Flood Risk Management by Community Stakeholders: A Malaysian Case Study

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ABSTRACT

Local knowledge has long been considered inferior to scientific knowledge. However, local knowledge has often assisted where scientific knowledge proved inadequate to solve the complexity of environmental issues. Scientific knowledge—despite being recognised as superior in various fields due to universal testing and approval—sometimes fails to accommodate what local communities manage to solve. This happens to both local and scientific knowledge if discrete views are followed. Therefore, instead of competing with each other's knowledge capabilities, they should be viewed as complementary. Different stakeholders hold different types of knowledge in their area of interest and both knowledge streams have their intrinsic potentials and limitations. In this paper, the issue of knowledge complementarity is explored in the context of flood hazards. Hazards such as floods may appear messy, and unpredictable, with unsorted and unorganised forms of data, information, and knowledge on the part of diverse stakeholders. Thus, this paper presents a research case study on multiple stakeholders in the district of Pekan, the state of Pahang, Malaysia, and how these multiple stakeholders manage flood hazards with their different types of knowledge. This case study uses Malay, Orang Asli, and humanitarian organisations in the Pekan district as the stakeholder groups. The research has led to the development of a conceptual framework based on the case study. The local knowledge by *Orang Asli* and *Melayu* as well as scientific knowledge by the humanitarian organisations have been categorized into mitigation, preparedness, response, and recovery. The lessons learned from the framework are discussed, together with the barriers to their implementation. Through the conceptual framework, interventions used and the roles of the key person in each of the stakeholders also have been highlighted.

Keywords: Floods; Local knowledge; Malaysia; Multiple stakeholders.

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INTRODUCTION

Practitioners avoid local and indigenous disaster risk reduction (DRR) knowledge due to a lack of documentation, which is not found in all generational classes, information that is not contextualised to specific communities, and the knowledge's inability to be scientifically confirmed (Dube & Munsaka, 2018). Stakeholders in disaster management frequently disregard and underuse local knowledge (Šakić Trogrlić et al., 2019). Meanwhile, scientific knowledge, which is outside the realms of indigenous knowledge (IK) and local knowledge (LK), is frequently utilised and performed with disregard for these knowledge streams, resulting in serious flaws in disaster management (Mercer et al., 2012).

A disaster is a "catastrophic scenario in which normal living patterns have been disturbed and extreme emergency efforts are necessary to save and protect human lives and the environment." (Ahmad Azan et al., 2011). According to Das (2012), as per the Indian Disaster Management Act, 2005, "disaster management" means a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for:

(i) Prevention of danger or threat of any disaster;

(ii) Mitigation or reduction of risk of any disaster or its severity or consequences;

(iii) Capacity-building;

(iv) Preparedness to deal with any disaster;

(v) Prompt response to deal with any disaster situation;

(vi) Assessing the severity and magnitude of the disaster;

(vii) Rehabilitation and construction.

Local knowledge (LK) is a set of facts that refers to a person's complete system of ideas, beliefs, and perceptions about the world around them. Information on local contexts or settings can also be included in LK, such as knowledge of specific traits, circumstances, occurrences, and relationships, as well as significant understandings of their significance. According to Geertz (1983), LK can be defined as “practical, collective and strongly rooted in a particular place” that forms an “organized body of thought based on the immediacy of experience”.

Scientific knowledge, on the other hand, is the knowledge that has been gained by careful study and is organised according to general principles. Three degrees of understanding of the nature of science were recognised by Carey and Smith (1993). Scientific knowledge consists of a collection of information, such as "how to accomplish something," at the first level of understanding. Scientific knowledge, at the second level of comprehension, is made up of tried and true notions about "how things work" and "why things happen." Finally, scientific knowledge is represented at the third level by theories that have world theories that not only explain but also anticipate phenomena.

Knowledge management (KM) is organised in a hierarchical manner and involves a series of phases (Sun & Hao, 2006). Because different forms of information and how knowledge is maintained can produce conflict when several stakeholders manage a certain area, it can lead to conflict. In organisational contexts, knowledge management has emerged as a crucial lever for improving performance, increasing productivity and creativity, and enabling innovation (Ioannis & Belias, 2020).

Organizations that use successful KM can innovate, implement changes, potentially shift from one type of knowledge to another, compete in the same market, and implement changes. KM approaches have been adopted by a wide number of governments, ministries, and agencies during the last ten years in an effort to develop more innovative and complex systems that connect people to information and knowledge (Riege & Lindsay, 2006). Politicians and public service professionals, in particular, use the information to alter their domestic environment and try to make a difference through public policy (Bridgman & Davis, 2004).

BACKGROUND OF STUDY

Local knowledge and Indigenous knowledge

Local Knowledge and Indigenous knowledge represent the world through the eyes of diverse indigenous peoples. It presents unique views on nature and science than typical Western science. It also provides varied viewpoints on nature and the people in nature. Mercer (2010) acknowledges this by stating that Indigenous knowledge is a body of knowledge that already exists among local people or that they have learned over time through experiences, society-nature relationships, community practices and institutions, and passing it down from generation to generation.

Before the entrance of Western education, native people in Africa had managed to live and adapt for generations, and this may be the key to building sustainable policies to minimise future issues through IK, as Iloka (2016) pointed out. Kelman (2020) proved that no single form of knowledge can be a panacea for catastrophe risk reduction; yet, IK has the capacity to contribute far more than is typically allowed. The authors demonstrated the use of a framework for merging knowledge in Papua New Guinea, as well as a participatory approach to lowering vulnerability or building capacity through time.

