Human adaptation for survival against floods in Sabah floodplain areas: the past and the present

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Abstract
Flooding has been one of the natural phenomena existed since thousands of years ago. This is the Mother's nature process of altering terrains to create vast biodiversities on the existing natural environments. This is also a process where excessive flood water streams through low-lying areas, resulting in the formation of alluvial fans, containing soils highly rich with nutrients, and making this land suitable for agricultural activities. The first occupants of the floodplain areas have already well informed on the occurrence of this natural event thus designed a standard way of living in harmony with floods. As the population in the floodplain areas grow, the demands to improve the socio-economic status increased, thus urban developments started to replace and diminish the existing natural environments. As generation upon generations continue to live within the area, the knowledge to live dealing with floods becomes distant. Non-native residents purchase parcels of land in the floodplain, without any understanding of the characteristics of floods in the area. Floods began to be seen as a vicious threat, rather than a natural facet of the land they live in. Hence, new flood management mechanism is established to ensure the present occupants of the floodplain areas are well adapted to live with floods. This paper devotes to discussing how the past and present floodplain residents live coping with floods, particularly in the flood-prone areas in Sabah, Malaysian Borneo. The findings of the study on how these two categories of residents cope with floods can be integrated into establishing official flood management measures to effectively manage flood disasters in Sabah.

Keywords
Floods, floodplain management, past and present, flood adaptation

INTRODUCTION

Flooding is among the major disasters affecting many countries every year. It can be the most destructive of natural disasters, and on a global scale, the damages caused by it, is increasing (Okada, 2003). In the Asia-Pacific region, especially parts of East and Southeast Asia, rainfall averages over 1,000 millimeters per year because of the influence of monsoons, and the volcanic and seismological belts linger in this region (Okada, 2003). High rainfall and unstable geological features forms large alluvial flood plains in the downstream areas. Flooding is defined as any abnormally high stream flow that overtops the natural or artificial banks of a river. A floodplain can be defined as "the area of a river valley which is covered with water when the river overflows during floods" (*Sabah Water Resources Enactment,* 1998). These areas act as a natural reservoir and temporary channels for flood waters.

Malaysia is a fast-developing country progressing towards industrial developments in urban areas. With the scarcity of land in the city and town areas, the development is encroaching flood-prone areas. This situation promotes further economic growth

especially in the commercial and residential aspects throughout the country, with little regard to the effects on the communities and environment. The urban areas are now facing tremendous strain to maintain their physical and social well-being in the face of such development activities (Ibrahim, 1996). Flood-prone areas in Malaysia are still under heavy development because there is no proper guideline for development in floodplains even though several major floods had occurred in recent years (both as localized flash floods and as basin-wide floods). Sinnakaudan *et al.* (2003) quoted, "a flood can be treated as a hazard if it has the potential threat to humans and their welfare'.

Sabah is not excluded from the terrible effect of flood. Figure 1 shows a flood scenario in Kinabatangan, Sabah. There is estimated RM 130 million financial losses and 200 reported deaths, in December 1996 flood event (see to Table 1) (Chan, 1997). Prior to this situation, Sabah has played a part in the preparation of guidelines for developments, known as the 'Sabah Water Resources Master Plan', in the year 1995. In this Master Plan, the issue of flood and flooding is considered as one of the current water issues in Sabah. In this Plan too, a suggestion for implementing a Flood and Floodplain Management has been put forward in order to reduce negative impacts of flooding and flood liability on individual owner and occupiers, and to reduce private and public losses resulting from floods (*Sabah Water Resources Master Plan,* 1995). A few years after the establishment of this Plan, the 'Sabah Water Resources Enactment' was enacted to provide for the sustainable management of the water resources in Sabah to promote orderly, equitable and efficient use of water and to maximize economic, social and environmental benefits for the future (*Sabah Water Resources Enactment,* 1998).

