The 2011 Thailand Floods in The Lower Chao Phraya River Basin in Bangkok Metropolis

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Table of Contents

1. Introduction

1.1 Floods in Thailand

Urban areas with the topmost vulnerability to coastal floods such as Guangzhou, Mumbai, Miami, New York, Ho Chi Minh City, Jakarta and Bangkok – just to name a few – specially reflect the danger for regions in the North America and Asia (World Bank 2013). Without measures taken at an earlier stage, urban delta cities such as Bangkok and others are projected to find the rising costs from flood damage to reach $1 trillion annually by the year 2050 (World Bank 2013). With this in mind, the promising safety, economic opportunities, social welfare, and quality livelihoods one is seeking from the cities will also be drowned. Most often than not, structural measures for natural hazards are implemented for these urban settings to ensure protection against the loss of economic and political assets due to greater concentration of infrastructure, population and higher land value. In turn, any failure to the protection measures against urban floods could lead to greater consequences, implicating multiple effects on national and local socio-economy.

Floods is a common natural phenomenon in the Chao Phraya River typically occur between August and December with a total of 13 severe floods observed in 1917, 1942, 1959, 1964, 1972, 1980, 1983, 1995, 1996, 2002, 2006, and 2011 (AIR World Wide; Nuanchan and Kandasamy 2016). In 2011, Thailand suffered its worst floods in more than half a century, nonetheless. Caused by excessive and continuous rainfall from successive, powerful monsoons and subsequent, numerous dam breaches, the flood inundated more than 6 million hectares of land in 66 of the country's 77 provinces, and affected more than 13 million people from July through December 2011 resulting in more than 800 deaths and 3 people missing (HAII 2012). 26 provinces or 16,668.55 sq.km of agricultural land were under water, indicating the total loss of crops for the rural and urban livelihoods of 687,522 farmers (Ministry of Agriculture 2012; World Bank 2012). Further significant damage extended to the industrial estates affecting domestic economy and global industrial supply chains. Both commercial financial institutions and the government's specialized financial institutions require approximately USD 14 billion (THB 411 trillion) as loans for rehabilitation and reconstruction alone (Haraguchi and Lull; World Bank 2012).

2011 flood in Thailand provides complete scenarios in which water resource materializes complex issues of geographic features, cultural values, spatial planning as well as political management through flood disasters. Bangkok flood management practice presents the case of the city in urgent need to readdress how water, risks and lives are interrelated.

1.2 The Chao Phraya River Basin

The Chao Phraya River basin is the largest artery for land and water resources development in Thailand. It stretches from the elevated northern plains to the low alluvial plains of the central regions, draining an area of 160,000 km^2 and covers 30% of the country's total land area. The expanse of the Chao Phraya River covers 4 major tributaries of the Ping, Wang, Yom and Nan located in the northern elevated plain where it originates. The confluence of the Ping and Nan tributaries at Pak Nam Pho in Nakorn Sawan is where the Chao Phraya watershed is being divided into an upper and lower watershed. The junction forms the beginning of the main Chao Phraya River channel of the lower basin which then flows south for 372 kilometers. From the central plain through Bangkok's delta, the capital of Thailand's political, commercial and industrial and cultural center the Chao Phraya drains out into the Gulf of Thailand.

