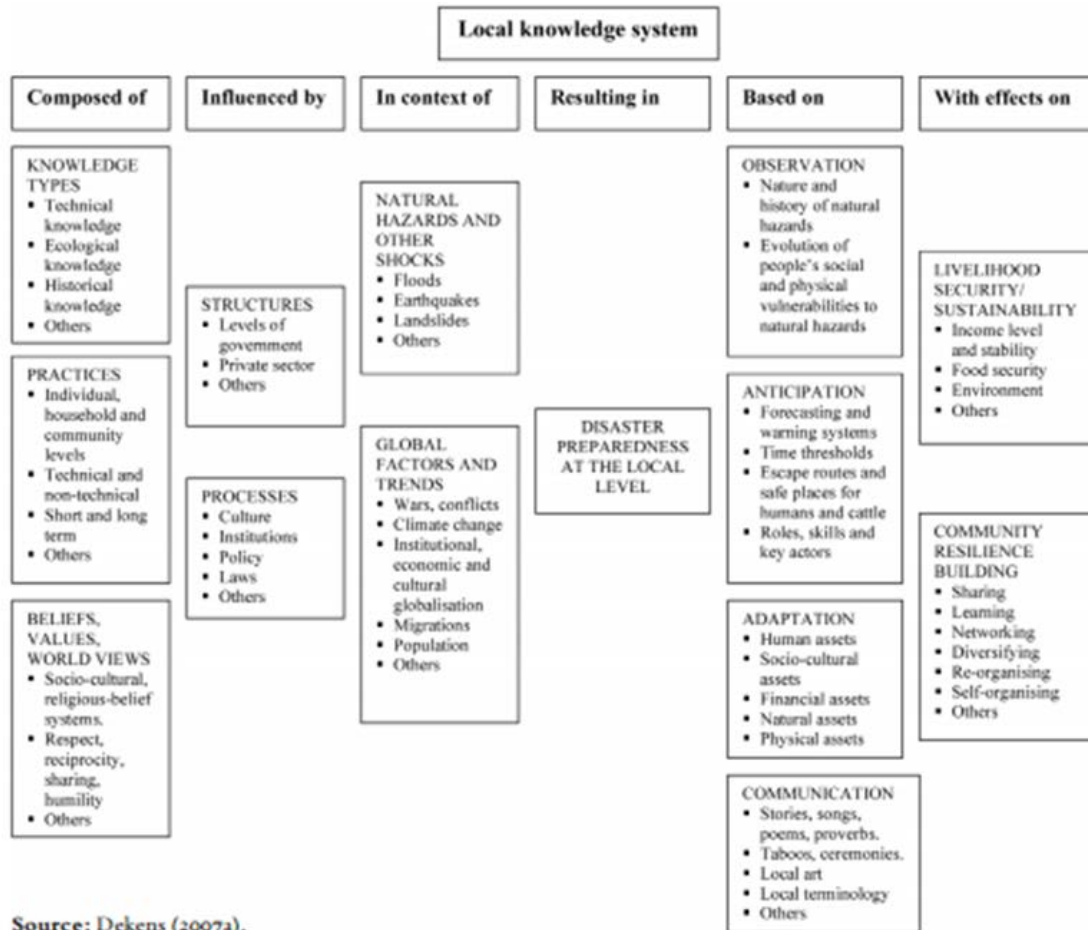
This research was undertaken through 30 semi-structured interviews conducted with residents who live in the Pahang River Basin, and who experience frequent floods. The communities represented include:

- Kampung Garok and Kampung Sungai Putat, near Jerantut town (upper-midstream)
- Kampung Gatok and Kampung Kerdau, near Mentakab town (midstream)

- Kampong Lebak, Kampong Loyang, Kampong Lompat, and Kampong Baru Pengkalan Jaya, near Temerloh town (midstream)
- Kampong Chenor, Kampong Teluk Melati, Kampong Paya Tin, and Kampong Batu Tiga, near Maran town (midstream)
- Kampong Mengkarak, Kampong Triang, and Kampong Jelam, near Bera town (midstream)

The overall area comprising these kampungs (urban villages) spans a distance of 91 km from north to south and 65 km from east to west. Field observations were carried out to observe disaster preparedness methods. Triangulation of the interviews was achieved through field observation and by convening a focus group discussion among fifteen village leaders. While factors such as political, natural, and financial assets are important to consider in assessing the overall adaptive capacity of a community, they are dealt with only cursorily in this study.