Figure 1: Floods in Sabah

Table 1: Official flood loss estimates for selected floods in Malaysia

Table I Official flood loss estimates for selected floods in Malaysia

Flood event (Year)	(Place)	Damage ($ million at 1993 prices)	Deaths	Persons evacuated
1967	Kelantan R. Basin	199.3	38	320,000
1967	Perak R. Basin	154.5	0	280,000
1967	Terengganu R. Basin	40.2	17	78,000
1971	Pahang R. Basin	93.1	24	153,000
1971	Kuala Lumpur	84.7	24	NA
1979	Peninsular Malaysia	NA	7	23,898
1982	Peninsular Malaysia	NA	8	9,893
1983	Peninsular Malaysia	NA	14	60,807
1984	Batu Pahat R. Basin	20.3	0	8,400
1986	Peninsular Malaysia	NA	0	40,698
1988	Peninsular Malaysia	NA	37	100,755
1988	Kelantan R. Basin	33.0	19	36,800
1988	Sabah	NA	1	NA
1991	Peninsular Malaysia	NA	11	NA
1992	Peninsular Malaysia	NA	12	NA
1993	Peninsular Malaysia	NA[a]	22	17,000
1995	Peninsular Malaysia	NA	0	14,900
1996	Sabah (June)	NA	1	9,000
1996	Sabah (December)	130.0[b]	200[c]	15,000

Notes:
NA = not available
[a] In the state of Kelantan, a total of 200 schools were closed during the 1993 flood resulting in 113,000 students missing school for a total of between six to 11 days
[b] The Sabah government estimated that damage to roads, bridges. schools, power lines, government offices and other public utilities would need at least RM130 million to restore (*The Star*, 1 January 1997). If private properties, industries, businesses, corps, livestock, shipping vessels and other privately owned assests were taken into account, the damage figures would have been at least many million Ringgits higher. More than 4,552 houses were destroyed during this event
[c] Another 104 people were still missing nearly a week after the event

Sources: DID Malaysia, Malaysian National Security Council and major newspapers

In Sabah Water Resources Master Plan (SWRMP), three measures of managing floodplains are recommended. This can be used singly or combined, which is determined through the floodplain management. These three measures are the structural measures, planning measures and contingency measures (*SWRMP*, 1995). This paper devotes in discussing how the past and the present floodplain settlers deal with floods in the Sabah floodplains, and hopefully the output of this paper will aid in establishing official flood management measures to effectively manage flood disasters in Sabah.

Background of the study area

Sabah is the second largest of the 14 states in Malaysia and is also known as "The Land Below The Wind". It is one of the two Malaysian states on the island of Borneo. Situated on the northeast of the island, Sabah is smaller than its sister state, Sarawak. The southern part of the island, called Kalimantan, belongs to Indonesia. The state capital is Kota Kinabalu, formerly known as Jesselton. The location of Sabah is shown in Figure 2, highlighted in green while the remaining states are coloured in grey. Its people are from 32 various indigenous groups. Amongst them are

Kadazandusuns, Muruts, Bajaus, Kedayans, Sulu, Bisaya, Rumanau, Minokok and Rungus.