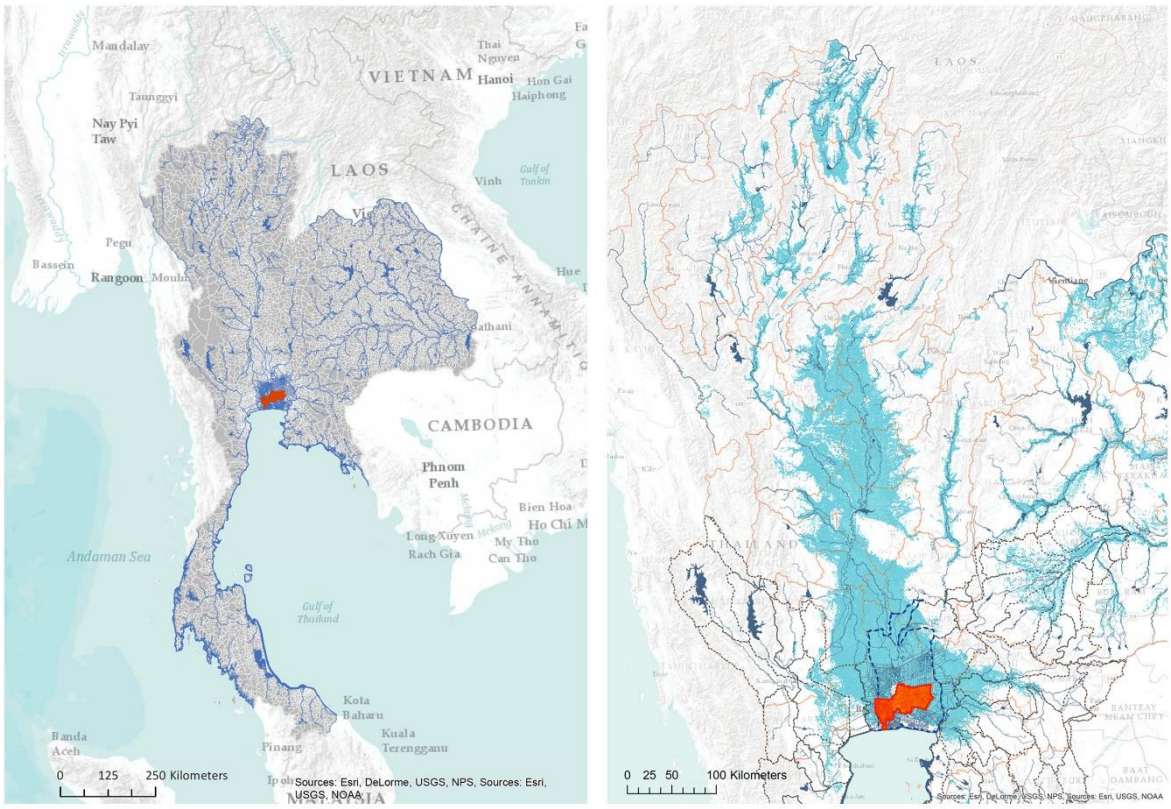

Figure 1 Maps of the Chao Phraya Delta

Figure 2 2011 Thailand flood in the Chao Phraya Delta with Bangkok at the downstream

Source: 2011 Thailand Flood.Pitchapa Jular (2017). GISTDA Geo-Informatics and Space Technology Development (2012), Esri Map.

The Chao Phraya is the principal source of water supply for the national domestic, agricultural and industrial uses. The entire basin sustains 40% of the total national population (23 million inhabitants in 1996), yielding 78% workforce and generate 66% of the national Gross Domestic Product (GDP). Approximately 11.5 million people resides in the lower Chao Phraya floodplain, in the highly populated Bangkok Metropolitan Area (BMA) and in the greater metropolitan region of Samut Prakan, Nonthaburi and Pathum Thani which is considered the most economically important sub-basin contributing to 78.2% of the total GDP of the overall basin.

The upper and the lower Chao Phraya Basin have distinct socio economic profiles. Demographically, rural residents are greatly concentrated in the upper basin (90%) in comparison to the 45% concentration in the lower Chao Phraya basin (ONWRC; UN World Water Assessment Program 2003). Bangkok alone represents the highest population density of 1,900 persons/km^2 which offers an overview of the close relationship between the urban areas and the water resources of the Chao Phraya (DHI 2015).

Urban areas

Urban land use in the Chao Phraya central plain alone makes up around 10% of the total area (ONWRC; UN World Water Assessment Program 2003). The delta plain of the Lower Chao Phraya has been heavily transformed for industrial use and intense rice cultivation which has left the only natural feature of thin strip of mangrove in the muddy tidal flats for coastal defence (ONWRC; UN World Water Assessment Program 2003). The encroachment of natural pathways in the low-lying delta of the Bangkok Metropolitan Area (BMA) through

deforestation and urbanization heightens the threat of coastal flooding into the Chao Phraya Basin from rising sea-level and high tide inundations.

Climatic & Hydrologic Cycle

The rainy season (May-October) and the dry season (November-April) constituted the tropical savanna climate for Thailand. The flows of the Chao Phraya River are dependent upon the highly seasonal monsoon rains in the wet season. This climatic variation also determines the availability of the basin's water resources, thus, heavily responsible for floods and drought across regions each year (ONWRC; UN World Water Assessment Program 2003).

The northern plains where the headwater of the main Chao Phraya River originates are elevated over 20 m. and gradually subsided to the wide, flat landscape of the well-watered plain in the central delta of approximately 2 m. above sea level (ONWRC; UN World Water Assessment Program 2003). The downstream part has particularly gentle slope with the elevation varies from 15m above sea level at the Chao Phraya Dam in Chainat (located 186 km from the river mouth), 7m in Ayutthaya (located 90km from the river mouth) and 5m in Bangkok respectively. This topography contributes to the lack of downstream discharge capacity – causing any flooding upstream to effect the water level rise downstream, dispersing flooding onto the floodplain (Komori et al 2012).

Flood control measures in the basin

The two major dams together being the Bhumipol dam located in the Ping River, and the Sirikit dam, located on the Nan River, have the capacity to control 22% of the runoff from the entire basin. Both dams were constructed mainly for the purpose of irrigation and power generation (Komori et al. 2012).

Large costly infrastructures such as the multi-purpose reservoirs, dikes and levees have been employed as the main measure for flood control and prevention by the Thai government. Responsible by the Royal Irrigation Department (RID), more than 3,000 dams were constructed since 1950 to store monsoon flows for agricultural supply during the dry season (DHI 2015; ONWRC 2003). The agency is also in charge of the water resource development in Thailand including large, medium and small scale and pumping irrigation projects. Despite the reduction of flood impact through the containment strategy, which refers to structural means such as dams, dykes and levee to contain or divert water into certain areas, the overall flood risk becomes higher as the water level reaches flooding elevation much faster (DHI 2015).

2. Background

2.1 The Water-City Connection in Thailand

Three most essential factors with regards to the waterfront area along the Chao Phraya River were the water ecology, the indigenous river settlement and the traditions and culture of former Bangkok's population (Powathong 2017). Rivers and water resources in Thailand represent not only the economic value but the inherent traditional way of living, cultural uniqueness and long established identity of the nation. Bangkok city planning was formerly operated in accordance to the interconnected distributaries of the rivers and canals, for both irrigation and transportation purposes.

