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Addressing Households' Awareness on Flood Occurrences in Ho Chi Minh City

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Abstract
Based on a 2023 large scale survey of households living in flood-prone districts, this study investigates households' awareness of flooding in Ho Chi Minh City and how they respond to it. According to research findings, present flooding is at or above the level seen ten years ago. The survey results also show that the majority of families have low hopes for floods to reduce in the near future. In addition, respondents voiced anxiety about floods and its impact on their lives. However, households still have limited access to contemporary flood adaptation tactics, which are mostly based on impromptu and rudimentary procedures. This necessitates that local authorities in Ho Chi Minh City will not only re-evaluate policies to assist people in overcoming the consequences of flooding, as well as upgrade/repair the local drainage system, but also organise flood awareness campaigns to constructively communicate about flood risks in HCMC to households, including the introduction of effective preventive measures that households can implement.

Keywords: Households' Awareness, Households' Measures, Flood Occurrences, Ho Chi Minh City

Introduction

Flooding is a growing concern of numerous coastal cities in the world which requires discussion to identify the risk and mitigating measures. This pertains concerns the safety of urban dwellers, the enduring ramifications of pollution, and the potential loss of assets and even human lives resulting from severe flooding. In fact, according to Jonkman (2005) [8], flooding is a main cause of over 500,000 deaths and affected around 2.8 billion individuals worldwide from 1980 to 2009. Moreover, this figure is expected to rise even higher in the coming years if appropriate measures are not taken to prevent flooding in several cities in Southeast Asia, where more frequent major storm events have occurred, and rainfall volumes have increased as a result of growing urbanisation and climate change.

Located in the vicinity of the Saigon River in the northern region of the Mekong Delta, Ho Chi Minh city (HCMC) has seen a significant metamorphosis to evolve into a bustling port metropolis and a sprawling metropolitan hub, accommodating a population of approximately 10 million individuals. However, HCMC is currently experiencing significant flooding due to urbanisation and climate change (Duy *et al.*, 2018) [4] and can be considered as a prominent illustration of the intricate physical and societal dynamics that intensify the likelihood of flooding among Southeast Asian cities (Abidin *et al.*, 2015) [1]. As a result, these flood events have caused significant economic problems for the local economy, resulting in an estimated losses of billions of USD in gross domestic product (GDP) from 2006 to 2050, despite the city's efforts in flood management and adaptation measures [1] (Asian Development Bank, 2010) [2]. In this respect, this study aims to evaluate the households' perspectives on flood occurrences in the city and their readiness to adopt private flood prevention measures.

[1] The Master plan of Ho Chi Minh City drainage system to 2020 (Plan 752), the Ho Chi Minh City environmental sanitation project for canal basin Nhieu Loc - Thi Nghe (supported by the World Bank in 2002), the Environmental improvement project Ho Chi Minh City for canal basin Tau Hu - Ben Nghe - Doi - Te (funded by the Japanese Government and the city budget in 2008), the canal pollution improvement project for canal basin Tham Luong Luong Ben Cat - Nuoc Len...

Study Area and Methods

Case sutdy: Ho Chi Minh city

HCMC, previously referred to as Saigon, is a lively and energetic metropolis situated in the southern region of Vietnam. It is surrounded by numerous provinces, including Binh Duong to the north, Tay Ninh to the northwest, Dong Nai and Ba Ria-Vung Tau to the east, and Long An and Tien Giang to the west and southwest, respectively.

The city is regarded as the most populous city in the country, with a population of around 9 million people, encompassing the suburban areas outside the city limits. The city's population density and urban structure have changed dramatically over time, with a shift towards suburbanization and development into outlying areas. The city's heart is having little or no population increase, whereas the outskirts are seeing more rapid development (Cox, 2012) [3]. HCMC is also described as a pivotal hub for Vietnam's economy, culture, and tourism. It has a diverse economy with key sectors including manufacturing, services, finance, and technology. The city's ports play a crucial role in Vietnam's export-oriented economy, handling a significant portion of the country's cargo transport (Nguyen *et al.*, 2016) [9].