The framework for this study is adapted from the local knowledge systems framework proposed by Dekens (2007). Dekens's framework (Figure 2) emphasizes the overriding processes that govern local disaster preparedness knowledge. According to this framework, local knowledge systems are composed of knowledge types, practices, and beliefs. Practices are influenced by people's belief systems, which moderate their understanding and perceptions of, and their responses to, disaster. In order to understand people's actions, it is important to document and understand local beliefs, perceptions, and values. Local knowledge is understood not just from a technical perspective but also from the point of view of non-structural knowledge. Oftentimes, this non-structural knowledge is connected to people's livelihoods and worldview. Furthermore, it is embedded within both the historical understanding of hazards and the actions and events of the present time. The importance of local history in influencing people's perception and response to disasters should be emphasized.



Source: Dekens (2007a).

Figure 2. Dekens's local and indigenous knowledge framework

Knowledge, practices, and beliefs are influenced by power relations. Local knowledge can only turn into practice through transformations that involve power, mediated by local institutions and associated power relations. Actions taken through these power structures are moderated by the policies and laws of the country. Local practices may vary by household, community, age, gender, profession, caste, or ethnicity.

Local knowledge is seen in the context of flood disaster preparedness resulting in preparedness at the local level. Dekens's framework suggests that the identification of local knowledge and practices should stem from four concepts: observation, anticipation, adaptation, and communication.

- *Observation* includes monitoring the environment and how it relates to natural hazards. People observe and understand natural hazards through their direct and indirect experience and

appreciation of local surroundings. Such observation over generations allows communities to have both a historical perspective of the local knowledge generated and a longitudinal view of the changes in the social and physical vulnerabilities to natural hazards.

- *Anticipation* refers to how an imminent hazard is forecasted. This includes identifying, interpreting, and monitoring environmental and meteorological indicators of early warning signs.
- *Adaptation* considers the ways a community deals with the threat of disaster by using local knowledge of disaster preparedness. The capacity to adapt depends on the existence of assets available to the community. These assets may come in many forms, which in this study include human, sociocultural, institutional, physical, and economic assets.³
- *Communication* refers to local knowledge transfer to peers and future generations. Local knowledge on disaster preparedness can be communicated by oral means or otherwise, and may involve understanding through informal education and internal learning processes.

Results and discussion

The results of the study shows that particularly in earlier decades, communities living in the Pahang River Basin have possessed ample local and indigenous knowledge and practices that provide flood resilience. Local knowledge and practices, however, are disappearing rapidly. Factors that are contributing to the erosion of local knowledge and practices include social mobility, urban migration, land use change, shifts in social arrangements, and a dependency approach to flood management.

In the following section, results are organized under the subheadings of observation, anticipation, adaptation, communication, and effects of local knowledge of flood disaster on sustainable livelihoods.

Observation

In this study, community member observations regarding natural hazards and disaster preparedness were derived from their experience with the local environment. Their local knowledge included understanding of the ecological surroundings, meteorology, and historical patterns of floods. Knowledge of the environment and agriculture includes characteristics of the onset, origin, velocity, and duration of water flow, rain, and wind. Environmental and agricultural knowledge also includes

the link between aspects of ecology, such as wetlands, forest, vegetation cover, and soil cover, and disaster management.

Physical environment. Results indicate that about half of interviewees felt that the physical environment plays a role in mitigating floods. For example, 53.3 percent of respondents said that wetlands play a role; 40 percent said the same of forest cover, 33.3 percent gave weight to soil and land elevation, and 30 percent indicated vegetation cover is important. Some community members attributed severe flooding—exacerbated by low absorption of rainwater in forested areas—to development, deforestation, logging, and sedimentation (Table 1). Such observations are supported by a study by Pauzi et al (2016), which emphasized the effects of deforestation on the severity of floods in the area. In these communities and in many other instances, individuals may understand the risk they face living in a flood-prone area, but lack the means to affect their situation (Wachinger et al, 2013; Njome et al, 2010).