Figure 6 Residents of Bangkok living on the river (Left), Floating Market in Bang Khun Non (Right)
Source: Prof.Peerasri Phowathong

In the 19th Century, Bangkok was given the title *'Venice of the East'*. Several canals, locally known as khlongs, spread out throughout the city of Bangkok along the Chao Phraya River and over the years, were the central part of the city's culture. Floods are the natural phenomenon in the Chao Phraya River Basin with the residents having historically adapted their lifestyle to deal with annual floods events, as well as exploiting the advantage of excessive water during the season for rice cultivation. Traditionally since the historical Ayutthaya period, indigenous irrigation an integrated system of man-made canals to the flows of the existing natural canals for both plantation and transportation (Powathong 2017). The city was made to be 'amphibious' – adaptive with the hydrological fluctuations such as the elevated stilt houses which are adapted for the residents to live with flood during high tide. The appropriation of land-use along the Chao Phraya river section, thus, embedded in the rise and fall of the water tides, allowing multi-purpose space such as communities, commercial space, markets, institutions and recreational area to operate all year-round regardless of wet or dry season (Powathong 2017).

Following new industrial era in the western world, new modes of transportation and infrastructural development was brought into Bangkok in the reign of King Rama IV and King Rama V. New urbanization was planned in accordance to the existing water bodies – rivers and khlong (canals). However, rapid agglomeration of development, businesses, social and economic opportunities in Bangkok attributed to the changing lifestyle between urban residents and the urban water ecology. While the adaptation has been historically effective, the report by DHI has identified significant economic losses to be increasingly alarming in the later era due to major causes of;

(1) The decline of flood retention areas and the confinement of flood plains due to increasing development
(2) Rapid urbanization in the river vicinity
(3) The intensification of agricultural practices
(4) Limited capacity of drainage system

The complete transformation of water transportation to an auto-oriented city as well as the encroachment of the agricultural land to new developments detached urban residents from the Chao Phraya River and put considerable risks upon water resource management of Bangkok. Former patterns of the natural rivers, canals and moats had been converted for drainage and sewerage due to the misconception brought by the urbanization to **drain surface water as**

fast as possible from the urban areas of Bangkok (Komori et al. 2012). Incrementally, the life of urban population is shielded from the water cycle, and thus, made to believe that the city cannot *and* should not be flooded.

2.2 The 2011 Flood

For the past century, Thailand had been experiencing constant severe floods which typically occurred in between August and December. Yet, the worst flood ever experienced in more than a half century in Thailand was the mega 2011 flood – indicating tremendous loss of lives and properties across socio-economic sectors. **Consequently, the 2011 flood in Thailand was ranked as the world's fourth costliest disaster over the period 1995 to 2011**, surpassed only by; the 2011 earthquake in Japan, the 1995 Kobe earthquake also in Japan, and the 2005 hurricane Katrina in the USA (Kittipongvises and Mino 2015).

The maximum ever recorded flood of 2011 was accounted by the total amount of 1,439 mm rainfall which was 143% higher than the average rainy season between two decades from 1982 -2002. The total water volume surpassed the 10 billion m3 storage capacity of the Bhumipol and the Sirikit Dams, reaching 15 billion m3 in early October of 2011. The extreme incidents combined generated large water volume that breached the reservoirs capacities and caused overtopping of the dams – consequently releasing tremendous floodwater downstream and amplified the inundation area lying below them (Aon Benfield 2012; Hydro and Agro Informatics Institute 2012; Royal Irrigation Department, unpublished data).

The World Bank (2012) pointed that the major differences between 2011 flood event and other severe floods was the slow, steady rate and the duration of the inundation which persisted up to 70 days before receding (Paopongsakorn and Meethom; TDRI 2012). The unexpected magnitude of the event was the result from the combination of natural phenomenon and mismanagement (Naunchan 2016, Paoponsakorn and Meethom 2013), including;

Natural Causes

1) Previous 5 tropical storms: Haima, Nock-Ten, Haitang, Nesat and Nalgae *(from June to October)*
2) Influences of the Southwest monsoon *(from the mid-May to October)*
3) Excessive precipitation accumulated *(from January to October 2011)*

Man-Made Causes

4) Water runoff from the major rivers
5) Man-made mistakes and mismanagement particularly in the water storage of the Bhumibol and Sirikit dams located upstream of the Chao Phraya River Basin

2.2.1 The 2011 Flood Impacts

To put it in numbers, the flood damage spread across 90.65 billion km2 of land, covering 66 out of 77 provinces – affecting 4,039,458 households and 13,425,869 people with more than 800 deaths and 3 people missing (HAII 2012). The total damage was estimated at 46.5 billion, an approximation of 1.43 trillion THB, with the private sectors bearing 90% of the total damage. Economically, the events significantly affected the second largest economy of South East Asia and the 6 months' halt in the production for most industries had cut the forecast for

the economic growth from 4.1% to 2.6% in 2011 (DHI). Flood lasted between mid-October through November 2011, inundating two-thirds of the country including the six industrial estates which accounted for 70% of the total damage in the manufacturing sector in Thailand (Minister of Finance and World Bank 2012).

