When Abnormal Becomes the New Normal: Coping with Water Hazards


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On 10 March, 2018, Dato' Paduka Ir. Haji Keizrul Abdullah delivered the Ir. T.T. Chiam Inaugural Memorial Lecture on water hazards and how Malaysia coped with such disasters. The Intergovernmental Panel on Climate Change (2014) reported that "warming of the climate system is unequivocal and, since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, amounts of snow and ice have diminished and sea levels have risen".

Global warming can produce "Black Swans" where the impact of highly improbable is becoming more frequent – a case of the abnormal becoming the new normal. How do we face the new phenomenon and avoid being a turkey in the eyes of Nassim Nicholas Taleb (2018)? Can we turn Black Swans white?

Four renowned international scientific organisations have discovered alarming evidences of global warming where the temperature rose very fast. See Figure 1. The effects of climate change can be seen from a number of observations such as "shrinking ice sheets, glacial retreat, decrease in snow cover, declining Artic sea ice, extreme events and ocean acidification" (NASA Global Climate Change, 2018).

Dato' Keizrul noted that "global warming/climate change inflicted other equally challenging consequences to Malaysia. Arising from the effect of precipitation, climate change produces floods that cause untold miseries". Precipitation may be explained as water droplets that are formed in the cloud and come down as rainfall, arising from evaporation of water at the earth surface. Global warming and climate change can cause heavier rainfall resulting from rapid evaporation which, in turn, produces floods.

What are the consequences of floods? Citing a source from ICC (2007), Dato' Keizrul said Malaysia's annual damage from flooding is estimated at RM915 million, with a drag impact on economy estimated at RM2 billion.

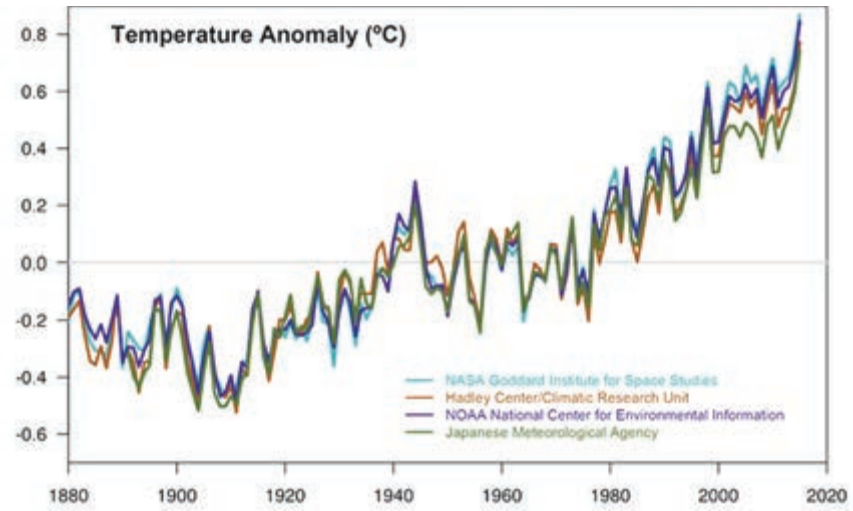

Figure 1: Scientific consensus: Earth climate is warming
Source: NASA Global Climate Change (2018)

Social economic damages from floods have been the focus of recent research ((Chan (2012), Lee and Irma Noorzurah Mohamad (2013), *Sani et al., (2014)* and *Hays (2015)*). However, the estimated economic losses, as reported by the four different sources mentioned below, differ considerably from one to another.

Firstly, Chan (2012) collected and compiled a table of records of floods in Malaysia, dating as far back as 1886. The worst floods occurred in Johor, between December 2006 and January 2007, where damage to property amounted to US$489 million and resulted in 18 deaths.

Secondly, in a study based on UNEP's (2013) Global Risk Data Platform, Lee and Irma Noorzurah Mohamad (2013) found that Malaysia's economic risk index from water-related disasters was estimated at around US$60 million, with at least 10 related deaths per year. This confirms there are huge casualties from flood damage. See Figure 2.