Forest	Wetlands	Soil and vegetation cover
<ul style="list-style-type: none"> • Felling of trees on river banks disturbs river flow and causes floods • Forests are a water catchment resource that helps retain and delay water flow to streams • Logging of forests aggravates floods 	<ul style="list-style-type: none"> • Wetlands are places where water is retained before and during floods • Wetlands absorb and fill up with water before impending floods, delaying water level rise • When wetlands are cleared, water that fills the wetlands quickly flows to rivers and causes rapid rise of water level • Water fills wetlands first before entering the river • The manner in which water fills up wetlands was very different during the 2014 flood from previous floods. Water from inland streams used to enter houses from one direction, but in 2014, water from the main river entered. Previously, flooding in the downstream areas was less than in the upstream areas, as water was retained upstream, but in 2014, both areas were equally severely affected. 	<ul style="list-style-type: none"> • Soil absorbs water but does not lessen flooding • After flooding occurs, vegetation cover does not help as the water level is already elevated • Bamboo prevents water flow • Prevents water from rapidly filling up of rise • Acts as buffer against rising water and wind

Table 1. Local knowledge about ecological indicators of flood hazards

Cultural and spiritual environment. Spiritual beliefs and ancestral practices complement local environmental knowledge. The beliefs prevalent among the Pahang River Basin communities may have originated from folk knowledge, such as dreams; appearance of spirits, dragons, and animals, or—as they are predominantly Muslim—from an Islamic perspective of fate.

Cultural fatalism—the belief that events are meant to happen and are beyond individual control or intervention—is prevalent in many cultures and expressed in varying degrees. Fatalism, or the acceptance of God’s will, is very prevalent among the Pahang River Basin communities. At the same time, Islamic teachings encourage them to avoid disaster and attempt to improve any adverse conditions they face. Eiser et al (2012) discussed fatalistic attitudes towards natural hazards that may or may not be underpinned by spiritual or religious beliefs.

A fatalistic attitude may undermine preparatory action or, conversely, enhance recovery efforts. An example of a positive outcome from cultural fatalism includes a degree of preparedness derived from Confucian beliefs in forward thinking, perseverance, and preparing for future adversity (Eiser et al, 2012). The results of this study show that some community members believe floods are also gifts from God. By viewing floods from a positive perspective, they may see the flood season as a time when community members come together to watch out for each other. Some interviewees mentioned new sources of income from farming land revitalized by floods and from the abundance of fish in the river when floods occur. Soon after the floods, fish come to spawn upstream and the villagers partake in a festival of fish gathering, locally known as *pesta ikan mungkus*, an event that local people look forward to in great anticipation. Children of these communities often view floods as a time for play, because the normal routines of life are disrupted.

Other beliefs related to floods include water spirits appearing at night, and a requirement of absolute silence when approaching the river in order not to aggravate floods (Table 2).

Dominant indigenous belief systems	Minor indigenous belief systems
Accepting a situation as God’s will, locally known as <i>redha</i>	<ul style="list-style-type: none"> • Continuous rain begins on Friday • Dreams of elephants • Crocodiles appearing from nesting places indicates large floods • Water spirits appear at night • A gift from God • When approaching the river, one needs to be absolutely silent in order not to aggravate floods • Dragons appear and go to Chini Lake

Table 2. Flood-related beliefs of local origin

Anticipation

Forecasting floods and anticipating the time or need for evacuation are major issues during floods. Participants in the focus group discussion expressed strong concerns regarding the lack of information at the sub-district level during evacuation. Clearly, community members need to have both local and modern knowledge to deal with evacuation decisions.

The knowledge possessed by community members, as well as their practices, beliefs, values, and worldviews, aids in the forecasting of imminent floods. Most respondents observed that flooding is imminent if rain falls continuously for three consecutive days during the months of November or December. Some also noted that several signs of impending floods are associated with the river water surface, such as a murky, turbulent stream-flow and an increasingly frothy surface, and large amounts of woody and leafy debris floating on the surface.