2.3 Bangkok Metropolis and Floods

2.3.1 Bangkok Metropolitan Area (BMA)

Figure 8 Bangkok centre heavily flooded in 2011

Source: Shutter Stock.Topten22

> Bangkok is one of the coastal low-lying delta cities among the world which is ranked at the 18th most vulnerable cities to coastal flooding *(World Bank 2013).*

Needless to say, the statement has just put Bangkok on the spot. Geographically, the city occupies an area of 1,568.737 sq.km or 7,761 sq.km including the greater metropolitan region. It is located in the central region of Thailand in the Chao Phraya River delta before the river drains off into the Gulf of Thailand. The main Chao Phraya River which dissected Bangkok to its east and west is considered to be the most important water body – the artery of the cities – as much as it is for the nation. Situated on the low-lying areas in the lower reaches of the river, Bangkok is particularly exposed to extensive riverine floods and is subject to annual flooding. In conflict to its character, the expansion of urban growth reduces floodplain area where floods can naturally overflow.

According to the statistics and analysis from the World Population as of 2017, Bangkok which is home to 9.8 million people or 12.6% of the country's population has grown so rapidly with very little urban planning or regulations. The greater number of population, 14 million or 22.2%, is concentrated within the surrounding Bangkok Metropolitan Area alone. This has led to inadequate infrastructure and haphazard layout which induce vulnerability to its inhabitants amid climate change concerns such as sea level rise, coastal monsoons and erosion in urban deltas (World Bank 2013). By 2030, Bangkok is expected to become one of the world's megacities with a population surpassing 10 million (World Population 2017) which will present critical challenges in disasters risk reduction management.

2.3.2 Why it is important to focus on flood in Bangkok?

The damage potential of floods in cities is extraordinarily high (WMO/GWP; APFM 2008). Given that Bangkok is highly concentrated in population and values of infrastructure and systems, small scale flood may lead to considerable damages which hinders urban development by years or, sometimes, decade. APFM reported a study with recent statistics clearly indicate that economic damages caused by urban floods are rising. By focusing on urban water and flood management, this will tremendously benefit other parts of the country as river basins by no means suggests that socio-environmental processes are spatially bounded (Molle 2005).

Bangkok is now facing an annual land subsidence of 10 cm due to the heavy use of industrial land and groundwater extraction (DHI 2015). The results of urbanization with the combination in the lack of public awareness and perception towards flood risks surmount great danger for the fate of the inhabitants in the Chao Phraya River Basin. Furthermore, climate change is exacerbating natural anomaly on precipitation, monsoon, and rising sea level causing increase in sea roughness and sea erosion exposed by mega delta cities around the world.

3. Action Taken

3.1 Bangkok Flood Management

The floods in Bangkok have not occurred so frequently as the excess water is stored in the floodplain above the city in flood management project known as the 'Monkey Cheek'. Together with the ease of gentle slope, flooding downstream seldom caused real damage to human life (Komoni et al 2012). With regards to flood control measures, the capacity of Bangkok's sewerage and canal systems are designed for rain water and not for flood discharge. The most important diversion, thus, are allocated to the Bang Pakong River in the east and the Mae Klong river in the west, beyond the administrative area of Bangkok (Komori et al.) The condition of urban drainage facilities also magnifies flood issue due to rubbish and debris which are generally not cleaned and maintained, thus, clog the bottlenecks of drainage channels and block water flows.

Due to large impervious areas occupied by developments in Bangkok, surface water such as rain, flood and waste water do not infiltrate into the ground, producing excessive run-off that overpower drainage network. This also intensifies flood crisis that is more difficult to mitigate once occurred. The Chao Phraya River in Bangkok exemplifies area of multiplying risks and exposure as settlements along the rivers are prone to all types of floods including riverine flooding, local flooding and coastal flooding.

Why the 2011 flood was more catastrophic

- The Chao Phraya River, which cuts across Bangkok's urban center to demarcate east and west side of the city, was overflowed as the result of the combined effects of severe floods flowing from the north and the backwater during high tide.
- The accumulated floodwater from the upper basin could not be contained due to the dysfunction and broken infrastructure at the two main gateway to Bangkok; Pathum Thani (hosting majority of migrant workers and industrial estates) and Nonthaburi located in the northern suburbs. The total of 14 water gates and dikes were destroyed, causing most inundation in the west Bangkok including the private areas lying near and along the Chao Phraya River (Singkran and Kandasamy 2016).
- Other aging of earth dikes built in the south of Manage Ake Village in Pathum Thani gave way to the large volume of water to enter the northern part of Bangkok including Chatuchak, Don Mueng, Lad Phrao, Lak Si and Sai Mai – all highly populated districts and the location to major infrastructure such as the Don Mueng airport.
- Resented residents whose areas were flooded dismantled the sandbags which were temporarily constructed by the DDS officials, subsequently led to floodwaters flowing downstream into the Prapa Canal and Sam Sen area in Bangkok's Dusit District (Singkran and Kandasamy 2016).
- Early warning system (EWS) failed tremendously in the South, let alone the insufficient availability of the system and the contradicting information from different agencies (Raks Thai 2013). Public's prediction and the lack of preparation to the severity of 2011 flood was mainly based on subjective intuition from previous experiences.
- People did not believe that there would be such severe floods early in the year while most communities relied on local knowledge of the seasons rather than warnings from various organizations (Raks Thai 2013). This highlights the short-coming of the institutional enabling environment to support existing local capacity and knowledge to prepare for flood, let alone to include civil society in the flood mitigation measures.

