Vulnerability and Integrated Adaptation Guidelines for Flood Risks in the World Heritage Site: The Historic City of Ayutthaya

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***Abstract*— *The Historic City of Ayutthaya is a Cultural World Heritage Site which possesses rich, local wisdom regarding living with water, and an outstanding universally accepted water management model. Surprisingly, the city which had withstood rising water levels for generations was significantly affected by the great flood of 2011 and repeated flooding in the following years. Through the lens of IPCC Vulnerability Framework and mixed methods, the study found that this area had become highly vulnerable to floods. Utilizing group discussions involving local knowledge experts and experienced stakeholders were proposed guidelines to reduce flood vulnerability by integrating local knowledge with flood adaptation at three levels: households, communities, and local administrative organizations. Local wisdom regarding living with water reflected the value of the Historic City of Ayutthaya as a World Heritage Site. Ultimately, the study came to the realization that local wisdom could be employed as a powerful tool to strengthen the capacity of households and the community in dealing with floods and to engage the community's participation in coping with the impacts of flooding.*

***Keywords*— Flood risks, flood vulnerability, integrated adaptation, the historic city of Ayutthaya.**

1. INTRODUCTION

Cultural world heritage sites are the legacy of all mankind, internationally essential and excellent cultural resources for the entire world to experience. Unfortunately, these sites have had to endure the indelible impact of natural disasters. One of the chronic dangers that world heritage sites are facing worldwide is flooding. The Outstanding Universal Value (OUV) and authenticity of numerous world heritage sites are threatened by the specter of flooding. Consequently, the economic opportunities, including tourism, of the site communities are affected negatively [1].

The Historic City of Ayutthaya, a World Heritage Site in Ayutthaya province, Thailand (Figure 1), is an urban area supporting a number of culturally valuable archaeological sites. This area was declared a World Heritage Site by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) on December 13, 1991 with Criterion iii of the World Heritage Criteria. Criterion iii declares a World Heritage site as a place that 'bears a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared.' [2] The Historic City of Ayutthaya exemplifies the standards of Criterion iii.

One of the many reasons the Historic City of Ayutthaya has been internationally recognized is its distinct location. The area is surrounded by three rivers: the Chao Phraya, Lopburi and Pa Sak. The early city plan was well organized in connecting the three rivers by canals that provided nourishment to citizens of the ancient city. Moreover, the canals functioned as transportation routes for the city inhabitants and natural forts to defend against enemies. The river-centric arrangement of the area imparted upon the Historic City of Ayutthaya a distinct local wisdom of living with water and innovative water management systems that were broadly accepted. The city brought valued human capital to the area [3] resulting in increased organization and harmony between people and the water surrounding them. Pillar house were consistent with the waterfront lifestyle of lowland communities [4]. For transportation, locals used boats due to the abundance of rivers and canals [3].

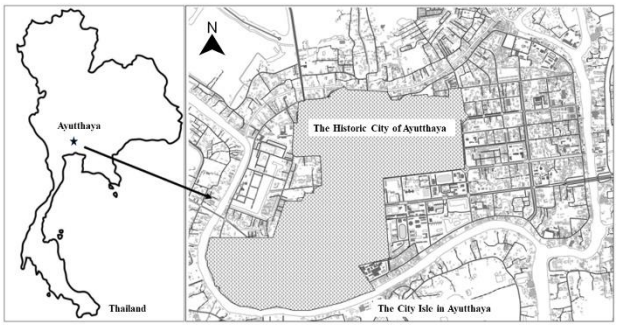

Fig. 1. The Historic City of Ayutthaya. (a) Map of Ayutthaya province. (b) The Historic City of Ayutthaya in the City Isle, Ayutthaya province.

Alarmingly, this area, once in harmony with water, has suffered great harm due to repetitive flooding. An evidence-based example of this harm was provided by the great flood of 2011. One thousand four hundred villages in the sixteen districts of Phra Nakhon Si Ayutthaya were submerged. Ninety percent of the province's population was in distress and damages exceeded four hundred billion Baht [5]. The next year, in 2012, more than five thousand households were affected by the overflowing rivers [6]. Following this, in 2013 six

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districts was flooded with five to ten centimeters high water with some areas receiving water twenty to thirty centimeters high [7].

