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The water Management Guidelines towards Alleviating Damage of Flood in Bangkok Metropolis

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ABSTRACT

As Bangkok Metropolis encountered the flood problem repeatedly causing a huge impact to all sectors, the government and Bangkok Metropolitan Administration has been trying to solve this problem continually. The objectives of this study were to: 1) study the alleviation of flood damage in Bangkok Metropolis; 2) study the factors of policy, budget, supervision and public participation on the alleviation of flood damage in Bangkok; and 3) create the water management guidelines towards alleviating flood damage in Bangkok Metropolis. This research was a combination of quantitative research and qualitative research. For the quantitative research, the sample group consisted of census residents in 12 districts of Bangkok having the whole area flooded in 2011. The acquisition of the sample group was based on multistage sampling. According to the proportion of people with census in 12 districts of Bangkok, the sample size was 20 times of the observed variables for 360 people. The research tools were questionnaires. The data was analyzed by a structural equation model. For the qualitative research, the data were collected by in-depth interviews with 3 groups of key informants totaling 21 people and the group discussions of 12 community leaders, 3 persons per district, totaling 36 people. The research tools were structural interview forms and the questions used in group discussions. The research findings revealed that: 1) the alleviation of flood damage in Bangkok was most importantly related to quality of life, followed by environment and infrastructure; 2) policy, budget, supervision and public participation had directly influenced on the alleviation of flood damage in Bangkok, with policy as the highest influencing factor, followed by public participation; and 3) water management strategies for alleviating flood damage in Bangkok including (1) drainage enhancement, (2) the co-ordination among Bangkok Metropolitan Administration, public and private sectors, (3) development of the water reservoir and drainage systems, (4) promotion on public engagement, and (5) appropriate legislation and law enforcement. The findings of the research will be beneficial to Bangkok Metropolitan Administration and the stakeholders in using the research information for planning and making decision on the water management strategies leading to the effective alleviation of flood damage in the future.

Keywords
Water Management Guidelines, Flood, Impact from Flood, Bangkok Metropolis

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Introduction

In 2011, Thailand experienced the most severe flooding in more than half a century. It was caused by too much rainfall. More than 37.5 million rai in 66 sites of 77 provinces were flooded affecting more than 13 million people. The flood damage cost USD 46.5 billion. About 70 percent of the manufacturing sector was damaged and lost. 90 percent was from private sector. The rehabilitation and restoration cost the budget of USD 48 billion. The commercial and government-owned financial institutes spent the loans in rehabilitating and restoring the country initially at approximately 411,000 million baht (The World Bank, 2012).

For the flood in 2011, one of the affected provinces was Bangkok having 38 areas affected. The impact was divided into 4 levels; 1) affected in the short-term in 9 districts, 2) less than 20 percent damaged in 8 districts, 3) more than 20 percent damage in 10 districts, and 4) totally damaged in 12 districts. This caused the distress to people. The people were evacuated to other areas. The illness spread. The houses were damaged by flooding. People could not work as usual. Some roads and transportation had been cut off. The flood caused the insecurity to properties, residence, and quality of life of people living in the area of 12 districts badly.

The country governor and the Bangkok governor had attempted to restore the impact and damage caused after the Bangkok flood. The water management was operated to prevent flood and manage the drainage in the forms of; 1) flood prevention system by constructing flood prevention levees to enclose the area to prevent flooding and high tide. The flood prevention levees were built in the east of Bangkok (Royal Initiative Levees) and the flood prevention levees along the Chao Phraya River, Bangkok Noi and Maha Sawat canals, 2) drainage system to solve flooding problems due to rainwater, 3) construction of 6 large drainage tunnels, 4) supply of ponds and wells as the Kaem Ling, 5) solution of flooding in the year 2011 and future arrangements with short-term and long-term measures, and 6) construction of drainage systems in major roads to solve the problem of flooding due to heavy rain. As the mentioned water management is a short term water management, it does not reflect the flood prevention or alleviation of impacts from flooding in Bangkok in the future.

Research objectives

To: 1) study the alleviation of flood damage in Bangkok Metropolis; 2) study the impact factors, including policy, budget, supervision and public participation on the alleviation

of flood damage in Bangkok; and 3) create a water management strategy for alleviating flood damage in Bangkok.

Literature Review

The water management plans to mitigate the impact of flood. For example, in Pakistan, the water policies have been clearly established. The aims of policy are to provide adequate and safe supply of drinking water, develop hydropower for economic growth, relieve flood and alleviate the damage from flooding, maintain water quality, and promote the environment (Pichara & Majeed, 2010). Some developed countries like Australia adopt water management policies to support research covering the hydrological framework by analyzing the use of economic models to optimize water allocation (MDBA, 2011). The water management needs to be committed so that strategies and policies can be used as a guide to aid the water-focused development and national policy development. Thus, the policy is important to water management (Stockholm International Water Institute, 2001).

