ENVIRONMENTAL GOVERNANCE AND SOCIOECOLOGICAL VULNERABILITY: A CASE STUDY OF HUNGRY WATER EFFECT ON MEKONG RIVER COMMUNITIES ADAPTATION IN CHIANG KHONG DISTRICT, CHIANG RAI PROVINCE, THAILAND

KORNKANOK SANABUD

MASTER OF ARTS

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Finally, this research may not have been successful if there was a lack of inspiration, which is our Mekong River. The author always keeps in mind that the Mekong River is life. Sustainable river management and water governance is vital to restoring a healthy life to the river and all creatures that depend on it. I extend my gratitude to all for your invaluable contributions that significantly enhanced the quality of this paper.

Kornkanok Sanabud

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ABSTRACT

The Mekong River supports immense biodiversity and sustains the livelihoods of millions who depend on its aquatic resources. However, the river is increasingly threatened by the Hungry Water Effect, a slow-onset disaster characterized by severe sediment trapping upstream. This leads to sediment and nutrient depletion downstream, triggering soil degradation, and riverbank erosion. Alarmingly, the Mekong River Commission (MRC) predicts that sediment levels will drop at only 3% by 2040, a grave sign for the river's ecological health.

This issue is particularly acute in Wiang Chiang Khong, a community in Chiang Rai Province, Thailand. The area's soil-based riverbanks are especially prone to erosion and ecological degradation. As a result, essential ecosystem services such as natural season of riverweed (Kai), nutrient cycling, and aquatic habitat stability are increasingly impaired, diminishing their capacity to support local livelihoods. This study draws on three key conceptual frameworks including Socioecological Vulnerability, Environmental Governance and Community Adaptation. Despite the growing concern, limited research has explored the localized socioecological impacts of the Hungry Water Effect or the governance responses at the community level. This research addresses that gap through a qualitative method case study in Wiang Chiang Khong.

The qualitative component involves in-depth interviews with 60 participants across six occupational categories that rely on the Mekong River including sector of fishery, hydro-based farmer, agricultural farmers, business owners, local NGOs, and local

government officials. The findings reveal that community adaptation in Chiang Khong is largely One-Sided Adaptation driven by necessity rather than coordinated support. With minimal assistance from state agencies or formal institutions, local responses remain fragmented, reactive, and unsustainable. Effective adaptation must go beyond survival. It requires systemic change that integrates top-down policy with bottom-up, inclusive participation. The future of the Mekong depends on recognizing that environmental challenges are inseparable from politics, and that equitable, participatory governance is essential for sustainable river management.

Keywords: Hungry Water Effect, Environmental Governance, Community Adaptation, Mekong River

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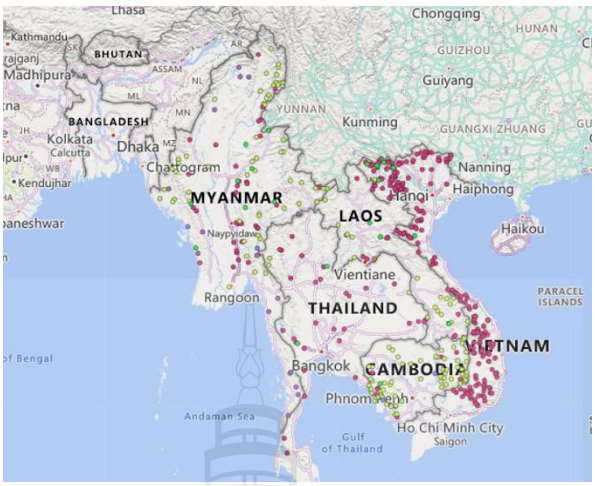
INTRODUCTION

1.1 Background of the Study

The Mekong River is one of the mainstream Rivers in Asia which originates in the Tibetan Plateau and flows through six countries including Yunnan Province in China, Myanmar, Laos, Thailand, Cambodia, and Vietnam. It has a total length of approximately 4,350 kilometers (2,703 miles). It is crucial for the region's economy and ecology immensely. It supports a rich biodiversity, including various species of fish and other aquatic life. Additionally, it provides water for irrigation, transportation, and hydropower generation. The Mekong Basin is home to millions of people who rely on the River for their livelihoods.

The hydropower dam in the upper part of the Mekong River was first established in 1990 as a mega development project with the aim to generate electricity to the region. Presently, the Lower Mekong Basin is a major location for the construction of hydropower dams, with the capacity to provide 30,000 megawatts (MW) of energy for the surrounding area. By 2030, 88 dams are planned to be constructed downstream of the Mekong River basin by the approval of regional authorities (Open Development Mekong, 2015). Eleven large hydropower dams are intended for the Lower Mekong mainstream, while more than 120 dams are planned for the tributaries.



Source Open Development Mekong (2015)

Figure 1.1 Dam Development Project

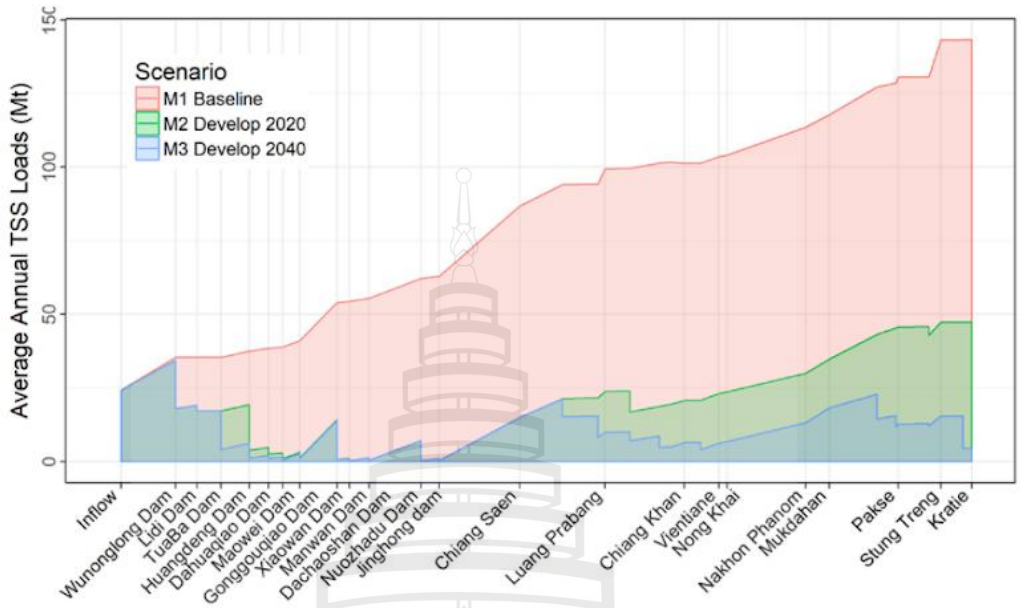
Due to the series of dam development in the mainstream and tributary of Mekong River, the huge impact on downstream people have arisen. According to the Mekong River Commission (MRC) report, "The Mekong River Basin encompasses a vast range of geographic and climatic zones. As a result, it is endowed with diverse and abundant natural resources". Obviously, the Mekong River is a collection of natural diversity for both human and non-human species who rely on ecosystem services in the Mekong River, which was mentioned by the Convention on Biological Diversity (1992) as "a complex of living organisms and the abiotic environment with which they interact in a specified location". In other words, it is a nature cycle of living species in the same location, especially the interaction between human and non-human who got direct and indirect benefit from the ecosystem, basically are known as ecosystem services. The various necessities of life that nature provides, such clean water for consuming, clean air for breathing, healthy soil for growing crops, good weather for the pollination process, are produced through ecosystem services. Regardless of importance of Mekong River to human and environmental health and well-being, these ecosystem services are looked over and frequently taken for granted (United States Environmental Protection Agency, 2023). From this point can be analyzed that the healthier the river, the richer the ecosystem services.

The context of the river ecosystem is also significant. It refers to a complex network of interactions between living organisms and their physical environment within and around a river. In the case of the Mekong River, there is a collection of River ecosystem play as ecosystem services which means Mekong River as a shared River where living species interact to each other and get benefit from the resource, therefore, it is significant to highlight that ecosystem service in the Mekong River offers fresh water for human uses, food source for all living things, irrigation for abundant farming and a foundation for diverse cultural traditions. Moreover, the Mekong ecosystem is a crucial natural capital that maintains the quality of water, food chain and human security of a million living things.

Typically, an incredible 15,000 m3 of water (Mekong River Commission, 2010) enters the Mekong mainstream from the nearby basin area every second, and it is enough to fulfill the daily needs of 100,000 people in the basin (Mekong River Commission, n.d.). Large areas of wetlands and woodland are irrigated by the water, which helps to provide food, construction materials, and medication in addition to providing habitat for hundreds of different species. But when hydropower dams are constructed in the upper part, the Mekong River flows unnaturally, it also affects the balance of ecosystem and natural resources (Soukhaphon et al., 2021). For instance when the River flow is not stable, fish cannot lay eggs, Riverweed (locally known as Kai) cannot grow, which leads to people who rely on those free natural resources having trouble. In the study area, it is the alongside the Mekong River, which is the best location of Kai or Riverweed (Scitific name; Cladophora and Rhizoclonium). Every year farmers are going to harvest Kai in the dry season, but since the dam was established, the number of Kai has decreased and impact directly on women farmers who collect Kai as main occupation during harvesting time.

The hungry water effect was defined as a slow-onset disaster where the sediment in the Mekong River was stuck in the upper part. Hungry Water is caused by the sediment and nutrient losses to degrade soil on the Riverbank, Riverbank erosion and River weed bloom (Manpati, 2022). The Mekong River Commission stated that the sediment in the Mekong River will remain at only 3% by 2040 as mentioned in figure 1.2 (Mekong River Commission, 2019). In the Northeast part of Thailand, there was an obvious result of the hungry River when the Mekong River changed to blue

color, not brown as naturally. In the Northern part, sediment has decreased to a critical level.



Short Tiltle	Description	Detail Information
M1	Baseline 2007	Infrastructures of six related sectors in 2007
M2	Development 2020	Infrastructures of six related sectors in 2007, currently under construction and planned for 2020
M3	Development 2040	Infrastructures of six related sectors in 2007, currently under construction and planned for 2020 and 2040

Source Mekong River annual commission report (2019)

Figure 1.2 The severe of hungry water effect

Furthermore, the extensive devastation inflicted by the floods in the vicinity of the River can be credited to the ‘hungry water’ phenomenon triggered by the sudden influx of sediment-deprived water from the upper parts of a River. The hungry water effect has had a major factor creating flood hazard especially in the dam nearby area such as Chiang Khong. According to United Nations Office for Disaster Risk Reduction (UNDRR) (2015), stated that disaster is a serious disruption of the

functioning of a community or a society due to hazardous events interacting with exposure, vulnerability and capacity conditions, leading to one or more of the following: human, material, economic and environmental losses and damage. Therefore, last year Kunming-Montreal Global Biodiversity Framework (GBF) was adopted at the 15th meeting of the Conference of Parties to the UN Convention (UNEP, 2022). The GBF includes four goals and 23 targets to be achieved by 2030, and also four long-term goals for 2050 related to the 2050 Vision for biodiversity. This study will adopt Target 8 and Target 11 of the GBF which are related to natures contribution to people and ecosystem services and climate adaptation and mitigation, respectively.

In places of Wiang Chiang Khong, located along the banks of the Mekong in Chiang Khong, the hungry water acted more vigorously because soil-covered banks characterize these areas compared to the rocky banks upstream. Moreover, the impact worsens with climate change, significantly affecting stream flow and sediment flux (Shrestha et al., 2018). The change in temperature and rainfall can also significantly affect soil erosion and sediment transport capacity. Although the heavy rainfall contributes significantly to the floods, the impact of hungry water was more conspicuous. So, utilizing the Kunming-Montreal Global Biodiversity Framework, this research will explain how hungry water negatively impacts biodiversity and function of ecosystem services (T11) and environmental governance is highlighted to minimize the impact of Hungry water through community adaptation process (T8).

In the sense of disaster management refers to an organization's or community's ability to coordinate assets and responsibilities during times of uncertainty. It covers disaster mitigation, preparedness, response, and recovery from natural hazards according to before, during and after the disaster event (UNDRR, 2015). The UNDRR defines disaster-risk management as the systematic method of implementing strategies, policies, and enhanced coping capacities to lessen the negative effects of hazards and the likelihood of disaster by utilizing administrative directives, organizations, and operational skills/capacities. When disaster risk management initiatives are effective, it tries to minimize the consequences of hazards by implementing preparedness, mitigation, and prevention-related actions and techniques. Therefore, the Sendai Framework for Disaster Risk Reduction is the

current framework for disaster risk reduction. It consists of four Key Priority Areas that logically cover every facet of disaster risk reduction. This framework was introduced on March 14, 2015, during the Third World Conference on Disaster Risk Reduction, which took place in Sendai, Japan, from March 14–18. By addressing the exposure and vulnerability of people and their assets, it creates the path for governments and societies to adopt practical actions to prevent the formation of new risks, lower the level of existing risks, and increase the social and economic resilience of communities.

By Priority 4 of Sendai Framework: Enhancing Disaster Preparedness for Effective Response and to "Build Back Better" in Recovery, Rehabilitation, and Reconstruction, it emphasizes the importance of community-based approaches in disaster adaptation efforts. It calls for the empowerment of communities to actively participate in decision-making processes and to integrate local knowledge, practices, and capacities into DRR initiatives. Therefore, community adaptation is one of main concern under the Sendai Framework. It refers to the process of adjusting to or mitigating the impacts of environmental changes to reduce vulnerability and enhance resilience. In the case of the hungry water effect, it requires adaptation strategies and actions that are planned, implemented, and managed by all stakeholders, taking into account their unique knowledge, resources, and vulnerabilities along with good measures and actions aimed at reducing the risk of disasters and enhancing the capacity of communities to prepare for, respond to, and recover from natural hazards and emergencies.

In addition, community adaptation is also a concern. In the Mekong region, it is a multifaceted process that requires collaboration, innovation, and empowerment at the local level to address the complex challenges posed by environmental change and socio-economic transformation. In this case the community adaptation should be raised to explain how local people adapt themself to the hungry water situation. At the national and local level, mitigation and adaptation are needed to support policy and disaster preparedness. In order to invest in, develop, maintain and strengthen people-centered to multi-hazard, the multisectoral forecasting and early warning systems, and emergency communications mechanism should be raised to take local people out of the risk situation.

The socioecological vulnerability refers to the susceptibility or exposure of social-ecological systems to harm, damage, or adverse impacts resulting from interactions between social and ecological factors. It emphasizes the interconnectedness and interdependencies between human societies and the natural environment, recognizing that vulnerabilities emerge from complex interactions between social, economic, environmental, and institutional factors. In the case of the Mekong River where people and nature are actively interconnected, when the hungry water has occurred, it forces social-ecological systems to be vulnerable due to the ability to withstand and quickly recover from the unexpected adversity.

Theories used in this research are Socioecological Vulnerability, Environmental Governance and Community adaptation in order to explore how hungry water's socioecological vulnerability affect the local communities and the river ecosystem, the adaptation process and the way that local government and community manage the situation of hungry water effect based on environmental governance theory. To understand the interaction between ecosystem in Mekong river and Chiang Khong community, DPSIR (Drivers–Pressures–State–Impact–Response) is intended to help understand environmental problems systematically and rationally, by distinguishing from the root cause to the impact and the response of society. In term of people and environment, DPSIR helps to reconnect between human behavior to environment and human impact. If we understand where the pressures come from then we can design appropriate responses. As DPSIR covers the economic, social and environmental sectors, it is suitable for use in conjunction with the principles of transparency, participation and accountability of Environmental Governance Concept.

From this, in order to achieve GBF, it is necessary to use environmental governance as a tool to examine function of local stakeholder (Figure 1.3) in the face of hungry water situation as well as how does local community adapt themself to the hungry water situation through three dimension of environmental governance which are (1) participation, (2) responsiveness and (3) effectiveness and efficiency. Therefore, this research highlights the importance of examining the hungry water effect as a contemporary hazard to the vulnerable community in Chiang Khong while also considering ecological vulnerability in the River as an interconnected socioecological system at risk of disaster.

1.2 Research Objectives

1.2.1 To analyze the socioecological vulnerability from the Hungry Water effect on the local communities and the river ecosystem in Chiang Khong

1.2.2 To examine the community adaptation process in the Hungry water situation which is classified under the environmental governance concept which are (1) participation, (2) responsiveness and (3) effectiveness and efficiency.

1.3 Research Questions

1.3.1 How does the hungry water's socioecological vulnerability affect the local communities and the river ecosystem in Chiang Khong?

1.3.2 How is the interaction between ecosystem and Chiang Khong community and how does they adapt themselves to the Hungry Water situation?

1.3.3 How do the local government and community manage the situation of hungry water effect based on three environmental governance dimensions which are (1) participation, (2) responsiveness and (3) effectiveness and efficiency?

1.4 Scope of the Study

This study is area-based research project conducted in Wiang Chiang Khong Subdistrict, Chiang Khong District, Chiang Rai Province, Thailand, during the period from June to September 2024. It focuses on the socioecological impacts of the Hungry Water Effect, an environmental phenomenon associated with sediment depletion and riverbank erosion along the Mekong River. The research specifically examines how this phenomenon affects the vulnerability of local ecosystems and communities in Chiang Khong, and how these communities adapt to its impacts.

The study involves 60 participants from six key sectors that are directly or indirectly related to or involved in responding to the Hungry Water Effect. These sectors include the fisheries sector, hydro-based farming sector, agricultural sector, local NGOs organizations and local government agencies. These participants provide

diverse perspectives and experiences that contribute to a deeper understanding of the local socioecological system under the Mekong River's changes. In addition to community-level impacts, this study also explores how local government institutions, particularly the Chiang Khong District Office and the Wiang Chiang Khong Municipality, have responded to the Hungry Water Effect. Their governance practices are analyzed through the concept of environmental governance, focusing on three core dimensions including participation, responsiveness, and effectiveness and efficiency. This multi-dimensional approach helps assess the quality and capacity of local governance in managing complex environmental challenges.