The ecosystem of the Pahang River Basin is characterized by multiple wetlands. Respondents observed that water fills the wetlands first before other land areas. Water weeds, such as water hyacinth, leave creeks and other wetlands to enter the river in great numbers. Due to land use change, however, the manner in which water fills the wetlands has changed significantly from the past, making forecasting based on wetlands difficult. Other meteorological warning signs include a siren-like sound from the sky, water overflowing onto roads and other land surfaces, high water levels upstream, and the wind blowing landwards (Table 3).

The results also showed that some community members depend on indigenous signs associated with animals and plants when forecasting flood occurrence. Some observed that just before flooding, carcasses of wild animals floated together with woody debris on the river surface. Buffalo carcasses are common sights at such times. It is also common to see livestock seeking higher ground. Respondents also noticed that birds, such as cranes, flew upstream, only to return downstream when the flooding subsided. Crocodiles appearing out of their nesting places were said to indicate large floods. Others observed that deep-dwelling earthworms appear on the soil surface, and millipedes, termites and ants climb up trees in droves.

The echo of unusual animal-like sounds in the air is another common observation. Other signs include snakes entering homes and resting at a level believed to be the flood level; birds making single, melancholic calls; driftwood floating in an upright position, the exposed length of which indicates the extent of flooding; groups of dragonflies flying along what is believed to be the level of flood water; large amounts of water hyacinth floating downstream; the absence of annual fruiting

mushrooms; the sound of wild animals such as tigers; abnormal flowering of the leguminous petai (*Parkia speciosa*) tree; and the death of fruit trees (Table 3).

The peculiar behavior of animals reacting to impending floods is a well-known phenomenon in many societies (Dekens 2007). Although such signs may be intriguing, Mercer (2009) warned that some amount of scientific validation must be carried out before they can be considered as useful local knowledge for disaster management.

Local perceptions/signs of flood associated with meteorology and river	Ecological indicators of imminent floods
<ul style="list-style-type: none"> • Continuous rain from the month of November • Fast flowing water rising quickly • Large amounts of floating logs and other debris in the river • Frothy river surface • Rising water level • Water filling wetlands first before other areas • A siren-like sound • Water overflowing on roads and other land surfaces. • Continuous rain for three days or more • Significant water level upstream • Wind blowing landwards 	<ul style="list-style-type: none"> • Snakes entering houses and resting at a level believed to be the flood level • Large numbers of deep dwelling earthworms appearing on the surface • Many millipedes climbing upwards on trees and buildings • Livestock and other animals escaping to high grounds • Birds flying upstream • Birds making single, melancholic calls • Drifting wood in upright position. The exposed length indicates the depth of flooding. • Many dragonflies flying at a level believed to be level of flood water • Large amounts of water hyacinth floating down the river • Fruiting bodies of certain mushrooms not making their annual appearance • Sounds of wild animals such as tigers • Crocodiles appearing on the water surface • The leguminous petai (<i>parkia speciosa</i>) tree not flowering • Death of fruit trees

Table 3. Local indicators of imminent floods

Adaptation

The capacity of communities in the Pahang River Basin to adjust to adverse situations like flood hazards has depended on their access to, and benefit from, assets related to local knowledge and practices. These assets can be categorized as human, sociocultural, institutional, financial, economic, political, physical, and natural assets.

Human assets. Human assets that respondents of this study deemed necessary for effective flood management include physical skills

such as swimming. In the past, youth who lived near the river tended to be powerful swimmers, as swimming has always been part of the adaptive culture of this region. Several respondents noted, however, that more recently, children (especially those who live in housing schemes located further from the river) do not tend to have swimming skills.

Another necessary skill in times of floods is planting and storing food without attracting the attention of wild animals. Some residents apply animal scents, such as that of tigers, to ward off wild boars from digging up food stored in the ground. In order to keep property from being damaged by muddy waters, people needed to know how to securely hang their belongings from the ceiling using ropes and knots. In the past, when flooding occurred, the ability to prepare traditional preserved foods such as pickled fish (locally known as *pekasam*) and smoked meats, and to cook in mass quantities were very useful. Carpentry skills for making rafts, boat-driving skills, first aid, and other survival skills were also helpful in adapting to floods.