When working with different types of knowledge in the context of disaster risk reduction, a balance must be struck between ignoring or overriding community knowledge and interests, which has resulted in negative consequences for the community or elsewhere, and accepting that negative consequences may result from decisions based on IK.

After Typhoon Haiyan hit the Philippines in November 2013, Cuaton and Su (2020) investigated the Mamanwa indigenous peoples' local IK and customs in Basey, Samar. Non-Indigenous peoples, local communities, DRR practitioners and scholars, as well as non-Indigenous peoples, can benefit from Indigenous peoples' local IK and practices, such as the Mamanwas in Samar, Philippines, according to the study. In the Mamanwas' preparation for Typhoon Haiyan, indigenous elders' wisdom and guidance, based on the omens given to them by Magbabaja, proved beneficial and contextually credible. The authors proposed that in addition to including and better articulating local-IK in relevant state policies, local DRR actors should focus on meaningful participation of local communities, especially Indigenous peoples.

Scientific Knowledge

Better incorporation of multi-risk scientific knowledge into policies and practices will require a long-term commitment from both sides, science and practice, and building new partnerships between them (Zuccaro & Leone, 2018). Such partnerships should enhance the knowledge transfer between science and practice and, among others, should help involve practitioners, as well as their requirements, in the scientific development of multi-risk methodology at an early stage.

A strong collaboration will be needed between natural sciences, social and economic sciences and the research community on climate change. Although a theoretical framework for multi-risk assessment and scenario development is in place, there is still a need for further harmonisation of methods and particularly terms across scientific disciplines. The scientific knowledge base must be expanded to quantitative vulnerability information, vulnerability curves, as well as surfaces for indirect catastrophe impacts such as loss of job efficiency, loss of device and network availability, evacuation costs, and medium-assistance costs (Taubenbock et al., 2013). A strong partnership will be required between the natural sciences and the climate change research community.

McWilliam et al. (2020) emphasised that modern science can add value by expanding the knowledge base using methods not available to local people through empirical studies and using theory in data-poor locations to fill empirical gaps and test empirically derived inferences.

Scientific expertise is increasingly becoming an integral part of DM and is shifting the role of science in policy-level disaster risk mitigation. However, according to Albris et al. (2020) science and policy operate in different domains between which there are often competing interests and modes of valuing knowledge.

Knowledge Management

The world is transitioning from a reliance on natural resources to a knowledge-based economy centred on research and development, skills, and education (Friedman, 2005; Gulbranson & Audretsch, 2008). Knowledge can be defined as knowledge held in people's thoughts, as well as their experience and understanding (Marwick, 2001; Alavi et al., 2005). It contains ready-to-use data that may be used to make decisions and take action (Chang & Lin, 2015).

Since the 1980s, other types of knowledge have been used to deal with the complexity of environmental issues and to bring local perspectives into environmental governance in order to manage the uncertainty associated with environmental challenges (Raymond et al., 2010). Raymond et al. (2010) conducted a review of environmental management literature and identified three types of knowledge: experiential/local knowledge (derived from personal experience and culture), scientific knowledge (derived from formalised scientific methods), and hybrid knowledge (a combination of the two) (generated through social learning and integration).

With multiple stakeholders managing flood risk will lead to different types of knowledge used. In this paper, we are going to discuss how multiple stakeholders with different types of knowledge manage flood risk. How can the approaches of multiple stakeholders inform a comprehensive framework for flood risk management? This study hopes to explore the following:

a) To investigate multiple stakeholders of different types of knowledge managing and combining different types of flood knowledge.
b) To explore multiple stakeholders of different types for knowledge and expertise in managing flood hazards in different phases.
c) To determine the flood knowledge managed by each of the stakeholders.
d) To explore interventions needed to bridge multi-governance.
e) To establish a framework on flood KM by multiple stakeholders.

METHOD

Logic of Inquiry (Qualitative)

This study adopted qualitative inquiry, in which the researcher sought to elicit responses from a particular group of people on their experiences of dealing with floods. The understanding of a group of the selected people's dealings with the floods was derived from their experiences which the researcher attempts to derive explanations from the experiences. The experiences collected from the selected group of people are one type of qualitative data.

Research setting and participants

This study took place in Pekan, Pahang, Malaysia. The lead author chose Kampung Permatang Siput and Temai Hilir, as well as a humanitarian organisation in Pekan, Pahang. Pahang is one of the 13 states in Malaysia. It is located on the east coast of Peninsular Malaysia at the latitude 03°45'N-03°75'N and longitude 102°30'E-102°500'E. The state occupies an area of 36,137 km2 of land (DSM, 2010). It is comprised of 11 districts: Bentong, Bera, Cameron Highlands, Jerantut, Kuantan, Lipis, Maran, Pekan, Raub, Rompin and Temerloh. Since, Pahang River's final discharge at South China Sea, the high-tide phenomenon from the South China Sea will cause flooding at Pekan district. According to Tekolla (2010), the sea wave during the high tide will increase the water level in the river column, thus causing the water level rises above the riverbank level, and the water will spill out and flood the Pekan areas along the river.

This study is a case study where the unit of the analysis is the Malay people from the Temai Hilir village, Orang Asli from Permatang Siput village, and the humanitarian organisations responsible for helping the community in these two villages, as well as the rest of the Pekan district. The researcher focused on these three stakeholders by doing in-depth interviews, mainly asking within the boundary of KM how they manage the pre-and post-phase flood. In this study, the researcher uses the terms humanitarian organisations that include both non-governmental organisations and civil society organisation.