The theories and concepts using in this study integrates three key theoretical including the theory of socioecological vulnerability by Adger (2000), the concept of environmental governance as defined by the United Nations Environment Programme (2017), and the community adaptation and resilience as proposed by Jai et al. (2021).

Given that existing studies on the Hungry Water Effect in the Mekong River remain limited, particularly those focusing on its localized socioecological consequences and the governance responses at the local level, this research aims to fill that gap by providing in-depth insights into how a local community in northern Thailand experiences and responds to this transboundary environmental phenomenon. The findings are expected to contribute valuable knowledge for both academic scholar and policy recommendation in the context of environmental governance and community adaptation in the Mekong region.

1.5 Conceptual Framework

Hungry Water Effect is the environmental phenomena combined with dam development and climate change. Since the first establishment of the dam construction, there were changes interrelated to such phenomenon both in human and non-human organism. The socioecological vulnerability refers to the level which exposure, susceptibility, and the ability of the socioecological system regarding to predict, manage, and recover from the hazard are negatively altered by environmental degradation. From this point, the Chiang Khong community's livelihood and function

of the ecosystem are impacted by the Hungry Water Effect and become vulnerable to the disaster when the river's ecosystem services do not function well to maintain the quality of people's life.

The community adaptation is emphasized as the alternative ways of Hungry Water Effect's stakeholder in order to response to the changes both in livelihood, practice and policy. The on-going environmental challenges faced by the Mekong river region, especially dam construction upstream, the loss of vital sediments, and changes in rainfall and river flow, the local community are being forced to find new and alternative way to adapt to in order to protect their way of life. Therefore, a good understanding of local vulnerabilities, including local perceptions of the various forces driving change, traditional and historical adaptation strategies, and the strategies or management policy that already exists within local administration, NGOs and local residents, which analyzed in the figure 3, should be used as building blocks for strengthening resilience and identifying appropriate adaptation strategies. The dimension of participation, responsiveness and effectiveness and efficiency of Environmental Governance can facilitate community adaptation by providing the necessary resources, information, and support as well as facilitating community participation in decision-making processes.

Environmental governance and community adaptation underscores the importance of collaborative and participatory approaches to addressing the management of hungry water issues and promoting resilience at the local level. By strengthening governance in each stakeholder, fostering community engagement, and building adaptive capacity, societies can better navigate environmental change and create more sustainable futures.

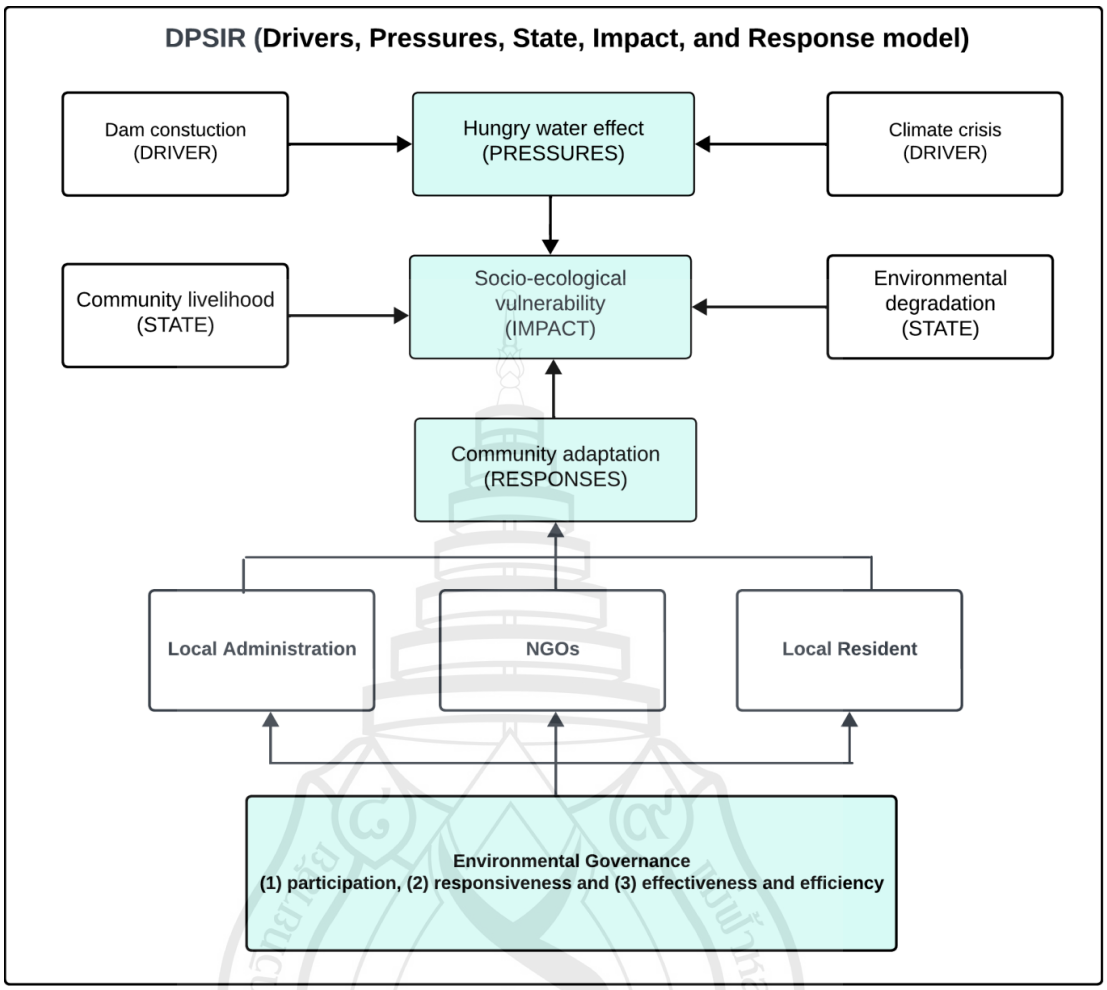


Figure 1.3 Conceptual framework

1.6 Research Outcome

The study provides valuable insights into the "hungry water effect" in the Mekong River Basin, highlighting the need for environmental governance among stakeholders to mitigate the adverse impacts of dam construction on mainstream ecosystems and communities. The outcome of the study is that enhancing the three dimensions of environmental governance prioritizing in this study including participation, responsiveness and effectiveness and efficiency can provide the evidence and policy recommendation on existing policy to ensure the long-term resilience and well-being of the Mekong River community.

In addition, this research highlights the importance of examining the hungry water effect as a contemporary hazard to the vulnerable community in Chiang Khong while also considering ecological vulnerability in the river as an interconnected socioecological system at risk of hybrid disaster. Finally, this research considers the unseparated interaction between humans and their environment are strongly affected and at risk by the hungry water disaster. Understanding socioecological vulnerability will provide new insight into the future direction of community adaptation for resilience in Thailand.

CHAPTER 2

LITERATURE REVIEW

2.1 Socio-ecological Vulnerability

Vulnerability is one of the defining components of disaster risk. It relates to several factors (UNDRR, 2017), including (1) Physical factors related to poor building design and construction, uncontrolled land use planning, etc. (2) Economic factors mean the uninsured informal sector, vulnerable rural livelihoods, dependence on single industries, globalization of business and supply chains, (3) Social factors: poverty and inequality, marginalization, social exclusion and discrimination by gender, social status, disability and age and (4) Environmental factor: poor environmental management, overconsumption of natural resources, a decline of risk regulating ecosystem services, and climate change.

Brooks (2003), Eakin et al. (2006), and Williamson et al. (2012) defined social vulnerability as the ability to adjust to changes in the social and environmental function. Conversely, Zang et al. (2017) define ecological vulnerability as the relationship between the ecological system's ability to adapt and its exposure to hazard. According to Maikhuri et al. (2017), socioecological vulnerability is associated with human and environmental capacity in any regional disaster. Therefore, it is necessary to identify risks and factors responsible for vulnerability. From Vincente and de Mesa (2008), the formulation of risk and vulnerability is explained in Figure 2.1 as follows:

$$Risk = Hazard \times Exposure \times vulnerability$$

Figure 2.1 Relationship between risk and vulnerability

In terms of social-ecological perspective, Berkes and Folke (1998) proposed a social-ecological resilience framework that highlights the interconnectedness of social and ecological systems and the need for adaptive management approaches to address

complex environmental challenges. Adger (2000) emphasizes the importance of social networks, community resources, and adaptive governance structures in promoting resilience at multiple levels. In the next six years, Adger (2000) has also considered the interaction between humans and their environment is inseparable. Therefore, if a community is at risk of any social and ecosystem changes, but does not adapt to those changes, it will become vulnerable.

The concept of Socioecological Vulnerability cuts across various sector related to environmental changes including fishery and tourism sector (Lazzari et al., 2021) in order to temperate coastal system. It reveals that depending on a single sector is risk to Socioecological Vulnerability and livelihood diversification is the possible way to reduce the vulnerability. The case study in the Mekong River basin shown that the institutional traps such as lack of decision-making rights and reliance on a single water source leading to water management is controlled from outside the community (Lebel et al., 2009). Also in Vietnam, the Socioecological Vulnerability is clearly demonstrated in the lower Mekong Delta, which is facing both saltwater intrusion from the sea and changes in agricultural policies. As a result, people who use the Mekong River for agriculture are facing serious problems and are vulnerable due to they are unable to adapt and cope with the situation in time (Smajgl et al., 2015)

The debate on Socioecological Vulnerability is discussed among ecological and social side. Ecologists often emphasize the resilience of systems, on the other hand, social scientists have instead focused on power, inequality, and access to resources (Cutter et al., 2008). In related concepts, resilience has been proposed as an alternative approach to the "vulnerability" perspective, which emphasizes risk and damage (Davoudi et al., 2012). However, critics argue that "resilience" often distracts from power structures and can become an excuse for not addressing structural inequalities (MacKinnon & Derickson, 2013). A second area of debate concerns vulnerability assessment, in particular, whether it should use quantitative indicator or qualitative and civic perspectives. Indices such as the SoVI (Social Vulnerability Index) have been criticised for potentially overlooking local contexts (Cutter & Finch, 2008), while the use of civic data (local knowledge, participatory mapping) has been questioned in terms of objectivity and spatial comparability (Ford et al., 2010).

Therefore, Socioecological Vulnerability in this study refers to the degree to which a social-ecological system is susceptible to harm from environmental changes and disturbances, and its capacity to cope with and recover from these impacts. It highlights the interconnectedness of social and ecological systems and how disruptions in one can affect the other. By using this concept is to explain the importance of examining the Hungry Water Effect as a hazard to vulnerable community which results in social and ecological degradation.

In terms of disaster resilience provides a more positive note rather than disaster vulnerability in the previous decade (Agrawal, 2018). In order to make people and communities more resilient to possible threats, it is important to address the underlying causes of those vulnerabilities. Disaster resilience is a shared responsibility among multisectoral actors starting from individual, then spread out to local communities, provincial level and federal level (Cutter, 2011). In the same way with the work of Rivera and Kaoucu (2015) which stated that increasing disaster resilience is complex and multiple levels of cooperation is necessary starting from government and institution to set the disaster management effort to interwinning risk management.

The relationship between vulnerability and resilience highlights the need of tackling the root causes of risk and vulnerability in addition to enhancing resilience and developing adaptive capacity at the individual, community, and institutional levels. Policymakers, practitioners, and academics may create more effective plans for lowering the risk of catastrophe, advancing sustainable development, and improving the welfare of vulnerable groups by combining vulnerability assessments with resilience-building initiatives. As Cutter et al. (2008) mentioned that a resilient community is potentially more successful to handle and recover from adverse circumstances, whereas extremely vulnerable communities may have less resilience to hazards or stresses. However, vulnerability and resilience are not necessarily mutually exclusive. Vulnerable populations may demonstrate remarkable resilience in the face of adversity, drawing upon social networks, cultural resources, and coping strategies to survive and adapt (Pelling, 2003).

2.2 Environmental Governance

One of the most crucial elements in guaranteeing efficient environmental management and conservation efforts is governance. Governance does not mean government (Wachhaus, 2013), rather, referring to the act of governing and being governed. In other words, governance is the act of entrusting a small group of people to enforce laws, establish norms, and specify behavior for the majority of people (The institute of Company Secretaries of India [ICSI], 2003). Upholding order, accomplishing goals, and attending to the needs of the community or population, all of these are dependent on effective governance. Many scholars develop various indicators and characteristics to measure the efficiency of governance. The United Nations Development Programme (United Nations Development Programme: UNDP, 2011, Chapter 8) has indicated the characteristics of good governance into six characteristics consisting of participation, inclusion, non-discrimination, equality, rule of law and accountability. While World Bank (1994) divided into eight major characteristics including participation, rule of Law, transparency, responsiveness, consensus oriented, equity and inclusiveness, effectiveness and efficiency, and accountability. However, the theory of good governance was applied in various fields of study, each field identified the characteristics of good governance differently, including public governance (Offe, 2009), private governance (Mendoza, 2015), global governance (Thakur & Langenhove, 2006; Dingwerth & Pattberg, 2006), collaborative governance (Vitasek et al., 2012) and also environmental governance. This study will focus mainly on environmental governance which applies to see how environmental resources are governed and managed.

The environmental problem has occurred for a very long time, as old as humanity. Since 1272, King Edward I of England has formed the law to ban the burning of sea coal to prevent air pollution (Benson & Jordan, 2015). This history of environmental governance obviously reflects the role of the central government in controlling and managing the environmental problems until it became a national act after the Industrial Revolution. However, government action accomplished little to tackle chronic air pollution in Britain's fast growing cities, with abatement efforts,

mostly regulatory in nature, generally left to local authorities. Currently, encompassed by multiple actors (Benson & Jordan, 2015). Apparently, environmental governance highlighted the importance of cross-scale governance combining state actor, market actor and individual actor through various kinds of partnership such as co-management, public-private partnerships (PPP) and private-social partnerships in order to manage the environmental resources (Lemos & Agrawal1, 2006).

The United Nations Environment Programme (UNEP) has defined environmental governance as the ongoing participatory process of making decisions on environmental issues. It comprises legally binding agreements, policy, and processes that govern environmental protection, in addition to institutions and organizations (UNEP, 2017). Over the past few decades, scholars have seen a gradual shift in the manner that the environment is managed. There are various sub-theory developing under the umbrella of environmental governance including common-pool resources management of Ostrom (2002) pursuing that external actors and institutions are needed. In the same way, Agrawal (2003) discusses the relationship between common-property and politics. It reflects that environmental management and political power in order to design management strategy are related. It may not be able to successfully address poverty, underdevelopment, and environmental degradation without paying attention to the politics that can generate these issues globally. On the other hand, if focusing only on the prism of institution and overlook human subjectivities to the environment to a greater or lesser extent, it also fails. Rather, it is critical to understand how these strategies and how they affect power dynamics mold human beings, their interests, and their agency. Therefore, environmental governance in this sense means the key component to guarantee efficient environmental management and conservation efforts.

“We understand global environmental governance (GEG) as the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection” – stated by Najam et al. (2006)

The statement mentioned above shows the significance of environmental governance that can be a process of environmental protection through policy and action. Najam et al. (2006) has mentioned that environmental governance can

command broad-based support in resources management through five goals including leadership, knowledge, coherent, performance and mainstreaming. In terms of Asian countries, during the late 1960s and early 1970s, the environmental problems were taken into account and began to be put into national policy. But due to the post-period of industrial revolution that most Asian countries developed environmental policy, law and norm from the model of western countries, so it was not successful and most of the environmental problems remained unsolved because of the differences of country background. However, the Asian economic crisis that began in 1997 has put a dampener on the region's rising environmental consciousness. And, ultimately, environmental governance belongs to the domain of public policy. Safety nets for the environment and society can only be established by governmental institutions and policies. Environmental policies need to be fully made public, incorporating all interested parties and societal groups.

The same pattern with a good governance perspective, environmental governance is discussed and developed into various characteristics. According to UNEP (2017), there are eight fundamental characteristics of good governance to ensure fair and effective manners, consisting of

1. Rule of law; refers to impartially enforced fair and equitable legal systems. A fair and incorruptible court and executive branch are essential.

2. Transparency; means decision making processes, as well as the enforcement of those decisions should be under a legal system and regulation. ‘In addition, information needs to be freely available and directly accessible to those who will be affected by such decisions and their enforcement’.

3. Consensus oriented; achieving a broad agreement on what is in the best interest of the entire community which necessitates taking into account the many interests within society.

4. Equity and inclusiveness; environmental governance should not benefit the majority but also include the minority, marginalized and vulnerable group.

5. Accountability; for those groups who are in the position of making decisions should be accountable to those who will be affected by their decisions or actions.

6. Participation; include direct and indirect participation. Participation in this sense requires the freedoms of expression and free association.

7. Responsiveness; requires processes and action to respond to all stakeholders who are at risk of any challenges in reasonable time.

8. Effectiveness and efficiency; referring to the result of any decision should meet the needs of society while making the best use of resources at their disposal. It also covers the sustainable use of natural resources and the protection of the environment.

The concept of environmental governance is adapted in various area around the world but there are both successes and in some cases, problems also arise. In the case of Amazon Rainforest, it is a positive case study of decentralized governance, which empowers local governments to manage forests and directly benefit from their conservation. This project promotes both environmental sustainability and poverty reduction but its success depends on transparency, access to information, and government support. This case study demonstrates that joint adaptation by local and the government will lead to the success of environmental governance (Schmink et al., 2019). On the other hand, the Lake Victoria Fisheries Organization (LVFO) is an example of multi-level environmental governance that unites three governments (Tanzania, Kenya, Uganda) in jointly managing fisheries resources but plagued by problems of weak enforcement, corruption, and overlapping governance levels (Onyango & Jentoft, 2010).