Non-Governmental Organizations Actions

Flood in 2011	Situation	Existing Program Before the Disaster
South flood response	Floods 2-3 meters high several provinces, 2-3 weeks	Migrant health in Suratthani province, CDRR* in Krabi province
North flood response	Flash flood affecting highland communities	Long term natural resources conservation
Central/Bangkok response	Flood 2-3 meters high in several provinces over extended periods of time (3 weeks-3 months), millions affected and threat to Bangkok as capital city.	**No significant program, although Bangkok is the location of Raks Thai office.**

The common perception for floods usually focuses on the operation outside the cities area as exemplified by the existing programs provided by actively engaging NGOs such as Raks Thai. Despite its headquarter in Bangkok, there is no significant program in response to flood mitigation and capacity building for urban communities in the central regions *(Column 3).*

Before

- **Department of Drainage and Sewerage (DDS) has the main responsibility in flood regulation of the Bangkok Metropolitan Area (BMA).** Underlined with the perception to protect and drain floodwater out of the city as fast as possible, the agency emphasized the structural means of dykes, levees and floodwalls as the main prevention measures.
- **'Monkey Cheek'** is a flood control project using water retention technique integrated with land use and floodplain management. Initially devised by His Majesty the King, Bhumiphol Adulyadej since 1995, the strategy stores water temporarily in selected floodplain during the high tide and release for uses in the low tide.
- After extensive flood damage in 1995 under the king's advice, several authorities convened for flood mitigation measures including the assistance from the Chaipattana Foundation, a NGO established in 1988 to develop projects of national and social benefit. Social inclusion aspects at that time had been brought back for the long-term solution.
- The attempt to link sustainable social, environmental and economic benefits and security have gradually subsided with the rapid urbanization and economic growth in urban areas in the past decades.
- In the downstream section of the high-density Bangkok area, the Disaster Prevention and Mitigation strategies and action plan, supervised separately by the BMA's agency had limited collaborations with the upper watershed flood management by the RID. Thus, insufficient attempt was put forward to integrate flood with urban water resources management in the city or between cities and other uses within the basin.

During

- In the west of the BMA, the flood spread to the entire Bang Phlat districts before entering Mahasawad canal in Taling Chan and Thawi Watthana district while to the east, the broken dikes along the Raphiphat Canal allowed water to flow into the Rangsit district in Pathum Thani (Naunchan and Kandasamy 2016).
- To prevent floodwater to spread to East of Bangkok, the DDS build flood defense dikes beside the Rangsit Canal located in Lak Hok Sub District (beside the Hok Wa Canal and along the royal initiative water ridge). In addition, sandbags were erected along the Phaholyothin Road starting from the Rangsit Bridge to the Prapa Canal (Singkran and Kandasamy 2016). The temporary dike (8.2 km long and 3 m above MSL) later failed in its operation to protect Bang Khen Bueng Kum, Lad Phroa and Khlong Sam Wa districts from being flooded.
- Floodwater may have been controlled and prevented from damaging certain assets. The decision was made mainly to divert floods from the 'higher land and properties value' to stagnate in other areas instead, shifting vulnerability and risks spatially in contrast to the natural hydrological flow pattern (Paopongsakorn and Meethom; TDRI 2012). This rationale for the flood management practice and decision, was resented by the residents whose areas were being flooded, leading them to dismantle the sandbags and upraised against officials from repairing the flood barriers.
- According to the Thai Water Partnership field officer, flood and water management within the entire Chao Phraya Basin from the upper to the middle regions are mainly regulated by the **Royal Irrigation Department (RID)** with the objective to provide water for both agricultural irrigation as well as to monitor water level for flood prevention.
- Under Ms.Yingluck's government, a new task force known as the **Strategic Committee for Water Resource Management (SCWRM)** was established during the 2011 flood as a special unit charged with the responsibilities of developing plans to prevent future floods.

KEY LOCAL RESPONSE AGENCIES

GOVERNMENT	ROLES / ACTION TAKEN
Department of Disaster Prevention and Mitigation (DDPM) **Ministry of Interior (MOI)**	• Key national agency for disaster preparedness and response
Royal Irrigation Department **(RID)**	• Controls/manages dams and irrigation gates
Ministry of Social Development and Human Security	
Thai Meteorological Department (TMD) **Ministry of Information and**	• monitors rainfall

Communications Technology	
Military units (Army, Navy)	• Emergency response and relief program
Special committees at the Office of the Prime Minister Level for major disasters	• Coordinate multiple government agencies involved in the response
Ministry of Foreign Affairs	• Coordinated with government-to-government assistance efforts internationally
LOCAL ADMINISTRATION	**ROLES / ACTION TAKEN**
Bangkok Metropolitan Administration (BMA)	• Controls response in Bangkok in multiple areas including flood prevention, evacuation camps, relief program and water canals in Bangkok.
Provincial Administration Organizations	• Allocate funding to respond to disasters
Tumbon (Subdistrict) Administration Organizations	• One mandate to respond to disaster affecting population in the responsible geographic area
NON-PROFIT ORGANIZATIONS	**ROLES / ACTION TAKEN**
Thai Red Cross (TRC)	• Provide large disaster aid capacity including medial team. TRC also has a province level network that is linked with the government structure. •
Save The Children	• Focused on aid for children (although was not a large player)
World Vision Foundation	• Appeals for donations through large direct mail set up
Local non-for-profit emergency/rescue organizations	• Immediate response to disaster on site, at the micro level
MULTILATERAL/INTERNATIONAL/BILATERAL	**ROLES / ACTION TAKEN**
European Commission Humanitarian Office (ECHO)	
UN Cluster	• Provide pooling information • Provide on-ground local response in specific areas
USAID	• Grant to assist migrants
Embassies/Bi-lateral Assistance Programs	• Key contacts in responding to the major disasters