The stakeholder's elaborations are as follows:

Malay

Article 160 in the Malaysian Federal Constitution (2010: 153), defines a "Malay" as "a person who professes the religion of Islam, habitually speaks the Malay language, conforms to Malay custom" (Salehuddin, 2018). Most of the Malay in Pekan, Pahang work in agriculture (oil palm, fisheries), craft making (weaving ticker), harvest collection, rearing livestock, and government work.

Orang Asli

According to Rahman and Mustapha (2020) existence of the Indigenous Peoples Act 1954 (Act 134) is under Aboriginal Peoples Ordinance No. 3 1954, which was amended in 1974, the stipulation of terms and qualification to be said to be a community of Aboriginal people have been explained in detail. According to Section 3 of the Indigenous Peoples Act 1954 (Act 134), Aboriginal people are defined as follows:

1. Whichever father is a member of Indigenous ethnic groups, who speak Indigenous languages and usually follow the Indigenous way of life and customs of Indigenous belief, and includes a descendant through the man;
2. Any person of any race adopted as a child by Orang Asli and those who have been raised as an Orang Asli, usually speak the Orang Asli language, according to the way of life of the Orang Indigenous peoples' customs and beliefs; or
3. Son of any unification between an Indigenous woman with one man of another race provided the child usually speaks the Orang Asli language and Indigenous beliefs and still to be a member of a People society, Original.

According to Zei et al. (2018) the majority of Orang Asli in the Pekan district of Pahang carry out forest harvesting work (Zei et al., 2018). Other than that, they also catch fish at the nearby river. There are also a small number of

indigenous communities that open oil palm plantations. The oil palm fruits are transported by the person themselves and sent to the oil palm factory located in Pekan town. Agricultural work undertaken by the indigenous community includes tapping rubber, collecting scrap rubber, collecting oil palm bunches and cleaning farms.

Humanitarian organisation
The Amendment was passed by the Malaysian Senate on 21 June 2016 and empowered the civil defence agencies to provide humanitarian aid under a more systematic management of assignments (Malaysia Disaster Management Reference Handbook, 2019). Malaysia's National Disaster Management Agency (NADMA), the army, the police and other local government agencies conducted evacuations, established emergency shelters and evacuation centres, and provided disaster relief (Malaysia Disaster Management Reference Handbook, 2019).

Amongst the organisations responsible for flood risk in Pekan, Pahang is Civil Defence, Land and District Office, Welfare Department, and the Malaysian Relief Agency in Pekan. All of these agencies are subject to any instruction of NADMA. Other agencies in Pekan, Pahang that may be involved indirectly with humanitarian organisation operations are Pekan District Council, Department of Orang Asli's Development, and Health Office.

The researcher will use the term 'humanitarian organisations' to indicate the agencies which are non-governmental and governmental agencies to highlight the work and initiatives done by all these agencies in managing flood knowledge.

Methods and Procedure of Data Collection
Qualitative approaches conduct purposive sampling (Ritchie, Lewis, Nicholls, & Ormston, 2013). The researcher selected participants with a purpose. Among the criteria that the researcher looked for were:

(a) participants 18 years of age or older
(b) participants who experienced floods in the Pekan district for at least five years
(c) participants who were in the flood area when the flood hazards happened.

The researcher selected the sample on purpose to understand the context of phenomena rather than performing it statistically to represent a population. According to Ishak et al., (2014), purposive sampling is used when:

(a) a researcher wants to select unique cases that are especially informative,
(b) a researcher would like to select members of a difficult-to-reach, specialised population,
(c) a researcher wants to identify particular types of cases for in-depth investigation.

Thus, in this study, these three criteria mentioned above regarding the use of purposive sampling meet the requirements for the participants' selection as follows:

(a) Malay, Orang Asli, and the humanitarian organisation have first-hand experience in dealing with flood risk which is very informative in providing data to the researcher,
(b) Malay and Orang Asli are quite difficult to reach, especially in the flood-risk area and have to go through several procedures to approach them for interviews,
(c) Since flood risk is under specific organisations and the Malay and Orang Asli is under different organisations respectively, a researcher has to be very specific in identifying Malay, Orang Asli and the humanitarian organisation that involves only in flood risk.

DATA ANALYSIS

In this study, the raw data are the interview transcripts. Since the interview transcripts contain textual data, computer-assisted qualitative data analysis (CAQDAS), such as Atlas. ti was used. The use of CAQDAS has made several tasks such as sorting, organising, interpreting, identifying concepts and categorising easier (Lewins, 2001). Coding is the process of analysing qualitative text data by taking them apart to see what they yield before putting the data back together in a meaningful way" (Creswell, 2015). Thus, the researcher had taken the data apart by coding the interview transcripts; then towards the end process, the researcher had given meaning to the analysed data.

Initial coding or the first cycle coding
The inductive approach is relevant when doing an exploratory study or when no theoretical concepts are available. Inductive coding may bring the researcher loyal to the data. However, the researcher may lose focus due to the abundance of code generation, and the codes become too complicated to form themes. For the first cycle of coding,

the researcher did inductive coding. At this stage, the researcher coded randomly without any pre-conceived ideas about the codes generated. As inductive coding may generate lots of data, the researcher generated an abundance of codes in the first cycle of coding.