HCMC has a tropical climate, with consistently high temperatures and two distinct seasons: a rainy season, influenced by the Southeast Asian monsoon, which occurs from May to November, and a dry season from December to April. Historically, HCMC has been prone to flooding due to its geographic location in the low-lying Mekong Delta region, with a substantial part of the city being less than one metre above sea level (Scussolini *et al.*, 2017) [12]. The city is intersected by a network of rivers and canals, which have historically rendered it a significant trading hub but also increase its vulnerability to flooding. The situation has been exacerbated by urbanisation since the city's growth has outpaced quick development and inadequate infrastructure. Consequently, there has been a rise in surface runoff, which has placed excessive strain on drainage systems (Nhung, 2023) [10]. Recently, flood risk management systems have transitioned from preventive measures to integrative and adaptive strategies. Hence, the Department of Urban Planning and Architecture (DUPA) is currently revising the Master design for HCMC with the objective of incorporating climate change concerns into the new urban design (Vachaud *et al.*, 2019) [13].

Methods

Many studies on natural disasters and floods are to focus on risk management approach. Sayers *et al*. (2013) [11] analyses the impacts and hazards of floods in three countries China, Hungary, and the United States, and then 3-steps response activities were advised: (1) Preparing for a response before the flooding happens; (2) Taking action during the flooding; and (3) Recovering after the flooding has occurred. Other guidelines and studies, such those conducted by World Bank (2012) [15] and Field (2015) [6], also support the idea that flood risk management can be effectively and promptly addressed by applying this research approach. Therefore, this article will analyse floods as a form of risk. According to IPCC (2012) [7], risk refers to the possibility of negative consequences occurring when hazards actually happen, leading to damage in various sectors and leaving people, property, and the environment vulnerable. Therefore, the occurrence of flooding poses potential threats to both human beings and the environment, which might result in various damages.

The paper's research method is quantitative questionnaire from the survey of flood-affected households in HCMC conducted in 2023, with a total of 750 quantitative interviews in 3 districts (Binh Tan district, district 8, Binh Thanh district), to assess their economic losses as part of the DECIDER project[2]. The paper incorporates selected data from the survey in the following manner:

First, conduct a survey to assess the level of households' awareness of flood occurrences, as well as the effects and harm caused by them in their daily lives.

Second, conduct a survey to gather the households' perspectives regarding specific financial setbacks, primarily focusing on expenses incurred during their lives. Empirical surveys have demonstrated that residential buildings residing in HCMC are regularly impacted by tidal occurrences, resulting in specific and significant damages caused by flooding.

Third, conduct a survey to gather households' particular measures for preventing and reducing the impact of flooding.

Results and Discussions

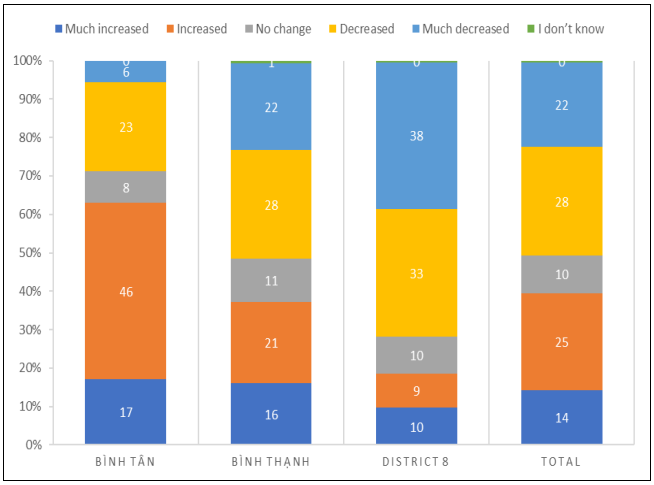
Households' awareness on flooding occurrences