Sociocultural assets. Also known as social capital, sociocultural assets of a community depend on the types of occupation, physical ability, skills, ethnicity, gender, caste, class, age, and family history existing within that community. The research revealed that flood-affected residents of the Pahang River Basin benefited from a range of assistance from various sectors of the broader community. For instance, Mr. Rahmat Awang Teh and his wife, Asiah Mahmud, of Kg Baru Pengkalan Jaya, explained that community members who had yet to be affected by the impending flood would assist those who were initially affected with evacuation. During floods, young men from the village gathered to find food for the affected community. The spirit of neighborhood camaraderie was strong in this village. Rationing food was unnecessary, as community members who had more to give were willing to share food with those who were lacking.

Ms. Hasnah Mohamed of Temerloh reiterated that there has been great cooperation among the people in her community. Vehicles were made readily available for the community to use during floods. Everyone in the community was ready to lend a hand in evacuation and did not depend on outside help. There were many non-governmental organizations that helped with clean-up efforts after the flood, and provided gas tanks, mattresses, and other supplies.

These and other examples attest to the solidarity and reciprocity that existed within parts of the community. All these efforts were informally organized through spontaneous efforts. Some respondents have lamented, however, that this communal cooperative spirit is slowly fading, making flood management more difficult. This study's findings indicate that a strong social network based on solidarity, sharing, and reciprocity is a key factor in determining the effectiveness of adaptive practices.

Institutional assets. Institutional assets are those informal arrangements critical to effective community monitoring of the local environment and the sustainable use of community resources. They include, for example, informal local arrangements for resolving conflicts, land tenure, natural resource management, and religious structures, as well as other economic and social structures within the community.

In the Pahang River Basin, formal community structures are entrusted with such roles. At the sub-district level, the *penghulu* (leader) presides over several villages. At the village level, village heads chair the Village Committee for Security and Development (known as the JKKK, the abbreviation for the committee name in Malay), whose members are chosen by the community. The *penghulu* and village heads are appointed by the government. Together, they are instrumental in community flood response and recovery.

This study revealed that trust and cooperation among these players have eroded over time, making flood management difficult. According to Mr. Jamaluddin Ayub, a former *penghulu* of a sub-district in Pahang, “In the ‘70s and ‘80s, *penghulus* were respected leaders. The situation has since changed. There is now a rather weak sense of respect and cooperation by the community for their leaders.” Mr. Hasani, a community leader from Chenor, Pahang, attributed this state of affairs to the lack of consultation with the community when selecting leaders.

Penghulus have traditionally been respected members of the communities. The results of the focus group discussion among community leaders revealed that there is now a lack of cooperation from community members with regard to evacuation orders issued by the *penghulus* and others. The community’s willingness to follow such orders grows in part out of trust, and in part out of previous experience of disasters (Lawrence et al, 2013; Wachinger et al 2013).

Economic assets. Floods affect the Pahang River Basin’s economy both in terms of reduced economic activity and property damage. This property damage may include, for example, spoiled crops, loss of livestock, damage to fish cages, and loss of cultured fish.

These are unwelcome economic setbacks, of course. At times, however, such losses have been viewed from a positive perspective, attesting to the adaptive capacity within the communities in the Pahang River Basin. In some cases, for example, a calamity has been seen as an opportunity to improve social networks. Community members come together and became more closely acquainted with each other in order to carry out tasks to expedite flood management. Some farmlands become more fertile after the floods, allowing residents to augment their income by selling crops from these farmlands and fish caught during the aforementioned *pesta ikan mungkus*.

Overall, it is clear that although the community members of the Pahang basin understand the risk of living close to the river, the perceived benefits of proximity to the river outweigh those risks. This conforms with one of the key reasons for the lack of personal action related to risk perception described by Wachinger et al (2013) and Hung et al (2007).

Physical assets. The respondents in this study are individuals whose residences are in flood-prone areas, and who therefore experience floods on a regular basis. Experience and geographic location are important factors determining risk perception (Wachinger, 2013). This is especially true where muddy floods affect the location of residence (Heitz et al, 2009). Hung et al (2007) found that geographical distribution influences the perception of flood risks more than time distribution.