Thirdly, *Sani et al., (2014)* noted that in 1996, a flood took place in Keningau, Sabah, which caused US$300 million in property damages and 241 deaths.

Fourthly, some 9% of land mass or 29, 720 km2 of land in the country is prone to flooding. (*Hays, 2015; Sani*

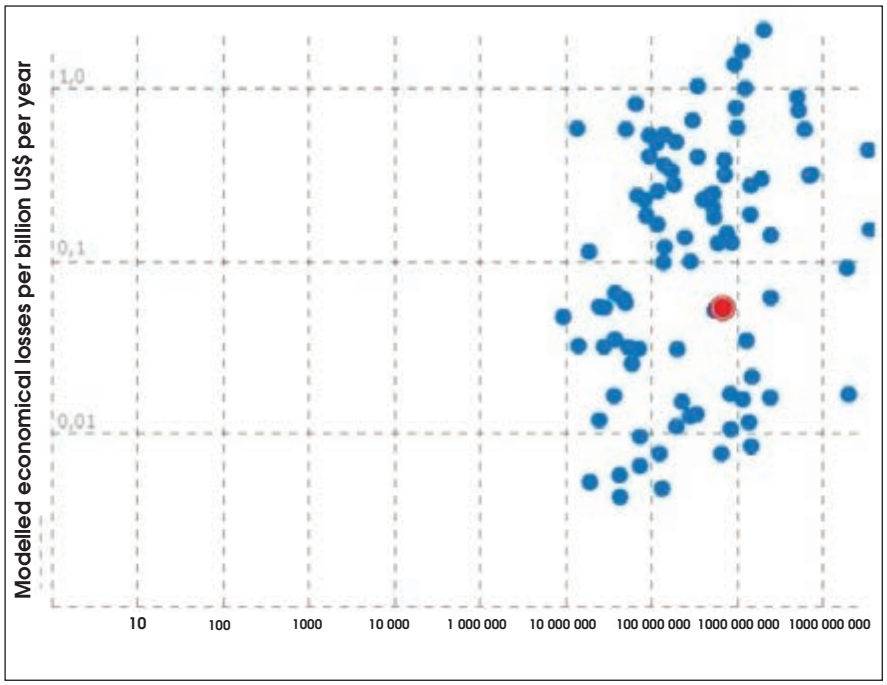

Figure 2: Global flood economic risk index (ERI), with the highlighted point (red) showing Malaysia. Source: Lee and Irma Noorzurah Mohamad (2013), cited from UNEP (2013)

et al., 2014). Hays (2015) provided an account of severe floodings experienced in the late 2004, late 2007, 2009 and 2012, which left many people dead and thousands homeless. For example, in the late 2004 flooding, at least 11 people were killed and 10,000 families evacuated from Kelantan, Terengganu and Pahang.

Indeed, more in-depth research is required in this specific area. What is the way forward? In which areas do we need to do more? This article brings to mind two questions inspired by Dato' Keizrul's lecture: On mitigation measures, what is Malaysia's experience in coping with the water hazards in the context of climate change? On adaptation measures, what should Malaysia do in disaster risk reduction?

MITIGATION EFFORTS IN COPING WITH WATER HAZARDS: GUARDEDLY OPTIMISTIC

According to Dato' Keizrul's lecture, at least six engineering control measures as "cure floods" solutions had been implemented by the Drainage & Irrigation Department (DID) in the past: Widening and deepening of rivers, construction of levees and bunds, upstream stream storage (e.g., the Klang Dam height was increased by 3 metres), off river storage (e.g., constructing the Batu River flood attenuation pond), diversion (flood bypass) and pondering & pumping.

"A point to note is that engineering control measures are capital intensive," said Dato' Keizrul. "As funds from the government are becoming more limited, the priority now is to turn to mitigation measures in order to reduce flood impact." See Table 1. Flood mitigation costs and flood mitigation measures will be discussed below.

