



Living with Risk: Understanding how Flood Exposure and Vulnerability Shape Community Adaptation in Chiang Mai, Thailand

A case study of Mae Kha Community

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1. Executive Summary

In Thailand, climate and flood risk management, especially along the canal is fragmented, under-resourced, and largely absent at the community level. No single agency holds clear accountability for the canal's drainage capacity. Early warning systems do not reliably reach informal settlements, let alone other disaster actions. National frameworks such as the National Adaptation Plan (2023), and National Disaster Risk Management Plan (2015), identify urban informal communities as vulnerable but provide no implementation pathway to households that lack formal land registration. These policy documents fail to deliver effective risk reduction and preparation efforts at the local level. Despite long-term flood and climate or environmental risks, many Mae Kha residents have lived along the canal for generations and choose to remain despite recurring floods because of place attachment, community networks, and the absence of viable alternatives. Consequently, this makes the communities the best case for exploring how they cope with the risks while reducing exposure.

Group interviews and field observations in both communities revealed five consistent patterns. First, flooding is experienced as prolonged and cumulative, not single events but multi-wave inundations lasting days to weeks. Second, all coping strategies are community-led and autonomous, specifically measures that address immediate impacts but not underlying causes. Third, land tenure divides the community's resilience. Then, women play a central but unrecognized role in flood preparedness and community recovery, carrying responsibilities that formal disaster management planning does not account for. Finally, state support is perceived as reactive and compensation-based rather than proactive to strategically address flood risks that the communities have faced.

Building on the findings and document analysis, this brief proposes (a) CODI to Extend Baan Mankong to public-land households, (b) Ministry of Interior (MoI) to assign one lead agency for canal governance with mandatory community participation. (c) DDPM to improve early warning systems, (d) DCCE revise the NAP to include tenure provisions for informal settlements, and (e) MoI to decentralize disaster authority and resources to local governments.

2. Introduction

Mae Kha canal spans 31 kilometers from Doi Suthep through the heart of Chiang Mai to the Ping River. It was designed to distribute seasonal rainfall and support agriculture across the city's inner and outer zones. Over the past few decades, unregulated urbanization has



Figure 1: Map of the communities along Mae Kha Canal

narrowed the canal, raised its embankment walls, introduced industrial effluents, and created settlements along its banks that now sit below the water level (Mettes, 2014; Nuanla-Or, 2016). Chiang Mai experiences flooding annually during the monsoon season, with major Ping River flood events recurring across 1952, 1973, 1994-1995, 2005, 2011, 2022, and 2024, resulting in disproportionate impact on the canal-side communities least protected by formal flood infrastructure (Pirard, 2025a). What was once a community waterway now hosting the heavily polluted water (Manene et al., 2024), changing into a primary urban flood prone area in Chiang Mai.

Two adjacent communities named ‘Kampaeng Ngam’ and ‘Hua Fai’ occupy canal banks in the city and peri-urban area, together housing between 700 and 1,000 households. Their residents include long-term Chiang Mai families, tribal-background communities whose members migrated from northern provinces, elderly widows and caregivers, and working-age adults, predominantly women, whose husbands work elsewhere. The communities are internally diverse in land tenure: some families hold occupancy rights under the Bang Mae Kong model (Baan Mankong applied locally), while others occupy Marine Department or Fine Arts Department public land on annual renewable contracts.

Studies found that population growth and urban encroachment are drivers behind the canal’s ecological degradation and reduced drainage capacity (Owatsakul et al., 2025). Besides flood risks, the informal settlements along the canal face challenges related to poverty, inequality, and inadequate urban planning within the historic city landscape (Duangputtan & Mishima, 2024). Despite recurrent flood risks and environmental challenges, many residents continue to stay in these flood-prone communities. This leads us to question how these communities stay in a place with high flood risks and deteriorated ecological conditions. To put this other way, how can we understand the relationship between local flood exposure, vulnerabilities and their coping strategies? By addressing this question, this policy brief attempts to propose five actionable measures to strengthen local adaptation strategies while reducing flood risks in the context of urban canal-side informal settlements in Chiang Mai.