Flooding happens every year in HCMC, and the risk of flooding increases dramatically when heavy rain, high tide, and flood flow combine. According to Van Hong and Phuong Đong (2021) [14], if no adequate prevention measures are implemented, the total flooded area in HCMC will rise from 7,450.7 hectares (3.61% of the whole city) in 2016 to approximately 9,039.91 hectares (4.38% of the whole city) in 2050, the districts in the city's south-southwest and southeast (districts 9, 8, 7, and the districts of Binh Chanh, Nha Be, and Can Gio) will be the most severely affected by flooding because they are low-lying areas with an average height of around 1m.

Based on the households' replies, the extent of flooding in HCMC has differed across various areas as compared to the preceding decade (Fig 1). Specifically, Binh Tan district has a notably high percentage of 63% of households reporting an increase in flooding, but in District 8, 71% of households believe that flooding has greatly decreased compared to the previous decade. In general, 50% of total households reported that flooding persists at a comparable or greater level than it did 10 years ago.

[2] Founded by the Federal Ministry of Education and Research of Germany, DECIDER project aims at developing knowledge-based solutions for the design, evaluation and implementation of robust, yet adjustable, adaptation pathways in the context of increasing flood risk in transforming rural-urban-systems. The project uses Ho Chi Minh City and its hinterland as a pilot, yet, it aims at facilitating a wider transfer of the results, methods and tools to other coastal cities with similar adaptation pressure. To achieve these goals, DECIDER develops innovative methods for the identification and evaluation of flood adaptation strategies and measures.

Unit: %

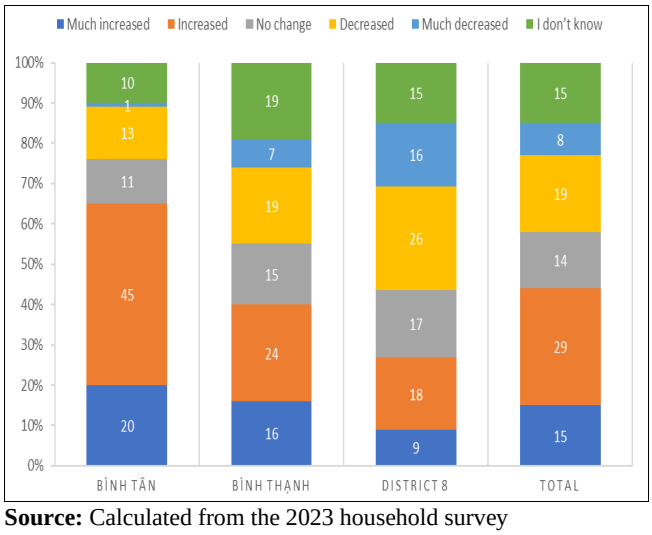


Source: Calculated from the 2023 household survey

Fig 1: Current situation of flooding in 3 districts compared to the previous decade

The survey results indicate that the majority of households have low expectations that flooding will decrease in the foreseeable future (Fig 2). Based on observations, the flooding issue in these dictricts is primarily focused in narrow passageways and unplanned residential neighbourhoods, which the authorities have not paid as much attention to as the districts' main roads. Consequently, the surveyed households that reside in these alleys experienced significant flooding and were compelled to find their own measures to decrease the damage caused by flooding. This is most concerning in Binh Tan district, where up to 76% of total families surveyed believe flooding will be comparable or likely to worsen in the next ten years, followed by Binh Thanh district (55% of total households) and district 8 (44% of total households). The survey results indicate that the existing authorities' flood risk management has several flaws. The local authorities have not conducted a thorough analysis of the underlying reasons and potential dangers associated with flooding, nor have they effectively collaborated with the affected communities to fully understand the impact of flood occurrences to their daily life.