Moreover, the great flood of 2011 has effects on the economy and industry in the area as it provided the workplace of most locals. The devastation caused 144 billion Baht in damage to Phra Nakhon Si Ayutthaya Province's five industrial estates. Furthermore, the tourism economy decreased approximately 50 – 70 billion Baht as the flooding events affected the confidence of foreign tourists. Likewise, the number of Thai tourists dropped, resulting in the loss of 20 billion Baht [8]. The decline in tourism had negative impacts not only on entrepreneurs in the area, but the overall Thai economy as well.

Taking everything into account, repetitive flooding in the area damages the archaeological sites which provide the community's cultural capital and bring income and tourist businesses to the community. The committee on flood disaster prevention and resolution, therefore, resolved to have Phra Nakhon Si Ayutthaya Municipality construct a permanent flood dam in the area. The aforementioned impacts of flooding reflect that the local people have ignored their traditions of enduring flooding through preparation in order to minimize damages. This distinct situation raises two questions for research: 1) What are the flooding vulnerabilities faced by local people in the Historic City of Ayutthaya? and 2) What guidelines can be applied to reduce flood vulnerability?

In order to find strategic guidelines for flood prevention and mitigation suitable for the area, the study focused on three factors of vulnerability: 1) Exposure to floods which had an influence on geographical function; 2) The sensitivity of a given community or ecological system affected by climatic stresses; and 3) Adaptive capacity, the ability of a human or natural system to adapt or cope with floods. The equation for vulnerability is as follows [9].

$$\text{Vulnerability} = \frac{\text{Exposure x Sensivity}}{\text{Adaptive capacity}} = \frac{\text{Risk}}{\text{Adaptive capacity}}$$

According to the above equation, one method to reduce vulnerability is to increase its adaptive capacity [10]. [11] stated that the term 'adaptive capacity' is presented as an antonym to 'vulnerability.' Consequently, a livelihood system with low vulnerability (a resilient livelihood system) should have high adaptive capacity. The loss of adaptive capacity precipitates the loss of opportunities and the constraint of alternatives during and after the moment when an individual has to confront stresses and shocks [12]. A resilient livelihood system is able to reconfigure easily without reducing essential life functions. The functions associated with production, the sustainability of natural resources, social relations, and quality of life during and after stresses and shocks should be maintained [13].

The augmentation of coping capacity can be achieved in order to decrease the damages caused by disasters or environmental degradation. Coping capacity assesses one's abilities to absorb various effects by adjusting to risks. This adjustment could be achieved by drawing on both tangible and hidden capitals to cope with changes. These capitals can reduce the probability and magnitude of harm [14]. These tangible and hidden capitals include economic assets, social and political assets, ecological assets, infrastructure assets and personal assets.

As a result, a vulnerability reduction guideline has been shaped to increase Ayutthaya's livelihood capital and take into account the local wisdom associated with the lifestyle of its people to live and cope with the risks of flooding. This guideline seeks to increase or construct the adaptive capacity of the community in order to enhance the community's resilience in preventing and mitigating the negative impacts of flooding, while maintaining the identity of a sustainable lifestyle. The community should establish self-reliance before asking for help from external agencies. Local wisdom and knowledge would be applied to solve the current problem and used as the key framework to answer the research questions in this study. The objectives of this study were to: 1) to examine vulnerability to flood risks in the area of the Historic City of Ayutthaya and 2) to create guidelines for the community's adjustment to cope with flood risks.

2. MATERIAL AND METHODS

The data was collected over three months during field work from September 2015 to January 2016. Mixed methods were applied in this study in order to respond to the two objectives. The first aim was to examine the Historic City of Ayutthaya's vulnerability to flood risks. In this process a questionnaire was used to collect data from 398 participants. The participants were household representatives, older than 18, who lived in the Phra Nakhon Si Ayutthaya municipality area. The questionnaire employed was tested for Cronbach's Alpha Value; the reliability of the questionnaire was found to be 0.91. This value indicated that the questionnaire was reliable and suitable for data collection. Additionally, in-depth interviews were conducted with 42 community leaders selected by purposive sampling. The leaders provided enough community experience to generate rich and deep responses about indicators of community vulnerability.