However, in many academic works have begun to question whether environmental governance, while sounding good in concept, does not always meet the requirements in practice, especially when faced with inequality, centralized state power, or authoritarian politics. In case of Participatory Wildlife Management in Kenya (Ribot et al., 2006), the Kenyan state has opened up space for community participation, but has used communities as a tool to reduce state costs rather than giving them real power. With this reason, the local community is unable to making any decision and conflict between local community and government has arisen. The same pattern with REDD+ (Reducing Emissions from Deforestation and Forest Degradation) that despite the emphasis on community participation, in Congo it has become a top-down mechanism by the state and foreign NGOs (Assembe-Mvondo,

2013). In South Africa where the government has tried to combine land rights restitution with resource conservation, such as establishing community-run protected areas, but the results have turned into conflict. It is because the state still controls through technical experts meaning that community has no real power and also there is conflict between the community and the conservation unit (Wynberg & Kepe, 2014).

The case of the Mekong River shows that environmental governance is still a problem and is just an idea that is widely discussed, but its actual implementation remains challenging. There is no real enforcement power, the upstream country (China) is not a full member of the MRC, or local communities are excluded from the decision-making process. Despite the Mekong River Commission (MRC) as a central water authority, major decisions but the construction of large dams in Laos, China and even the Don Sahong Dam are often made without real cooperation from all countries and lack enforcement powers (Hirsch, 2010).

Although the implementation of environmental governance still faces challenges in many aspects, however, managing environmental problems requires proper management principles in order to lead to sustainable environmental management. Therefore, this research will use three characteristics of environmental governance theory which are (1) participation, (2) responsiveness and (3) effectiveness and efficiency to examine the situation of the Mekong River's socioecological system (SES) as well as to explore the social dimension that enables ecosystem-based management through environmental governance. Such governance connects individuals, organizations, agencies, and institutions at multiple organizational levels. The analysis of environmental governance can explain the role of actors, especially local administration, NGOs and local community, and strategy conducted to manage resources in Mekong River under decision making process.

Regarding the three chosen characteristics, the dimension of participation plays a key role in environmental governance (Dong et al., 2023) especially those who have relevant environmental knowledge that can offer a helpful resource for the government to use while making environmental decisions. Participation in environmental governance can take various forms, including consultation, collaboration, co-management, partnership, and empowerment (Reed, 2008). Different levels of participation exist, ranging from individual participation to

community-based initiatives, stakeholder engagement in policy-making processes, and transnational governance mechanisms (Newig et al., 2010). The dimension of participation in environmental governance has been associated with numerous benefits, including improved decision quality, increased social legitimacy, enhanced social capital and trust, better implementation of policies, and increased capacity for innovation and adaptive management (Pretty, 1995). However, there are also challenges and limitations to participation, including issues related to power dynamics, unequal access to resources and information, representation of marginalized groups, conflicts of interest, and the complexity of multi-stakeholder processes (Cornwall, 2008). Successful participation often requires creating enabling environments that support meaningful engagement, provide adequate resources and support, promote transparency and accountability, and foster collaboration and trust among stakeholders (Leach et al., 2010). Participation enables communities to draw upon local knowledge, expertise, and traditional practices to develop contextually appropriate adaptation strategies that are socially, culturally, and economically viable (Barnett et al., 2008). Therefore, in the case of the Mekong River, public participation in decision making is significant to influence community adaptation as mentioned in USAID Mekong Adaptation and Resilience Report (2015) that participation is “crucial” to developing response systems and to sharing the responsibility of adapting to the threat. From this point reveal that successful community adaptation to the disaster cannot be achieved without public participation from stakeholder.

The dimension of responsiveness, according to the UNDP (1997) stated that responsiveness is a key dimension of good governance, which emphasizes the ability of governments and institutions to respond to the needs and aspirations of people. In the context of environmental governance, responsiveness involves the capacity of governance systems to address environmental issues in a timely, effective, and inclusive manner, while considering the interests of present and future generations (Lemos & Agrawal, 2006). Despite the importance of responsiveness, environmental governance systems often face challenges and barriers that hinder their ability to effectively address environmental issues. These may include bureaucratic inertia, vested interests, power imbalances, limited resources, conflicting priorities, and institutional fragmentation (Jordan et al., 2010). Ensuring responsiveness also requires

addressing issues of equity, justice, and inclusivity in decision-making processes, particularly concerning marginalized and vulnerable populations (Schlosberg, 2004). Therefore, the responsiveness of governance systems to disasters plays a crucial role in facilitating community adaptation and resilience by providing the necessary resources, support, and guidance to affected communities (Lebel et al., 2009). By fostering collaboration, coordination, and communication among stakeholders, responsive governance systems can help build resilience, reduce vulnerability, and enhance the capacity of communities to cope with and recover from disasters.

The effectiveness and efficiency dimension are characterized by clear goals, well-defined policies, robust regulations, adequate enforcement mechanisms, and measurable outcomes (Young, 2002). The OECD (1999) stated that evaluating the efficiency of environmental governance involves analyzing resource inputs, outputs, and outcomes to assess the cost-effectiveness of policies, programs, and interventions. However, effective governance systems can also enhance efficiency by reducing uncertainty, promoting regulatory certainty, encouraging innovation, and fostering private sector investment in environmental management (Potoski & Prakash, 2005). Achieving both effectiveness and efficiency in environmental governance requires balancing environmental, economic, and social objectives, as well as considering long-term sustainability and intergenerational equity (Fiorino, 2006). Governance systems that strike the right balance between effectiveness and efficiency are more likely to support successful community adaptation by providing the necessary enabling conditions, resources, and incentives for building resilience and enhancing adaptive capacity (Pelling & Manuel-Navarrete, 2011).

2.3 Community Adaptation

A focus on community adaptation is necessary because nowadays there are various disasters experienced most by people and most of people in the community have to adapt themselves to response to any disaster (Smit & Wandel, 2006). Regarding of disaster in community experience, the useful concept is resilience that emphasize to study adaptive capacity of community for instant, how they to cope

with, adapt to, and benefit from the changes (Nguyen & James, 2013). The Paris Agreement and Sustainable Development Goal 13 require measuring the progress made on disaster adaptation. As the work of Adaptation to Disaster Risk (Jia, 2021) mentioned that adaptation and adaptive capacity should focus on four core issues: (1) adaptation to what, (2) who adapt (3) how does adaptation occur and (4) what is adaptation and how good the adaptation.

Some study has merged resilience with the role of social capital in order to build community resilience in various contexts, especially in the context of disaster management (Aldrich, 2017; Pfefferbaum et al., 2017) which mentioned that resilience depends critically on social capital.

When the two concepts were merged together, there are six concepts that explain how social capital influences the rise of community resilience. The first concept is about community networking explained that the higher number of actors in social networks, the better of response to shock. The second concept is network diversity, it related to "bonding and bridging" of social capital. Bonding is coping with adverse conditions and shocks within communities. Bridging is aimed at knowledge sharing which helps to shape cooperation between groups. The third concept is about networking that helps with a combination of natural, physical, economic and human factors. The fourth concept emphasized the role of formal organizations, it relies on laws, national policy and regulations. The fifth concept involves network structures, norms and trust being related to proactive resilience. And the sixth concept highlighted the significance of socio-cultural dimensions of social capital in shaping proactive resilience.

In the book of Natural Disaster and Risk Management (Agrawal, 2018) has stated that, at community level, resilience can be enhanced through community perception and the simple step of providing basic needs of people such as education and affordable food will help to enhance resilience. In the same sense with Sok et al. (2011) that action taken by villagers could help build resilience at the household and community levels. Also another perspective from Mavelli (2019) argues that complexity challenges traditional top-down governance and forms the foundation for resilience as a postmodern governance approach. Resilience frameworks reshape

neoliberal perspectives on complex systems, critiquing "actually existing neoliberalism" which manages complexity 'from lower' levels of governance.

The debate on community development has been widely accepted as a tool for promoting community strength, especially in enabling communities to be self-reliant and participate in decision-making regarding their own resources. However, academic work in the past decades has questioned and criticized the community development approach in many aspects, including power structures, sustainability, and the role of the state or external organizations in defining the goals of development. The support school of thought believes that community development is a tool that can reduce power inequality by opening up space for people to play a role in managing their own resources or lives. For example, Freire (1970) proposed the concept of creating "conscientization" through the process of learning and critiquing the community, which leads to structural changes from the grassroots. Chambers (1994) also proposed the Participatory Rural Appraisal approach, which is a process of involving communities in analyzing problems and designing solutions by themselves, believing that the "true experts" are local people, not developers.

At the same time, many scholars have noted that community development in many contexts has become a tool for state or capital control rather than true community empowerment, especially when the participatory process is merely an invited space created by the state or NGOs without real community needs. Ferguson (1990) suggested that "development" is often made technical and anti-political, which prevents people from questioning power or structures. Meanwhile, Miraftab (2004) points out that neoliberal development approaches often emphasize community self-reliance, but on the contrary shift responsibility from the state to the people without providing real resources or power.

In terms of the Mekong River basin, there are two sides of literature in terms of community adaptation which are related to climate change and hydropower development. Looking at the adaptation to the particular risk due to change of climate pattern (Gustafson et al., 2018; Evers & Pathirana, 2018). Therefore it is crucial to create adaptation plans at the local level in a way that enhances resilience against the increasing threats. In terms of climate adaptation, the book of regional environmental change (Lebel et al., 2013) mentioned that in certain instances, local organizations

have the capacity to take a primary and pivotal role in introducing distinctive adaptation strategies tailored to the specific local environment, utilizing resources that are readily accessible within the community. Also, could serve as a driving force in facilitating the adoption of certain practices by offering technical expertise and material assistance to individuals.

Another factor is hydropower development which is classified as a major river of change in the Mekong River basin. To find the alternative way could be one solution to adapt to the changes for example in case of Vietnam, there is shifting the land use from agriculture to aquaculture in areas intruded by saltwater is an alternative way to increase income and to adapt to new flow regime conditions (Binh et al., 2020). In terms of gender, women have to adapt themselves to situations, not less than men. Once the hydropower was constructed, the role of women was changed due to the reason that they cannot rely on the Mekong River as used to be. It is related to human security lead to local people have to push themselves to survive in the uncertain environment (Uthai, 2018).

CHAPTER 3

RESEARCH METHODOLOGY

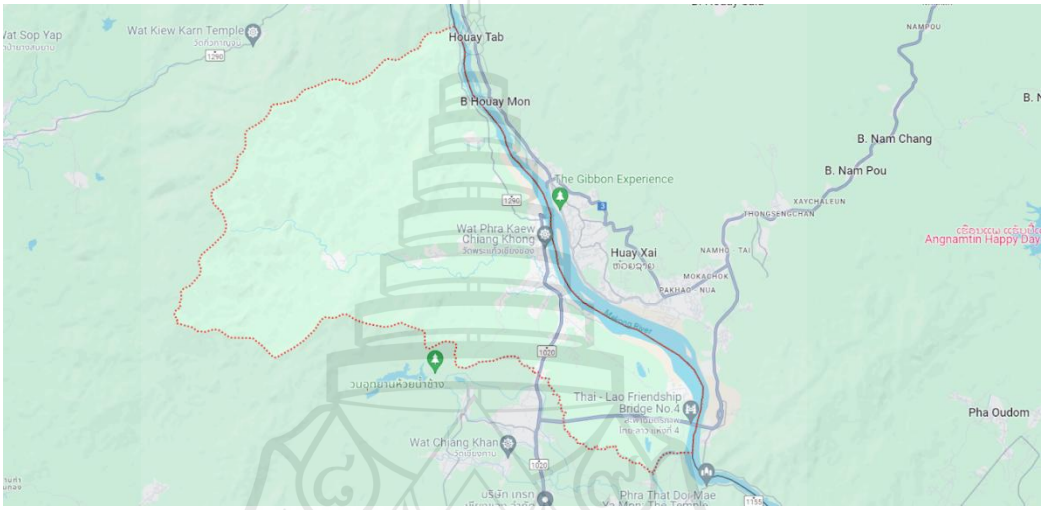
3.1 Research Design

This research will utilize mix methods by using both qualitative and quantitative in a case study of local people impacted by the hungry water effect based on the concept of socioecological vulnerability and disaster adaptation. The qualitative data will be collected by an in-depth interview based on six main careers of villagers who got impacted from the hungry water effect. Quantitative data is collected by questionnaire which applying Enhanced Vulnerability and Capacity Assessment (eVCA) from the International Federation of Red Cross and Red Crescent Societies (IFRC) into the question list.

3.2 Research Site

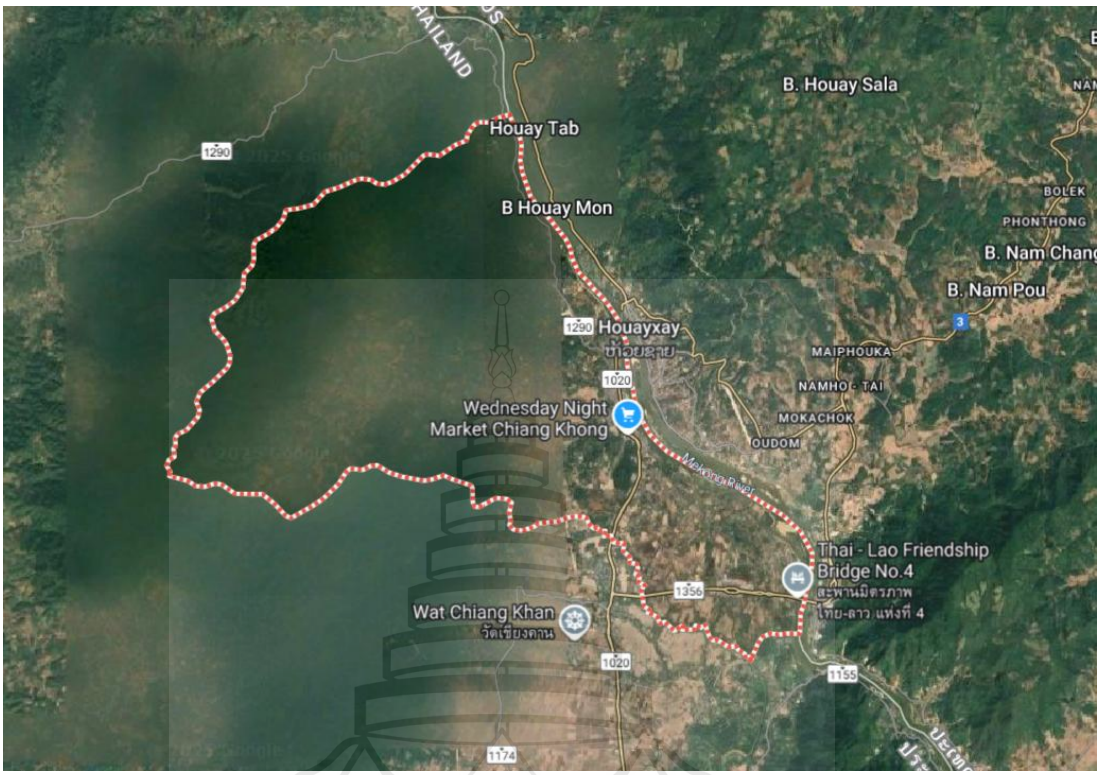
The site of the study will be conducted in Wiang Chiang Khong Sub-district, Chiang Khong district, Chiang Rai province which located close to the Mekong River and Laos PDR. The Hungry water effect was first reported in the northern part of Thailand around the area of Baan Had Krai (village no.7) which is located in Wiang Chiang Khong sub-district, Chiang Khong district. Wiang Chiang Khong Municipality covered approximately 1.8 square kilometers or 1,135 rai along the Mekong River with a long history that community livelihood and the River are tightly connected. Importantly, this area was popular for giant catfish (Scientific name; Pangasianodon gigas) due to the narrow area of River geography and the water flow smoothly, therefore it is possible to catch giant catfish, which is a fish that lives in deep water so it swims through this strait. Even though, currently, giant catfish are limited, the traditional culture about giant catfish still exists. In April every year, the relevant organization and villagers will organize a warship ceremony to bless the god

who protects the fish and community. Importantly, the Mekong area of Wiang Chiang Khong sub-district is one of the important origins of Riverweed or Kai (Scitific name; Cladophora glomeratawhich) it was popular until the community became known for Kai as one of community unique product. A professional group of housewives and farmers in this area has been established to encourage people in the community to have careers and additional household income.



Source Google Maps (2024a)

Figure 3.1 Location of Chiang Khong



Source Google Maps (2024b)

Figure 3.2 Location of Wiang Chiang Khong Sub-district

3.3 Data Collection

The interview questions separate in three themes, aim to reflect socioecological concerns and specific information on hungry water effects, their career experience related to the issues, and their adaptation. The interview will utilize open-ended questions and will be conducted during the field research in purposive sampling method to generate sampling populations of interviewees. Each interview highlighted the answer on the impact of hungry water on local people in Chiang Khong, the interaction between people and nature, and how they adapt themselves to be resilient and what are their alternative ways of living.

The sampling of interviewees was divided based on relevant occupational categories in using with Mekong River for their main career, there are 60 people in total as mentioned in table 1, consisting of (1) fishery sector, people who catch fish for their main salary and members of a fisherman union, (2) hydro-based farmers,

people who harvest Kai or other river foodstuff as their main salary and members of the OTOP union, (3) agricultural sector, people who use water from Mekong River for their agriculture, (4) business owner, people who use Mekong River for their business such as restaurant along Mekong, (5) NGOs, who working in the field and working with the change of Mekong River and (6) Local government, who working directly on water policy and water management strategy.

Table 3.1 Occupational categories

Occupational Categories	Number
1. Fishery sector	
Head of Pla Buak (Giant Catfish) union	1
Fishermen who catch fish in Mekong River for their main salary/member of Pla Buak (Giant Cat Fish) union	9
2. Hydro-based farmers	
Head of Kai (Riverweed) OTOP union	1
Farmer who plant vegetable in the River bank/ Farmer who harvest Kai in the Mekong as main salary	9
3. Agricultural sector	
Head of Chiang Khong agricultural group	1
Bean, Cucumber, Maize and Banana farmer	9
4. Business owner	
Head of Chiang Khong hotel union	1
Other business owner along Mekong	9
5. NGOs	
Rak Chiang Khong School, Living River organization and their network	10
6. Local government	
Head and staff in Chiang Khong sub-district level administration	5
Head and staff in Chiang Khong district level administration	5

3.4 Data Analysis

The data from the interview will be analyzed by using descriptive methods which explaining their perception on hungry water effect, livelihood experience and disaster adaptation.