Unit: %



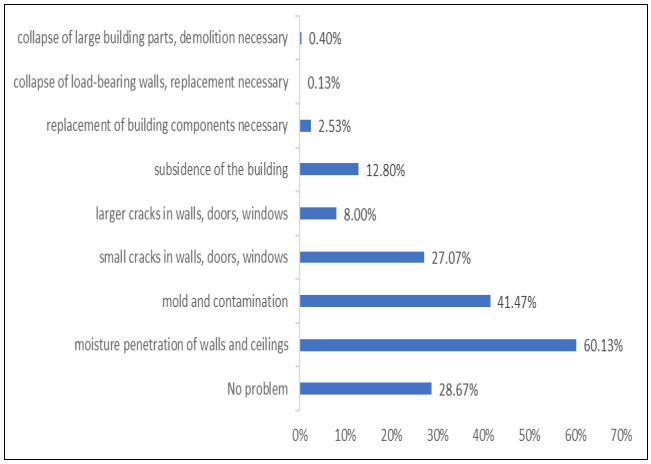
Source: Calculated from the 2023 household survey

Fig 2: Household expectation of flooding in 3 districts in the next decade

Damage caused by flooding

Multiple research findings and reports from both domestic and international organisations, including those from the Vietnam Ministry of Natural Resources and Environment, World Bank, and McKinsey, all affirm that flooding leads to substantial socio-economic harm and the cost of damage can reach billions of dollars if there are no proactive efforts to address this issue. Similarly, survey results also indicate that, in the face of flooding, a mere 28.5% of families reported no impact on physical variables such as dwelling and property, whereas more than 71.5% of households reported varying degrees of impact on their housing (Fig 3).

Unit: %



Source: Calculated from the 2023 household survey

Fig 3: Degrees of impact on residential building due to flooding

Flood-related damage necessitates that households undertake remedial actions to restore their assets. According to the survey data, households have to allocate significant sums of money for repair expenses, ranging from a minimum of 1,000,000 VND to a maximum of 2,500,000,000 VND. Out of the three districts examined in HCMC, Binh Tan district has the highest average cost for repairs, totaling approximately 88,200,000 VND. District 8 follows with an average cost of 63,500,000 VND, and Binh Thanh district has the lowest average cost of 37,800,000 VND. Moreover, the cost of repairing will be much higher if the households decided to completely repair every damage in the residential building.

Table 1: Costs for house repairs due to flooding

Unit: millions VND

		Binh Tan	Binh Thanh	District 8
Total cost to repair after flood occurrence	**Average**	**88.2**	**37.8**	**63.5**
	Maximum	2,500.0	1,000.0	1,200.0
	Minimum	2,0	2,0	2,0
Total cost to repair every damage	**Average**	**241**	**189**	**243**
	Maximum	4000	5000	5000
	Minimum	1	1	3

Source: Calculated from the 2023 household survey

Therefore, with an average monthly income of roughly 5,000,000 - 10,000,000 VND, lower than the average earnings in HCMC ranging from 13,800,000 to 18,400,000 VND (Emerhub, 2024) [5], saving money for the purpose of enhancing and restoring houses and valuables affected by flood occurrences proves to be very challenging for them.

Table 2: Ranges of households' income

Unit: %

Ranges of income	Binh Tan	Binh Thanh	District 8	Average
Less than 1 million	1.59	2.40	2.01	2.00
1 million – 5 million	6.77	6.80	13.25	8.94
5 million – 10 million	53.39	50.40	50.60	51.46
10 million – 20 million	29.88	30.00	26.10	28.66
20 million – 30 million	3.59	6.80	4.02	4.80
30 million – 50 million	2.39	0.40	0.80	1.20
50 million – 80 million	0.40	0.00	0.40	0.27
No comment	1.99	3.20	2.81	2.67

Source: Calculated from the 2023 household survey

For business households, the impact of floods seem to be particularly significant as it directly impacts their income (Table 3). The survey results found that business households reported an average income loss of approximately 21.4% due to floods. Additionally, it took them an average of nearly 1.6 days for these households to resume their business.