Table 1 Criteria for assessment in each aspect

Criteria level	Exposure to flood impacts	Sensitivity for flood impacts	Adaptability to floods
L	0.00 – 1.00	0.00 – 1.00	0.00 – 1.00
M	1.01 – 2.00	1.01 – 2.00	1.01 – 2.00
H	2.01 – 3.00	2.01 – 3.00	2.01 – 3.00

To analyze the quantitative data, descriptive statistics were applied to examine the following aspects: exposure to flood impacts, sensitivity to flood impacts and adaptability to floods. Frequency, percentage, mean and standard deviation were analyzed to evaluate

vulnerability. The scores in each question were different (0, 1, 2 and 3 points) and then the scores of each aspect were calculated and evaluated based on the average scores into a three level scale: L = Low, M = Moderate and H = High as presented in the table below [15].

The second objective of the project was to propose guidelines for the community to adjust and cope with flood risks. The thirty participants were selected via purposive sampling and comprised of: community leaders, community representatives, local knowledge experts and government organizations in the Phra Nakhon Si Ayutthaya municipality area. The sample group volunteered to participate in focus group discussions which were used as the data collection tools in this study. The study sought suitable guidelines to prepare the community for future flooding on all levels – households, communities, and local administrative organizations – by applying the flood risk management shaped by local wisdom. To indicate the validity of the data, data source triangulation was employed

To analyze the qualitative data collected from the focus group discussion, the data was categorized into groups and content analysis was applied. The findings were described in three different levels: 1) household adaptation 2) community adaptation and 3) adaptation of the organizations in the area. In the process of data analysis, the translated transcripts and notes were read reflectively and repetitively. After several reviews, the data was categorized into main themes and sub-themes which emerged from the participants' information under the research framework. These themes were employed to ensure that the findings would meet the objectives of the study.

3. RESULTS

Demographics

Overall, a total of 399 valid samples were obtained. The sample group consisted of 223 females and 176 males comprising 55.9% and 44.1% respectively. Regarding age, the majority of the sample group, 154 people or 38.6%, were between 21 – 30 years old. Concerning education, 262 respondents (65.7%) had not received a Bachelor's Degree. In terms of income, the majority of the sample group, 195 respondents or 48.9%, had a monthly income less than 10,000 Baht. For accommodation, 289 respondents (72.4%) lived in single detached houses. Finally, the group's career data showed a majority of respondents (111 people or 27.8%) were housekeepers, followed by 98 who were employees (24.6%).

Exposure to flood impacts

The quantitative study found the average exposure to flood impacts was 2.01 with a standard deviation of 0.838. This score can be categorized in the high level (H) according to Table 1. This clearly reflects that Phra Nakhon Si Ayutthaya study's location faces the dangers of high flood levels and long flood duration. This finding was consistent with the qualitative study, as stated by one local person:

"*It flooded to the roof and lasted for 2 months which was longer than usual.***"**

It was found that the area's exposure to flood impacts is high due to several variables. 1) The topography of the Historic City of Ayutthaya is floodplain causing high flood risks to the area. 2) Changes in the Ayutthaya city plan have become a major contributing factor to repeated flooding, as many ancient drainage canals within Ayutthaya Island were covered up for road and residence construction. Consequently, when it rains during flooding season, the water cannot flow, resulting in drainage overflow and eventual flooding. The current moats or canals have not been taken care of and some have become drainage from the city area. Some canals are very shallow due to the blockage of sediments and garbage. 3) Changes in residence designs in the Historic City of Ayutthaya have also become a factor in flooding. Over the past 50 years, house designs have changed from flood resistant, elevated houses located on the waterfront to in-ground buildings located next to roads. House designs have changed alongside the economic and social development of Thailand. As people's relationship with roads increased, their connection to the water diminished. As a result, the prevalence of the one-story, in-ground house design increased the exposure to flood risk.

Sensitivity to flood impacts

The quantitative study found the average sensitivity for flood impacts was 1.38 with the standard deviation of 0.616. This score is categorized in the moderate level (M) according to Table 1. The information received from the interview focused on the sensitivity for flood impacts can be illustrated in many aspects.

Residential Aspect: A 2-meter flood level and longer flood duration had greater impacts on single-story houses and houses located along the river banks, rivers and canals than on elevated houses and houses with two (or more) stories. Moreover, evacuation from houses with greater flood impacts was much more difficult.

Food and beverage aspect: During a flood, access to food and beverages proved challenging. People were unable to find either clean water or food by themselves. They had to wait for help from state agencies or the Flood Relief Operations Centre. Food and beverages, which were transported by boats or helicopters, were sometimes spoiled and could not be eaten due to the distance and heat of transportation.