OTHERS	ROLES / ACTION TAKEN
Mass media	• Major source of information for the public through each channel's news program • Large donation channels for the public
Ad-hoc volunteer groups	• Local and social media formation provide physical aid to the affected population
Community organizations	• Provide physical aid (already existed prior to floods)
Private sector	• CSR (corporate social responsibility) programme provided aid and support *Note: Many are the victims of floods themselves**

Non-Government Organization Actions

- NGOs such as Raks Thai responded to the Central affected region occurred during the flood situations in each of the locations – Ayutthaya, Lopburi (Thai population) and Phathumthani (migrant populatioryn). The flood relief strategy focusing on these regions as the event was seen as a national disaster and would affect Bangkok which could potentially paralyze the country for an extended period.
- Field staff from Raks Thai conducted assessments both with the migrant population around Pathumthani (immediately north of Bangkok) and in Ayutthaya/Lopburi for the Thai population. This was conducted during the heights of the floods in both areas. Staff had to rent boats to conduct the assessments and initial relief kits at the beginning of the response.

Exemplified by the effective and fast operation to help the victims, it is important to consider the capacity of these NGOs into the National Disaster Prevention and Mitigation action plan and management in order to enable their effectiveness in the relief response. At the moment, Raks Thai reported that there is no formal process for initiating the response that is based on systematic monitoring of the flood situation.

After

- The **SCWRM** committee collaborated with the Japan International Cooperation Agency (JICA) who was assigned to conduct the comprehensive flood management plan for the Chao Phraya River Basin under the supervisory panels consisted by the representatives from the **Royal Irrigation Department** (RID) and the **Department of Water Resources** (DWR) (Singkran and Kandasamy 2016).
- After the 2011 flood damage, the SCWRM and the NESDB published an outline to the national Master Plan for Water Resource Management with the strategy to adopt the King's initiatives and the Philosophy of Sufficiency Economy as guiding principles in the drafting (SCWRM 2012). However, the timeline of the plan is not concretized and there had been little development with regards to the proposed agenda based on the constant damage caused by floods afterwards. (See appendix for further information).

- There is a progress on the installation of the early warning system in the Chao Phraya River Basin with the initiation from the BMA and HAII in partnership with DHI in August 2016 (DHI 2015).
- The Prime Minister Yingluck Shinawat proposed to consolidate the water governance under the "Water Ministry after 2011 flood event. However, the reformation did not take place once 2011 flood issue died down.
- The project aimed to alleviate the issues of flood and drought and has been revived under the administration of Gen.Prayut-Chan-O-Cha Gen. The revision of the Kaem Ling Project is undergoing the study on existing possible area for water retention. The *Kaem Ling* project was initiated by King Bhumiphol Adulyadej (King Rama IX) of Thailand as the flood control measure. The floodplain next to the river are used to divert excessive water into the area and store it before slowly releasing the water to alleviate flood peak or use the water as a supply for dry season. The research will be conducted by the **Department of Water Resources (DWR)** with the proposal of five areas which involves environmental impact assessment. Released in 2016, The Ministry of Agriculture and Cooperatives will build 30 *Kaem Ling* areas in five northeastern provinces. Out of the 30 water retention areas, nine will be built in Nakhon Phanom, eight in Mukdahan, six in Nong Khai, four in Bueng Kan, and three in Loei (Thailand's Public Relation Department, 2016).
- Recently in 2017 after another devastating flood hits the northeastern part of Thailand, the new government under Gen.Prayut Chanocha has announced similar strategy, proposed earlier by the former Prime Minister Yingluck Shinawat, to consolidate water resource management under one water ministry. The implementation will take time to prove its promises.

4. Synthesis

4.1 Lessons Learnt: Flood management in the BMA

2011 flood management and operations highlighted the consequences from the inadequacy of well-planned strategies, and the motivation to garner public approval and participation before, during and after floods event. The urban public sectors were largely dependent upon the information and assistance provided by the government following the limited promotion of awareness, knowledge and capacity building about flood risks. The following are the synthesis from the 2011 flood sequences;

- Numerous structural measures were emphasized in several sub-projects following the initiation of the plan to prevent and mitigate the floods in the Chao Phraya River Basin with insufficient considerations of the impacts to the surrounding areas. Dams, dikes and levees often failed in their operations and cannot withhold the increase uncertainties of the natural phenomenon. The failure, with no flexible mitigation alternatives, contributed to greater damage after floodwater broke out.
- The BMA did not provide any flexible measures for uncertainties in case of flood disasters within the urban areas demonstrating the need to place more emphasis on water-related risks planning. This subsequently led to public misconception to avert water away from Bangkok urban center without prior awareness and preparation strategy to handle the situation.