Table 3: Income impact on business households due to flooding

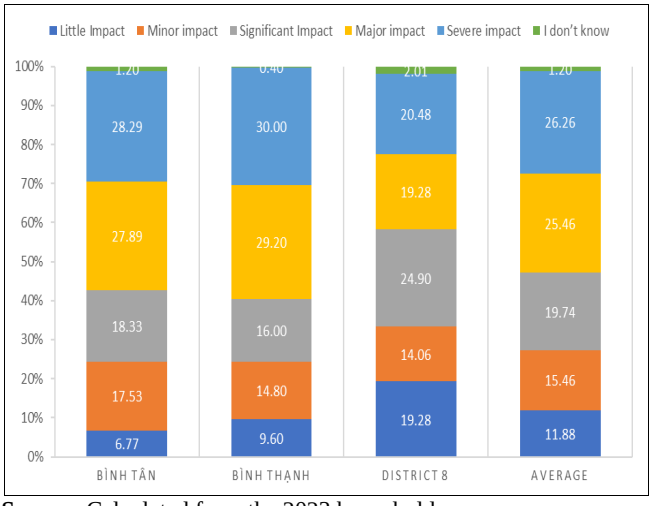
Unit: millions VND; %

	Binh Tan	Binh Thanh	District 8	Average
Estimate the total direct loss due to the most recent flood	3.5	1.4	10.1	5.0
Duration to get back to normal daily trading / production because of the most recent flood	1.3	1.5	2.1	1.6
Monthly income loss percentage during the most recent flood	19	26	19	21.4

Source: Calculated from the 2023 household survey

The survey results indicate that flooding has an adverse effect on the well-being of individuals residing in locations that experience regular flooding. Indeed, a significant majority of 71.46% of surveyed households concur with this assertion (Fig 4). Especially, among them, a significant proportion of up to 51.72% said that the health of their family members is severely impacted by the current flooding.

Unit: %



Source: Calculated from the 2023 household survey

Fig 4: Health impact to family memebers due to flood

Overall, the survey findings indicate that most households possess a clear understanding of the immediate detrimental impacts of floods on their well-being and overall quality of life. Flooding is a significant issue that has a direct impact on the socio-economic development and local residents' livelihood. It necessitates the collaborative involvement of various stakeholders, including the local authorities in managing flood risks. For a risk management strategy to be effective, the local authorities must establish a strategy that takes into account population and regional characteristics. Additionally, the local authorities must have a clear understanding of local residents' views and limitations when it comes to responding to the hazards associated with current flooding.

Household measures to flood occurrences

As mentioned, floods have a direct impact on individuals, households, possessions, and domestic business. Therefore, it is imperative to implement preventive measures in order to substantially mitigate the extent of the losses. The survey results indicate that the majority of households exhibit a passive approach towards addressing flood events. This is primarily due to the insufficient warning notifications prior to the occurrence of a flood event (Table 4). From the survey, 40.40% of households said that they were aware of the flooding themselves, while 52.53% of households stated that there was no warning and the flooding took them by surprise.

The reason for these replies is that they are able to anticipate the occurrence of flooding by closely monitoring the monthly pattern and frequency of high and low tides, as well as observing weather indicators such as clouds and rain. This enables them to prepare in advance for the specific time of the month when flooding is likely to occur. In Vietnamese tradition, the "full moon worship" ceremony takes place during the full moon phase and is typically used as a reliable indicator of high tide. However, occasionally, due to heavy rains at the beginning of the rainy season and the water was not drained in time as the drainage system was blocked and the ward's pump was damaged, hence catching many households off guard due to sudden floodings. In fact, due to their works, many respondents often receive the announcement of flooding only after their houses have already been flooded and severely damaged.