Excretion, waste and sewage management aspect: Being unable to use toilets in a normal manner, flood victims had to urinate into the water, defecating into trash bags and throwing them into the water alongside other waste products. As a result, waste management became a serious post flood problem; the great flood of 2011, the Division of Public Health and Environment of the Historic City of Ayutthaya spent more than a month disposing of flood waste.

Health impact: A common health problem flood victims faced was Tinea Pedis or Athlete's Foot, developed after spending extensive periods of time in the

water. Flood victims could take care of the symptoms of Athlete's Foot by themselves by using household medication which came in disaster relief packages. The people who faced the most difficult situation during flooding were those who had congenital or chronic diseases. They required regular medical attention, yet stayed in their flooded houses rather than moving to temporary shelters. Those in need of medication and medical attention could experience worsening symptoms. Additionally, people were unable to receive emergency medical treatment as the provincial hospital was severely damaged by the flood. Patients had to be sent to hospitals in other provinces.

Psychological impact: Flood victims were quite anxious concerning unpredictable situations, missing life's necessities, flood expense, loss of income, and damages to career sources. Some excerpts of this anxiety are presented below:

"*I am in a shelter now. I'm worried that my house might be broken into.*"; and

"*I am concerned about the expenses that will follow the flood, such as house repairs and living expenses, because I cannot work during the flood. Some of my neighbors have sold their stuff to get money.*"

Economic and social impact: Local people in the flooded areas were directly affected as they lost income because they could not work. Many of them lost their workplaces. For instance, souvenir shops in tourist attractions were flooded. In addition to tourist attractions, victims who worked in the flooded industrial estate also lost their job, terminating their income. Furthermore, people could not withdraw money from savings accounts due to the fact that banks were closed and automated teller machines (ATMs) were out of order. Shops were also closed. As people struggled with their income, passenger ship fares increased from 300 to 1,000 Baht.

Archaeological site impact: All archaeological sites in the Ayutthaya municipal area were affected by the flood; local people had no opportunity to take care of those sites or even to prevent possible damage before the flood. Locals first ensured the safety of themselves and their families from the flood. The only thing people could do was to wait for the waters to subside and for eventual reconstruction by the Fine Arts Department, as stated by one respondent:

"*I feel depressed because this flood had a great impact on historic sites, but I could not do anything as I am also having a hard time now.*"

Adaptability to floods

The quantitative study found the average adaptability to floods was 1.37 with a standard deviation of 0.755. This score was categorized in the moderate level (M) according to Table 1. The information from the respondents reflecting their adaptability to the great flood of 2011 was presented in aspects as follows:

Equipment preparation: Most people thought that it was not necessary to prepare any equipment for flood prevention because they believed that the flood barrier constructed by Phra Nakhon Si Ayutthaya Municipality would surely prevent flooding.

Emergency flood evacuation plan preparation: Some communities had meetings for flood preparation and evacuation plans, but they were discontinued due to the lack of funding to support all communities. Consequently, flood preparation only took place at the individual level.

Support/help from agencies outside the community: The flood relief received from outside agencies was relatively adequate and difficult to access, as one respondent said:

"*Actually, a lot of stuff was sent to help us, but because of bad communication and difficult transportation, it took too much time to go out and receive flood relief supplies. As a result, the goods were not delivered to flood victims throughout the area.*"

Furthermore, government support was inadequate. To illustrate this, the first remedial budget of 5,000 Baht per household was grossly insufficient for house reconstruction due to undervaluation of losses by the government.

Career adaptation during the flood: During the flood, people in the Historic City of Ayutthaya were unable to work, resulting in a lack of income. This problem occurred with most local people with the exception of people with salaries such as government officials who were less affected than the average citizen. Throughout the flooded areas, victims were unable to find part-time jobs or other ways to earn money. Nevertheless, some turned the crisis into an opportunity for commerce, as in the following statements:

"*I see a chance to make money during the flood. People cannot cook by themselves, so I sell food.*"; and

"*I took my boat out to transport the villagers. The money is quite good during the flood.*"

Accommodation adaptation to floods: During the flood, people were unable to withstand the inundation of their homes; they, therefore, had to abandon their houses for a long period of time. They had to evacuate to shelters or live with relatives in other provinces. Only few remained in their homes, secluded on second floors with difficulties subsisting.