- Various committees established by executive decrees, such as the SCWRM, have been created under different governments for different occasions which rely solely on the executive power to implement actions (Nikomborirak and Queenship 2015). This vertical management executed by higher authorities restricted public engagement and their roles in the collective DRR contribution. Bureaucratic political barrier needs to be overcome with cross-cutting horizontal governance and management such as the capacity building in the residents, public and private sectors as well as across the government departmental agencies.
- Different municipalities for water resource management become increasingly decentralized and disconnected as the river progresses downstream towards Bangkok. After Rangsit district, water management and flood prevention measures are responsible by the **Bangkok Metropolitan Administration** (BMA). Insufficient coordination between upstream and downstream authorities (25 River Basins Organizations) become the major issue for flood mitigation as water is subject to cross scales, usage and management, geographically and politically of the Chao Phraya River Basin. This presented greater consequences of damage in the downstream urban and greater metropolitan areas.
- Ad-hoc and transitory measures are often evoked after crisis than before the crisis. The existing National Water Resource Committee (NWRC) were not prepared and employed for flood management. The establishment of a new body, Strategic Committee for Water Resource Management (SCWRM), which is headed by the Prime Minister duplicate roles and responsibilities. The temporary set up of agencies in response to crisis often overlaps with the responsibilities assigned to already existing disaster management agencies. When the roles were unclear, flood disaster management and operation became complicated and competing and thus hampered the effectiveness of DRR.
- Public education on flood early warnings and flood evacuations immensely fell short, especially for the Bangkok urban population living upon one of the highest flood-prone delta areas. Flooding is familiar annual occurrence in Thailand and is particularly common in the lower Chao Phraya River, yet, the urban population became increasingly less accustomed to its occurrence due to the detachment from natural water cycle by new development of urban settings. All of which contributes to the lack of awareness to the water-related hazard, uncertainties and growing concerns by the both unaffected urban residents and flood- affected communities. Different approaches on water and flood education are required for both population groups to build a resilient inclusive urban water governance.

Unaffected urban residents

The population mainly living in the inner urban area where high economic and development agglomeration are prioritized and protected against flood damage, have never been affected by flood crisis. Thus, it is without their interests to leverage water governance and policy for the holistic water management approach. Yet, the extreme flood events such as 2011 will become more frequent and unpredictable as informed by several global predictions on the effect climate change. Unaffected by flood now, these residents need to realign their

perception to include future risks and external forces on their own consequences and safety with regards to the encroaching flood severity.

- Other ad-hoc decisions improvised by the water resource and flood management authorities also reflected in the erection of sandbags in the uninformed residential areas. Adversely, affected populations living in those flooded areas demonstrated public discontent, resistance and unacceptance to the government flood management decision. The lack of risk awareness, inclusion and capacity building from the public sector prior to flood event curtails the effectiveness in disaster mitigation efforts. At the regional level, Thailand has co-established **Mekong River Commission** (MRC) to promote Integrated Water Resource Management (IWRM) system in 2002 in the Lower Mekong region. Shared water resources and governance between Thailand, Cambodia, Vietnam and Lao PDR has been managed through integrative nexus across sectors, scales and boundary for sustainable Lower Mekong Region.
- During the floods disasters, mass media communications employ television channels as the major portals flood tracking. This implies lack of concerns to the wider marginal population, the immobility caused by the disasters with no access to television portals regardless of other available technology to mobilize public capacity and knowledge. In addition, the public, who relied heavily on televisions, were often bombarded by unnecessary information and competing media calling for donations while trying to track flood situations at the same time (Raks Thai 2013). Limited communication channels and irrelevant information creates inefficacy, misconception and distraction to prevent further damage for the communities. Disaggregated information also provides difficulties in flood tracking to assist vulnerable civil groups in preparing and making decision with regards to flood situations.
- The inability to evacuate many people from flooded areas as well as the inefficiency of evacuation of people to the area which was to be subsequently flooded such as the Don Mueng Airport where an additional FROC was set up to supplement inadequate operation of the central FROC body. Lack of identification and mapping of flood-risks and evacuation areas leads to higher losses. These are clearly the consequences of inadequate disasters warning data collection, information systems and the flood hazard maps to communicate to the public prior to floods. Poorly planned evacuation strategy and under-equipped evacuation camps prolong assistance, thus, increases costs of funding, time and related losses.

5. Recommendation

Integrated approach

The case study advocates for CBFM and IFM as complementary frameworks for inclusive top-down and bottoms-up implementation to encourage true collaborations of the holistic flood management; CBFM provides platform to encourage participation and adaptive capacities to manage flood situations at the local scale while the IFM provides a viable development policy option as a key outreach for flood managers, policymakers and development planners in the sub-national and national scale.

The existing BMA flood management framed by the structure of the political institutions and organizations required long term commitment and political willpower to drive resiliency from top-down decision making approach. By strengthening the participation from the communities through the **community-based flood management (CBFM)** framework, the **Integrative Flood Management (IFM)** in the Chao Phraya River Basin can be augmented incrementally and collectively to benefit both short and long term solution to DRRM. The issues to an effective flood management identified in the previous section are largely based on the political regime, therefore, in order to mobilize and reform the future of water governance in Thailand, responses need to come from proactive citizen as the catalyst to reformation.