The budget matters because when various effects occur, the improvement is needed in order to return to normal as soon as possible. This requires a lot of budgets in the operation. In 2016, Vietnam had 4 provinces flooded with more than US $ 1.7 billion in regeneration budgets (The World Bank, 2017). This is in accordance with the Czech Republic setting the state budgets and from external sources to bring measures to prevent flooding. This includes the "ad hoc" government decision to loan from the European Investment Bank (EIB) for flood protection (Slavíková, 2015). Tokyo metropolitan area has to spend more than 15 billion baht to be used for water protection each time (Morita, 2013). Therefore, the budgets play an important role in water management to reduce the impact of urban flooding or in various cities.

The citizen participation is of great importance for water management because the factors that cause flood are partly human actions .The participation of communities or citizens will prevent or mitigate the impact of flood damage to a certain extent. A study by Wehn, Rusca, Evers & Lanfranchi (2015) found that public participation demonstrates a role in examining interactions between citizens and authority. Public participation in decision-making makes various departments recognize the influence of people in flood risk management. White, Kingston & Barker (2010) identified public participation in the process of managing flood risk. The power and level of impact of public participation at this stage is limited to decisions about personal safety and the protection of their own property during flood. The role of citizens increases at the stage of recovery and mitigation procedures. In the decision-making of people, the community views and recommendations on measures reflect the problems and needs in the local area to increase information and awareness in adopting the agency's approach to next flood risk management (White, Kingston & Barker, 2010).

The governance is an important factor because water management must be transparent. The law is updated to promote international cooperation, link development issues and seek funding. The database is developed to supplement the decision-making (National Water Reservoir) supporting the River Basin Organization, supporting the exchange of information between public and private sectors, irrigation management, preparation, promoting public relations, public participation and related sectors. The awareness of the conservation of water resources can be raised (Thynne, 2008). A comparative study of flood risk management was conducted between Jakarta and Rotterdam. It was found that bringing governance as a challenge helped making the water management policies of both cities more efficient (Ward, Pauw, van Buuren & Marfai, 2016). The governance involves the individuals and each person has different roles. The gathering of persons for supervision will lead to the alignment of ideas, communication, and actions. The strong interactions will build trust in working altogether effectively, especially in water management (Candel & Biesbroek, 2016).

Research scope

This research study defined a mixed method of quantitative research to find the influence of factors affecting the mitigation of flood impacts of Bangkok and qualitative research to develop a water management strategies to mitigate the impacts of Bangkok's flood.

Research conceptual framework

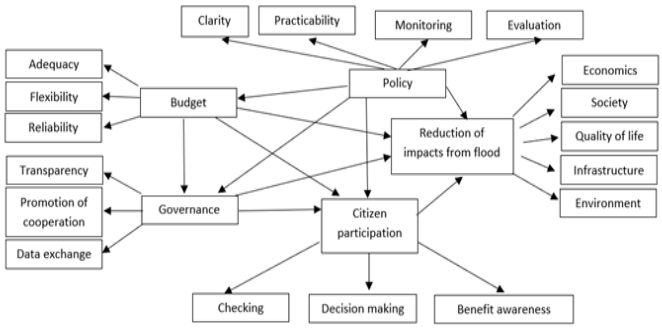

Figure 1 Research conceptual framework

Research methodology

Quantitative research: The population is people who have census in 12 districts of Bangkok being flooded in 2011 in a raised and long period of time, namely, Taling Chan, Thawi Watthana, Bang Phlat, Bang Khae, Phasi Charoen, Nong Khaem, Don Mueang, Bang Khen, Sai Mai, Laksi, Chatuchak and Khlong Sam Wa. The sample group consisted of people with census in each of the 12 districts of Bangkok for a total of 360 people were able to communicate in Thai language, aged 30-60 years old, and agreed to participate in this research. The proportional sampling was used to show the district, sub-district, number of population and sample groups of each district.

The research tools were questionnaires of sample opinions on policy factors, budget, supervision, citizen participation, and the reduction of impacts from flooding of Bangkok for a total of 90 items. From 5-level estimation scales, each item contained IOC equaling to .60-1.00. The questionnaires were tested with people in Chatuchak for 30 persons to analyze the confidence using the Cronbach's alpha
coefficient. The confidence value of the whole questionnaire obtained before being used was .893.