Transfer of local wisdom regarding floods to the next generation: Local wisdom associated with water is essential capital to adapt one's self to live in harmony with water. However, the reality of modern life has changed the way water is utilized, from canals and rivers to the tap. Crowded waterways have given way to roads for transport. Because flooding had not occurred often in recent years, people ignored local wisdom about living

with water. Local wisdom was not transferred into practice; it became an antiquated tale told by the older generation about how they prepared for the flood season and how to live with flooding. In addition to the ignored wisdom, people in the present generation lacked the skills to live with water, such as: piloting and repairing boats, net fishing and cooking with charcoal. They tended to wait for government support and look for engineering procedures to solve the problems presented by the flood. One respondent shared about how local wisdom was passed on:

"*No one taught me; I remembered from what my parents did. People in the past called it water season or flood season. No one told them if the water would come or not. They just prepared their fishing tools. Fish came with water. When water came, they went fishing, getting fish for food. Today, we don't know when water will come. We depend on the news to tell us.*"

Vulnerability to flood risk

In order to assess the vulnerability to flood risk, the main components were applied to the previously presented equation [9]. Two steps were conducted: Step 1, the average scores for exposure to flood impacts and sensitivity to flood impacts were assessed to examine the vulnerability to flood risk. It was found that when the average scores for exposure to flood impacts, which were high (H), were assessed with the average scores for the sensitivity for flood impacts, which were moderate (M), the ultimate flood risk for the Historic City of Ayutthaya was high (H), as is shown in Table 2.

Table 2. The assessment of flood risks

Flood risks		The sensitivity for flood impacts		
		L	**M (1.38)**	**H**
The exposure to flood impacts	**L**	L	L	M
	M	L	M	H
	H (2.01)	M	**H**	H

Table 3. The assessment of the vulnerability to flooding

The vulnerability to flooding		**Flood risks (H)**		
		L	**M**	**H**
The adaptability to floods	**L**	M	H	H
	M (1.37)	L	M	**H**
	H	L	L	M

The second step was to examine the flood vulnerability by assessing the level of flood risk with the average score of adaptability to floods. It was found that when the high level of flood risk, (H), was assessed with the average score of adaptability to floods, 1.37, or moderate (M), the vulnerability to flooding of the Historic City of Ayutthaya was high (H), as is presented in Table 3.

Community adaptation methods to flood risks

Based on the group discussion with key informants, it was clear that in the past Ayutthaya's locals were close and familiar with rivers and had outstanding local wisdom regarding living with rivers. Ayutthaya's terrain is a flood plain, similar to an island, surrounded by 3 main rivers interconnected through many small canals. In the eighth month (September in the traditional Thai belief) of every year, abundant rain from the north flows south to the Historic City of Ayutthaya overflowing people's fields and riverside accommodation. This water usually flooded the area until the twelfth month (November in the traditional Thai belief). This occurrence takes place annually and is known as the 'water season or flood season' lasting approximately 4-5 months. Afterwards, waters tend to recede in the first month (December in the traditional Thai belief). People in the past anxiously anticipated the fertility of the flood season when water helped rice in the flooded fields grow rapidly. Crops were everywhere and aquatic animals, especially fish and shrimp, came with the water. People in the past could catch fish and sell them in front of their houses. Sometimes, they could simply grasp around tree roots or house poles and catch shrimp with their bare hands.

In the past, people regarded the flood season as a normal situation that they had to understand and live with in harmony. Their culture suited the terrain and climate of the area. The local wisdom about the water management could be categorized into several aspects: 1) the wisdom about house construction. Due to combating the flood season every year, they elevated the height of their houses to the maximum water level in the twelfth month (which could be around 1.80 meters), when the water level was stable. As a result, they were able to protect their houses from flooding. In addition to elevating the houses, poles and walls were constructed to lean slightly inward, functioning as a strong frame and bulwark against the strong water current. High gable roofs helped drain rain faster, and long eaves protected the interior from rain and the sunlight. Construction materials were locally available and construction was completed using the doweling technique. Consequently, houses in the past were able to be disassembled. When house owners wanted to relocate, the house would be disassembled and transported down the river to a new location. People left the area under the house open, functioning as a multi-purpose space to store charcoal, dry food, and boats and house small livestock like chickens. While the flood season was approaching, people would move their belongings from downstairs to upstairs. For the second aspect of the local wisdom about water management, it was about transportation. Due to the fact that the area was full of canals, it was named 'the East Venice.' Boats, therefore, became the most important transportation in the past and people were skillful in boat paddling. The third aspect of the water management wisdom was about flood season preparation. While the flood season was approaching,

people would move their belongings from downstairs to upstairs and repair their boats, maintaining their only mode of transportation for the flood season.