Deductive coding or the second cycle of the three stakeholders

Deductive coding is generally theoretical concepts or themes drawn from Linneberg and Korsgaard (2019). The researcher refers to the code from the literature that is within the boundary of 'DM' or 'FM'. Focusing too much on the deductive approach will mean the researcher may miss new codes, or findings and thus not generate new knowledge. Thus, the researcher made the deductive coding in the second cycle of coding. The abundance of codes from the first cycle of coding was reduced by the second cycle of coding, which is by the deductive approach.

Transition between coding process and themes formation

After finishing with the inductive coding or the first cycle of coding, the researcher continues with the second cycle or deductive coding. In this second cycle, the coding involves pre-defined codes or codes that are available in the literature. However, there are still codes that the researcher inductively coded, when the researcher saw the patterns among the first cycle of codes. When the researcher revisited the first cycle of coding, they found several codes that needed to be combined and some codes that needed to be split.

Table 1: Lists of the initial coding of the three stakeholders

Malay	Orang Asli	Humanitarian organisation
Food ration	Cause of flood	Updated information
Front base	Effect of flood	Types of information
Raft houses	The sudden increase in water level	Types of data recorded
Boat transportation	Order for evacuation	A place to get information
Early warning signs	Flood expectation	A person in charge of recording data
Water velocity	Flood aid eligibility	Information collected
Terrain	Flood duration	Information distributed
Annual routine	Different lifestyle	Info and data coordination
Reasons to evacuate	Personal preparedness	Centre to organize data and info
Order to evacuate	House condition	Centre to organize data and info
Store personal belongings	Personal belongings affected	Equipment used stored in safe place
Materials which can withstand flood effect	Reasons activities affected	Leader's role in distributing info and data

Table 2: Deductive coding of the three stakeholders

Malay	Orang Asli	Humanitarian organisation
Experience	Experience	Experience
Older generations	Older generations	Meetings
Observation	Observation	Public information
Building stilt houses	Net fishing	Evacuate victims

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Ethical issues

This research had been into consideration the participants involved including voluntary participation, informed consent, anonymity, confidentiality, the potential for harm, and results from communication.1

RESULTS

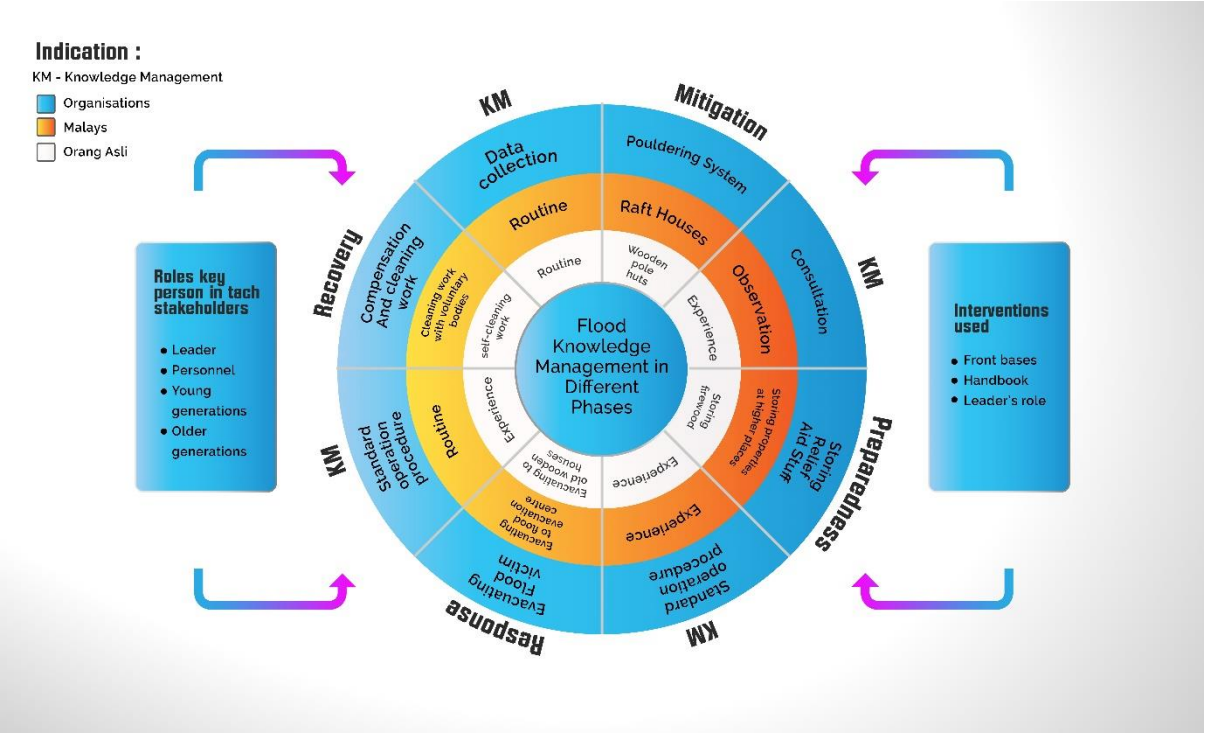

Figure 1: Flood knowledge management framework in Pekan, Pahang

Based on the figure, the flood KM in Pekan, Pahang shows how three different stakeholders manage the flood based on the knowledge that they have. Based on the framework, the circle represents each of the stakeholders. The humanitarian organisations are in the outermost circle, Malay in the middle, and the Orang Asli is the innermost. The smaller the circle, the lesser the authority or influence each of the stakeholders has whereas, the larger the circle, the larger the influence the stakeholders have on the FM. The KM in each of the pies is in relation to the phase next to KM. Consultation in KM by private agencies is for the mitigation phase, in which the activity is building a 'poldering system'. Interventions are used to facilitate the challenges that exist among different stakeholders to manage the flood hazard.