Table 1: Flood mitigation expenditure in Malaysia

Period	RM	REMARK
1971-1975	14 million	2nd Malaysia Plan
1976-1980	56 million	3rd Malaysia Plan
1981-1985	141 million	4th Malaysia Plan
1986-1990	155 million	5th Malaysia Plan
1991-1995	431 million	6th Malaysia Plan
1996-2000	845 million	7th Malaysia Plan
2001-2005	1.8 billion	8th Malaysia Plan
2006-2010	4 billion*	9th Malaysia Plan
2011-2015	5 billion*	10th Malaysia Plan

As flood mitigation costs can escalate through time, the government has introduced, among others, Private Financing Initiative (PFI) as a procurement strategy which allows participation by the private sector. One example is the SMART Tunnel in Kuala Lumpur (Lee and Irma Noorzurah Mohamad, 2013).

The word mitigation refers to an act of making a condition or consequence less severe. Thus flood mitigation refers to any act that will lessen the impact of flooding so that it is less severe and harmful to flood victims. Four mitigation measures commonly adopted in Malaysia were discussed: Integrated river basin planning and management, flood risk mapping, flood forecasting and warning as well as control at source.

Integrated river basin planning and management: In the Network of Asian River Basin Organisations (NARBO) Regional Conference held in April 2015, Dato' Keizrul defined a river basin "as geographical areas determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus". A River Basin Authority is one which is tasked to ensure that water quality is achieved for daily use optimally and sustainably. So far, the River Basin Authority can only be found in the state of Selangor.

Flood risk mapping. Marco (1994) explained flood risk mapping as "a tool for land use planning in flood-prone areas". Based on experiences of previous flood-inflicted disasters, the Malaysian Disaster Management & Relief Committee, with relevant stakeholders, was tasked with overseeing the planning, restoration, reconstruction and delivery in post-disaster recovery exercises. Flood risk mapping is used to lessen the damage of future impact from flood recurrence.

Flood forecasting and warning. This is a flood warning dissemination system relying upon network data, telemetry data, radar data and rainfall forecast that promotes decision support on a timely basis (HR Wallingford, 2017). One such

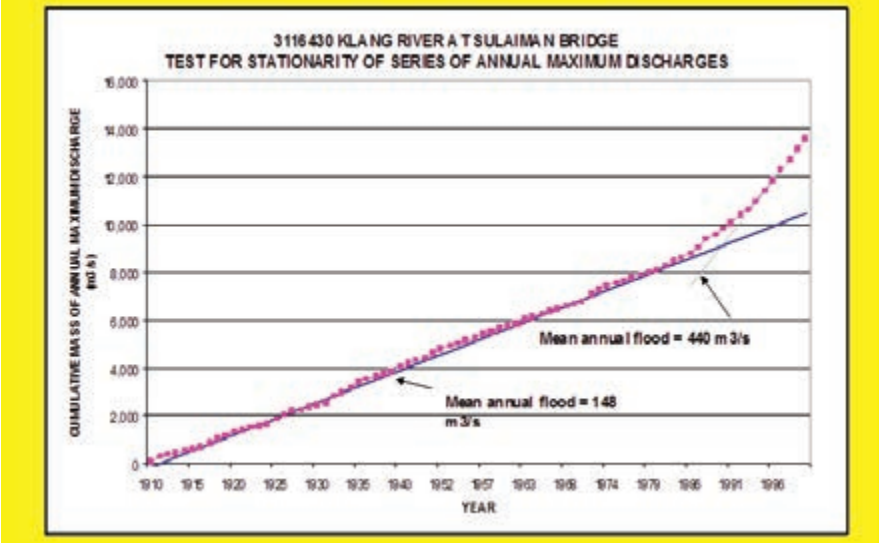

Figure 3: Data from the Klang River at Sulaiman Bridge
Source: The T. T. Chiam Inaugural Memorial Lecture

system was installed in Sungai Muar in 2014.

Control at source. Uncontrolled housing development in low-lying flood plains contributed to floods in urban centres. The key to controlling floods at source is to properly manage runoff quality and quantity in the implementation stage of housing development. One example of flood control at source is the construction of detention facilities.