To analyze the data, socioecological vulnerability, this thesis will apply The Driver-Pressure-State-Impact-Response framework (DPSIR) to explain the interaction between society and environment. The DPSIR framework aims to examine and evaluate environmental issues by uniting diverse scientific fields, environmental administrators, and invested parties, and to address them by integrating principles of sustainable development. Therefore, applying DPSIR helps to systematically analyze the issue, inform decision-making, and develop targeted interventions to minimize its adverse impacts on riverine ecosystems and communities. The indicators are categorized into drivers, which put “pressures” in the “state” of the system, which in turn results in certain “impacts” that will lead to various “responses” to maintain or recover the system under consideration (Ness et al., 2010)

In this case, based on the DPSIR framework, the hungry water effect is a driving force which got pressure from the trapping sediment behind the dams and the shift of climate pattern associated with driving forces that exert stress on the Mekong River. The sediment losses resulting from the pressures exerted by driving forces leading to the collapse of ecosystem and livelihood as impact of hungry water effect. Importantly, environmental governance and disaster adaptation are crucial to the actions taken to address or mitigate the impacts of environmental changes.

3.5 Ethic Consideration

The interviewees will be aged above 18 years old from each career sector. They will receive an ethics consent form before the interview and ask permission to put their message into research without showing their real name. All of this will be explained before the interview session starts.

CHAPTER 4

RESEARCH FINDING

The Mekong River is not only a vital waterway for the Chiang Khong but also a lifeline that sustains the socioecological fabric of the local communities. Chapter 4 explore into this complex relationship by examining the environmental governance mechanisms and the adaptation strategies employed by the community in response to the Hungry Water Effect. This chapter builds on the foundational concepts introduced in the Chapter 2, where the theoretical frameworks of environmental governance and socioecological vulnerability were reviewed.

In this chapter, the study focuses on the specific governance dimensions that influence the management of natural resources in Chiang Khong and assess how these structures support community adaptation. The chapter begins by introducing the phenomena of Hungry Water Effect which combine between dam construction and climate change. Following this, the Mekong River is looked as ecological services which provide benefit for the community and will explain the interaction between these ecological services and community. Also, it explores the practical adaptation strategies that the local community has developed in response to changes in the river's ecosystem, especially when sediments in Mekong River were stuck in the upper part.

The chapter also examines the role of various stakeholders, including government agencies, non-governmental organizations (NGOs), and local community groups, in shaping environmental governance and supporting adaptation efforts. By analyzing case studies and firsthand experience from community members, gaining insight into the effectiveness of these governance strategies and the resilience of the local population in the face of socioecological vulnerabilities.

4.1 The Interaction of Ecosystem Services and Mekong River Community

DPSIR or (Drivers, Pressures, State, Impact, and Response model of intervention) is a causal framework using to explain how society and the environment interact to each other. The DPSIR Model describes five indicators of Socioecological Vulnerability linked with divers, pressures, state, impact, and response. Based on the DPSIR model, it states that 'drivers' which put 'pressures' in the 'state' of the system, which in turn results in certain 'impacts' that will lead to various 'responses' to maintain or recover the system (Ness et al., 2010). With this reason, DPSIR is a tool that helps to analyze complex socioecological systems by considering at cause-effect relationships between different factors. Therefore, it will be shown that when drivers and pressures occur in the social-ecological system, changes in environmental state will affect social systems and how the resulting effects lead to responses to those changes.

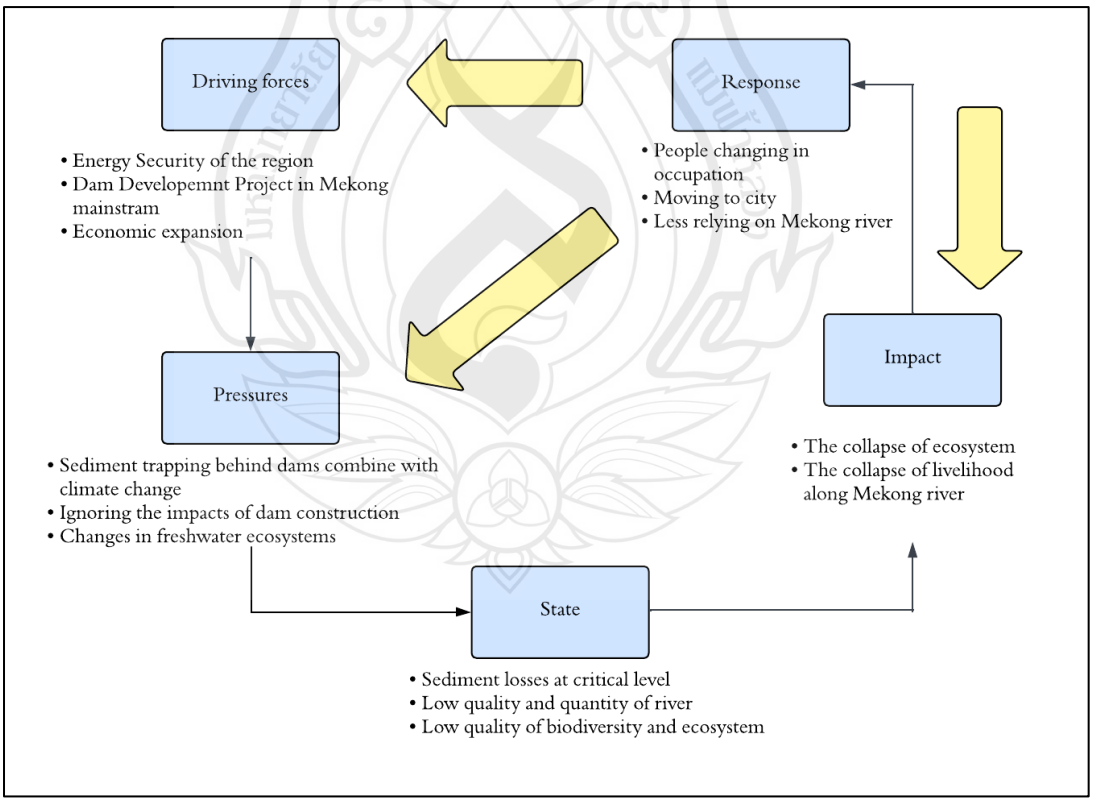


Figure 4.1 DPSIR framework

The DRIVER: In the figure 8 shown that energy security and economic expansion have led to a large number of mainstream Mekong Dam projects, despite reports stating that dams may not be the best solution for the energy transition due to environmental and ecological damage. However, the increasing number of hydropower dams on the Mekong River shows that this is the main driver of the Hungry River Effect in the communities along the Mekong River, which has direct impacts on social and ecological dimensions.

The PRESSURE: As mentioned in Chapters 1 and 2, the Mekong River provides ecosystem services to people along the Mekong River, especially in Wiang Chiang Khong, who have relied on the Mekong River's ecological services mainly for their daily living. The relationship diagram in Figure 12 shows that there are many changes that put pressure on the communities, including the decrease in sediment, which makes the Mekong River more clear, which has an impact on life and the cycle in the Mekong River. When sediment decreases, minerals and fertility are also decrease, resulting in pressures which are ignoring impacts that may occur directly from dam construction.

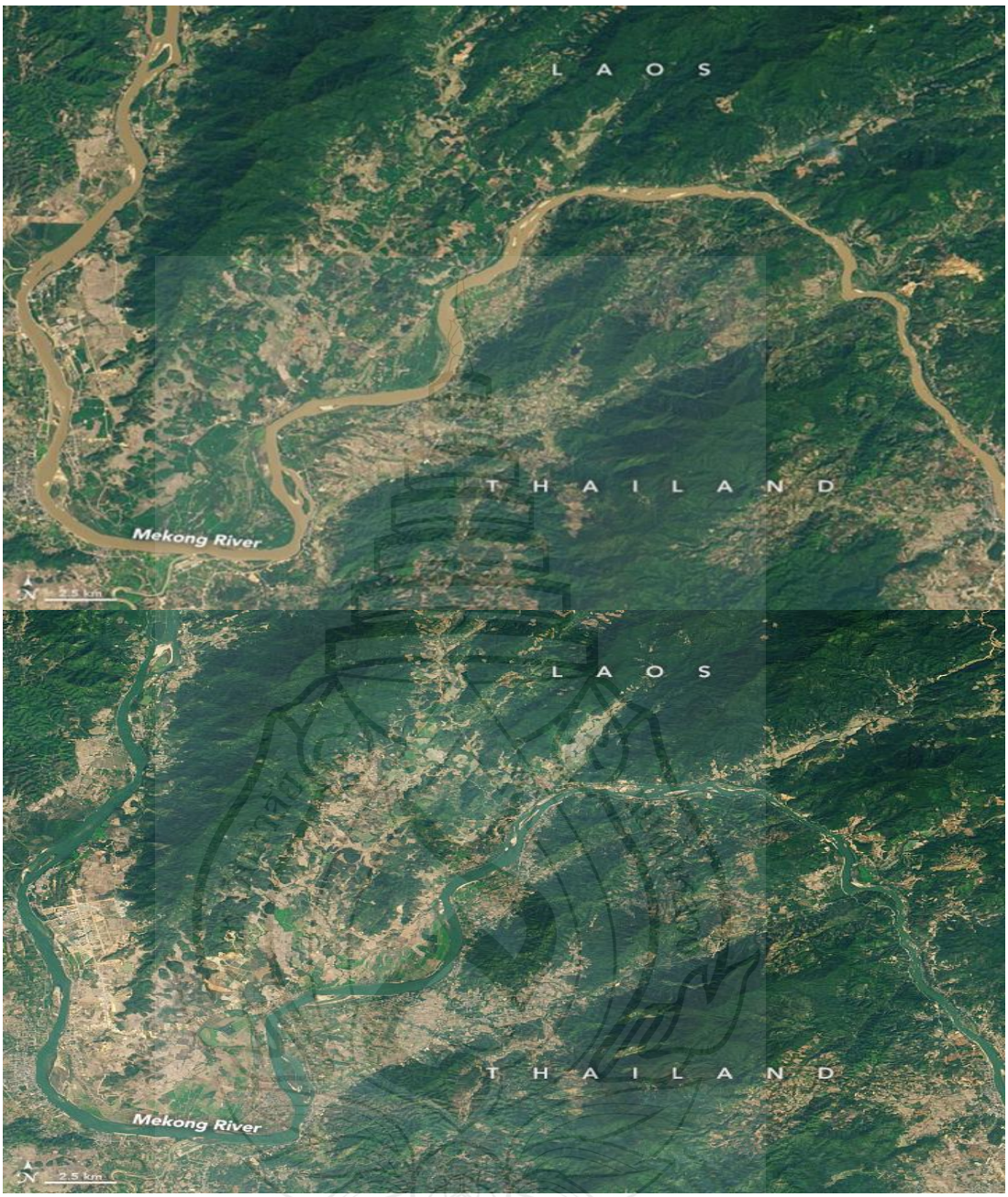
The STATE: The current state of the socioecological system is the amount of sediment in the Mekong River has significantly decreased. From the MRC report, it shows that the sediment in the Mekong River will continue to decrease to 97% by 2040, including the current quantity and quality of the Mekong River has significantly decreased. It can be seen from the color of the Mekong River changing from brown to blue, as shown in Figure 9, which is a satellite image comparing the color of the Mekong River in January 2015 and 2020. It can be seen that the color of the Mekong River has clearly changed. In addition, from the interviews with fishermen in the study area, all 10 fishermen unanimously said that from their lifelong experience fishing, the fish amount in the Mekong River has decreased by more than 90%. The farmers who rely on the Mekong River for agriculture also said that finding raw materials along the Mekong River, such as riverweed, is becoming harder to find and the quality is not good enough to use.

The IMPACT: From the current situation that has occurred, it related socioecological impact which mean when dams are constructed and the amount of sediment in the Mekong River are decreases, the functioning of ecosystem services in

the Mekong River also collapse. Therefore, the livelihood of people along the Mekong River has reached a point where they have to adapt to the changing environment. The collapse of the Mekong River ecosystem has led to the collapse of the way of life of people living along the Mekong River.

The RESPONSES: The only way to survive in this area, that is at risk and vulnerable to the Hungry River Effect, is to adapt and respond to the main drivers, pressures, and impacts. The community's adaptation method here is to change their main occupation from relying on the Mekong River ecosystem services, based on interview, to other occupations that rely less on the Mekong River, including leaving the area to seek other occupations in the city. All of the adaptations that the community has made have continued to the local culture that may be disappeared.

From the Hungry Water Effect situation, it is shown through the DPSIR Model that the construction of dams on the mainstream of the Mekong River is an important variable in the natural phenomena that occur, both the abnormal fluctuation of the river, the retention of river sediments that cause the collapse of the ecosystem, and most importantly, the destruction of the natural cycle that supports millions of people. It is therefore clear that when the Mekong ecosystem changes, the ecological services that people in Chiang Khong rely on are destroyed, causing changes in people's way of life, including lifestyle, economy, culture, and participation in decision-making. This makes Chiang Khong socioecologically vulnerability due to its primary dependence on the Mekong River, as well as the uncertainty of life in the midst of constant disasters.



Source Earth Observation

Figure 4.2 Change in Mekong River color

4.2 The Hungry Water Effect on Local Communities and River Ecosystem

4.2.1 Hungry Water Effect in Mekong

The Mekong River flows from the Tibetan Plateau to low land before entering the delta in Vietnam (Mekong River Commission, 2019), the process of flowing from high plateau to the sea level, it loses its stored energy in various way including the first step of boulders and cobblestone transport, at vegetation along the bank, in bends, in irregularities of the channel bed and banks, and in sediment transport. The water forms a system of Rivers and channels as a result of these processes (Carling, 2009). Complex patterns are formed by the splitting and joining of these channels. Along the way, the flow of water also produces a variety of habitats, including floodplains, wetlands, and Riverbanks, all of which are home to diverse kinds of species. The transportation process of sand and gravel in the River plays a significant role in shaping River channels. In other words, it helps to determine the size, shape, and path of the River (Mekong River Commission, 2019). The 'Hungry Water' occurred due to the continuity of sediment transport is interrupted by dam construction or eliminating the sediment from waterway due to mining, it will lead to less sand and gravel available for the water to carry, the River channel may change or become narrower, deeper, or even shift its course. This kind of situation happens because the River has less material to build and shape its bed and banks until it becomes sediment-starved as it called 'Hungry Water Affect' (Kondolf, 1997).

Consequences of severe Hungry Water reflect on various dimensions especially River bank erosion and habitat degradation. The phenomenon of hungry water has been studied in many areas, for example, in the case of Isar River, Eastern Alps, Germany (Heckmann et al, 2017). Due to the dam construction which creates a reservoir trapping most of the sediment that the River carries, the water flowing out of the dam is clear and lacks sediment. These changes can be harmful to the ecosystems downstream. Plants and animals that rely on certain River conditions might lose their habitats. Fish might have trouble spawning if the Riverbed is too eroded. Dams disrupt the natural flow of sediment in Rivers, causing the water downstream to erode

the Riverbed and banks more aggressively. This can lead to significant changes in the River's shape and negative impacts on the environment (Heckmann et al, 2017).

In the case of the Mekong River, the Hungry Water Effect is characterized by reduced water flow and sediment load downstream of large hydropower dams (Kondolf et al., 2014). In this work has calculated cumulative sediment trapping by hydropower dams, it results that under full construction of all planned dams, cumulative sediment trapping will be 96%. The sediment starved-River has significant ecological, socio-economic, and environmental implications for the Mekong basin, which supports one of the most biodiverse and productive freshwater ecosystems in the world. According to China's economic development plan, the Mekong River flow patterns have changed and the fluctuation has been more severe after the dam operation. The hydropower dam greatly influenced the sediment flow and transport which impacted the community downstream (Soukhaphon et al., 2021) and later becoming a cause of hungry water in the Mekong River. Moreover, the shift in climate patterns has become a global crisis which directly impact on global environmental and socio-economical issue making Hungry Water Effect more severe. In addition, the massive flood in 2009 has resulted in a change in the flow duration and characteristics of Mekong River, adversely affecting both community livelihoods and the ecosystem along the River system (Chantha & Ty, 2020). In the work of Kondolf et al. (2018) has stated that, by the year 2100, almost half of the delta's land area is projected to be submerged below sea level due to the issues of sediment load and its transportation. The Mekong River community is increasingly vulnerable to this kind of this damage. From this point of view obviouse show the hungry water effect in Mekong, currently, has created sediment-related impact on ecosystem health (Wild & Loucks, 2012).

In 2014, the study of Kondolf (2018) mentioned that the total sediment reduction to the Delta in a "definite future" scenario involving 38 dams (constructed or under development) would be 51%. Cumulative sediment trapping will reach 96% when all planned dams are built out. That is, it would be projected that just 4% of the pre-dam sediment load would reach the Delta after in-channel stored material is depleted. The same result with the Mekong River commission's annual report in 2019 (MRC, 2019) stated that by 2040 at the delta, there will be only 3% of sediment. The

results of the two studies show that hydropower dams have caused a great deal of harm to the Mekong River. This scenario indicates that ways of transporting sediment through or around dams should be researched in order to minimize the effects of downstream sediment starvation. It would also have significant effects on the efficiency of the River and the resilience of the Delta landform itself.

The severity of hungry water results in erosion and loss of habitat, reduced sediment load downstream disrupts the natural processes of sediment deposition and erosion, leading to loss of habitat for aquatic species and degradation of Riverine ecosystems (Kondolf, 1997). Sediment-starved reaches are more susceptible to erosion, which can further exacerbate habitat loss and destabilize Riverbanks. Also, as a result of fisheries, the Mekong River supports one of the world's most productive inland fisheries, providing livelihoods and food security for millions of people. The hungry water effect can disrupt fish migration patterns, breeding habitats, and nutrient cycling, leading to declines in fish populations and biodiversity loss. This poses significant challenges for riparian communities who depend on fishing for their livelihoods.