The results of the three stakeholders are combined to see which groups exercise the knowledge the most. The results combined also highlight each of the stakeholder's strengths and weaknesses in implementing flood knowledge. It is also to see whether the stakeholders 'knowledge can complement each other's knowledge based on their limitations and strengths.

Local Knowledge (Malay and Orang Asli)

Experience

The Malay community in the Pekan district has experienced flood risk almost every year, as has been reported by the Department of Irrigation and Drainage (DID). Thus, the experience has been used as a reference for most of the decision-making in the Malay community's KM, as can be seen in the following quotes by the participants:

> *Yes, because the floods of the past years, the water has reached until here (show the sign of the limit of the flood water) that is why almost all the villagers at this area will evacuate…*

Based on the floods of the previous years, we are not experiencing flash floods; we know when to expect the floods, so we have ample time to prepare…

I remember when I was a young boy, one major flood in the 1970s, the flood water reached until the roofs of the house…

…when I was appointed as the village head, I still remember that we had our own flood committee that we will act without having to act for the emergency siren… we know our roles and responsibility… so we always prepared and the Malay villagers themselves were ready to be evacuated to the flood evacuation centre …because we can predict when the flood will happen, it is not flash floods…

Experience had been used by the Malays as a benchmark or guideline to prepare for flood hazards. Through experience as well, knowledge is created in the Malays' minds or cognitively. For example, the experience of how high the floodwater is, in the community uses that as a reference to determine the poles of the stilt houses.

Orang Asli

The experience of the flood means the Orang Asli community prepares two to three months before the flood hazard. The Orang Asli participants interviewed in this study were mostly young and newer generations. They informed the researcher how to prepare for the flood based on the advice and knowledge passed on from their late parents. The advice or knowledge passed on to them includes which location to build a house based on the flow path of the floodwater.

. *..my late father showed me to build house in this area, because based on his experience, no floodwater comes to this area…but just five metres over there, it is the floodwater's path…*

… I remember as I was a kid in 1970s the flood was terrible, it was up to the top of the roof... that's why we tackle precautions to build stilt houses and choose the area where the floods never come…

Scientific knowledge (Humanitarian organisations)

Initial reconnaissance

The Secretariat of the Pekan district of the DM, CDF, will go into each village in the district to look for villagers' information. The information collected from the villagers is the number of families in each village, the number of members in a family, villagers that have chronic diseases, and pregnant women. Once CDF has listed the relevant information of villagers with chronic diseases, the CDF will cooperate with the Health Office of Pekan District to take those vulnerable groups to the hospital. This is done one or two months before flood hazards.

An initial reconnaissance is an act of KC where the humanitarian organisation will collect early information and put it in reports or documented forms. After the initial reconnaissance, interaction happens between the humanitarian organisation and the villagers. This is in line with the definition of KC which is an interaction between individuals and their environment through a continuous process (Nonaka et al., 2000).

… in August or September…we will collect information about evacuation centres, whether they need to be repaired or not…we also collect information regarding pregnant women, people with chronic illnesses...all these people need to be taken out of the village…

Villagers' information

As there are two local communities in the Pekan district, Malay and Orang Asli, two different organisations are involved in getting the information from each of these local communities. The Land and District Office of Pekan will list the number of families in a village and the number of households in each family for the Malay communities. Meanwhile, the Department of Orang Asli Development will collect the same type of information from the Orang Asli communities. The reason the information collected is to be shared with the Welfare Department regarding flood relief aid distribution. The Welfare Department will deliver relief aid distribution to the Malay and Orang Asli based on the information given by the Land and District Office as well as by the Department of Orang Asli Development.

When both departments collect the villagers' information and disseminate it to other humanitarian organisations, KU and KS have happened. KS takes place when both departments share the villagers' information with other

humanitarian organisations. The humanitarian organisation receives the villagers' information and processes the information and utilises it to distribute flood relief aid.

> *…we will collect information regarding the villagers before and during the flood...before floods we have to know the numbers of pregnant women and those that have chronic illnesses so that we can take them out of the villages and bring them to the hospitals…during the flood we will collect information regarding how many people are in family and who is eligible for compassionate money after the floods…*

Front base

Each of the subdistricts in the Pekan district will have one front base. The function of the front base is to store the first flood relief aid supplied by the Welfare Department of the Pekan district. Usually, the flood relief aid will be delivered two or three months before the flood hazard. Among the flood relief aid delivered are biscuits, rice, comforter, pillow, mats, dried foods, canned foods, and hygiene kits. The representatives from each of the villages within the Temai subdistrict will collect flood relief aid when the flood occurs.

Flood victims at the evacuation centre get flood relief aid immediately when they go to the centre. Malay communities will usually evacuate to the evacuation centre. Meanwhile, Orang Asli communities remain in their village. According to the procedure of the flood relief aid distribution, the community that does not evacuate and loses access due to the flood will receive the flood relief aid after three days of their village's loss of access.

DISCUSSION

The key persons for each of the stakeholders facilitate breaking down the barriers that exist between different stakeholders that have different types of knowledge. Authority or the influence of stakeholders on FM is a crucial chain that connects the authority and the community (Saifulsyahira et al., 2016). According to Othman et al. (2013) Malaysia's FM is decentralised management. Decentralised management means that the mandate is not only to the top authority, but the mandate to make decisions is also shared with other stakeholders such as local communities, private agencies, and non-government organisations. Full end-to-end operations and processes involved in FM require proper structuring in the form of simple operating procedures as follows: a system of communication or governance; mechanism, priorities and activities; information, technology and skills needs; risk analysis, impact evaluation and mitigation; learning curve or KM; as well as content management criteria (Othman et al., 2013).