In the past 50 years, due to economic growth and urban expansion, more roads have been constructed. The canals in Ayutthaya City were filled in to create more roads. Flood barriers were constructed, so the water from canals and rivers rarely breached the city. As people gained exposure to houses in Bangkok or Western styles, their values changed, resulting in an architectural shift in Ayutthaya. New, concrete houses were built in the ground, next to roads abandoning the elevated, waterfront models of the past. This overall change in house design reflects the stronger connection people have to roads in the modern world, and the lesser connection with water. This lost connection proved costly when the city was threatened by flooding.

Therefore, local wisdom should be taken into account to find adaptation guidelines for the population. The first thing that should be considered by everyone in the Historic City of Ayutthaya is their attitude towards water; instead of thinking about water as disaster, people should understand that flooding is a season. Nevertheless, people in Ayutthaya's historic city still perceived flooding as a disaster with a negative impact on living and historic sites. They thought that the government and municipality were responsible for solving flood problems through the proposed construction of a dam around the city. Individuals themselves lacked readiness for flood prevention. The focus group proposed that people's attitudes towards floods should be adjusted to see it as, 'a season that happens every year.' This adjustment helps people find innovative and proactive solutions to flooding, reducing its overall damages. More importantly, the integration of local wisdom is essential in all sectors, these can be categorized into 3 levels:

(**1) Adjustment at the household level:** Firstly, accommodation should be suitably renovated to accommodate the flood plain. Houses should be elevated in order to avoid flooding (Figure 2). Construction materials could be adapted to withstand flooding and to match the preference of home owners, as was stated by one community leader:

"Accommodation must be highly elevated. Houses can be built from concrete or wood based on the preference of the home owner. The location should be on a hill, not far from the river, and have a strong river bank."

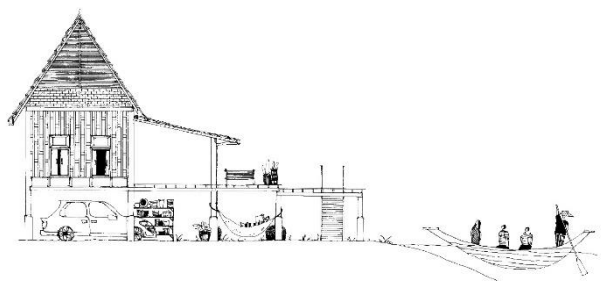

Fig. 2. Pillar house elevated in order to avoid flooding.

Secondly, supplies should be prepared in order to survive during the flood. For example, boats, the only vehicle during flooding, should be made from wood in order to safeguard against electric shocks. Food and water are the most vital items during the flood season and thus should be safely stored in jars or tanks. The importance of food and water is illustrated in a statement by a local knowledge expert:

"*There must be jars in every house. They could be big ones like in the past or small ones to store water, salt or other supplies for consumption. They provide houses with a bank of water.*"

Furthermore, all household supplies and electrical appliances should be placed higher than the water level, especially higher than the water level of previous years. Moreover, electrical systems such as plugs and switches should also be moved higher than the water level.

Finally, people should prepare to make a living during the flood. For example, one option could be converting a house into a homestay during the flood season to attract tourists. Visitors might want to learn the real lifestyle of people in Ayutthaya; locals can make money to replace their regular income and reduce the stress caused by economic tension during the flood. This adaptation can reduce dependence on external assistance. The aforementioned adaptation was reflected in a statement by a local wisdom expert:

"*The connection of wisdom to reality is seeing something as a holistic system including the government sector and other relevant sectors. The community should initiate solutions to the flood problem. Villagers have to change their attitudes toward water. They should see water as a being, not just a natural resource. Water is the goddess Ganges who gives life, food and support. This awareness should be imparted on the new generation to seek new solutions for flash flood problems and ways to live with water. When rivers and canals are clean without water hyacinths, community tourism can be promoted to attract tourists to experience the local lifestyle. Villagers have a chance to create community products such as souvenirs, increasing income for the community. This is also a way to create unity and decrease inequality. Everything must be integrated.*"