Dato' Keizrul re-emphasised the impact of development and the side-effects in the urban centres: "As further development takes place, flood magnitude continues to increase, i.e. a case of the goal posts keep getting wider". Academic Dictionaries Encyclopedias (2018) explains that the mean annual flood is "over a series of years, the mean average of the maximum flood discharges experienced in a particular river recurrence interval should be once every 2.33 years". One example in Malaysia was the Klang River under the Sulaiman Bridge where the mean annual flood jumped from 148m^3 per second in 1940 to 440m^3 per second in 1991. See Figure 3 for empirical evidence on the increasing trend of annual flood discharge at the said bridge.

In the next section, flood adaptation measures as a better "cure floods" method than the existing mitigation measures were discussed.

ADAPTATION MEASURES IN DISASTER RISK REDUCTION

The implementation of flood mitigation measures are normally costly and involves elaborate institutional arrangements (integrated river basin planning and management, flood risk mapping, flood forecasting & warning and control at source).

Dato' Keizrul believed that adaptation measures were more cost-effective and included building resilience into the potential flood victims so that they would be better prepared to face the challenges. He offered three examples:

1. The "living in harmony with floods" concept through effective flood plain management, can help control housing developments in the flood plain.
2. A more environmentally-friendly option such as the natural ecosystem, can be adopted to reduce flood threats. An example is the planning of Putrajaya City where existing lakes and wetlands are retained as natural features. See Figure 5.
3. Building resilience into potential flood victims should be emphasised so that they would be better prepared to adapt and able to recover from natural disasters. This approach entails consideration of "risk, insurance, social safety nets/ compensation, relief measures, recovery, and rebuilding for flood

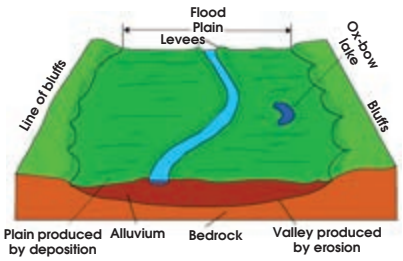

Figure 4: Living in harmony with floods
Source: The T. T. Chiam Inaugural Memorial Lecture

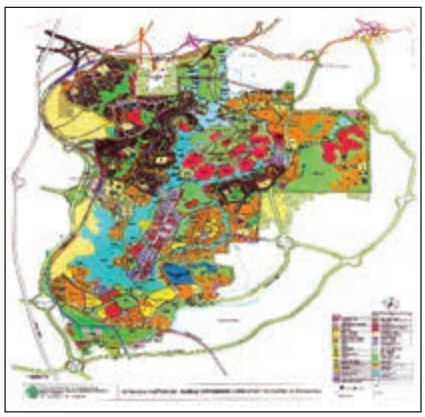

Figure 5: Putrajaya wetlands, use of lake as detention basin and wetlands for water quality improvement

victims well before the occurrence of flood," Dato' Keizrul noted.

4. The recognition of building resilience to disasters, in communities (and nations for that matter) has been the main thrust of the United Nations International Strategy for Disaster Reduction (UNISDR) programme. During the World Conference on Disaster Reduction held in Hyogo, Japan, on 18-22 January, 2005, five priority action plans were identified for immediate implementation by all signatory nations, Malaysia included, reproduced in full here (UNISDR, 2005):

i. Ensure that disaster risk reduction (DRR) is a national and local priority with a strong institutional basis for implementation.
ii. Identify, assess and monitor disaster risks and enhance early warning.
iii. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
iv. Reduce the underlying risk factors.
v. Strengthen disaster preparedness for effective response at all levels.

Readers keen to learn more about water hazards and climate change adaptation can look forward to a richer field awaiting to be explored further (Fussel, 2007; Silva and Costa, 2016).

CONCLUSION

When global warming and climate change meet at the intersection of urban development, the condition is ripe for extreme floods. The Black Swan Theory was manifested through the onslaught of the 2014 Great Flood in the north-eastern states of the peninsula.