The influence or the authority in the framework flood KM in Pekan, Pahang is represented by the three-level circular diagram (see Figure 6.1). The JPBBD is represented by the outermost blue circular diagram. The outermost circular diagram indicates the power and control that JPBBD has on the overall FM in Pekan, Pahang. Different colours on the circular diagram indicate the distinct power of the stakeholders.

The Orang Asli community has a smaller population compared to the Malay community. In addition, the Orang Asli community has a simpler lifestyle, they take on simpler mitigation, preparedness, response, and recovery process. Whereas, the Malay community takes on a much more complex mitigation, preparedness, response, and recovery processes, due to the more complex lifestyle they have. For example, the Orang Asli community has fewer belongings in their houses and also smaller houses, they tend to take mitigation measures by putting malleable PVC pipes on their door openings to prevent the floodwater from entering the house. However, the Malay community has bigger houses and more belongings inside their house, so they build raft houses outside to store their valuable belongings. In addition to that, the Malay community mostly lives near the Pahang River, whereas the Orang Asli community lives two to three kilometres at the back of the Malay community. Thus, the flood threat received by the Malay community is greater than the Orang Asli community. The Malay community has to prepare with more structures and other preparedness mechanisms compared to the Orang Asli community.

The Malay settlement acts as a front base and almost all facilities that the Malay community has. JPBBD will make use of these facilities for FM. Schools are located in the Malay settlement and are used as evacuation centres. Based on the communal facilities in the Malay settlement, the Malay community has to be more involved with the JPBBD during flood evacuation. Once the flood hits, young adults from the Malay community will help evacuate the Malay villagers. On the other hand, Orang Asli is not as involved with the evacuation process, as Orang Asli can move to the wooden hut at the back of their house once the flood hits. Based on the evacuation scenario, more management is needed for the Malay community compared to the Orang Asli community.

According to Spiekermann et al. (2015), the nature of knowledge-action is such that informed decisions can only be made with intelligent use of available information and pre-existing knowledge. This requires a constant learning process, which necessitates an effective application of one's mind in order to understand context-specific information and utilise it. In the Orang Asli context, they only know about flood hazards in their context. Thus, the Orang Asli's knowledge is only applicable to their influence. In the meantime, Malay knowledge has quite a larger influence as the Malay FM has to consider the needs of the Orang Asli community as well. This scenario can be seen during the distribution of the flood relief aid when the storage in the Malay front base has to consider distribution to the Orang Asli community. In contrast, JPBBD has to exercise and utilise its knowledge within its area of responsibility, which includes Malay and Orang Asli stakeholders. Thus, the influence of JPBBD is the largest combining and extending the Malay and Orang Ali stakeholders.

According to Alias et al. (2018), there are several preparedness actions that will be taken by the local communities:

- preparedness at the household level
- signing up to receive flood warnings
- taking out insurance with the policy that will cover them for flooding.

Based on the case study, almost all Malay villagers take the preparedness actions mentioned, but this is not the case for the Orang Asli community. The Orang Asli community only works as rubber tappers or collect forest products to make a living. Most of the Orang Asli's houses are not covered by insurance. Due to their simple house structures, they do not need maintenance. If the Orang Asli finds that their house is not conducive to living in, they are entitled to apply for the People's Housing Project (PPR) for free with the condition that their monthly income is less than RM3,000. Based on the researcher's observation, the PPR houses are built on slabs on the ground. These PPR housing structures face risk in a flood threat. Once the flood hits the area, the Orang Asli still has to move to their old wooden stilt houses that they keep usually at the back of the PPR houses.

According to Jahan Nipa et al. (2020), income comes into play and affects disaster preparedness. Income plays a role in perceptions towards disasters or floods and also the buying power of insurance.

CONCLUSION AND RECOMMENDATIONS

This study stemmed from different kinds of knowledge implemented to manage flood hazards by multiple stakeholders. There were issues between the implementation of LK and external knowledge to deal with flood hazards. The discrepancy between this knowledge is that LK is mostly not written and is tacit. At the same time, external knowledge had been tested, proven and documented. Thus, it is explicit. Although external knowledge may prove to be valid, the knowledge may not apply to a specific flood context. On the other hand, LK is undocumented and not proven yet by any scientific research. However, LK helps local communities deal with the flood risk that is contextual in nature.

The researcher decided to adopt a case study in the Pekan district in the Pahang state of Malaysia. The uniqueness of the Pekan district is that the indigenous and the non-indigenous communities live side-by-side. Still, they have different knowledge regarding the flood hazard. In the meantime, local authorities and other humanitarian organisations are responsible for managing and responding to the flood risk in the Pekan district.

Available knowledge from multiple stakeholders should be merged if there is a clash between what and how each stakeholder wants to implement the knowledge. Since the main objective of flood risk management is to reduce casualties, useful knowledge can be merged, combined, and integrated so that standardisation can happen and facilitate HO and allow authorities to act accordingly. The knowledge merged and combined must be processed so that it can become reliable sources, disseminate to the public, and ensure the community can properly understand the information and knowledge formed (Sardjono et al., 2020).