As a result, the Mekong River's "hungry water effect" calls for an integrated strategy that takes into account the intricate interactions between political, social, and ecological variables. This might entail multi-stakeholder cooperation among riparian countries, enhanced sediment control techniques, sustainable fisheries management, and strategic planning. Stakeholders may seek to mitigate the hungry water effect's negative effects and promote the long-term sustainability of the Mekong basin environment by understanding its dRivers and implications.

4.2.2 Dam Development in Upper Mekong River

The Mekong River Commission (MRC) have stated that the Mekong River is one of the world's largest rivers, flowing 5,000 kilometers through China, Myanmar, Laos, Thailand, Cambodia before going to the delta in Vietnam. A brief history of dam development, the first large dam in Laos was completed in 1971, called the Nam Ngum Dam which is located in upper part of Mekong River. However, Cold War prevented the dam construction for few decades until the Pak Mun Dam began constructed on the Mun River which is knew as the most important Mekong tributary in Thailand in 1990 (Missingham, 2003). In China part, the first dam was constructed

in 1990 as well, called Manwan Dam, and completed in 1993. Later, the Nam Theun Hydropower Project located in central Laos is the biggest dam ever constructed in the Mekong River Basin, receiving approval from the World Bank in 2005 (Porter & Shivakumar, 2011). During the 2010s, there was a notable rise in the building of hydropower dams, particularly in China, Cambodia, and Laos. Laos, for instance, had 61 hydropower dams with a combined capacity of 7207 MW and an annual generation capability of approximately 37,366 kilowatts (Liangyu, 2019). In China, the 2010s witnessed the construction of many significant dams, notably the Xiaowan and Nuozhadu Dams, on the main Lancang (Mekong) River. Currently, the main Lancang River in China is the site of 11 dams, and there will be more dams constructed on the River's tributaries (Chen et al., 2020).

In the case of Chiang Rai province, northern province in Thailand, there were about twelve large dams (Consisting of Wononglong Dam, Lidi Dam, Tuoba Dam, Huangdeng Dam, Dahuaqiao Dam, Xiaowan Dam, Manwan Dam, Dachaoshan Dam, Nuozhadu Dam, Jinghong Dam, Luang Prabang Dam and Xayaburi Dam) nearby both in Laos and on the Chinese side. In term of storing water, only Nuoxhadu and Xiaowan Dams alone storing water counted as 8% of the total amount of Mekong River (Binh et al., 2018). In Thai scholar perspective, Wichian proposed 'Transnational Enclosure' in the upper Mekong region as one-sided development that focuses only on economic development and neglects other impacts (Santasombat, 2004). Therefore, transnational enclosure began with decision making that was open for state and capitalist occupied local territory, and transformed into expandable resources. The enclosure against local people, River, wisdom and local universe out of their culture by forcing them into new cultures that give all benefit to state and capitalist. It mentioned the Mekong River was taken from self-dependency into state-property leading to the Mekong River was transferred into exploitable economic resources and many development projects occurred alongside the Mekong River. Therefore, the transnational and national development projects both caused ecological impact and degradation of natural resources.

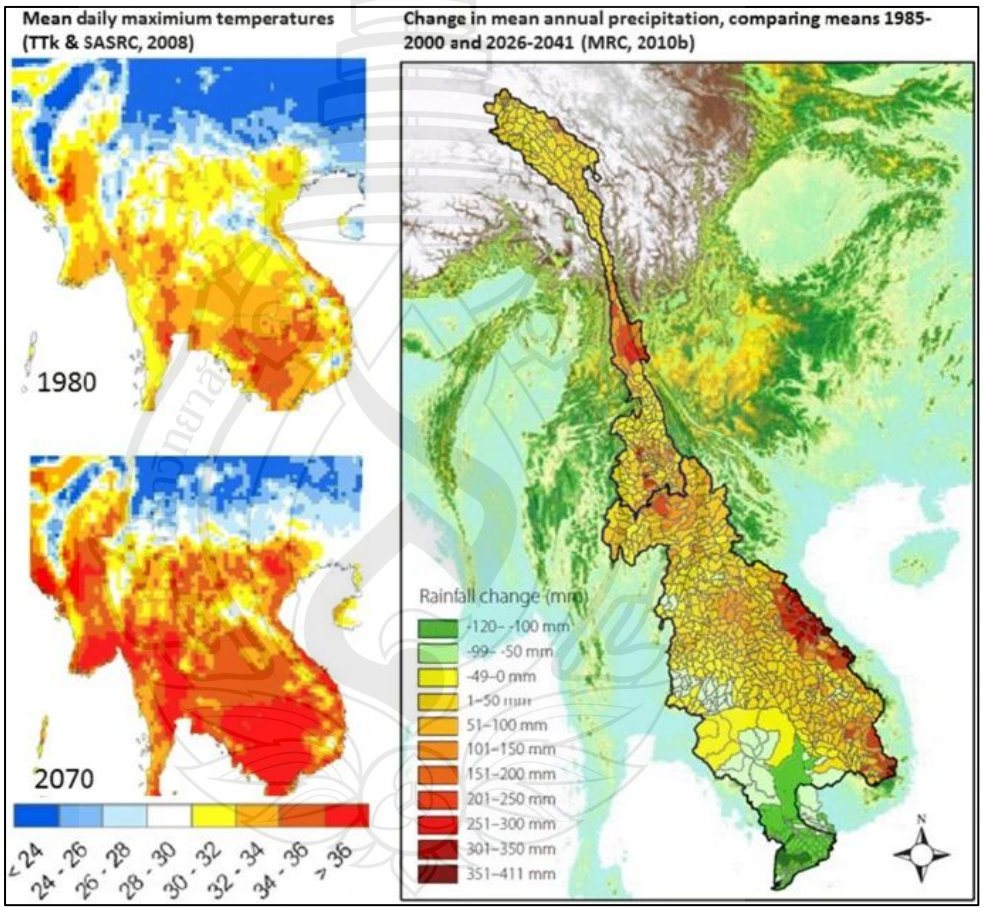
4.2.3 The Shift of Climate Pattern in Mekong River

The safety and sustainability of the water resources in the Mekong River basin are seriously threatened by climate change (Hoang et al., 2016). However, there are

significant challenges to socioeconomic growth in the Mekong River basin related to water resources, such as climate change-induced hydrological shifts. Previous research indicates that the hydrological regime now in place will change due to climate change, presenting difficulties for ecosystems and socioeconomic advancements (Eastham et al., 2008; Hoanh et al., 2010; Västilä et al., 2010). For example, models of the Mekong's flow regimes under various climate change scenarios by Västilä et al. (2010) and Hoanh et al. (2010) indicated that the hydrological cycle will probably intensify, leading to higher annual and seasonal River discharges. As a result, they also propose that rising River flows in the floodplains of Cambodia and Vietnam during the rainy season raise the danger of flooding. Some research also raises the possibility of a discharge decrease during the dry season in some specific climate change scenarios (Lauri et al., 2012; Kingston et al., 2011).

Monsoonal activity, particularly the south-west monsoon and, to a lesser degree, the north-east monsoon, is the primary dRiver of the hydrological regime of the Mekong (Costa Cabral et al., 2008; Delgado et al., 2012). While the north-east monsoon is active from November to February, the south-west monsoon is more prevalent from May to September. The hydrology of the basin is divided into two hydrological seasons with unique flow characteristics by these monsoonal processes. The wet seasons, which run from June to November, provide a significantly higher percentage of the yearly flow. According to calculations from MRC (2010), the wet season flow makes up between 75% and 85% of the overall yearly flow, depending on the area. A highly productive aquatic ecosystem and one of the world's main rice production areas are supported by seasonal variation in River flow, particularly the flood pulse that occurs in the downstream delta (Lamberts & Koponen, 2008; Arias et al., 2012). Hydrological changes in the Mekong River, like extreme floods and droughts, create serious safety risks and economic problems. Floods can destroy crops and infrastructure, causing huge financial losses. Droughts reduce the water available for farming and can lead to saltwater moving into the River, further harming agriculture and local communities. This is especially problematic in the low-lying areas of the River delta, where these impacts are felt the most.

Moreover, the impact worsens in an era of shifted climate pattern, it significantly affect stream flow and sediment flux (Shrestha et al., 2018). The shift in climate pattern can also significantly affect soil erosion and sediment transport capacity. So, the impact of hungry water was more conspicuous. According to figure 4.3, the ECHAM4 A2 climate scenario, the Mekong River basin experiences average regional warming. In addition, the summer months or the warm season generally last longer. The climate scenario demonstrates a rising trend in precipitation, which is the consequence of increasing rainfall intensity as the length of the rainy season approaches that of the baseline decade.



Source TTK and SASRC (2008)

Figure 4.3 ECHAM4 A2 climate scenario

Therefore, relating to the phenomenon of Hungry Water, the flows in the Mekong River are affected by both human activities especially dam development and climate change. In addition to the vital relevance of water flow for maintaining

livelihoods in the basin, nutrient and sediment fluxes are also essential for maintaining farmland and preventing coastline erosion in the Mekong Delta. Shrestha et al. (2018) assess the effects of reservoir building and climate change on sediment discharge in the Nam Ou River in Laos, a tributary of the Mekong River Basin, as well as the effects of climate change on reservoir sedimentation. They evaluated sedimentation rates in the absence of climate change and under several climate change scenarios, including the establishment of one, three, or five reservoirs in succession in the River. According to Shresta et al., the Nam Ou Basin's increased sediment yields due to climate change will have a detrimental effect on the reservoirs' ability to store water. But the construction of reservoirs will reverse that trend and lower the outflow's sediment load by 44–89%. They come to the conclusion that the construction and maintenance of dams affects downstream flows considerably more than does climate change. Therefore, they advise looking into suitable reservoir management techniques even more in order to prolong the life of reservoirs and maintain the downstream functions that sediments offer.

Previous research has unequivocally demonstrated that the Mekong River's sediment movement is directly impacted by climate change. The loss of significant sediments and minerals, which are essential for maintaining the river's health, is anticipated to occur in the near future, particularly when it combine with the construction of over 80 dams in the upper part of the river. The Mekong River plays a crucial role in sustaining the livelihoods of millions of people living along the riverbanks. Its rich sediment deposits not only support the river's diverse ecosystem but also provide essential nutrients for agriculture, fisheries, and overall biodiversity. However, the increasing impacts of climate change are disrupting the natural sediment transport in the Mekong River. These changes have led to reduced sediment loads, altering the river's hydrological dynamics and posing serious threats to its ecosystem. The construction of over 80 dams in the upper section of the Mekong River further exacerbates this issue. As a result, sediment deposition downstream is significantly reduced, leading to the degradation of the River's ecosystem. The loss of sediments and minerals impacts not only the physical characteristics of the river but also its biological processes. Therefore, the Mekong River's sediment transport is facing

unprecedented challenges due to the combined impacts of climate change and the construction of dams (Warner, 2010).

However, the researcher conducted interviews about the most frequent hazards occurring in the study area according to the EVCA procedure and concluded that the Hungry Water Effect, where the amount of sediment in the Mekong River significantly decreased, caused two hazards to the community which are the water became clearer and water become uncertain, which resulted in many subsequent impacts further.

4.3 Socioecological Vulnerability Affect to Chiang Khong Local Community

The Hungry Water Effect is a phenomenon that occurs when Mekong Rivers have insufficient sediment loads related to their erosive capacity, often due to upstream damming. This causes the water to seek sediment by eroding riverbanks and beds, leading to significant changes in the river's morphology and environment. In the case of Chiang Khong, the socioecological vulnerability to the Hungry Water Effect is a significant concern due to the presence of upstream dams and environmental changes. And it is one of the causes of hazard in Chiang Khong, especially the concern of riverbank erosion. Additionally, climate change and dam construction in the upper Mekong River are the main causes of flood disaster in Chiang Khong. Therefore, the hazards that occur frequently in Chiang Khong are significantly related.

From interviews with 60 representatives in total, found that the socioecological vulnerability of Wiang Chiang Khong sub-district has impacted two major dimensions:

1. Environmental Losses Impact

The Mekong River is one of the world's most biodiversity rivers, second only to the Amazon and Congo River, and is home to around 1,148 species of fish, with millions of people relying on it for their livelihoods. The MRC report on hydrology, flood and drought (2019) stated that 19% of the river's fish species are

severely threatened by the environmental changes, highlighting that the decline in fish stocks will impact the millions of people whose livelihoods depend on it. According to the report from 25 regional and international groups, examined impacts of the 4,900 kilometre (2,600-mile) river, mentioned fish populations have declined by 88% between 2003 and 2019. Also, 74 fish species are assessed as vulnerable to extinction, with 18 critically endangered.

The result is the same as with the interview result, most of fishermen and farmers who mostly rely their life on Mekong River said that compare to 20-30 years ago, fishing was the main occupation and main income for people in Chiang Khong, especially for villagers in Wiang Chiang Khong Municipality who live along the Mekong River. According the interview of participant no.7 (P7) mentioned as following message;

“Nowadays the number of fish in the Mekong River has decreased by more than 90% (based on their experience). Even if you have a boat, you can’t go out to catch fish. The fish you catch are not tasty (as shown in figure 4.4) because the tasty fish have all become extinct”

The phenomenon of the Hungry Water Effect has resulted in a decrease in the amount of sediment. The River is very clear, causing the quality of the Mekong River decrease and the number of fish has also decreased accordingly. As shown in figure 11, if comparing to the past, for 2-3 hours per day fishermen can catch fish almost full of the cage. But in nowadays, it significantly decreases from full of the cage to just only small proportion. From interviews with fishermen, when comparing the number of fish nowadays to the past, the leader of the Chiang Khong local fishermen group said that the amount of fish has decreased by 90%. Although fishing is a professional career that requires high skills and experience, due to the uncertain situation of the River and the obvious decrease in the number of fish, fishermen can no longer be a main occupation. However, fishing still exists, but it is only a hobby to provide food for the family on some meals not main income of salary.

Note Taken by author

Figure 4.4 Fish in Mekong River nowadays

Note Taken by author

Figure 4.5 Fried fish

The decrease in sediment in the Mekong River has a direct impact on the River ecosystem, causing the abundance of river resources to decrease. Not only fish but Kai or Riverweed has also decreased in both quantity and quality. This includes

the cultivation of bean sprouts using sediment from the Mekong River for planting, which has problems with unstable water flow and the quality of sediment that affects the size and taste of the bean sprouts.

From interviews with farmers who work in agriculture along the Mekong River, they said that the clarity and uncertain of the water make farming more difficult because farmer cannot predict the daily changes in the Mekong River. Therefore, relying on the Mekong River has now become an alternative rather than the main way of living. Farmers who grow bean sprouts along the Mekong River said that in the past, they would grow bean sprouts on the bean sprout island as shown in figure 4.6, which is an area where the Mekong River has become shallower and formed as sandy area. In the dry season, it will be a wide sandy beach where farmers can go down and grow vegetable. However, nowadays, bean sprout islands are not very visible because they are smaller. Growing bean sprouts must be done in containers that are easy to move because sometimes if the water suddenly rises, they have to rush down and lift the bean sprouts to higher ground instead.

Note Taken by Bean Sprout Farmer

Figure 4.6 Bean Sprout Island in Chiang Khong District, Chiang Rai Province

The planning of dam construction without the environmental concern and lack of disaster mitigation are causing a huge impact on the local community. Importantly, the dam development projects were planned in the upper part and became a matter of concern in the lower part. The upstream Mekong development has led to significant maintenance of sediments and nutrients (Kummu, 2005) and could

reduce the socioecological system. The Chiang Khong were also among the first to report unusual changes in the River as it was too drying up with a severe threat of algae blooms. When the River water clarity remains high, the algae bloom increasingly causes a bad smell of green mats, destroying traditional fisheries and leading to environmental deprivation and loss of livelihood.

2. Livelihood impacts

In term of food security, the Mekong River is an important source of food security called “Community Kitchen” that people can find food at all times without any expenses. Food security is the main issue impacting from hungry water effect because the Mekong River is a collection of food stuff and the local food chain, more than 85% of people living along the Mekong River (MRC, 2019) relies on this source of the River for their daily life. In the case of Chiang Khong, when the dam development project came into the community, it blocked the Mekong River natural line which led to an unnatural biodiversity cycle and destroyed their food source.

Note Taken by author

Figure 4.7 The wonder of Chiang Khong city map

From the figure 4.7, it shows the wonder of Chiang Khong city map with the large Mekong River flowing through it, surrounded by mountains, beautiful culture and wisdom, including the abundance of natural resources, especially in the Mekong River, which is the main River in community. But currently, according to the report in many organizations found that the number of fish in the Mekong River has significantly decreased, along with other natural resources, which has reduced the food security, personal security and community security.

According to the MRC annual report on the effects of the dams on fish populations, ecosystems, and biodiversity, by 2040 the dams will be causing the disappearance of over 900,000 tons of fish in the Mekong River, or the equivalent of $4.3 billion. The analysis predicted that by 2040, about 55% of Thailand's fish stock will be lost, making it the country with the greatest rate of fish loss. Many portions of the Mekong River will soon become lake ecosystems due to the development of dams, which will impact the River’s environment and eventually push many of the native fishes to the brink of extinction (MRC, 2019).

In term of personal security, role of women and men in the family will be destroyed due to the destruction of the main natural resources they rely on. For example, the role of women farmers in Chiang Khong, they have a very important role in the family who are responsible for all aspects of the household. Starting from doing domestic work, taking care of the children, including the important role is the dimension of food. This is the basic duty and heart of the family starting from the collect the raw materials, preparation, and seasoning. In which women have to find raw materials for food, women have used this area to transform nature into culture and became a symbol of the locality. It is indirect violence when the dam development is constructed, it prevents women from accessing vital food sources. As same as a patriarchal system that dominated the role of women, as same as a capitalist society that pushed local women to be marginalized.

Migration is the consequences when ecosystem and livelihood were collapse. In Chiang Khong, there are only elderly and children remaining in the community. Due to the changes in the Mekong River, small-scale farmers could be those who are most vulnerable, as their capital is limited by the small profits they derive from farming. With the development of the many industrial zones, people now

have another alternative for a living in addition to moving to the city to secure a job and family income. However, both big and small have been severely affected by the dam construction in the upper part and need bigger resources for growing their crops. These expenses are acceptable for large-scale farmers, but small-scale farmers may find them difficult to repay, especially when they borrow a lot of bank loans. From this point, the dam development has created insecurity to the local community and risk to loss of local culture and livelihood.