5.1 Community-Based Flood Management (CBFM): The Chao Phraya Basin

The Community-Based Flood Management (CBFM) is the enabling approach to which the communities are strengthened to become the critical stakeholders with major roles and impact on the enhancement of the IFM, with the IWRM at its core. The underlying principle is to consider the best response must come from the most vulnerable people. In fact, CBFM must be comprehended as strongly emphasizing of "community aspect" of Integrated Flood Management (IFM). On the same basis with the Community-Based Disaster Risk Management (CBDRM), CBFM strengthen and empower communities' capacity to manage floods events. The three main objectives to flood management are defined by GWP (2016) as; **saving lives, minimizing adverse impacts** and **providing flood benefits.**

As clarified by the GWP report, the community empowerment reinforces their internal cohesion and solidarity, developing autonomous decision-making processes and capabilities, until **to be incorporated in a balanced top down and bottom up relationship system with institutional players** – reflecting the other proposed complementary IFM framework which consolidated the holistic approach to the multi-disciplinary management, yet, cross-boundary river basin scale.

Participatory approach

Participatory process in the community can overcome these shortcoming of governance and lay foundation for urban flood risk management. In this process, the decision making context work both ways, from top-down and bottom-up approaches which equally address the importance and involvement of all stakeholders to improve both **horizontal** and **vertical governance** in resource management. The process where the aspirations, concerns, capabilities and participation from local households to communities to local authorities to district and national institutions are adequately input in an **iterative manner** (WMO/GWP 2008).

The heart of the community-based flood management lies in the right attitude to collaborate. The case study of Mae Sot watershed in Tak province of Thailand demonstrates, first and foremost, true understanding of the local mechanism from the Thai Water Partnership as the facilitator. Through methods such as participatory risks assessment (PRA) and mapping, the local citizens had come to an understanding about their own environment followed by the capacity to put forward solutions for their own interests. Consequently, this changes their perception towards the local authorities leading to the genuine will to collaborate with the local government, thus, achieving a sustainable and proactive engagement both ways.

5.2 Integrated Flood Management (IFM): National Framework

Integrated Flood Management seeks to extend flood risks perception in the context of the Integrated Water Resource Management (IWRM) which recognizes that the single

intervention has an implication for the whole system and that the integration of development and flood management can yield multiple benefits from a single intervention (IFM 2009). The four main objectives of the IFM extends its focus at the local level to nurture an all-inclusive management to encouraging inclusive, cross-sectoral participation at all levels, open communicative approach, decentralization of decision-making process and lastly, the involvement of stakeholders in the planning and implementation.

Once the management structures of the stakeholders are identified, the way to improve holistic implementation has to include many of the benefits associated with floods. To put this into context, net benefit derives from floods from the Chao Phraya River is also interlinked with the cultural values and traditional knowledge such as flood water for agriculture, environmental sustainability, water taxi transportation, waterfront recreational space, shared community area or for urban development such as opportunity to improve integrated urban water management (IUWM).

6. Conclusion

A big number of cities have always been in close relationship with water. The floodplain of Bangkok is located near the delta which provides the city with water resources, rich alluvial soil and prosperous ecosystems as well as deep cultural ties. The interplay of the urban and natural environment of the Chao Phraya River Basin lends the areas for the quality livelihoods, trade, growth and, at the same time, the potential risks inherent to its topographic features including the natural hydrological fluctuations, inundations and the associated calamities. It is urgent that historical and local adaptation between risks and livelihoods in the Chao Phraya river basin needs to be brought back and realigned with the current urban uncertainties.

Low-lying urban deltas with densely populated demography like Bangkok is particularly vulnerable, considering its relatively low adaptive capacity. Amid these uncertainties, yet, cities can better prepare for Disaster Risk Reduction beforehand through resilience governance, planning and management in the water regime. The paradigm shifts in water governance which shapes the way urban dwellers think, act and adapt to the current and future risks will contribute to greater success of living with the growing uncertainties ahead. It is an alternative for cities to think out of the box and turn ‘crisis’ into ‘opportunities’ where disasters such as floods provide potential benefits for all sectors.

The goal of this case study is to relink the Bangkok metropolis to the **integrated flood management** (IFM) framework with regards to maximize benefits of floods through the role of land use adaptation, zoning and regulation to store water and reduce run off in urban areas. With the political barriers, collective public participation can be garnered to mobilize an integrated flood management approach by empowering the urban community as the catalyst of change through **community-based flood management** (CBFM). The case study focuses on the community with regards to reduce their vulnerability, strengthen their capacity and roles.

In order to conceive a paradigm shift in water governance through CBFM, the mindset of the urban residents needs to be readjusted. In sum, several findings in the report has demonstrated the underlying issue of misconception towards flood-risks perception from both national and local perspectives**. First**; water governance has not been solidified into the national agenda to holistically connect flood mitigation to the urban water management. **Second**; there were a tremendous lack of knowledge about flood-risks in urban areas which can be categorized into

two main groups according to the existing divide between Bangkok's flooded and non-flooded communities;

In providing a way forward, more studies need to be conducted on the perception of these population groups to make an appropriate communication on flood risks, mitigation strategies and adaptive capacity. The glorifying paradigm is indeed impossible without the players. The implementation and management for flood and water resources require strong awareness, collaborations and proactive governance from all levels and sectors – the civil, institutional and governmental. It is an ambitious goal to create an all-inclusive world, yet incremental steps have to be taken responsibly, and most importantly by us as the citizens from all sectors to collaborate, exchange and adapt for the future, starting – now.

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