The data was collected with the sample population by coordinating with the community leaders of each of the 12 sub-districts. The appointment was made with the sample group. The researchers introduced themselves and clarified the research objectives as well as asking for help in collecting data with the sample group. The completeness of all questionnaires were checked. The complete questionnaires were used to analyze the data using descriptive statistics and structural equation models to test the relationship between the latent and observed variables and the relationship between independent and dependent variables using LISREL program.

Qualitative research: There are 2 target population groups: Group 1 was the key informants in the in-depth interview covering 3 groups of stakeholders, namely, (1) policy makers consisting of Bangkok executives, Director of the Drainage Bureau of Bangkok (both former and current) for 4 persons, (2) 5 government officials in related agencies, and (3) community leaders in 12 districts that were flooded throughout the entire area in 2011 for 12 persons totaling 21 persons. Group 2 were people who participated in the group discussion. They were people who have a census in 12 districts of Bangkok that were affected by flooding throughout the entire area in 2011 for 3 people each, totaling 36 people. The group discussions were done for 6 persons each.

The research tools and quality audit tools were structured interview forms to interview a group of 21 key informants with 16 open-ended questions containing the individual IOC values between .80-1.00 for the questions of 6 group discussions. There were 9 open-ended questions containing the individual IOC values between .80-1.00.

The data was collected and analyzed using the in-depth interviews with key informants individually. The 6 group discussions were conducted. The content analysis was conducted on the obtained data. The opinions were categorized and set by the main points and secondary points to create the water management strategies for reducing the impact of Bangkok's flood.

Research results

1) For reducing the flood impacts of Bangkok, the sample group expressed their opinions that they were of the highest level of importance in 3 aspects and were at the highest level in 2 aspects. The most important aspect was the quality of life ($\bar{X}$= 4.98, SD = 0.16), followed by the environment ($\bar{X}$= 4.68, SD = 0.31) and infrastructure ($\bar{X}$= 4.34, SD = 0.96). The social aspect was of the highest importance ($\bar{X}$= 4.07, SD = 0.95) and economic aspect was of high importance ($\bar{X}$= 3.91, SD = 0.63).

2) Regarding the influence of policy factors, budget, supervision and citizen participation on the mitigation of flood impacts of Bangkok, from the structural equation model analysis, it was found that the policy affected the flood impact reduction of Bangkok (DE = 0.77). The budget affected the flood mitigation of Bangkok (DE = 0.12). The governance affected the flood mitigation of Bangkok (DE = 0.23). The citizen participation affected the mitigation of flooding of Bangkok (DE = 0.39). The policy affected the citizen participation (DE = 0.26). The budget affected the citizen participation (DE = 0.50). The governance affected the citizen participation (DE = 0.17). The policy affected the governance (DE = 0.79). The budget affected the governance (DE = 0.12). The policy affected the budget (DE = 0.71).

3) The water management strategies to reduce the impact of Bangkok's flood included enhancing the drainage efficiency, cooperation between Bangkok public and private sectors, development of support and drainage systems, promotion and building on the cooperation of the public sector and proper legislation and law enforcement.

Discussion of results

The reduction on the impacts of Bangkok's flood had the highest importance in 3 aspects and had the high importance in 2 aspects. The quality of life had the highest importance, followed by the environment and the infrastructure. The social aspect had the high importance and the economic aspect had the least importance. It could be discussed that when the flood occurred, it directly affected people's livelihoods. The residential houses were drowned for months. The illness and the difficulty in traveling directly impacted the quality of life (Walker, Holling, Carpenter, & Kinzig, 2004). This was correspondent with Nwigwe & Emberga (2014). The flood impact on the environment could be discussed that the severe and prolonged flooding inevitably caused environmental damage (Husain, Trak & Meshram, 2016; Memon & Sharjeel, 2015). For the infrastructure, it could be discussed that experiencing flooding for a long time affected the infrastructure in terms of transportation. Various facilities were broken, destroyed, damaged, or did not work properly (Nwigwe & Emberga, 2014; Nedvedová, 2013; Mitchell, 2017).

The policy to reduce the impact of Bangkok flood could be discussed that the water management to reduce the impact of flood required the policy to determine management guidelines to be more efficient (Pichara & Majeed (2010; MDBA, 2011; Stockholm International Water Institute, 2001). The budget affected the reduction of impact of Bangkok's flood. It could be discussed that effective water management had to be involved with budgets because it was needed in renovating and restoring the areas and people who had suffered various damages to return to normal condition as soon as possible. This required a plenty of budgets in the operation. For example, in 2016, Vietnam had 4 provinces flooded with more than US $ 1.7 billion in regeneration budgets (The World Bank, 2017). Tokyo needed more than THB 15 billion to protect Tokyo against flood each time (Morita, 2013).