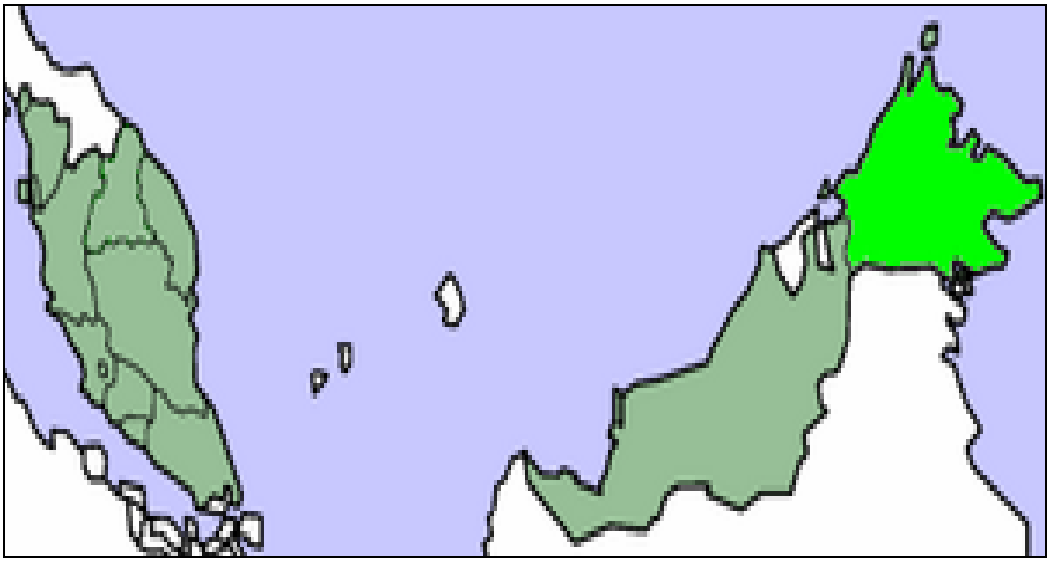

Figure 2: Location of Sabah, Malaysia

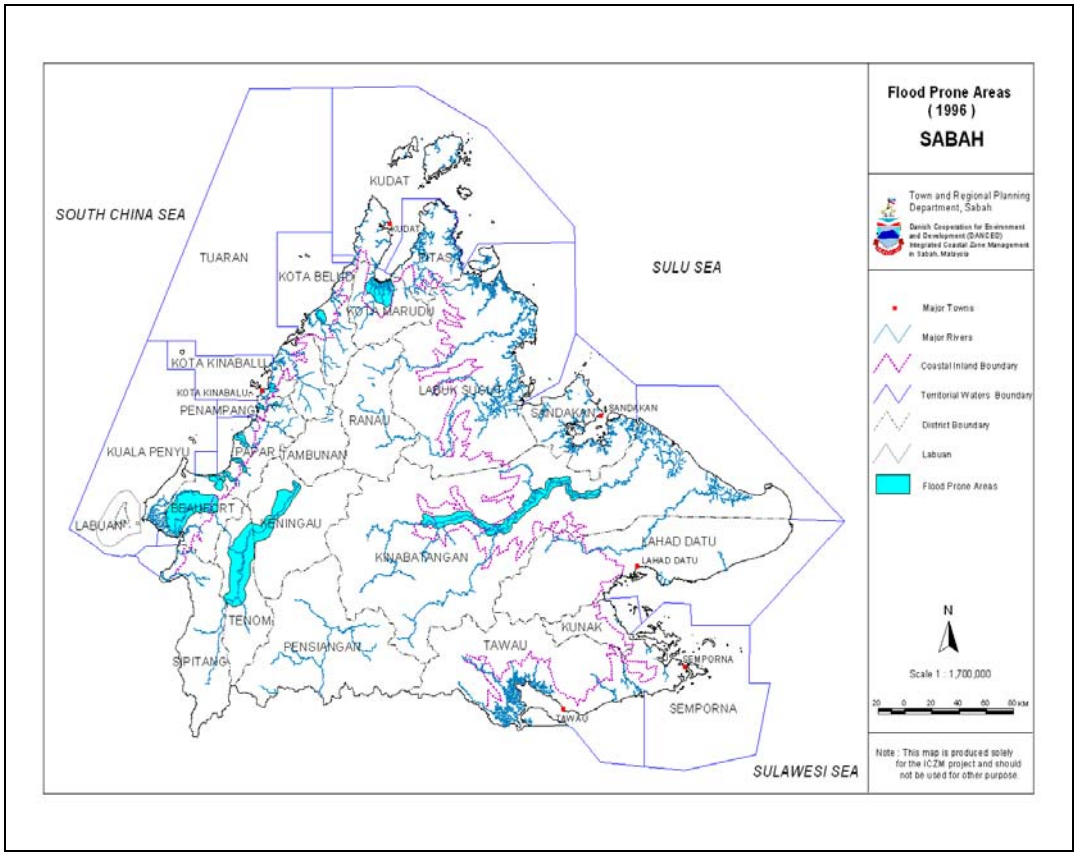

Figure 3: Flood prone areas in Sabah, Malaysia

Flood prone areas in Sabah are shown in Figure 3. As shown in the figure, virtually every district in Sabah is affected by flooding to some extent but areas most affected are mostly in the West Coast with the exception of the Kinabatangan River in the East

Coast. The severity of flooding in these areas varies from year to year and from river to river. The Department of Irrigation and Drainage monitor flood in the low-lying areas and compile annual records of such floods.

LIVING ADAPTATION TO FLOODS

The past residents

The floodplain settlers in Sabah floodplains in the past are well accustomed to floods. Most of them have developed a traditional adaptations and responses to reduce the effects of flooding. These measures have been effective however; their extent is constricted because they are fragmented and uncoordinated. Nevertheless, by incorporating these methods taken by the past residents into the official systems would greatly reduce flood losses.

One's cultural background is a structural influence, which shapes one's perception as well as behaviours in response to hazards. Often, despite having the most sophisticated and modern response systems, overall disaster reduction is ineffective largely because the victims do not understand these modern systems and hence do not know how to response effectively to them. Many families living have lived on floodplains for centuries and have evolved many responses to reduce and mitigate flood disasters. Adaptation to extreme environments, including flooding is inherently a human survival trait. Hence, over centuries, communities living on floodplains have evolved many adaptations and have learnt to respond positively towards flood hazard reduction. Like their perception, individual response in terms of strategy adoption is strongly moulded by cultural forces.