The aim of this article is to find means to turn Black Swans white. Dato' Keizrul, the speaker of the Ir. T. T. Chiam Memorial Lecture, had addressed the two questions in this article in relation to water hazards: Flood mitigation measures adopted in the past by the Malaysian DID and flood adaptation measures more popularly endorsed by UNISDR (2005). While flood mitigation measures are costly, building resilience involving the collective efforts of the affected communities can be a successful adaption solution in the long run for Malaysia. ■

REFERENCES

[1] IPCC (2014), Climate change 2014 synthesis report summary for policy makers,http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf. Accessed on 9 June 2018.

[2] Taleb, N. N. (2018), Nassim Nicholas Taleb homepage http://www.fooledbyrandomness.com/. Accessed on 9 June 2018.

[3] NASA Global Climate Change (2018), Global climate change, vital signs of the planet, https://climate.nasa.gov/scientific-consensus/. Accessed on 9 June 2018.

[4] ICC (2007), Impact of climate change, https://www.researchgate.net/profile/Simon_Hales/publication/216811932_Climate_Change_2007_Impacts_Adaptation_and_Vulnerability_Contribution_of_Working_Group_II_to_the_Fourth_Assessment_Report_of_the_Intergovernmental_Panel_on_Climate_Change/links/56a0e8a608ae2c638ebe0b2a.pdf. Accessed on 9 June 2018.

[5] Chan, N. W. (2012), Impacts of Disasters and Disasters Risk Management in Malaysia, http://www.eria.org/Chapter_14.pdf. Accessed on 9 June 2018.

[6] Lee and Irma Noorzurah Mohamad (2013), Flood economy appraisal: An overview of the Malaysian scenario, https://www.researchgate.net/publication/263544470. Accessed on 9 June 2018.

[7] *Sani et al.*, (2014), Floods in Malaysia historical reviews, causes, effects, and mitigation approach,https://www.researchgate.net/publication/268152474. Accessed on 9 June 2018.

[8] Hays (2015), Land and geography of Malaysia, http://factsanddetails.com/southeast-asia/Malaysia/sub5_4e/entry-3703.html. Accessed on 9 June 2018.

[9] UNEP (2013). Global Risk Data Platform. http://preview.grid.unep.ch/. Accessed on 9 June 2018.

[10] Dato' Keizrul (2015), Integrated river basin management in Malaysia, http://www.mwa.org.my/pdf/wm2015/d2/405%201120-1200%20Dato%20Paduka%20Dr.Ir.Hj.%20Keizrul%20IRBM%20in%20Malaysia%20-%20Keizrul%20[Compatibility%20Mode].pdf. Accessed on 9 June 2018.

[11] Marco (1994), Flood risk mapping, https://link.springer.com/chapter/10.1007/978-94-011-1098-3_20. Accessed on 9 June 2018.

[12] HR Wallingford (2017), National Flood Forecasting and Warning System for Malaysian rivers, https://www.geoconnexion.com/news/national-flood-forecasting-and-warning-system-for-malaysian-rivers/. Accessed on 9 June 2018.

[13] Academic Dictionaries Encyclopedias (2018), Mean annual flood, http://geography_glossary.enacademic.com/921/Mean_Annual_Flood. Accessed on 9 June 2018.

[14] UNISDR (2005), Building the resilience of nations and communities to disasters (Hyogo Framework), https://www.preventionweb.net/files/8720_summaryHFP20052015.pdf, Accessed on 9 June 2018.

[15] Fussel H. M. (2007), Adaptation planning for climate change: Concepts, assessment approaches, and key lessons, https://www.researchgate.net/profile/Hans-Martin_Fuessel/publication/215677053_Adaptation_Planning_for_Climate_Change_Concepts_Assessment_Approaches_and_Key_Lessons/links/09e415099025ac7a1a000000/Adaptation-Planning-for-Climate-Change-Concepts-Assessment-Approaches-and-Key-Lessons.pdf. Accessed on 9 June 2018.

[16] Silva, M. M. and Costa, J. P. (2016), Flood adaptation measures applicable in the design of urban public spaces: Proposal for a conceptual framework. https://www.mdpi.com/2073-4441/8/7/284/pdf. Accessed on 9 June 2018.

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