The availability of reliable knowledge is important, especially when multiple stakeholders are present. Reliable knowledge can be collected during reconnaissance and implemented by authorities. Authorities might go into villages and collect reliable information so that during the response, relief aid can be distributed accurately. Local communities may rely on different information sources for different types of disasters. For example, in the case of landslides, information often travels faster among local communities than from public sources (Xu, 2017). For earthquakes, which can be unpredictable and cause severe disasters, studies have shown that local communities are more likely to trust public information to make decisions (Zhu et al., 2011). Local communities' access to

disaster information, especially accurate and effective information, is extremely limited (Xu et al., 2020; Zhu et al., 2011).

A recommendation for this study is to add more villages to increase the reliability and trustworthiness of the results. Future recommendations would be to add more than one village for the Orang Asli and Malay communities. Within the humanitarian organisations, probably more than one key person each organisation would add more depth to the data being collected. More villages involved means more in-depth analysis could be done. Moreover, this would result in more reliable results.

From the perspective of LK, most of the types of knowledge formed are tacit knowledge. Tacit knowledge is a verbal form of knowledge. Most of the holders of tacit knowledge are the older generations. With the less number of older generations, the valuable tacit knowledge might also start to diminish. Thus, future study needs to be done to preserve this valuable tacit knowledge as references and guidelines for future research.

Since the Malay and Orang Asli communities were involved in the FM decision-making, a further study of the effectiveness of the involvement of local communities in FM decision-making should be conducted. Further study on FM by various organisations within the local government is needed to see which areas of FM are overlapping, fragmented or ineffective.

TRANSPARENCY STATEMENT

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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CONFLICT OF INTEREST

The author hereby declares that there is no conflict of interest in this study.

REFERENCES

Ahmad Azan, R., Ungku Azly, U., & Mohd Juraimy, H. (2011). Disaster basics: The life cycle of the disaster management and roles of agencies in Malaysia. *Journal of Occupational Safety and Health*, 8(1), 21-32.

Alavi, M., Kayworth, T. R., & Leidner, D. E. (2005). An Empirical Examination of the Influence of Organizational Culture on Knowledge Management Practices. *Journal of Management Information Systems*, 22(3), 191-224. doi:10.2753/MIS0742-1222220307

Albris, K., Lauta, K. C., & Raju, E. (2020). Disaster knowledge gaps: exploring the interface between science and policy for disaster risk reduction in Europe. *International Journal of Disaster Risk Science*, 11(1), 1-12.

Alias, N. A., Siwar, C., Ismail, M. K., & Idris, N. D. M. (2018). *Flood Disaster Management in Sungai Pahang Basin: Case of Temerloh. In Improving Flood Management, Prediction and Monitoring*: Emerald Publishing Limited.

Bridgman, P., & Davis, G. (2004). *The Australian policy handbook*: Allen & Unwin.

Carey, S., & Smith, C. (1993). On understanding the nature of scientific knowledge. *Educational Psychologist*, 28(3), 235-251.

Chang, C. L.-h., & Lin, T.-C. (2015). The role of organizational culture in the knowledge management process. *Journal of Knowledge management*, 19(3), 433-455.

Creswell, J. W. (2015). *Revisiting mixed methods and advancing scientific practices. In* The Oxford handbook of multimethod and mixed methods research inquiry.

Cuaton, G. P., & Su, Y. (2020). Local-indigenous knowledge on disaster risk reduction: Insights from the Mamanwa indigenous peoples in Basey, Samar after Typhoon Haiyan in the Philippines. *International Journal of Disaster Risk Reduction*, 48, 101596. doi:https://doi.org/10.1016/j.ijdrr.2020.101596

Das, P. (2012). Disaster management in India: policy review and institutional structure. Asiapac *Journal of Socical Sciences*, 4, 37-52.

Dube, E., & Munsaka, E. (2018). The contribution of indigenous knowledge to disaster risk reduction activities in Zimbabwe: A big call to practitioners. Jàmbá: *Journal of Disaster Risk Studies*, 10(1), 1-8.

Friedman, M. (2005). *The optimum quantity of money:* Transaction Publishers.

Geertz, C., & Knowledge, L. (1983). *Further Essays in Interpretive Anthropology (*Vol. 21): Basic Books New York, NY.

Gulbranson, C. A., & Audretsch, D. B. (2008). Proof of concept centers: accelerating the commercialization of university innovation. *The Journal of technology transfer*, 33(3), 249-258.

Iloka, N. G. (2016). Indigenous knowledge for disaster risk reduction: An African perspective. *Jamba* (Potchefstroom, South Africa), 8(1), 272-272. doi:10.4102/jamba.v8i1.272

Ishak, N. M., & Abu Bakar, A. Y. (2014). Developing Sampling Frame for Case Study: Challenges and Conditions. *World Journal of Education*, 4(3), 29-35.

Ioannis, R., & Belias, D. (2020). Combining strategic management with knowledge management: Trends and international perspectives. *International Review of Management and Marketing*, 10(3), 39-45.

Jahan Nipa, T., Kermanshachi, S., & Patel, R. K. (2020). *Impact of Family Income on Public's Disaster Preparedness and Adoption of DRR Courses*. Paper presented at the Creative Construction e-Conference 2020.

Kelman, I. (2020). *Disaster by choice: How our actions turn natural hazards into catastrophes*: Oxford University Press.

Lewins, A. (2001). CAQDAS: computer-assisted qualitative data analysis. *Researching social life*, 302-323. London SAGE

Martin, J. (2016). *Malaysia: Disaster Management Reference Handbook.* By The Centre for Excellence in Disaster Management and Humanitarian Assistance (CFE-DM), 1-99.