3. Methods

This policy brief is based on group interviews and neighborhood observations conducted in two communities called “Kampaeng Ngam” and “Hua Fai” located along Mae Kha Canal in Chiang Mai. The group interview intends to explore residents' exposure and vulnerabilities to flood risks as well as their coping mechanisms. Hence, group interview was conducted with residents in these communities representing different age groups, occupations, and ethnic backgrounds (*see Annex 1: participant summary*). The discussions explored several themes, including experiences of flooding and environmental hazards, coping mechanisms during floods, livelihood challenges, mobility decisions, and expectations regarding government support. The research team undertook neighborhood observations to document physical conditions within the community. These observations focused on housing structures, drainage systems, waste management practices, environmental risk points, and public infrastructure. Observing the physical environment helped contextualize residents' experiences and provided visual evidence of the challenges described during interviews. Document study over National Adaptation Plan (2023) and National Disaster Risk Management Plan (2021-2027), and Asian Disaster Risk Reduction Center, Thailand Country Report (2023) was conducted to generate analysis on institutional setup, targets and plans on adaptation and disaster risk management, mitigation, and preparedness

Ethical considerations guided the research process. Participation was voluntary, participants were informed about the study's purpose, and personal identifiers were not recorded to protect privacy. Three main limitations are associated with this brief. A translator assisted in translating interviews from Thai to English. The study involved only two female participants from the community, so the findings represent limited perspectives and may not capture the full diversity of experiences in two of the Mae Kha Canal settlements. Environmental observations were conducted within a specific time period and may not reflect seasonal variations. Nevertheless, the combination of interviews and observations provides useful insights into residents' experiences of flood risk and their adaptation measures.

4. Findings from Community Conversations and Observations

4.1 Climate and Environmental Risks

Findings from group interviews with residents of the Mae Kha community, supported by field observations, indicate that climate and environmental conditions play a central role in shaping the community's exposure to flooding. Participants consistently emphasized that the community's location near the Ping River and the Mae Kha Canal system exposes households to rising water levels during the rainy season. According to residents, water levels in the river and canal frequently become higher than the surrounding residential areas. During periods of heavy rainfall, water naturally flows from these waterways into nearby streets and homes, making flooding a recurring experience for many households.



Figure 2: Highest water level in 2024 flood

Interviewees recalled several major flood events that have significantly affected the community over the past two decades, particularly in 2005, 2012, and most recently in 2024. Residents described these floods not as single short-term events but as prolonged periods in which water levels rose in multiple waves. As a result, floodwater often remained in the neighborhood for several days or even weeks, slowing the recovery process. While residents did not report fatalities or severe medical emergencies during these events, many households experienced repeated damage to housing structures, furniture, and household belongings. For many families, the primary burden lies in the continuous cycle of repairing homes and replacing damaged items after each flood.

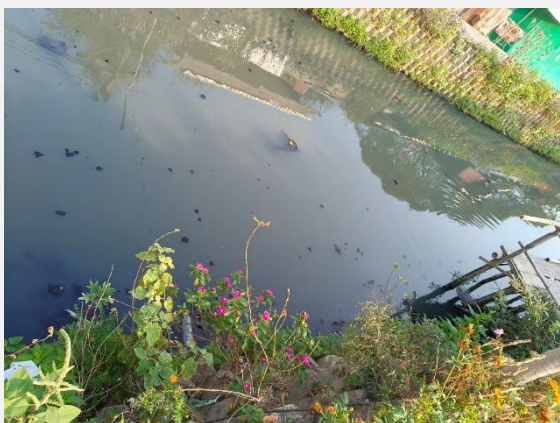


Figure 3: Mae Kha Canal

Environmental conditions within the canal system were also frequently mentioned as contributing to flood risk. Residents explained that the canal has become increasingly polluted over time due to the accumulation of waste, sediment, and mud. These conditions reduce the canal's drainage capacity and limit its ability to effectively channel excess water during heavy rainfall. Observations during the field visit also confirmed that canal water contains visible waste and sediment buildup. These environmental issues not only contribute to increased flooding but also create sanitation concerns and negatively affect the overall quality of the local environment.

Overall, the findings suggest that although flooding in the Mae Kha community has not resulted in large-scale casualties, its recurring nature continues to affect environmental conditions, infrastructure, and the daily lives of residents. The combination of geographical exposure, environmental degradation of the canal system, and repeated flood events contribute to persistent climate and environmental risks, specifically flood risks for the community.