The present study revealed a perception among respondents that large floods only occur every 30 to 40 years. Despite this belief in the relatively rare nature of floods, recently many residents have taken steps to prepare themselves for eventual floods, often focusing on solutions to protect property, such as constructing floating platforms. Many such infrastructural investments are aimed at minimizing the impacts of a natural hazard. The present study suggests six forms of adaptive physical strategies:

- transport
- infrastructure
- architectural design
- sustenance
- safety
- information

Transport. During flood events, community members are supposed to make available boats, trucks, and four wheel vehicles at a minimal cost that is just enough to cover the cost of petrol. However, a focus group discussion among community leaders in Pahang revealed that there is an acute lack of transport equipment that is likely to be available during an evacuation.

Infrastructure. One month prior to an anticipated flood event, community members inspected areas on higher ground for possible shelter locations (such as Letang Hill and Tutuh Hill, for those who lived near Temerloh). Where suitable locations were found, people dug holes in the ground to store food to minimize the amount of belongings to be transported when floods arrived. They prepared plastic bags to store goods, bought or kept rice from the previous harvest, and stored other foodstuffs and related items in elevated spaces within homes or on rafts. Medical supplies, safety equipment, carpentry tools, candles, and flashlights were considered to be important items to have in place before floods.

Architectural design. In earlier times, when elevated houses on stilts or pillars was the preferred design to keep houses above water and safe from animal attacks, architectural design served as a physical asset. A distinctive local tactic to prevent inundation by flood waters was to build detachable houses—using steel bars to stabilize stilts or pillars—that could be lifted and carried to higher ground by large groups of people, in a community effort known as *gotong royong*. Presently, due to the globalization of architectural design, non-elevated houses are the norm.

Sustenance. For sustenance, community members prepared smoked, pickled, or salted dried fish, as well as other meats such as deer and buffalo meat. They stored food in special containers called *upih* and *kepok* (for rice storage). Food and implements such as fishing nets and cooking gas were collected a couple of months before the impending flood. Traditionally, coconut husks were used as fire starters. But hunting for wild animals (such as mouse deer), fishing, and gathering plants from bushes or the jungle for food—as was done fairly easily in the past—has now become difficult, as these animals and fish have become scarce, and the bushes and jungles are now replaced with oil palm and rubber plantations. While community members used to confidently use river water for all drinking and washing, now some residents maintain large containers for rainwater harvesting, and thereby avoid the need to consume river water that may be contaminated.

Information. By receiving information and communicating with each other, including through the use of mobile phones, community members stay vigilant and alert.

Communication

The aim of local knowledge transfer is the revitalization, sharing, valuing, and application of this wisdom at the local level, as well as globally. Transmission of local knowledge between generations and within the community depends on its specific context, as well as who uses it and how it is used. In the past, this local knowledge of flood events and practices was embodied in individuals and captured in collective memories, and passed down through oral traditions based on rituals, ceremonies, worship, proverbs, poems, and songs (Dekens, 2007). In the Pahang River Basin and elsewhere in Malaysia, local knowledge has evolved over many years under particular ecological and linguistic contexts. Local communities were interconnected with their natural surroundings and have developed complex understandings of the local environment and its ecosystem dynamics and how to manage them.

Local knowledge and practices are shared through oral traditions, especially proverbs. Proverbs have been used to relay and motivate the sense and need for cooperation, as well as the need for preparedness in

dealing with floods and other life challenges (Table 4). Perhaps the best example of this is the Malay proverb “*Bagai aur dengan tebing*,” which translates to, “like the relationship between bamboo and the slope.” The proverb expresses mutual gains in positive relationships and cooperation. The Malay proverb “*Alah bisa tegar biasa*,” which means, “toxic experience loses out to familiarity,” signifies acceptance of and adaptation to adverse situations such as flood disasters, once experience and skills prevail. In summary, such proverbs allude to the cooperation, knowledge, and preparedness that are crucial to flood management and disaster risk reduction.