McWilliam, A., Wasson, R. J., Rouwenhorst, J., & Amaral, A. L. (2020). Disaster Risk Reduction, modern science and local knowledge: Perspectives from Timor-Leste. *International Journal of Disaster Risk Reduction*, 50, 101641. doi:https://doi.org/10.1016/j.ijdrr.2020.101641

Mercer, J., Kelman, I., Taranis, L., & Suchet-Pearson, S. (2010). Framework for integrating indigenous and scientific knowledge for disaster risk reduction. *Disasters*, 34(1), 214-239.

Mercer, J., Gaillard, J. C., Crowley, K., Shannon, R., Alexander, B., Day, S., & Becker, J. (2012). Culture and disaster risk reduction: Lessons and opportunities. *Environmental Hazards*, 11(2), 74-95. doi:10.1080/17477891.2011.609876

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long range planning*, 33(1), 5-34.

Othman, M., Ahmad, M. N., Suliman, A., & Arshad, N. H. (2013). *Towards COBIT-based Framework to Govern Flood Management*. Paper presented at the PACIS.

Rahman, A. A., & Mustapha, R. (2020). Cabaran Pelaksanaan Dakwah terhadap Masyarakat Orang Asli oleh Majlis Ugama Islam dan Adat Resam Melayu Pahang. *Islāmiyyāt,* 42, 59-67.

Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., & Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. *Journal of environmental management*, 91(8), 1766-1777.

Riege, A., & Lindsay, N. (2006). Knowledge management in the public sector: stakeholder partnerships in the public policy development. *Journal of Knowledge management*, 10(3), 25-39.

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2013*). Qualitative research practice: A guide for social science students and researchers*: Sage.

Saifulsyahira, J., Edre, M., AF, A. F., & Juni, M. H. (2016). Governance of flood disaster management: Malaysian case study. *International Journal of Public Health and Clinical Sciences*, 3(1), 17-30.

Šakić Trogrlić, R., Wright, G. B., Duncan, M. J., van den Homberg, M. J., Adeloye, A. J., Mwale, F. D., & Mwafulirwa, J. (2019). Characterising local knowledge across the flood risk management cycle: a case study of Southern Malawi. *Sustainability*, 11(6), 1681.

Salehuddin, K. (2018). THE VALUE OF KNOWLEDGE IN THE MALAY MIND: A COGNITIVE SEMANTIC ANALYSIS. *International Journal of Asia-Pacific Studies*, 14 (2): 39–59, https://doi.org/10.21315/ijaps2018.14.2.2(checked

Sardjono, W., Harisno, & Perdana, W. G. (2020). Improve Understanding and Dissemination of Disaster Management and Climate Change by Using Knowledge Management Systems. IOP Conference Series: *Earth and Environmental Science*, 426, 012158. doi:10.1088/1755-1315/426/1/012158

Skjott Linneberg, M., & Korsgaard, S. (2019). Coding qualitative data: a synthesis guiding the novice. *Qualitative Research Journal*, 19(3), 259-270. doi:10.1108/QRJ-12-2018-0012

Spiekermann, R., Kienberger, S., Norton, J., Briones, F., & Weichselgartner, J. (2015). The Disaster-Knowledge Matrix – Reframing and evaluating the knowledge challenges in disaster risk reduction. *International Journal of Disaster Risk Reduction*, 13, 96-108. doi:https://doi.org/10.1016/j.ijdrr.2015.05.002

Sun, Z., & Hao, G. (2006). HSM: A hierarchical spiral model for knowledge management. Retrieved from https://ro.uow.edu.au/commpapers/36

Taubenböck, H., Goseberg, N., Lämmel, G., Setiadi, N., Schlurmann, T., Nagel, K., . . . Dech, S. (2013). Risk reduction at the "Last-Mile": an attempt to turn science into action by the example of Padang, Indonesia. *Natural Hazards*, 65(1), 915-945.

Tekolla, A. (2010). *Rainfall and Flood Frequency Analysis in Pahang River Basin*, Malaysia. TVVR10/5012.

Xu, D., Peng, L., Liu, S., Su, C., Wang, X., & Chen, T. (2017). Influences of migrant work income on the poverty vulnerability disaster threatened area: A case study of the Three Gorges Reservoir area, China. *International Journal of Disaster Risk Reduction*, 22, 62-70. doi:https://doi.org/10.1016/j.ijdrr.2017.03.001

Zei, L. H., Yew, V. W., Azima, A., Sia, M. K., & Chan, G. K. (2018). Perubahan sosioekonomi komuniti orang Asli Jakun akibat Rancangan Penempatan Semula: Satu kajian kes di RPS Runchang, Pahang (Resettlement Programme and its impact on socioeconomic development of orang Asli Jakun: A case study of the RPS Runchang, Pahang). *Geografia-Malaysian Journal of Society and Space*, 14(4). 127-141

Zhu, X., Wu, X., Jung, K. H., Ohman-Strickland, P., Bonanno, L. J., & Lioy, P. J. (2011). Ambient concentrations and personal exposure to polycyclic aromatic hydrocarbons (PAH) in an urban community with mixed sources of air pollution. *Journal of exposure science & environmental epidemiology*, 21(5), 437-449.

Zuccaro, G., & Leone, M. F. (2018). Building Resilient Cities: A Simulation-Based Scenario Assessment Methodology for the Integration of DRR and CCA in a Multi-Scale Design Perspective. *Procedia engineering*, 212, 871-878. doi:https://doi.org/10.1016/j.proeng.2018.01.112