4.2 Everyday Vulnerabilities and Coping

Through the interview with the residents, it is found that households' vulnerability to flooding is closely linked to limited household resources and social dynamics within the household. Discussions with residents revealed that many households depend heavily on remittances sent by male family members who have migrated abroad for work. Within the community itself, income opportunities are often limited. Some residents engage in part-time employment, while others operate small food stalls to help meet daily household expenses. Migration has also shaped the demographic composition of the community. Many of the people who remain in the neighborhood are women, older adults, and children. As a result, women often carry primary responsibilities for household care, including looking after children and elderly family members. During flood events, these responsibilities can intensify, as women must manage evacuation preparations, protect household belongings, and ensure the safety of dependents. Field observations further suggest that housing conditions contribute to the community's vulnerability. Many houses are built very close to the canal banks, reflecting both the spatial constraints of the settlement and long-term patterns of land use. Some houses are constructed using temporary materials or incremental building methods that reflect the economic constraints of the residents.

Group interviews with residents reveal that coping strategies against floods in the Mae Kha community mainly rely on practical experience of living in a flood-prone environment instead of relying on large-scale structural protection. These strategies reflect adaptive behaviors shaped by local knowledge, available materials, and the need to respond quickly when water levels begin to rise. One of the most common coping practices described by residents involves protecting household belongings from floodwater. When heavy rainfall is expected, families move important items such as furniture, electrical appliances, and personal belongings to higher floors or elevated areas within the house. Residents also place sandbags, rocks, or other locally available materials around doors and entrances to slow the flow of water into their homes. Although these measures cannot completely prevent flooding, they help reduce damage to household property during peak water levels.

Preparedness in the community also relies heavily on information shared by local authorities. Residents explained that they closely monitor announcements from the municipality, particularly updates regarding dam water releases and warnings about rising water levels. Access to such information allows households to anticipate flooding and prepare in advance, such as reinforcing temporary barriers, relocating belongings, or arranging

temporary evacuation if necessary. In this way, early warning information plays an important role in shaping how residents manage immediate flood risks.

During severe flood events, some families temporarily relocate to safer areas until water levels recede. According to participants, community leaders often remain in the neighborhood during these periods to coordinate support and share information among residents. Their presence helps maintain communication within the community and ensures that assistance is organized for households that remain affected by the floods. Recovery efforts after floods are largely driven by community solidarity. Residents often assist one another in cleaning mud, removing debris, and repairing damaged houses once floodwater subsides. This collective effort allows the community to recover more quickly despite limited external assistance.

Despite high exposure to recurring flood and the communities' vulnerabilities, the respondents expressed their preference to remain in the areas partly due to their attachment to the communities and, in other part, to their perceived understanding of flood occurrence. The respondents mentioned that they are supposed to stay in the areas since they need to take care of elderly community members who are having emotional ties to the place. The interviewees' appreciation of flood as natural phenomenon appears to have contributed to their decisions to remain in the areas. Moreover, across the interview section, their motivation to stay in the area was observed to be stemmed from their perceived confidence in self-resilience measures that they are taking in response to the flood episodes.

Overall, the findings suggest that the Mae Kha community demonstrates local adaptive measures such as monitoring of information, temporary relocation, and collective recovery. These coping mechanisms mainly address the immediate impacts of flooding rather than the underlying environmental and structural factors that continue to produce risk.

4.3 Flood Knowledge

Interviews and observations suggest that awareness of climate change and its connection to flooding remains relatively limited among some community members. Many residents perceive flooding primarily as a natural phenomenon that occurs seasonally and believe that it is largely beyond human control. In discussions with interview participants, floods were often described as unavoidable events that communities simply must endure and adapt to. A resident said that

"It (the flood) is a natural disaster, so the government cannot help much about that. Once this disaster happened, the government could only provide food, water, snack boxes, and stuff" (Female Community Leader, 2026).

This demonstrates that the awareness raising regarding climate issues, particularly floods, from the government is limited to informal settlement locations. This perception influences how residents understand flood risk and the kinds of responses they consider possible. Rather than viewing flooding as partly linked to broader environmental changes or

urban management issues, many residents focus on short-term coping measures. As a result, long-term prevention or climate-related mitigation measures are less frequently discussed at the community level.

These findings suggest that improving community awareness about climate change and its relationship with environmental management, urban drainage systems, and land use planning could play an important role in strengthening long-term resilience. Greater access to information and community-based education may help residents better understand the broader drivers of flood risk and encourage more proactive approaches to risk reduction.