4.4 Community Adaptation in Chiang Khong District

As a result of the hungry water effect, the River has a greater capacity to erode its banks downstream, leading to increased erosion, loss of land, and changes in the River's ecosystem. In the context of the Mekong River and the local community in Chiang Khong District, adaptation to such a situation would involve various strategies, both traditional and innovative, to mitigate the impacts and sustain their livelihoods.

The lives of 64,000 people, which are located in an area of 836 square kilometers in Chiang Khong District, we cannot denied that the livelihood of the people here must be related to the Mekong River. Conservation of the Mekong River by Chiang Khong people, they must do everything possible not only to preserve the environment but also for their survival. However, in the present time, in addition to fighting against government policies that try to push for development, which is something that the people in the area do not oppose, on the other hand, they must find better options for the community. But what cannot be forgotten is that the groups of local villagers are also fighting against environmental changes as well.

The participant no.50 (P50), told an interesting story about development that worsens the environment, especially development that does not correspond to the context of the Chiang Khong area.

He has mentioned that "Chiang Khong is an important area for national development because even though it is a small area, it has a good ecology for settlement and development. This is because of the Mekong River. Furthermore, it is a

fertile agricultural area, so it is the best place to grow rice, especially Khao Niew Khiao Ngu, jasmine rice, or even more than 20 types of fruit trees, such as longan, mangosteen, and even durian, because of the geographical the favorable weather conditions"

From the information, it is obvious that the ecosystem cycle in Chiang Khong is very essential to support the completeness of the ecosystem. However, the arrival of development that is not consistent with the context of the area has completely changed the socioecological system. The obvious community adaptation is the strengthening of the local civil society, which aims to gain the attention form the governmental sector. The interviewee illustrates that civil society in Chiang Khong has become much stronger and tries to call for the right to choose the development that corresponds to the reality of the community context. Firstly, it started with a small group, but currently, it expanded to be bigger. Civil society comes together to discuss and express opinions along with a plan to move forward together on what they want Chiang Khong to be.

"The results of the joint discussions of all 7 sub-districts working together resulted in a form of community development called 1 city, 2 forms. It should be developed under the context of the community capital. The community must be developed economically without destroying the environmental aspect. This plan does not mean that Chiang Khong people are afraid of the development. However, establishing an industrial estate in the area is impossible because it will greatly affect the ecosystem of the area and is more severe than what outsiders imagine"

Adaptation is essential, this is what all the interviewees mentioned. Therefore, the interview and questionnaire results in each sector will have different adaptations as follows:

1. Fishery sector

1) Tourism; some groups of fishermen have turned to tourism sector by changing their fishing boats into tourists boats, taking tourists on a cruise to see the scenery on the Mekong River. However, due to the economic system in Chiang Khong, this profession has not had a sustainable income because the number of tourists in the area has decreased after the construction of the 4th Thai-Lao Friendship

Bridge. In one day, there are only 1-2 boats that receive tourists, so income is uncertain and they have to find other jobs to support their main income instead.

2) Moving to agriculture is one option that most fishermen choose to do because they already have some basic skills. Most of the agriculture they do is land-based farming, such as corn, bananas, cassava, etc. For some fishermen who do not own their own land, they have to rent land to do agriculture.

3) General labor, some of them choose to change their freelance career to general labor, such as being a dRiver at a resort, a gardener at a resort, or a construction worker, etc.

2. Hydro-based farmers

The adaptation of farmer is to change their harvesting and growing methods, as well as making their product available for sale throughout the year. From interviews with female farmers whose main occupation is producing Kai product, they said that the number of quality of Kai has decreased, making it insufficient for processing and export. Therefore, the farmers solved the problem by contacting Kai farmers in Laos and buy it to process and export instead. However, some farmers who think that harvesting Kai is becoming more difficult have changed themselves by turning to growing backyard garden for sale instead, such as spring onions and coriander, which can be grown on the house's backyard.

However, farmers who grow vegetables along the banks of the Mekong River have found that they can no longer grow vegetables because the banks of the Mekong River have been eroded and there have been constructions along the banks, forcing this group of farmers to find other occupations instead. Most of them are changing from River bank gardens to backyard gardens.

Only farmers who grow bean sprouts can continue their careers, but there are only two families remaining that can still grow bean sprouts as their main career. However, they still have to adapt to both the uncertainty of water levels and the poor quality of sand sediments. From interviews with farmers who grow bean sprouts along the Mekong River, they said that twenty years ago, bean sprouts from the sand along the Mekong River were very delicious. They were long and big. However, at present, the Mekong River rises and falls unnaturally, so during floods season, the flow of sand sediments is reduced. The taste of bean sprouts is not the same. It is also

difficult to predict the rise and fall of the River. Therefore, during floods season, bean spout farmer have to turn to growing water bean sprouts instead. Although the taste is not as delicious, but it is more predictable.

3. Agricultural sector

Farmers who use water from the Mekong River for farming may not be directly affected by the Hungry Water Effect. However, the problems of water shortages during the dry season and flooding during the flood season, as well as the unstable of the Mekong River, have also required farmers to make significant adaptation. This is because there is not only a problem with the quality of the water, but also the amount of water that is not enough to meet demand. This problem has reduced farmers whose main occupation is rice farming from being able to farm twice a year to only being able to farm once a year. The adaptation of this group of farmers is to turn to agriculture that does not require a lot of water, such as legumes, and to reduce their dependence on the Mekong River and turn to agriculture that uses rainwater or groundwater instead. In order to solve this problem, local agencies must take responsibility to make it easier for the villagers to adapt themselves.

4. Business owner

The Mekong River business consists of resorts, hotels, guesthouses, and restaurants on the banks of the Mekong River. The Hungry Water Effect has a direct impact on the costs that the business sector have to pay more than before, as well as the risk of disasters, which are at higher risk due to problems of Riverbank erosion, landslides, and flooding. When combined with the economic dimension, where the number of tourists in Chiang Khong has decreased due to the change in border policies, tourists entering the Chiang Khong are only for passing to the Friendship Bridge. They do not come to relax or travel in Chiang Khong like before. For this reason, the business sector has been directly and indirectly affected by the natural changes that have occurred. From interviewing the owner of the guesthouse on the banks of the Mekong River, she said that during this economic system, business is very uncertain. To adapt, it is necessary to reduce expenses, such as hiring a maid on a monthly basis, now it is reduced to a one-time fee, and the business owner does most of the work by herself. In terms of expanding the business area, the idea has to be put on hold.

For the restaurant business, when the number and the variety of fish species in the Mekong River in Chiang Khong has decreased, which used to be a point of attraction for tourists to taste fresh fish, has now decreased. Including the decrease in fish species, tourists are less motivated to come to the area. In addition, the cost of raw materials used in cooking has increased by about 10 times, causing restaurant has to increase food prices accordingly. In this regard, the menus in restaurants have been adjusted to have fewer dishes to reduce the cost of stocking ingredients. Most restaurants try to focus on ingredients that are easily found in the market or buy ingredients directly from farmers, such as buying bean sprouts from bean sprout farmer. The adaptation in this section is focused on reducing costs and relying less on the Mekong River.

5. NGOs

NGOs are important stakeholders in pushing for the impacts of the Hungry River phenomenon. From the interview with the Rak Chiang Khong group, an NGO working in the study area, it was stated that local NGOs play two important roles:

1) Supporting adaptation for people in the community through various projects. From the interview, it found that the Rak Chiang Khong group has promoted local knowledge as part of community adaptation because it is clear from the environmental changes that people have started to rely less on the Mekong River and have forgotten their local wisdom. Therefore, the NGO sector has tried to support the inclusion of local knowledge as part of the adaptation methods, for example, promoting of local wisdom through museums or local libraries that collect local history, local wisdom and local knowledge to encourage youth to pay more attention to their local areas. It also sets up its own organization area as a study area, a source of spatial data collection, to show local people and outsiders that Chiang Khong has its own specialties and advantages.

2) Social movement for better quality river management policies. In terms of activism, the Rak Chiang Khong group has strong networks with NGOs at local, regional, national and international levels. Therefore, driving the issue of environmental changes in the Mekong silver is another job that the organization has been doing since its establishment, including organizing forums, seminar and training on issues related to the Mekong River in the Chiang Khong area. This is to show that

environmental management at all levels are extremely important and that public participation in any decision-making process should be paid attention. It is clearly show that when the Mekong River ecosystem collapses, it has an impact not only on the community level but also on a wider scale.

Both of these elements must be implemented simultaneously. On the one hand, it allows the community to survive in a situation of ecological and social changes. On the other hand, it is to push that adaptation cannot be carried out unilaterally, it requires good resource management policies to ensure stability and sustainability for the community's future. At the same time, finding a common solution to restore the Mekong River ecosystem is another issue that local NGOs give importance to.

6. Local Government

In response to the environmental problems, local authorities have implemented the installation of CCTV in environmental and natural resource risk areas in three areas: the area along the Mekong River, the area along the Som River, and the area along the Duk River, a tributary in the area. The main objective is to reduce the risk of bank erosion during the flood season so that villagers can prepare for it in time. This issue will be further explained in section 4.4

Table 4.1 Summary of community adaptation

Sector	Adaptation Process
Fishery	Tourism / Change carrier
Hydro-based farmers	Less rely on Mekong River / Change carrier
Agricultural sector	Less rely on Mekong River / Land rental issuue
Business owner	Reduce expenses / Increase food price
NGOs	Social movement / Support community adaptation
Local Government	Reduce disaster risk area

According to the adaptation results (Table 4.1) show that people who are in fishery and hydro based farmer are completely change their carrier to not rely on Mekong River anymore. But on the other hands, all of the adaptation strategies occurring in Chiang Khong have the intention of maintaining the uniqueness of the

Chiang Khong community as much as possible. In other words, it is to maintain the socioecological capital through preserving local culture along with organizing a social movement to raise awareness in society that good development should be based on the social capital of the community along with environmental governance that allows all stakeholders to find solutions together and manage existing resources sustainably.

While local communities are directly affected by the ecological consequences of upstream dam development, they are frequently excluded from formal decision-making processes. Transnational dam developers and state agencies often operating under bilateral agreements or regional infrastructure frameworks exercise disproportionate control over resource allocation and project design, leaving local stakeholders with minimal voice in shaping outcomes that deeply impact their livelihoods. Despite limited access to institutional power, local communities have demonstrated various forms of agency in responding to the Hungry Water Effect. Some groups have engaged in forms of resistance, such as mobilizing protests and submitting petitions against upstream dam construction. Others have opted for adaptive strategies, including shifting to aquaculture and developing community-based ecotourism. These actions reflect not passive victimhood, but a dynamic repertoire of local resilience, negotiation, and transformation in the face of structural disadvantage.

4.5 Environmental Governance

4.5.1 The Dimension of Governance in Hungry Water Management

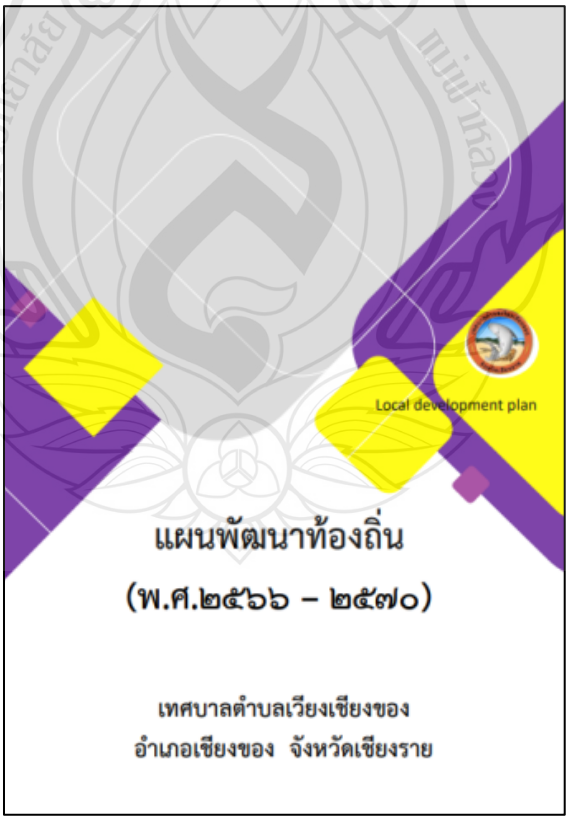
From the questionnaire of 50 participants in the environmental governance in terms of managing the hungry water in Chiang Khong, questions were asked in three dimensions: responsiveness, efficiency and effectiveness, and participation. The questionnaire was rated on a five-point scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. In terms of adaptation to the changes in the Mekong River, the research participants were asked to rate the work of local agencies and how they helped adapt to changes in the Mekong River. The results of the questionnaire are as follows:

Table 4.2 Environmental governance rate

Dimension	Average Rate
1. Responsiveness	
1.1 The local government has effectively responded to the challenges posed by the "hungry water" effect.	1
1.2 There are adequate measures in place to support your occupation in dealing with changes in the Mekong River.	1
1.3 The local government has communicated its actions and policies clearly to the community.	1
2. Effectiveness and efficiency governance	
2.1 The policies and initiatives implemented have successfully mitigated the impact on community livelihood.	1
2.2 The positive outcomes from the government's interventions is effective	1
2.3 The support provided has been sufficient to help community adapt to environmental change	1
3. Participation in governance	
3.1 The voice of people is heard in decision-making processes related to water management and environmental policies.	3
3.2 There are adequate platforms for people to express concerns and suggestions to the authorities.	1
3.3 People have been actively involved in the development and implementation of water management policies.	1
4. Adaptation strategies	
4.1 You have received adequate support and resources from local government or NGOs to help with adaptation	2
4.2 The support provided has been timely and appropriate to your needs.	2
4.3 Lack of resources (financial, technical, etc.) has hindered your ability to adapt to environmental changes.	4

From the results of the questionnaire, it can be concluded that in terms of responding to the Hungry River phenomenon, there is still insufficient response and there is still unclear communication of policies and practices. In terms of efficiency and effectiveness, the designed policies are still unable to solve the problems and alleviate the impacts of the Hungry Water Effect on the community effectively. In addition, the results are not sufficient to help the community adapt to the changes in the Mekong River. However, in terms of participation, relevant agencies have listened to the voices of the local people to be a part of decision-making. However, there are insufficient channels to convey concerns and provide advice. And the implementation of any policies to manage water in the area has not yet allowed the public to participate sufficiently. Finally, in terms of adaptation, relevant agencies have not yet participated in helping the people adapt to the impacts sufficiently. There is also a lack of budget and equipment to help alleviate the suffering caused by the Hungry Water Effect.

4.5.2 Local Development Plan



Source Wiang Chiang Khong Municipality

Figure 4.8 Local development plan (2023-2027)

According to the Ministry of Interior's regulation on the preparation of the development plan of local administrative organizations in 2005, it is stated that local administrative organizations must announce the implementation of the local development plan. Therefore, for Wiang Chiang Khong Subdistrict Municipality, which is responsible for the study area of this research report, the development plan of the local administrative organization has been prepared and announced the latest version in 2023 to 2027, and has been disclosed to the public. This local development plan report is the third version, updated in 2023, in order to be consistent with the problems and needs of the public, which will lead to local development and further benefit the public. This local development plan consists of four parts: Part 1: General conditions and basic information; Part 2: Local administrative organization strategy; Part 3: Implementation of the local development plan; and Part 4: Monitoring and evaluation.

In the second part, local administrative organization strategy, the vision of the plan was mentioned that "the people will have a good society and be resilience to change". In this part, there are five strategies consist of strategy 1: increasing economic value; strategy 2: developing society and improving the quality of life; strategy 3: managing natural resources and the environment; strategy 4: maintaining security, peace, order, and reconciliation; and strategy 5: developing administration. The issues of environmental management and community adaptation are mentioned in the strategies 2 and 3. The strategy 2 focuses on social development and improving the quality of life, in number seven of strategy has mentioned about increase the potential of people in the community to be able to adapt to changing environments. At the same time, under the strategy 3 on natural resources and environmental management, in the second point, it states that natural resources and environmental management must be sustainable. In the third point, it states that people have sufficient water for consumption and agriculture throughout the year and that the river banks do not collapse. In addition, the issue of participation according to the principles of environmental governance is included in the strategy 5 on administrative development. In the first point, it states that people must participate in local development.

From the strategic plan mentioned above, it shows that the issues of environmental management and public participation in designing and proposing ideas have been included as part of the strategic plan for community development. However, an interesting point is that in the indicators of the strategic plan, the details of natural resource and environmental management are not clearly specified. Most of them focus on waste management and water source dredging. However, the issue of the quality of the Mekong River is still not yet included in both strategic plan and indicators. Furthermore, in the indicator of strategy 5 on public participation, it is stated that the people are appointed as a committee to carry out the missions of local agencies and that there is promotion and support for public participation in local development. There is an assessment of public satisfaction with the administration according to the principles of good governance of the municipality. From this observation, it can be seen that the community development plan of the municipality uses the principle of public participation as one of the strategies for local development. However, in the issue of natural resource and environmental management, the issue of the Mekong River has not been touched much.

In addition, the SWOT assessment has identified the water resource problem in the weakness section, stating that the Mekong River, which is the main River, has natural tidal characteristics because China has built dams. Therefore, the rise and fall of the River depends on China determination. In addition, the tributary Rivers, Duk River and Sam River, are shallow and therefore cannot store water. According to the strong flow, causing the banks to erode, damaging houses along the Riverbanks, and there are budget limitations. In the weakness of SWOT analysis also stated that people still lack a thorough understanding of the conservation of natural resources and the environment. Environmental resource management belongs to the job of government agencies or the private sector, such as maintaining the cleanliness of Rivers and canals and planting trees. The municipal administration is still not fully operational because the budget is limited and not enough to provide public services. In addition, solving some development issues requires approval or consent from relevant agencies because it is beyond the authority of the municipality.