Table 4: Types of warning received by households prior to flood occurrences

Unit: %

S. No	Types of warning	Percentage
1	I knew myself	40.40
2	TV	10.27
3	Radio	1.20
4	Newspaper	0.40
5	Social media/internet	2.80
6	Neighbors/friends	2.93
7	Loudspeaker announcement	0
8	PC officer	1.33
9	No warning/by surprise	52.53

Source: Calculated from the 2023 household survey

The survey results also indicate that household efforts to reduce flood damage are both uncomplicated and temporary (Table 4). Most surveyed households reported that their primary measure during the flood occurrences were to move furniture (44.53%), move vehicles (20.40%) to safe area, save document and valuables (33.2%), and pump down water (19.6%).

Table 5: Households' emergency measures to prevent damages due to flood

Unit: %

Measures	Binh Tan	Binh Thanh	District 8	Average
Saved document and valuables	33.47	37.20	28.92	33.20
Moved vehicle to safe area	20.32	21.60	19.28	20.40
Moved furniture to safe area	43.03	46.00	44.58	44.53
Putting products at higher places (dry-proofing)	12.75	6.40	8.84	9.33
Brought children, elderly, sick people to safe area	4.38	7.20	4.42	5.33
Pumped down water	33.86	10.00	14.86	19.60
Use sandbags, temporary & small-scale protection	10.76	15.20	23.69	16.53
Sealing doors or windows against water infiltration	3.98	3.20	1.61	2.93
Other	11.55	10.00	4.02	8.53

Source: Calculated from the 2023 household survey

Moreover, based on the research done by Yang and Garschagen (2023) [16], it was found that the majority of local residents do not receive external supports due to moderate flood occurrences and their subjective adaptation to the impacts. However, the most vulnerable groups did receive various supports, indicating the existence of a basic flood-safe system in the city. Long-term adaptation measures are not often applied, primarily because vulnerable groups are not able to afford them, while wealthier individuals do not feel the need.

Overall, this demonstrates that the local authorities currently lack a flood risk management programme or mechanism that can efficiently establish direct communication with the locality. As a result, households' measures remain mostly spontaneous. The reason is that when a flooding incident occurs, such as when a sewer tank or a manhole get clogged, and the local residents wish to remedy the situation, the official process is lengthy whereby the neighbourhood group head have to report to the Neighbourhood Executive Board, followed by the Ward government, which continues to submit to the District and City levels. As a result, obtaining government feedback is highly unpredictable and involves significant delays, which ultimately hinders the early resolution of flood points and the timely reduction of flood risks.

Based on survey results, as the tide level gradually rises over time, several households have become aware of the potential severe damage that future floods could cause to their houses. Therefore, they believe it is necessary to raise and reinforce their floor or foundation to prevent floodwater from entering their houses (in some cases they even raise their floor up to 100cm). Furthermore, several households said that they chose to fortify their houses during certain periods of floods simply because their houses did not sustain any damage. Alternatively, if water infiltrates their residences and results in property damage, individuals must allocate funds to purchase or replace the affected assets, leaving them with insufficient resources to fortify their houses as originally intended.

Conclusion

Based on a survey conducted on flood-affected 750 households in 3 districts of Ho Chi Minh City, it is evident that flooding remains the most severe environmental issue for households in the city. Due to deteriorated sewer systems and drainage infrastructure, along with the influence of climate change, the combination of intensified rainfall and abnormally high tides is causing a progressively more significant occurrence of floods.

According to the survey results, flooding causes extensive damage to households' residential buildings, incomes, and healths. Nevertheless, households still lack significant access to contemporary flood adaption strategies, primarily centred on impromptu and rudimentary methods. This issue is caused by both financial constraints and the inadequacies of the existing local authorities' flood response strategy. In general, in order to improve the situation of responding to flood risks, local authorities in Ho Chi Minh City need to not only focus on re-evaluating policies to support people to overcome the consequences of flooding, upgrading/repairing the local drainage system, but also organising flood awareness campaigns to constructively communicate about flood risks in HCMC to households, including introducing effective precautionary measures that can be implemented by a household.

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