4.4 Tenure and Housing Insecurities

Land tenure and settlement patterns were also identified as important factors shaping vulnerability in the Mae Kha community. Historical and socio-economic dynamics have attracted low-income migrants from marginalized areas, including mountainous regions, other provinces of Thailand, and neighboring countries, who move to the city in search of employment opportunities (Duangputtan & Mishima, 2024). One interviewee mentions that

“Some of us who live in this community are illegal (informal settlement) and live in a public area. Therefore, if the government wants to have those lands back, all the places that belong to the public must be given back” (A long-time resident, 2026).

Due to limited affordable housing in Chiang Mai, many of these migrants settled informally along the Mae Kha Canal. As a result, these areas received limited attention from authorities in the past and remained relatively neglected. Over time, informal settlements developed along the canal and near the outer city wall surrounding the historical center. These settlements are often characterized by inadequate housing structures and limited public infrastructure. Limited public space, inadequate drainage systems, and overcrowded living conditions further increase the vulnerability of residents during flood events.

4.5 Women's Agency

Group interviews also highlighted the important role women play in supporting household resilience and community recovery during flood events. Women are often at the center of family survival strategies, taking responsibility for organizing household preparedness, protecting essential belongings, and ensuring the safety of family members during floods.

In many households, women manage daily activities such as food preparation, childcare, and maintaining household hygiene, responsibilities that become particularly challenging during flood periods. Despite these difficulties, women often take the lead in coordinating family responses, including preparing emergency supplies, organizing temporary relocation, and maintaining communication with neighbors and community members. Women also contribute to strengthening community cohesion during and after floods. Interviewees described how women frequently participate in collective clean-up activities, help neighbors repair damaged homes, and support vulnerable community members such as

elderly residents or children. Their involvement helps sustain social networks that are crucial for community recovery.

These observations suggest that women's agencies play a significant role in maintaining household stability and community resilience during disasters. However, their contributions are often informal and may not always be fully recognized within formal disaster management planning.

4.6 State Support Remains Reactive rather than Proactive or Strategic

Residents generally perceive government support as limited and largely reactive rather than proactive. According to interview participants, municipal authorities mainly respond during or immediately after flood events by providing emergency relief or conducting temporary clean-up activities. Long-term preventive measures are less visible from the perspective of residents.

One example frequently mentioned by residents is canal cleaning campaigns, which are often organized during public events such as Father's Day or Mother's Day. While these activities help remove waste from the canal temporarily, they are irregular and may not provide a long-term solution to the problem of sediment accumulation and reduced drainage capacity.

5. Policy Analysis

Mae Kha residents' vulnerabilities are shaped by the interplay of various socio-economic and political factors, thereby having implications for the local agency of coping with the flood consequences. These include communities' limited tenure security or housing rights, lack of strategic urban planning practices, disconnected nature of canal administration, and limited institutionalizations of risk mitigation and preparedness.

5.1 Land Tenure Analysis

The two communities studied occupy a patchwork of land administered by different legal regimes, specifically one under CODI's Baan Mankong Model with limited security and the other being public land under the Marine Department or Fine Arts Department jurisdiction with annual renewable contracts, providing no investment security and no protection against non-renewal. Such tenure insecurity provides no incentive for residents to make long-term structural investments that can decrease their exposure to floods while contributing to building other adaptation measures. The National Adaptation Plan (2023) outlines 'human settlements and security' as one of six priority adaptation sectors, while explicitly recognizing flood risk, displacement, and urban informal settlement vulnerability as areas requiring adaptation action. However, the NAP's sectoral mechanism does not address the institutional setup of land tenure reform, nor does it provide a framework for engaging informal settlements, which lack formal administrative registration, in local adaptation

planning processes. Also, the NAP remains limited in terms of outlining operationalized mechanisms and practical actions at the local level (Sutthipath Kanittakul, 2025).

5.2 Poor Urban Management Practices

Unregulated urbanization has narrowed the canal and introduced industrial and commercial effluents from factories, markets, and businesses established along its banks that have transformed it from an agricultural and transportation resource into what a researcher describes as an open sewage line (Nuanla-Or, 2016). The interview respondent recalls the canal as swimmable within living memory. It is now monitored by environmental agencies as one of northern Thailand's most contaminated urban waterways. Technical analysis of the 2024 events mentions that river encroachment by hotels, restaurants, and government offices has reduced the Ping's flood corridor by up to one-fifth of its original width, creating a bottleneck effect in the inner city (Pirard, 2025 b). The ecological degradation of the canal driven by these external forces and authorities' limited land-use planning has not only resulted in increasing communities' vulnerability to floods but also determined to what extent they can cope with the disaster.