From the community development plan of Wiang Chiang Khong Subdistrict Municipality and the interview with the mayor, it shows that local governments are still facing challenges in many aspects, such as budget, communication with the community in natural resource and environmental management, and the scope of authority to take care of the Mekong River, which is an international River. Any orders or actions related to the Mekong River can only be done within the municipality. However, in terms of politics, on a larger scale, orders must be given from the central government, which local governments themselves do not have the authority to make decisions at the international level. Therefore, the management of the quality of the Mekong River caused by hydropower dam and climate change, which has resulted in the impact of the Hungry Water Effect, still requires cooperation from stakeholders at all levels, not only local governments, but also the central government, which must recognize the problem and take action to ensure that community adaptation occurs along with effective policy design.

CHAPTER 5

CONCLUSION, DISCUSSION AND RECOMMENDATION

The Mekong River, one of the longest rivers in Asia, spanning approximately 4,350 kilometers, serves as a crucial resource for the region's economy and ecosystem. However, rapid hydropower dam development in the mainstream and tributaries of the Mekong has led to significant ecological and socio-economic consequences for downstream communities. The dam development project has disrupted the river's natural flow, causing ecosystem imbalances and impacting local livelihoods. The Hungry Water Effect phenomenon results from unnatural sediment transport, reducing nutrient-rich deposits downstream and leading to soil degradation, riverbank erosion, and loss of aquatic vegetation, especially Riverweed (Kai). This has directly affected communities, in the study area, Chiang Khong district, where people mostly rely on their livelihood on the ecological services from the Mekong River. Due to dam construction, the availability of this vital resource has drastically declined, impacting local economies and food security.

In 2019, The Mekong River Commission (MRC) warns that sediment levels in the Mekong will decline to just 3% by 2040, exacerbating environmental degradation. To address these challenges, this study applies the Community Adaptation and Environmental Governance theories to assess socioecological vulnerability in Chiang Khong. Additionally, the Sendai Framework for Disaster Risk Reduction underscores the importance of community-based adaptation strategies. The socioecological vulnerability of the Mekong region highlights the deep interconnection between human and environmental systems. The degradation of the River ecosystem due to hydropower projects disrupts traditional livelihoods, food security, and biodiversity. Thus, environmental governance plays a key role in balancing economic development with ecological preservation. Effective policies and community-driven initiatives can help mitigate the negative impacts of hungry water, ensuring sustainable development and the protection of the Mekong River's vital resources.

Therefore, the finding of this study revealed that the socioecological vulnerability caused by changes in the Mekong River's sediment has had a significant impact on the ecological services that the people of Chiang Khong depend on. Fish numbers have declined, preventing fishermen from continuing their career. The Mekong River has become more unstable, preventing Riverweed farmers from harvesting food stuff. The clearer Mekong River has had an effect on the fish migration cycle and disrupted the ecosystem's cycle, which has led to the Riverweed not being able to grow to its full potential, leading to the culture of growing vegetables on the Riverbank having also declined. These impacts have made the Mekong River ecosystem more vulnerable to the changes that are occurring, and have had a double effect on the communities that rely on the resources in the Mekong River for their livelihoods.

Community adaptation is a method that Chiang Khong communities use to respond to disasters that affect their main resources. From Chapter 4, it can be seen that participants from each sector have different adaptations to disasters in the Mekong River. However, one common adaptation is that people try to change their careers from relying mainly on the Mekong River to relying on other economic systems, such as tourism and trading. Therefore, it is very important to receive support from local policies to make community adaptation more effective. From the findings, in terms of environmental governance, there are still complex responsibilities because the Mekong River is an international River that requires comprehensive supervision in all sectors, from regional, national, provincial, and local levels. This study shows that the local management of the Mekong River in terms of (1) participation, (2) responsiveness, and (3) effectiveness and efficiency still has an off-point focus. However, from the community development plan, the municipality has been making attempts to solve the problems of the impacts caused by disasters of the Mekong River, such as installing CCTV cameras in the riverbank erosion areas, supporting One Tambon One Product (OTOP), etc. So, this chapter presents the summary of the research findings, conclusion, discussion, policy recommendation, and recommendation for further study of the study for the thesis entitled "Environmental Governance and Socioecological Vulnerability: A Case Study of

Mekong River Community Adaptation in Chiang Khong District, Chiang Rai Province, Thailand."

5.1 Conclusion

5.1.1 Hungry Water Effect Phenomenon in Chiang Khong District

The hungry water effect is a significant environmental consequence of hydropower dam construction along the Mekong River, exacerbated by climate change. Typically, around 15,000 cubic meters of water (MRC, 2010) flow into the Mekong mainstream every second, providing enough water for 100,000 people daily. This immense water supply sustains wetlands, forests, and diverse aquatic habitats, supporting biodiversity while also benefiting agriculture, construction, and medicine. However, the construction of hydropower dams in the River's upper reaches has disrupted this natural balance, altering the ecosystem and threatening the livelihoods of communities that depend on the River.

One major impact of these dams is the unnatural regulation of water flow, which affects the reproductive cycles of aquatic species. Fish struggle to lay eggs, and Riverweed, known locally as Kai, fails to grow as it should. This decline in natural resources directly impacts local communities, especially in Ban Had Krai, a village in Chiang Khong District, Thailand. The village is known for its Kai harvest, which provides an essential seasonal income for women farmers. Since the construction of hydropower dams, Kai production has sharply declined, leading to economic hardship for those who rely on harvesting it during the dry season.

The hungry water effect is defined as a hybrid disaster, a phenomenon caused by both human activities and natural environmental changes. Shaluf (2007) describes hybrid disasters as those arising from a combination of human decisions and natural forces. In this case, the development of large-scale dams is a direct human intervention that has led to ecosystem degradation, loss of riverbank stability, and increased vulnerability to climate-induced disasters. One of the most critical consequences of dam construction is sediment retention in upstream reservoirs.

Normally, rivers transport sediment that replenishes soil and supports aquatic ecosystems. However, when sediment gets trapped behind dams, downstream areas suffer from soil degradation, Riverbank erosion, and the loss of essential nutrients. This results in depleted ecosystems and reduced water quality, which further intensifies the challenges faced by local communities. The MRC (2019) has warned that by 2040, the sediment levels in the Mekong will decline to only 3% of their natural state, leading to significant environmental and socio-economic disruptions. One visible sign of the hungry water effect occurred in Northeastern Thailand, where the Mekong River turned blue instead of its natural brown color. This unusual phenomenon indicates a severe reduction in sediment, which has led to increased erosion and ecological instability. The Northern Mekong region has also seen alarming sediment depletion, making it more susceptible to environmental hazards.

Beyond ecosystem degradation, hungry water contributes to severe flooding. When sediment-depleted water is suddenly released, it erodes Riverbanks more aggressively and increases flood risks, particularly in areas like Chiang Khong. This amplifies the vulnerability of local populations who depend on the River for their livelihoods. Addressing the hungry water effect requires comprehensive environmental governance and adaptation strategies which explained throughout the study. Protecting the Mekong's ecosystem is essential to ensuring both human and environmental well-being in the region.

5.1.2 The Impact of Hungry Water Effect on Chiang Khong Community

The hungry water effect is a major environmental issue that occurs when Rivers lack sufficient sediment to sustain their natural balance. This phenomenon is often caused by upstream dam construction leading to increased erosion of Riverbanks and significant changes in the River's ecosystem. In Chiang Khong, located along the Mekong River, this effect has contributed to severe socioecological vulnerabilities, particularly in the form of Riverbank erosion and flooding, which are closely linked to both climate change and hydropower development.

In terms of environmental losses and ecological disruptions, this disaster is reflected in the experiences of local fishermen in Wiang Chiang Khong Municipality. Previously, fishing was a primary occupation, but due to declining fish stocks, it has become unsustainable. Fishermen who once filled their cages in just a few hours now

struggle to catch even a small proportion of what they once did. According to interviews, the local fishing community has seen a 90% decrease in fish stocks. As a result, fishing has shifted from a professional livelihood to a subsistence activity, with families relying on occasional catches for meals rather than income. The decline in sediment levels also affects Riverweed (Kai) and agriculture. Kai, which grows in shallow, nutrient-rich waters, has significantly declined in both quantity and quality. Farmers who rely on the Mekong's sediment to grow crops, such as bean sprouts, are also struggling. Unpredictable water levels and poor sediment quality have led to reduced yields and forced many farmers to adopt alternative farming methods. Traditionally, bean sprouts were cultivated on "bean sprout islands", seasonal sandy patches in the Riverbed, but these islands are disappearing, making agriculture more challenging.

In terms of livelihood and social impacts, the changing River conditions have had far-reaching consequences beyond the environment. The Mekong River has long been considered a "community kitchen", providing an accessible source of food for residents. However, dams disrupt the river's natural ecosystem, making food security increasingly fragile. A report from the Mekong River Commission (2019) predicts that by 2040, over 900,000 tonnes of fish will be lost, valued at $4.3 billion, with Thailand expected to lose 55% of its fish stocks. The loss of natural resources has also affected social structures, particularly gender roles. In Chiang Khong, women play a vital role in household food preparation, relying on the river's resources. The depletion of fish and other natural food sources restricts their access to essential ingredients, leading to economic and cultural marginalization. This situation mirrors the broader impact of capitalism and patriarchal structures that push rural women to the margins of economic security.

Another significant consequence of environmental degradation is migration. As fishing and farming become unsustainable, many people, especially young adults, are forced to leave their communities in search of work. As a result, Chiang Khong is increasingly populated by only the elderly and children, weakening community ties and local traditions. Small-scale farmers, who lack the financial resources to invest in expensive adaptive strategies, are among the most vulnerable. Meanwhile, large-scale

farmers who can afford advanced irrigation and soil management techniques continue to expand, widening economic inequality.

5.1.3 Chiang Khong Community Adaptation to Hungry Water Effect

Adaptation is crucial for Chiang Khong residents facing environmental and socio-economic challenges caused by the Hungry Water Effect. Each sector has developed distinct strategies to cope with these changes.

5.1.3.1 Fishery Sector, fishermen have adopted three main adaptation strategies as follows;

1. Tourism: some fishermen have converted their fishing boats into tourist boats, offering cruises along the Mekong River. However, due to economic downturns and reduced tourist numbers after the construction of the 4th Thai-Lao Friendship Bridge, income from tourism remains unstable.

2. Agriculture: fishermen have transitioned to land-based farming, growing crops such as corn, bananas, and cassava. Those without land must rent farmland from the capitalist or people who own land in the community.

3. General labor: Apart from their previous job, Most of them, who don't have land or connections, shifted to general labor jobs such as resort dRivers, gardeners, or construction workers to supplement their income.

5.1.3.2 Hydro-based farmers, who rely on the Mekong River for crop cultivation, have adapted by changing their harvesting methods and diversifying crops. In this case, it can be referred to:

1. Kai farmers: due to the decline of Kai production, some farmers now purchase Kai from Laos for processing and export. Others have transitioned to backyard gardening, growing crops like spring onions and coriander.

2. Riverbank farmers: With Riverbank erosion and construction reducing arable land, farmers have shifted from Riverbank to backyard gardening. And Bean sprout farmers, there are only two families that continue growing bean sprouts, despite challenges from unpredictable water levels and poor sediment quality. Some have adapted by growing water bean sprouts, which are less affected by environmental fluctuations.

5.1.3.3 Agricultural Sector, farmers using Mekong River water for irrigation have been forced to adapt to water shortages during the dry season and flooding during the wet season. Adaptation strategies include:

1. Reducing rice farming cycles from twice a year to once a year.
2. Shifting to crops that require less water, such as legumes.
3. Relying more on rainwater and groundwater rather than Mekong River water.
4. Seeking local government support to facilitate adaptation efforts.

5.1.3.4 Business Sector along the Mekong River, including hotels, guesthouses, and restaurants, face higher operational costs and disaster risks due to Riverbank erosion and declining tourism. Adaptation strategies include:

1. Cost reduction, businesses reduce expenses, such as hiring fewer employees and taking on more responsibilities themselves.
2. Menu adjustments, restaurants reduce the number of dishes and rely on locally sourced ingredients to cope with rising costs and decreased fish variety.
3. Strategic purchasing, some restaurants buy directly from local farmers to reduce dependency on declining Mekong River resources.

5.1.3.5 NGOs who play a critical role in adaptation through two key initiatives, include:

1. Supporting Local Adaptation: NGOs promote local knowledge preservation through museums, libraries, and community study areas.
2. Advocacy for policy: NGOs advocate for better River management policies, organizing forums and training programs to emphasize public participation in decision-making processes.

5.1.3.6 Local Government

To address environmental risks, local authorities have installed CCTV cameras in high-risk areas along the Mekong, Som, and Duk Rivers. This monitoring system helps predict and mitigate Riverbank erosion and flooding, allowing villagers to prepare in advance.

5.1.4 The Environmental Governance of Wiang Chiang Khong Municipality

In Thailand, the review of conservation policies and regulations with an emphasis on environmental sustainability was part of the 7th National Economic and Social Development Plan (1992-1996). This plan prioritized environmental protection as the top priority of the Thai government, in line with the Development, Improvement and Conservation Act and the National Environmental Quality Act (1992). This law aims to reform natural resource management and environmental conservation in Thailand through effective, transparent, and responsible monitoring. This Act aims to increase public participation through decentralized management processes led by local officials, adhering to the principle of "Polluter Pays".

In line with the current situation, the 12th National Economic and Social Development Plan (2017-2021) has now evolved into the stated goal of "security, prosperity and sustainability" for the economy, society and natural resources, with the philosophy of "sufficiency economy" that is environmentally friendly for sustainable development is one of the important approaches in line with the 2030 Agenda of the United Nations Sustainable Development Goals.

To be part of this agenda, the National Legislative Assembly of Thailand has developed a 20-year national strategy (2017-2036) which is used by relevant ministries, such as the Ministry of Natural Resources and Environment, to develop a policy framework for more sustainable environmental outcomes. For example, the National Environmental Quality Management Plan (2017-2021). This policy focuses on four main components related to the management of Thailand's natural resources, which are environmental quality management, natural resource protection and restoration, natural resource efficiency enhancement, and international cooperation on climate change.

Thailand also complies with other global policy frameworks including the Global Strategy for Biological Diversity 2011-2020 and the Aichi Biodiversity Targets. Thailand intends to use these frameworks to comply with international agreements such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Ramsar Convention on Wetlands.

Under the leadership of former Prime Minister General Prayut Chan-o-cha, Thailand has a policy to create a livable society with an economy that is resilient to

climate change and a low-carbon society. At the same time, Thailand aims to use this policy to push itself towards becoming a high-income country.29 The challenge to progress from a middle-income country will involve doubling Thailand's GDP per capita from US$6,357 per year to US$12,236 per year using a model of economic and social development that does not devalue environmental resources.

As mentioned, it can be shown that environmental policies have been given attention and included in the National Policies and the National Social and Economic Development Plans. However, in the local development plans, there is very little mention of natural resources and the environment, specifically the resources that exist in the community. The Wiang Chiang Khong Subdistrict Municipality has prepared and announced its local development plan (2023–2027) by the Ministry of Interior's 2005 regulation. This plan is the third version, updated to align with the evolving needs of the community, and consists of four main parts: general conditions and basic information, local administrative organization strategy, implementation of the plan, and monitoring and evaluation.

A key component of the plan is the local administrative organization strategy, which envisions a resilient and socially cohesive community. The strategy is divided into five key areas: economic development, social well-being, natural resource and environmental management, security and public order, and administrative development. Environmental concerns and community adaptation are integrated into the Strategy 2 (Social Development and Quality of Life) and the Strategy 3 (Natural Resource and Environmental Management). According to Strategy 2, it emphasizes enhancing community capacity to adapt to environmental changes, while the Strategy 3 focuses on sustainable resource management and ensuring adequate water availability for consumption and agriculture. Additionally, the Strategy 5 (Administrative Development) promotes public participation in local decision-making. Despite including environmental concerns in the strategic plan, there are significant gaps in its implementation. The indicators for environmental management mainly focus on waste management and water source dredging, while the quality of the Mekong River is not explicitly addressed. Similarly, while public participation is encouraged, it is primarily limited to committee appointments and satisfaction

assessments, rather than actively involving the community in designing environmental policies.

The SWOT analysis of the development plan identifies water resource management as a major weakness. It highlights the impact of China's upstream dam operations, which control the water level of the Mekong River, leading to unpredictable fluctuations and erosion along Riverbanks. Additionally, local tributaries like the Duk River and Sam River are too shallow to store sufficient water. Thus, budget constraints further limit the municipality's ability to address these issues effectively. These include another key challenge, which is the lack of environmental awareness among residents, as many still perceive resource conservation as the responsibility of the government or private sector. Therefore, the Chiang Khong Municipality sector could not genuinely respond to the existing problem related to the Mekong River.

According to the interviews with the mayor of Wiang Chiang Khong, reinforce the structural limitations faced by local governments can be seen that while the municipality is responsible for managing local environmental issues, it still lacks the authority to influence transboundary policies affecting the Mekong River. The decisions regarding hydropower dams, climate change adaptation, and water management are controlled by the central government and international stakeholders, making it difficult for local governments to take independent actions. These highlight the needs for multi-level cooperations, where the local, national, and international stakeholders work together to address the significant environmental challenges posed by hydropower development and climate change.

Ultimately, while the Wiang Chiang Khong Municipality's development plan acknowledges the importance of environmental sustainability and public participation, it falls short in addressing the larger transboundary issues affecting the Mekong River. From these, effective management truly requires greater recognition from the central government. Meanwhile, it is necessary to have strong community engagement and coordinated efforts across all levels of governance to ensure long-term sustainability and adaptation to environmental changes.

5.2 Discussion

From the conclusions of the study, the researcher clarified the results of all studies obtained both in-depth interviews and questionnaires by dividing the data of the research results according to the three research questions. Therefore, the next part of the research is to analyze and present a discussion of the theoretical results as discussed in Chapter 2.