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| <ul style="list-style-type: none">• <i>Bulat air kerana pembedung, bulat manusia kerana muafakat</i>: “Circular shape of water body due to circular pipes, circular human” (ie. one understanding/agreement due to cooperation)• <i>Muafakat membawa berkat</i>: “Cooperation brings benefits”• <i>Bagai aur dengan tebing</i>: “Like bamboo and slopes” (cooperation)• <i>Sediakan payung sebelum hujan</i>: “Have an umbrella before the rain” (be prepared)• <i>Alah bisa tegar biasa</i>: “Toxic experiences lose to familiarity” (to be able to accept adverse situations once experience prevails) |
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Table 4. Proverbs related to coping mechanisms

In other studies, proverbs were effectively used to convey local knowledge to young children (Schafer and Pence, 2006). In the Pahang River Basin, residents reported stories of a fictitious Chini dragon that appeared from a hill slope upstream, which collapsed during a large flood. Its sinuous path downstream caused the river to meander and finally head towards Lake Chini. Other residents reported another fictitious figure, Sang Kelembai, who had mystical powers to transform people into elephant-like rocky figures occupying part of the riverbed. Such stories may encourage both young and older people to be interested in observing nature and its powers.

The importance of effective communication in flood management cannot be overstated. Understanding and using local knowledge and practices can support effective communication. Hence, a linguistic study conducted by Zarina (2016), which identified common words used by flood victims of the neighboring state of Kelantan, may assist communication in future flood management programs in the area. A similar study conducted in the Pahang River Basin would open avenues to information about the context of local knowledge, and facilitate informal local knowledge dissemination as emphasized by Dekens (2007).

Effects of local knowledge of flood disasters on sustainable livelihoods

To sustain a long-term and comprehensive perspective on disaster preparedness—one that creates or enhances equitable participation through empowerment—flood management also needs to comprise sustainable livelihoods. This should include issues of poverty, land control, and material resources at the local level.

A large number of flood-affected individuals in the Pahang River Basin live near the poverty level. A previous study on the Pahang River Basin indicated that although the government has tried to address housing needs of the poor, and has provided relief funds and microfinancing to poor communities in disaster areas, specific programs to address sustainable livelihoods are lacking. That study recommended that flood-affected individuals diversify their source of income (Chamhuri, 2015). But if such income diversification leads to rural-urban migration, the preservation of local knowledge may be further eroded (Chiwanza et al, 2013).

Field observation undertaken through the present study indicates that some residents are involved in ecotourism and small-scale sustainable farming, which have the potential to contribute to this diversification of economic activity. Ecotourism has an added role in showcasing local knowledge to a wider audience and may aid in local knowledge preservation.

Recommendations for incorporating local knowledge into flood management

To reiterate, incorporating local knowledge in flood management programs reduces risk. Although the government of Malaysia has taken some steps to involve communities in flood disaster risk reduction (National Security Council Malaysia, 2012), there remains a disconnect between what the government perceives as strategies for disaster risk reduction and the globally-recognized role of local knowledge in risk reduction. Simply stated, the government's official flood management system is *not* building local knowledge into its strategies for risk reduction. A more comprehensive approach is needed—one that involves community groups and incorporates local knowledge. Key recommendations for this comprehensive approach to flood management are as follows:

1. Identify local knowledge related to flood management. The present study has identified many aspects of local knowledge related to flood management in Pahang. Research on local knowledge can fall under the broader thematic area of Pahang River Basin Management. Through this entry point, policy tools can be formulated that should address research and documentation. Similar studies can and should be replicated in other parts of Malaysia, and elsewhere in the world.

2. Value flood management that utilizes local knowledge.

Observations by generations of individuals in the Pahang River Basin have allowed these communities to develop both a historical perspective and a longitudinal view of the changes in the social and physical vulnerabilities to natural hazards. But this local knowledge is disappearing quickly; therefore, it is critically important to capture and showcase local knowledge.

Formal education at both lower and higher levels should include local knowledge. Similarly, informal education initiatives should also include local knowledge awareness. In promoting and bringing awareness about this local knowledge, locally contextual practices and methods of delivery should be emphasized. Such knowledge should be understood in context, and be cast in a way that strengthens its potential integration with other knowledge and operational systems. Careful consideration of appropriate channels of communications will make the transmission of local knowledge more effective.