5.3 Fragmented Canal Administration

Canal maintenance responsibility disperses across at least four agencies: the Chiang Mai Municipal Government, the Royal Irrigation Department, the Fine Arts Department (for sections adjacent to heritage-classified land), and the Marine Department (for sections on public waterway land). Community leaders' communication channels and municipality announcements on social media provide information about when cleaning occurs, but residents have no voice in deciding how, when, or where maintenance is prioritized. According to the interviewees, the practical result is that a festival-linked cleaning campaign, Father's Day, or Mother's Day, substitutes systematic maintenance scheduling. This demonstrates that communities only rely on community-level adaptative measures to respond to flood risk despite having provincial and local adaptation plans mandated by the NAP (2023).

5.4 Reactive Disaster Management

According to a study assessing spatial planning for flood risk reduction, Thailand's flood emergency responses fail to consider land use management techniques (Chaladdee et al., 2022), revealing weakness in flood risk mitigation and strengthening disaster preparedness by the authorities. A study examining negative externalities of local adaptation practices in Bangkok argues that autonomous adaptation measures, such as raising floors, sandbagging, and building second floors, while resourceful, can be considered a symptom of weak municipality governance, thereby leading to maladaptation among the individuals and businesses (Limthongsakul et al., 2017). The mirrored situations in Mae Kha communities reflect an absence of risk mitigation practices conducted by the authorities that make the communities bear the full burden of flood risk management.

Moreover, Thailand's disaster governance has been characterized by limited capacity of local governments driven by limited decentralization and extensive horizontal and vertical fragmentation in the highly polarized political context (Marks & Lebel, 2016). The 2024 Chiang Mai crisis replicated this structural pattern: flood response leadership was assigned to provincial governors, while community residents received information via social media rather than formal early warning systems. The National Disaster Risk Management Plan (2022-2027) assigns the Department of Disaster Prevention and Management (DDPM) as lead coordinator for disaster prevention, mitigation, response, and recovery across 13 implementing departments. The Plan's organization is aligned with the Sendai Framework's four priorities: understanding risk, strengthening governance, investing in resilience, and enhancing disaster preparedness. The 2024 Chiang Mai experience exposed the Plan's implementation gap: 13 departments operated without a clear coordination protocol, early warning systems failed to reach vulnerable communities in time, and there was an absence of participatory disaster preparedness actions (Jepkemei, 2025). The interviewees perceive government action over floods as emergency relief support and monetary compensation, reflecting that disaster response remains reactive rather than anticipatory for both risk mitigation and preparedness actions.

6. Policy Options and Recommendations

The following five recommendations are made based on the findings and associated policy analysis.

(a) Extend the Baan Mankong program to cover households on Marine Department and Fine Arts Department land

In the Mae Kha communities, households in the Bang Mae Kong section can acquire a collective loan to secure their land and improve their homes. Households on adjacent public land, administered by the Marine Department or Fine Arts Department, cannot access this program since they only have annual rental contracts. The government should negotiate five-year security agreements between these departments and community households, giving residents enough tenure to invest in reducing their exposure to floods, raising floors, reinforcing stilts, and installing water barriers without having fear of losing everything if the contract is not renewed next year.

(b) Assign one agency to oversee Mae Kha canal maintenance and requires community participation in developing and implementing the canal management plan

Currently, no single agency is clearly responsible for the condition of the Mae Kha canal. The municipality, Royal Irrigation Department, Fine Arts Department, and Marine Department all have overlapping yet uncoordinated roles. Canal cleaning happens during festival days when community members volunteer, not as part of a scheduled maintenance plan. The national government should develop a canal governance consortium with a clear budget, a published annual maintenance plan, and a community contact point. Designing and conducting plan

require consultation with and participation of Mae Kha canal communities including vulnerable group members such as women, and ethnic group members.

(c) Give canal-side communities advance notice before dam gates are opened

When the Royal Irrigation Department or DDPM decides to release water from Mae Ngat or other upstream reservoirs, Mae Kha canal communities should receive at least 24 hours' written notice through the community leader, the municipal announcement system, and the community Line group. This leads to households having enough time to move their belongings upstairs, arrange temporary accommodation, and alert elderly and disabled neighbors before water arrives. Right now, residents find out through social media or when the water is already coming in.