The governance affected Bangkok's flood impact mitigation. It could be discussed that in reducing the impacts of flooding, there should be water management that was efficient, transparent, verifiable, in collaboration with many agencies, both the public and private sectors to participate in water management (Thynne, 2008; Ward, Pauw, van Buuren & Marfai, 2016; Candel & Biesbroek, 2016). The citizen participation affected the reduction of impacts of flooding of Bangkok. It could be discussed that part of the severity of the flood was caused by people in the area who dumped the waste into sewers, ditches, constructing the buildings, dwellings or houses encroaching on public places or ditches, dumping

grease into sewers resulting in the barrier to drainage and obstructing the flow of water (Thecla, 2014; Mukherjee, 2016; Begg, Callsen, Kuhlicke & Kelman, 2018; Wehn, Rusca, Evers & Lanfranchi, 2015).

The policy affected the citizen participation. It could be discussed that policy was a framework and a guideline for action or decision-making to provide various actions to achieve the objectives and goals set effectively. This could make the management be systematic and official (Baba, Cherches, Mora & Ticlau (2009; Kaseya & Kihonge, 2016).

The budget affected the citizen participation. It could be discussed that the water management must be involved with budget to help in the implementation of prevention or mitigation of impacts caused by flooding for the people. When the public saw or perceived, it created the satisfaction and greater public engagement (Kim & Schachte (2013; Buele, Vidueira, Yagüe & Cuesta, 2020).

The governance affected the citizen participation. It could be discussed that the governance was an important process that the government sector, especially Bangkok, needed to have in order to make water management more efficient. The transparent and good governance would build trust and credibility to the people as well as creating the citizen participation (Waheduzzaman, 2010). The policy influenced the governance. It could be discussed that the policy was a framework and guideline for the implementation or decision making to provide various actions for achieving the objectives and goals set effectively. With the clearly established policy, the water management policy implementation would be more efficient (Vedantham & Kamruddin, 2015; Ahmed & KhanOrthy, 2017).

The budget affected the governance. It could be discussed that budget was a factor of success in organizational management. For the water management, without the water management budget to reduce the flood impact, Bangkok might not be able to operate. Constrained budgets inevitably affected governance (Albassam, 2015; Egbide & Agbude, 2014). Policy on budget could be discussed that policy was a framework and guideline for the action or decision making to provide various actions for achieve the objectives and goals set effectively. It was therefore imperative to set a budget for management to achieve the policy goals. Thus, the water management required the adequate policies and budgets for successful implementation (Diamond, 2013).

The water management strategies to mitigate the impact of Bangkok flood included:

1) Optimization of drainage: It could be discussed that flooding for a long time had many impacts. Optimizing drainage was therefore a key strategy in water management to reduce flooding impacts (Ramos, Pérez-Sánchez, Franco & López-Jiménez, 2017). This was correspondent with Chang, Tan, lai, Pan, Liu & Tung (2014).

2) Cooperation between Bangkok's public and private sectors: It could be discussed that Bangkok was a capital city with a large number of residents causing the density and congestion. Partly, the area was not the responsibility of Bangkok alone. Therefore, there was the overlap in terms of problematic areas, major obstacles to successful water management (Ever et al., 2012; Kittisak Sangthong and Issarat Rinthaisong, 2016).

3) Development of supporting and drainage systems: It could be discussed that preventing or reducing impacts from flooding in Bangkok needed to be upgraded or developed with water support system and drainage effectively. The development of water support systems involved the increase of areas supporting water, for example, having a giant tunnel to support more water, finding the monkey cheek area to support water, etc. This included the increase of efficiency in the drainage to be larger and faster without affecting downstream areas (Chang et al, 2014; La Loggia, Fontanazza, Freni, Notaro, Oliveri & Puleo, 2012).

4) Promotion and building cooperation of the people sector: It could be discussed that the citizen participation was essential to water management because the citizen participation showdc the role of monitoring the interaction between citizens and authorities. The participation in decision-making made various departments recognize the influence of people in flood risk management (Wehn, Rusca, Evers & Lanfranchi, 2015).

5) Proper legislation and law enforcement: It could be discussed that Bangkok had a large number of residents. Housing were built encroaching on public places or by the canals. This included throwing garbage into the sewers, canals, or rivers obstructing the waterways and slowing down the drainage. The proper legislation and law enforcement were required (Wichai Thosuwanchinda, 2015). This agreed with Piyachart Sinlapasuwan (2014).

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