Disasters often acts as "agents of change", resulting for instance, in innovations in hazard-resistant architectural and construction designs (Chan, 2004). In the Sabah floodplains, the most unique adaptation that has evolved in response to flood disasters is the kampong stilt houses. These houses originally evolved as an adaptation to the occupation of swamp-land and frequent flooding in riverine/coastal areas. This permanent form of flood proofing is still predominant in the traditional rural areas where frequent flooding is prevalent. Another common form of traditional adaptation is that of clustered houses built on water, which is known as water villages. One other example of flood proofing houses dwelt by the past residents is the houseboats dwelled also by the Bajaus. The pictures of these unique flood hazard resistant structures are shown in Figure 4 and 5.

In rural villages, especially where paddy farming is the main occupation, the locals have double use for their farming lots. The fields are located much lower than the land on which houses are built because wet paddy needs to be inundated by water most of the time. When the rivers overflow their banks, paddy fields act as a form of retention ponds. The picture of paddy fields is shown in Figure 6.

The present residents

According to the Sabah State Water Resources Master Plan (1995), the purpose of structural mitigation is to change the flood's behaviour by reducing flood levels, or excluding floodwaters from areas at risk. Structural flood mitigation works suggested

in the Master Plan are the construction of flood mitigation dams, levees and dikes, bypass flood channels, channel improvements, flood diversion channels, retarding basin, on-site detention ponds and flood-proofing.

Figure 4: Water village

Figure 5: House-boat

Figure 6: Paddy fields

Flood mitigation dams are purposely constructed to reduce downstream water level through reducing water discharges. Levees and dikes are considered the most economical measure, which is to build earth or concrete bunds to protect existing development in flood-prone areas. Bypass flood channels are constructed to redirect water away from areas at risk, and reducing the water levels along the mainstream in the protected area during flood events. Channel improvements are made to increase the capacity of river channel through widening, deepening or realigning the channel, and through the clearance of obstructions along the riverbanks and bed. Flood diversion channels have the same function as bypass flood channels, except that this structure do not rejoin with the original stream. Retarding basin (also known as detention basin) is a small dam that provides temporary storage for floodwater, thus delaying downstream discharges and flood levels. On-site detention is a method that has the same function as retarding basin, except that it is installed in private properties. Flood proofing is a method of protecting critical structures and services such as water supply and treatment plants for reducing future damages.

Chan (1997) quoted that structural solutions were attempts of controlling floods and non-structural solutions were largely preventive efforts. These strategies could also be implemented in the flood-prone areas that were not fully developed. Non-structural flood mitigation measures can also complement the structural approaches in areas where future development may occur, and they may also represent an independent approach where some control over floodplain development can be exercised at low cost. As quoted in Guidelines for Reducing Flood Losses (United Nations, 2004), "non-structural approaches do not mean "no use", but rather "wise use"". Several methods can be classified under the floodplain management measures namely land-use planning, zoning of flood-prone areas and gazetting forest reserves and water catchment protection areas.

The main point of land-use planning is to integrate flood-prone areas into the broader plans for the urban and surrounding areas. Zoning of flood-prone areas in the other hand is a way to prevent development from occurring on flood-prone areas for the flood damages reduction. Gazetting forest reserves and water catchment protection area means that any kind of development and activities, such as timber logging and hillside developments are either restricted or totally banned in the allocated area.

CONCLUSION

Addressing flood issues in Sabah is not only to reduce flood hazards, but also it is an indication of other socio-economic problems such as poverty and underdevelopment in many areas in the state. The government is keen to reduce flood loss but many official responses employed though able to reduce some impacts of flooding, have not completely successful in the overall management of floods. This is because structural measures are predominantly focused upon solving the flood risk problems. As mentioned before, present residents relying too much on such measures may not understand these modern systems and hence do not know how to response effectively to them, causing more complication on reducing flood losses. Obviously, solely relying on structural and non-structural measures to address floods would be limiting. Flood hazard in Sabah can be tackled effectively through a comprehensive approach incorporating structural and non-structural flood mitigation methods, as well as integrating traditional flood adaptation strategies applied by the past floodplain

residents, into the official flood management system. Effective flood hazard management is vital in effort to manage flood hazard problems successfully. Otherwise, flood hazards will continue to put great pressures on the country's economy, aggravate poverty and income inequity in Sabah in particular.

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