(d) Establish a clear public framework for addressing land tenure insecurity of the informal communities

Ministry of Interior should a clear public framework outlining how tenure issues can be addressed, such as through temporary use rights, collective tenure arrangements, or formal rental agreements with clearly defined lease periods.

(e) Distribute authority and resources to local governments to initiate and strengthen disaster response, risk reduction, and preparation

The Ministry of Interior should develop a single inter-agency coordination protocol for urban flood events in secondary cities, addressing the operational challenges documented in the 2024 Chiang Mai crisis. The Ministry should distribute adequate resources to provincial governments, especially in flood-prone areas, with authority to issue evacuation orders and access emergency funds without national-level authorization.

7. Conclusions

This study explored how flood exposure and local vulnerabilities influence residents' adaptation strategies and their decisions to remain in flood-prone communities in Chiang Mai, particularly along the Mae Kha Canal. The findings show that flood risk is shaped not only by environmental exposure but also by underlying vulnerabilities such as insecure land tenure, limited household resources, and shifting social dynamics within households.

Despite these challenges, residents have developed practical coping strategies based on lived experience, including moving belongings to higher areas, using temporary barriers, monitoring flood warnings, and temporarily relocating during severe flooding. Community cooperation also plays an important role in response and recovery efforts. However, these strategies mainly address immediate impacts rather than the structural causes of flooding.

To reduce disaster risks in the Mae Kha community, policy interventions should address structural vulnerabilities, particularly in strengthening land security, improving residents' access to timely information, and promoting greater decentralization of authority and resources for local disaster management. Overall, the interaction between flood

exposure and local vulnerabilities shapes how residents adapt to risk and explain why many households continue to remain in flood-prone areas despite recurring flood events.

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9. Annexes

Annex A-Participant Summary

1st interviewee	
Gender	Female
Age	67
Occupation	Community leader
Household Situation	Lives with three family members
Community Role	Vice-president of the community, village health volunteer, leader of the women's group, and leader of the elderly community group
Key Characteristics	Born and raised in the canal-side community in Kampaeng Ngam Community along the Mae Kha Canal. Highly active in community leadership and social activities, representing the perspectives of long-term residents and elderly groups.

2 nd interviewee	
Gender	Female
Age	32
Occupation	Housekeeper
Household Situation	Lives with three children; husband works abroad
Community Role	Community resident
Key Characteristics	Born and raised in the community. Responsible for household management and childcare. Family livelihood depends on remittances from her husband working overseas. Represents younger households facing economic and caregiving responsibilities in canal-side settlements.

Annex B - Interview Guiding Questions

Background information (vulnerability, exposure, coping capacity)

1. Name, age, family members, occupation.
2. Can you give us estimates numbers of households in this community?
3. What is the main livelihood in your community?
4. How long have you stayed here.
5. Have you ever faced any hazard?
6. How often do you face hazards or flooding?
7. Tell us a little bit about why your family decided to "stay and adapt". Here instead of moving somewhere else?
 - a. What makes you "really want to stay here" despite the risks?
 - b. What makes this place meaningful to you? What do you love/bond with land the most?
 - c. When you think about the future of your family here, what kind of future image comes to mind?
8. If one day you need to move, do you think the family "can move"?
9. What are the main obstacles if you have to move?
 - a. What is the thing that "makes you unable to move" even if you sometimes want to go? – Debt / No place to go / Elderly people / Fear of losing land rights / Children studying / Attached to the community / No money to start over
 - b. Have you ever seen someone move and fail?
 - c. Have you ever felt "stuck" or "forced to stay"?
 - d. If you have the money and the opportunity to do so. Would you move?
10. What conditions would make you think you need to move?
11. What adjustments have you tried in the past? (Resources, building structures, subsidies etc.)
 - a. Any temporary relocation experience?
12. If the climate is not severe, what do you want to develop or do next here? Would you rather have him stay here or somewhere else?
13. If the adaptation you are making fails. Do you have a "backup plan"? If you move out, are you worried about land rights or compensation?
14. What support do you need from the government or external agencies to stay stable now?
 - a. What would you like to say to the government about helping families "live and adapt"?

Annex C- Map of Mae Kha Canal



Figure 4: Source: (Duangputtan & Mishima, 2024)

Annex D- Photo Documentation