3. Integrate local knowledge into flood management.

Communities living in the Pahang River basin have a body of local knowledge and practices that can be incorporated into the present flood management system.

The influence of past experience, trust, and beliefs on risk perception and its connection to preparedness for action needs to be taken into account in flood management. Such a strategy may hinge upon stressing the responsibility to expend effort and take action—in other words, invoking Islamic principles that invite such responsibility. Flood management authorities should cooperate with religious leaders and authorities to formulate awareness programs that include this perspective.

The importance of strong social networks for effective flood disaster management in the Pahang River Basin should be emphasized and recognized by the government. The appointment of community leaders—such as *penghulus* and village heads who facilitate such networks—should be based on community consultation, thereby enhancing their legitimacy. The government should also encourage local community activities that promote enhanced familiarity with local knowledge.

This study has highlighted the importance of the local ecology, such as wetlands, in local knowledge and practices for flood management in the Pahang River Basin. In planning for future development, national and local governments should give due consideration to the local ecology and ecosystem services, especially with regard to flood disaster risk reduction. For example, when drafting master plans for areas in the Pahang River Basin, the government needs to consider the benefits that wetlands and forests provide in the mitigation of flooding.

Survival skills—such as swimming, preparing and cooking preserved foods, and boat-driving—should be encouraged, along with

skills in carpentry and hanging furniture. These and other skills will allow affected communities to be more self-reliant in times of floods.

Employment opportunities and avenues to diversify income that lead to sustainable livelihoods and stem rural-urban migration must be given close attention. Vocations related to ecotourism, and production of local handicrafts and foods, are among the income-generating activities that may encourage younger generations to remain in rural areas. This would contribute to strengthening the social structure and the sustainability of local knowledge systems and information. Visitors and residents alike should be encouraged to “buy local” whenever, possible, and funding should be made available to support income diversification.

Communication in flood management should take the local context into account. This builds trust, strengthens understanding among flood management officials and community members, and increases the chances of cooperation on the part of local constituencies.

Advocacy for the inclusion of local knowledge in flood disaster management plans is necessary at the international, national, and local levels. Those actively supporting the inclusion of local knowledge should be engaged in regional policy discussions and formulation of institutional frameworks appropriate for the Pahang region to promote research, education, and advocacy tools. A Pahang River Basin Regional Resource Group should be established to pursue such an agenda, and to establish linkages with various community resource groups. The National Disaster Management Agency could initiate the formation of this resource group, tapping into existing interest shown by local community-based organizations. Similar recommendations have been proposed by the UN-ISDR (2008) in its policy note for Disaster Risk Reduction.

While some lessons taken from local knowledge can be replicated elsewhere, others may be the source of inspiration for governments or communities to innovate in order to solve local disaster-related problems. Integration of local knowledge into disaster risk reduction strategies has been explored in the Transferable Indigenous Knowledge (TIK) criteria, introduced by the UN-ISDR (United Nations Office for Disaster Risk Reduction) Disaster Reduction Hyperbase Initiative (DRH) database. Examples of local knowledge from the Pahang River Basin that can possibly be registered under TIK are the importance of social networks, community consultation, preparation of preserved foods, and construction techniques for floating rafts and platforms.

Conclusion

Community engagement in flood disaster management has gained traction in many parts of the world. This paper reports the results of the study of communities affected by floods in the Pahang River Basin who

have combined local knowledge and practices with modern solutions for flood management. Toward that end, this study has documented examples of local knowledge and practices found within the region. Identifying and understanding local knowledge allows flood management officials to better communicate with affected communities. The study confirms the importance of strong social networks and credible local authorities to achieve effective flood disaster management. Recommendations include identification of local knowledge, assignment of value to local knowledge, and integration of local knowledge in flood management. Such strategies promote better flood management, self-reliance, sustainable livelihoods, and sharing of local knowledge globally.

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Notes

¹ Malaysian Meteorology Department, 2017

² Personal communication

³ Political and natural assets were not central to this study.