(2) Adjustment at the community level: The community of the Ayutthaya City area is urbanized. Most houses have limited space and each house is adjacent to one another. The people of Ayutthaya maintain a moderate level economic condition. To renovate their houses or to purchase supplies to combat flooding is difficult due to their financial limitations. Therefore, adjustment at the community level is necessary. Each community can provide flood prevention facilities that everyone in the community can share. Furthermore, the community multi-purpose yard or the community sports ground should be elevated to the level

of a 'hillock' for multipurpose use during flooding (Figure 3). Public toilets, septic tanks, parking areas and firewood storage can be located on the hillock.

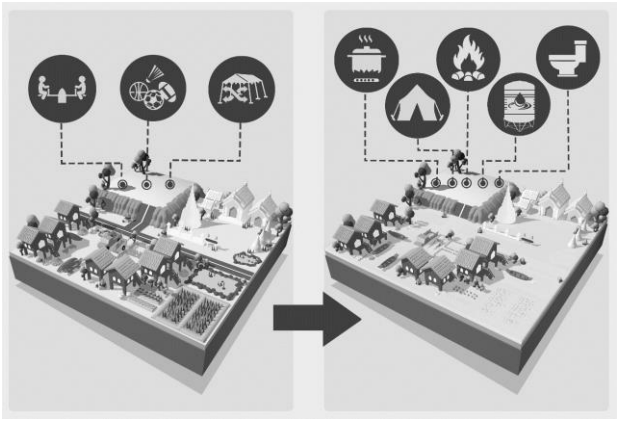

Fig. 3. A hillock for multi-purpose use during flooding.

In addition to physical adjustment, the community should have a committee to develop comprehension and preparation to deal with flooding in a proactive manner, as stated by an elder:

"*There should be a participatory plan that engages all sectors to design how the new Ayutthaya should be reactive or proactive and create strategic plans in order to solve problems in the area.*"

(3) Adjustment of the agencies in the area: All agencies are vital in integrating local wisdom with development strategies and putting these strategies into practice for the local community. Each agency should have certain responsibilities; for example, the Phra Nakhon Si Ayutthaya Municipality should dredge canals regularly in order to maximize the drainage function of the canals, as was done in the past. The municipality should organize a committee to spearhead flood prevention preparation, flood alerts and the establishment of emergency shelters. Educational institutions should integrate local wisdom regarding living with water into their curriculums, teaching skills such as boat paddling and cooking with charcoal instead of gas. This integration will encourage students to learn methods to live better during the flood season. The Department of Public Works and Town and Country Planning should adjust the city plan and urban development plans in order to prevent any construction that may obstruct water flow and drainage. This can help avoid a situation in which water is trapped within the community for a long time. The Royal Irrigation Department should restore the canal system in the Historic City of Ayutthaya, a system of local wisdom which helped solve the flood problems of the past. For example, rivers and canals should be utilized as floodways and should be dug deeper. This activity can engage the community and create a connection between individuals and agencies while organizing the community's readiness to deal with flooding, as stated by a local knowledge expert:

"*All sectors involved with water, such as The Royal Irrigation Department should consider how to restore rivers and canals as floodways and monkey cheeks (water retention areas). They should consider the traditional use of these canals and rivers as floodways. They need to dredge them by involving the community and creating ecological cooperation through a network of connections.*"

The Tourism Authority of Thailand should promote eco-cultural tourism by supporting the community in establishing homestays to allow both Thai and international tourists experience the traditional lifestyle of Ayutthaya, the World Heritage Site. Tourists can appreciate the local wisdom accumulated by ancestors over generations to live harmoniously with water. Additionally, homestays can create income for the community during floods when they cannot go to work.

4. DISCUSSION

In order to find an appropriate framework for flood management generated by the local community of the Historic City of Ayutthaya, the results mentioned in prior sections require interpretation. This study shows that local wisdom not only increases adaptive capacity but also functions as an effective tool to manage threats to the community. The utility of local wisdom is illustrated below.

Local wisdom as a tool for disaster preparedness

The Historic City of Ayutthaya possessed local wisdom about water management that helped people in the past live harmoniously with water, avoiding any negative effects from floods. Local wisdom is inherited and its value is universally accepted which is assured by the fact that the Historic City of Ayutthaya was declared a World Heritage Site. At the intersection of three rivers, the selection of the city's location reflects the wisdom of the region's past inhabitants. The city plan is complex but suitable for a community that lives symbiotically with water, a common characteristic of Thai settlements. Local wisdom is rooted in local cultures and social interactions; then verbally passed on to future generations [16]. Modern generations can draw knowledge from the local wisdom of the past and propose it as an alternative perspective and approach to solve problems in the modern community [17]. Furthermore, local wisdom could be applied to prepare for disasters [18] , [19] and to avoid the risks of flood damages by evaluating the terrain. The Historic City of Ayutthaya is among many areas in which local wisdom has been inherited and utilized to manage floods for generations. Local wisdom helps understand the history of flooding in their area, flood periods, frequency, the violence of previous flood disasters, and post-flood impacts [20]. Local people predict floods by utilizing a system of early warning signs such as: local weather indicators, signs of environmental hazards, and changes in animal behaviors and vegetation patterns [20]. For example, in Rajasthan, India, tribal people predict the

highest level of flood waters by observing the height of bird nests alongside rivers [21].

Additionally, local people know the signs impending floods and prepare evacuation routes and safe places for their families, communities and livestock [20]. House construction can utilize local wisdom to adapt to flooding. In Papua New Guinea, the Singas community that lives by the river Markham builds their houses on stilts which can cope with flooding and are easy to dismantle and transport [22]. The study found that in addition to the common practice of building houses on elevated land or platforms, local people avoided using vulnerable materials. They preferred traditional huts and houses which floated during floods [23]. Beyond accommodation, local wisdom taught people to utilize waterways, drain excessive water away from their fields [24] , store food, move valuable belongings, and prepare evacuation routes. Local people know the safest and fastest evacuation routes to water provisions for everyone in an emergency evacuation [20].

Local knowledge as a means of participation

Local wisdom is a motivator for community inclusion and participation in preparing for and managing disasters. Local wisdom maintains a bottom-up approach [25] which encourages participation between local people and government organizations (higher-level institution) through prevention and management of disaster risks [17]. The guidelines for disaster risk prevention and management are based on local wisdom and practices accumulated over time, as communities in risk areas have experienced managing and coping with disasters [17]. This accrued local wisdom can be applied to develop disaster preparedness plans and help improve sustainability of the community.

The comprehension and respect of local people towards local wisdom contributes to cost-effective long-term expenses [26]. The application of local wisdom in developing a disaster risk management and preparedness plan proves an intelligent use of human and financial resources. One must compare the cost of local wisdom to that of massive construction projects such as damns or ridges around The Historic City of Ayutthaya. Though effective in reducing flood risks, these projects demand high budgets and investment. Local wisdom offers an interesting, simple, and inexpensive risk reduction alternative.

In addition to the benefit of cost-effectiveness, local wisdom promotes self-reliance and reduces dependence on external assistance [27]. People can immediately cope with disasters without waiting for or hoping for assistance from the government or external communities. A community's self-reliance can lead to collaborative communities sharing their similar experiences. A community will be self-reliant only if it has the social capital to promote community strength. More importantly, the community could employ local wisdom and learning processes created and inherited by the community to ensure its future. Using local wisdom and community experiences in solving community problems might result in a happier society with less dependence on external assistance.

5. CONCLUSION

The present study found that the community in the Historic City of Ayutthaya is highly vulnerable to floods. Adaptation guidelines were proposed through a participatory process that allowed people in the community to apply local wisdom about water management to the preparation procedure for future floods. The study found that local wisdom should be integrated with the plans of agencies in establishing sustainable flood preparedness strategies for the future. The Historic City of Ayutthaya poses many problems in combating flooding in a World Heritage Site. The study puts forth that if flood problems cannot be resolved by costly engineering techniques, the integration between local wisdom and adaptation guidelines for flood risks can be an alternative to decrease flood vulnerability and create sustainability.

More importantly, the application of local wisdom motivates participation among all sectors of society: households, communities and local agencies. People can establish policies to increase the potential of the community, applying local wisdom to obtain the proper capacity to cope with flooding. All of these steps seek to strengthen the learning community and establish strategies based on community knowledge passed down from one generation to the next. Ultimately, the community requires some mechanisms to drive strategies in order to help people cope with floods in the context that matches with the community.

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