5.2.1 Unseparable Environmental Management and Policy

Agrawal (2003) has explored the relationship between common-property resources and political dynamics, emphasizing how environmental management is deeply intertwined with political power. The effectiveness of resource management strategies is often dependent upon the broader political and institutional landscape in which they are implemented. To address any issues in a certain society, it may be unproductive or even harmful to ignore the political institutions that influence access to and control over resources.

At the same time, an overly institution-focused approach, which prioritizes governance frameworks and regulatory mechanisms without considering human subjectivity, such as local knowledge, cultural values, and individual relationships with the environment risks failing to address the complexities of environmental issues. As a result, the way people interact with and depend on common-property resources plays a crucial role in shaping sustainable management outcomes.

Therefore, a balanced approach is necessary, one that recognizes the structural power dynamics influencing environmental policies and incorporates the local community. This can ensure that management strategies are not only politically and institutionally sound but also socially and culturally relevant. Without such an integrative perspective, environmental policies risk being detached from the realities of those most affected by resource scarcity, inequitable access, and ecological change. Especially, on the issue of the Mekong River, which is an international River and has been made a playground of political power, becoming even more complicated.

The Mekong River, as an international River spanning multiple countries, is a prime example of how environmental issues are deeply embedded in political power

struggles. As Agrawal (2003) argues, environmental governance cannot be separated from political institutions and power dynamics. The Mekong is not only a natural resource but also has become a geopolitical battleground where states, corporations, and local communities compete over water rights, hydropower development, and ecological sustainability.

The hydropower dam development is often framed as a solution for economic development, yet it also reflects the political and economic interests of powerful states, regional organizations, and private investors. These projects reshape River flows, disrupt sediment transport, and trigger ecological degradation, and the most dangerous is directly contributing to phenomena like the Hungry Water Effect. However, the decisions surrounding these projects are rarely made with environmental concerns as the primary priority. Instead, they are shaped by political agendas, diplomatic relations, and economic negotiations between Mekong countries.

This aligns with the argument that we cannot separate the environment from politics as mentioned by Agrawal (2003). To explain this, political power determines who has access to resources, whose interests are prioritized, and how environmental governance is structured. Ignoring this reality means overlooking the root causes of environmental problems. Policies that focus solely on institutional arrangements such as transboundary agreements or conservation frameworks without addressing the political and economic inequalities that drive environmental exploitation are unlikely to be effective. Furthermore, the perception of the environment as an apolitical entity is itself a political act. Governments and international agencies may frame environmental challenges as purely technical or managerial issues, problems to be solved through better policies, more research, or improved infrastructure. However, this depoliticized approach masks the underlying power dynamics that determine whose voices are heard in decision-making and whose livelihoods are most affected by environmental changes.

A truly effective environmental management strategy must acknowledge that nature and politics are fundamentally inseparable. In the case of the Mekong, this means recognizing how state interests, corporate influence, and local struggles intersect in shaping the River's future. It also requires shifting from a Top-Down approach, state-driven governance models to focus more on inclusive approaches that

empower local communities, indigenous groups, and civil society organizations in decision-making processes.

5.2.2 Chiang Khong Community Adaptation Methods

Community adaptation to disaster risks, as outlined in the study of Jai et al. (2021) reveals four core questions as follows (1) “What” is being adapted to (2) “Who” is adapting (3) “How” does adaptation occur and (4) “What” does adaptation look like, and how well it’s done. When applying this framework to Chiang Khong District, it becomes evident that the local villagers have long been adjusting to the challenges posed by the Hungry Water Effect phenomenon. Each sector of the community has developed different methods of adaptation, primarily as a means of survival. However, while the first three aspects of adaptation can be identified within the community, the fourth, “how well it’s done” remains a crucial point of discussion in this thesis’s discussion.

The findings of this research found that adaptation in Chiang Khong is largely reactive rather than proactive. Rather than being a well-planned, long-term strategy to cope with changes in the Mekong River, adaptation among villagers is often a forced response to worsening conditions. Most community members do not wish to abandon their traditional way of life or shift away from their long-settled livelihoods, such as the fishery and agricultural sector. However, due to significant transformations in the River ecosystem and an inadequate response from government authorities, many have had no choice but to abandon their previous occupations and seek alternative means of survival. Therefore, the “how well it's done” of the Chiang Khong villagers' adaptation is only a “ONE-SIDED ADAPTATION”. To explain this, it is an adaptation born out of necessity rather than choice (Jia et al. 2021), with little to no support from relevant agencies or authorities. As a result, it does not constitute a “well” or sustainable adaptation process but rather an ongoing struggle for survival.

One of the most notable observed in the research is the complete shift in occupation among many villagers, particularly those in the fisheries and agriculture sectors. Many former fishermen have turned to general labor jobs, while those who once farmed along the riverbanks have had to relocate their agricultural activities to higher ground. These shifts indicate a growing attempt by the local population to reduce their reliance on the Mekong River, which was once central to their way of life

and social capital in the community. However, this one-sided adaptation is likely to have profound long-term consequences, particularly in terms of the community's social and cultural relationship with the River. The Mekong River has historically been more than just a source of livelihood, it has been a vital component of the community's social fabric, serving as a hub for cultural practices, traditions, and social interactions. As people move away from direct reliance on the river, this connection is likely to weaken, ultimately diminishing the River's role as an essential part of the local identity and heritage.

Furthermore, one-sided adaptation caused farmland problems. To say this, when villagers move away from their traditional livelihoods without sustainable alternatives, it can lead to unexpected harm to nature. For instance, farmers who once grew vegetables along the riverbanks, where the land was freely available, now face new challenges as they move their farming activities to higher ground or switch to growing crops like maize corn, or cassava. One of the biggest issues is land ownership because most farmers in the area do not have their own farmland, forcing them to rent land from local investors or wealthy landowners. This shift not only increases their financial burden, but also puts them at risk of falling into debt making it even harder for them to sustain their livelihoods in the long run.

Another major consequence is the community's increasing vulnerability to future disasters. Because adaptation has been largely reactive and individualistic rather than a coordinated effort supported by policy and infrastructure, it does not build long-term resilience. Instead, villagers are left to cope with changes on their own, often with limited resources and knowledge of alternative adaptation strategies. If the environmental conditions in the Mekong River continue to deteriorate whether due to dam construction, climate change, or other external factors, the community will find itself even weaker position and lacking the necessary support systems to adapt effectively.

Ultimately, one-sided adaptation is an unsustainable response to the challenges facing Chiang Khong. Without comprehensive and inclusive adaptation strategies that involve government agencies, local organizations, and the affected communities themselves, the long-term consequences will continue to worsen. Effective adaptation requires collaboration among relevant sectors to empower communities rather than

leave them to struggle alone. As a result, the cycle of forced adaptation and increasing vulnerability will persist, leaving the people of Chiang Khong with fewer and fewer options for a stable and sustainable future.

5.2.3 DPSIR Model and Mekong River's Hungry Water Effect

The DPSIR (Drivers–Pressures–State–Impact–Response) model is a very useful analytical framework for understanding and dealing with complex environmental problems such as the Hungry Water Effect in the Mekong River. In addition, the analysis of the causes of the Hungry Water Effect in all 5 actors can also help identify points of intervention to effectively manage the problem as follows:

DRIVER: Economic growth and energy security in Mekong countries have led to the creation of several large dam projects, despite evidence of dam construction's impacts on ecosystems and communities. Therefore, adopting mechanisms such as the Strategic Environmental Assessment (SEA) before approving large energy projects should be prioritized.

PRESSURE: The construction of dams has reduced the sediment in the river, which plays a crucial role in the fertility of the river and the livelihoods of the communities in Wiang Chiang Khong who depend primarily on the river. Therefore, responsible dam release measures that take into account sediment volumes and develop common regional policies to control and offset the impacts of sediment depletion, such as the establishment of a transboundary environmental fund.

STATE: The current state of the Mekong River is facing a serious problem of decreasing sediment quantity and quality, which has resulted in ecosystem degradation, fishermen are catching less fish, and farmers are unable to obtain enough raw materials from the river. The appropriate solution is to restore the river ecosystem, such as planting native plants and increasing natural moisture, promoting research and monitoring the status of the ecosystem with continuous community participation, and using geographic information systems (GIS) to display and analyze changes in the river in an accurate and systematic way.

IMPACT: When the Mekong River ecosystem collapses, the ecosystem services that once supported the villagers' livelihoods are reduced or disappear, causing people to inevitably change their way of life. The solution is to develop policies to help those affected by environmental changes, such as providing financial

assistance or retraining, creating mechanisms for community participation in restoring and adapting to the ecosystem, and enhancing knowledge about changes in the river and their impact on the lives of the younger generation through education and youth activities, in order to create understanding and cooperation in conserving natural resources together in the long term.

RESPONSES: In the Response phase, it was found that communities in Wiang Chiang Khong began to change their occupations from relying on resources from the Mekong River to occupations that do not rely on the river, such as moving to work in the city, which leads to the risk of losing local culture and traditional ways of life. To cope with this situation, the solution is to support the development of a sustainable resource-based economy that is still connected to the river, such as ecotourism or ecological agriculture, providing learning spaces or community cultural centers to preserve and transfer local knowledge, and creating local adaptation plans that are flexible and respond to changes in the ecosystem appropriately and sustainably.

Additionally, in the response phase, it was found that communities in Wiang Chiang Khong began to change their occupations from relying on resources from the Mekong River to occupations that do not rely on the river, such as moving to work in the city, which leads to the risk of losing local culture and traditional ways of life. To cope with this situation, the solution is to support the sustainable development of a resource-based economy that is still connected to the river, such as ecotourism or ecological agriculture, providing learning spaces or community cultural centers to preserve and transfer local knowledge, and creating local adaptation plans that are flexible and respond to changes in the ecosystem appropriately and sustainably.At the same time, responding to such impacts must go hand in hand with strengthening effective environmental governance, especially in the following dimensions:

Transparency: Environmental information, such as water release from dams, sediment volume, and impacts on communities, should be disclosed so that people can access it equally and consistently.

Participation: Allow local communities to play a role in decision-making processes, both at the river management level, development planning, or monitoring the impacts of various projects.

Efficiency and Effectiveness: Promote government agencies, international organizations, and the public sector to work together in an integrated manner. Use resources efficiently and respond to problems promptly.

Therefore, developing an adaptation plan based on environmental governance will help communities cope with the impacts of the Hungry Water Effect sustainably, while preserving their local identity and cultural diversity in the long run.

5.3 Policy Recommendation on Community Adaptation to Hungry Water Effect in Chiang Khong District, Chiang Rai Province

To ensure effective community adaptation to the Hungry Water Effect in Chiang Khong District, this study recommends a series of strategies that reflect participatory and sustainable environmental governance. These recommendations are categorized into short-, medium-, and long-term measures to guide local policy and planning efforts.

Short-term Strategies: In the immediate term, local authorities should require all development plans to include a clear inventory of key local resources such as fish stocks, riverweed (Kai), and agricultural land that hold both ecological and socio-economic value to the community. This resource mapping should be conducted with the participation of community members and updated regularly to inform adaptive decision-making. At the same time, community-led monitoring programs should be established to assess environmental changes, particularly in relation to sediment decline and river health, with findings communicated to relevant government agencies and civil society organizations.

To promote inclusive adaptation, local governments should initiate regular multi-stakeholder dialogues that bring together community groups, NGOs, academics, and local officials. These platforms would enable knowledge-sharing, trust-building, and coordination of grassroots efforts. Parallel to this, local adaptation practices should be systematically documented to identify existing strengths and critical gaps in resources, capacity, and policy support.

To address the immediate livelihood crisis, especially for those affected by the collapse of river-based fisheries, short-term support should focus on training and funding for aquaculture and Kai farming, which offer sustainable alternatives. Special attention should be paid to promoting women's roles in these alternative livelihoods, particularly in Kai harvesting, where their leadership is already well established.

Lastly, awareness campaigns should be conducted to inform the public and decision-makers about the ecological consequences of dam development and the need to prioritize alternative energy solutions. These efforts should also include knowledge exchange forums on solar, wind, and decentralized renewable energy options.

Medium-term Strategies: In the medium term, institutional arrangements should be created to embed local ecological knowledge into planning processes. This could include the formalization of community advisory boards that work directly with local governments to influence environmental management and development agendas. Capacity-building programs should be implemented for local government staff to strengthen their skills in participatory governance, conflict resolution, and climate adaptation.

At the district or provincial level, collaborative adaptation platforms should be developed, supported by both public funding and private investment. These platforms would allow for the joint implementation of integrated adaptation projects such as ecotourism, agroecology, and climate-resilient agriculture. Such projects would provide economic alternatives while protecting environmental systems and strengthening community agency.

To ensure the economic viability of alternative livelihoods, medium-term efforts should focus on developing local value chains, including fish and Kai product processing, branding, and market access. Local entrepreneurship should be supported through business development services and financial assistance, helping communities move from subsistence to self-sustaining enterprises.

Regionally, cooperation with neighboring countries and basin-wide institutions such as the Mekong River Commission (MRC) should be enhanced to advocate for strategic reassessment of dam projects, especially those planned in ecologically sensitive zones. Cross-border advocacy coalitions and technical studies

can play a role in influencing infrastructure decisions that affect transboundary river systems.

Long-term Strategies: In the long run, local resource governance should be institutionalized through legal frameworks and mandates that recognize the rights and responsibilities of communities to manage their ecological resources. Local governments should incorporate these frameworks into planning regulations and budgeting processes, ensuring that environmental considerations are mainstreamed into all sectors.

A transboundary, regional-scale data-sharing system should be developed ideally in partnership with the MRC to monitor environmental shifts, share local knowledge, and inform policy alignment across national borders. This would enable long-term ecological learning and support early-warning systems for communities affected by upstream developments.

Inclusive adaptation must eventually be embedded into national climate change and disaster risk management strategies, reflecting a bottom-up approach that values local experience and knowledge. Institutionalized cooperation among countries in the Mekong Basin should be promoted under a regional environmental governance regime that protects ecosystems while safeguarding community rights and interests.

Regarding energy policy, a regional framework for clean energy transition should be developed based on principles of environmental justice and energy democracy. This would require long-term coordination among Mekong countries to prioritize truly renewable energy sources such as solar and wind over hydropower, which, despite its low carbon profile, often leads to irreparable environmental degradation. Legally binding regional agreements should be pursued to balance energy demand with ecosystem protection, under transparent and accountable governance mechanisms.

5.4 Recommendation for Further Study

5.4.1 The study could be expanded to examine the economic policies of communities along the Mekong River, particularly after the construction of the Thai-

Laos Friendship Bridge. The Hungry Water Effect has led to a shift in the community's adaptation strategies, with local populations moving away from traditional reliance on the River ecosystem and instead depending more on alternative economic systems, such as local trade and tourism. However, despite this shift, these new economic activities, including trade and resort development, still face significant challenges that hinder the long-term sustainability of these economic systems. Further exploration of these issues can provide valuable insights into how communities can adapt to changing circumstances and create more resilient economic structures.

Local NGOs often play a crucial role in bridging the gap between government policies and community needs, providing both immediate relief and long-term strategies for adaptation, these organizations are often well-positioned to understand the specific vulnerabilities and resources. Therefore, the idea of the role of local NGOs should be more considered in supporting community adaptation, particularly in the context of the challenges posed by the Hungry Water Effect and the broader environmental changes along the Mekong River.

REFERENCES

Adger, N. W. (2000). Social and ecological resilience: Are they related?. *Progress in Human Geography*, *24*(3), 347-364. https://doi.org/10.1191/030913200701540465

Agrawal, N. (2018). *Natural disasters and risk management in Canada: An introduction*. Springer. https://doi.org/10.1007/978-94-024-1283-3 243-262. https://doi.org/10.1146/annurev.anthro.32.061002.093112

Agrawal, N. (2018). *Natural disasters and risk management in Canada: An introduction*. Springer. https://doi.org/10.1007/978-94-024-1283-3

Aldrich, D. P. (2017). *The importance of social capital in building community resilience*. Springer. https://doi.org/10.1007/978-3-319-50171-0_23

Arias, M. E., Cochrane, T. A., Piman, T., Kummu, M., Caruso, B. S., & Killeen, T. J. (2012). Quantifying changes in flooding and habitats in the Tonle Sap Lake (Cambodia) caused by water infrastructure development and climate change in the Mekong Basin. *Journal of Environmental Management, 112*, 53–66. https://doi.org/10.1016/j.jenvman.2012.07.003

Assembe-Mvondo, S., Brockhaus, M., & Lescuyer, G. (2013*). Assessment of the effectiveness, efficiency and equity of benefit-sharing schemes under REDD+: Case studies from Cameroon*. Center for International Forestry Research (CIFOR). https://doi.org/10.17528/cifor/004264

Barnett, W. S., Jung, K., Yarosz, J. D., Thomas, J. Hornbeck, A., Stechuk, R., . . . Burns, S. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial, *Early Childhood Research Quarterly, 23*(3), 299-313. https://doi.org/10.1016/j.ecresq.2008.03.001

Benson, D., & Jordan, A. (2015). Environmental policy: Protection and regulation. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed., Vol. 7, pp. 778–783). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.91014-6

Berkes, F., & Folke, C. (eds.). (1998). *Linking social and ecological systems: Management practices and social mechanisms for building resilience*. Cambridge University Press.

Binh, D. V., Kantoush, S., Saber, M., Mai, P. N., Maskey, S., Phong, T. D., . . . Sumi, T. (2020). Long-term alterations of flow regimes of the Mekong River and adaptation strategies for the Vietnamese Mekong Delta. *Journal of Hydrology: Regional Studies, 32*. https://doi.org/10.1016/j.ejrh.2020.100742

Binh, D. V., Kantoush, S., Sumi, T., & Mai. (2018). *Impact of Lancang cascade dams on flow regimes Vietnamese Mekong Delta, 74*, 487-492. https://doi.org/10.2208/jscejhe.74.I_487

Brooks, N. (2003). Vulnerability, risk and adaptation: A conceptual framework. *Tyndall center for climate change research working paper, 38*(38), 1-16.

Carling, P., Jansen, J., & Meshkova, L. (2014). Multichannel rivers: Their definition and classification. *Earth Surface Processes and Landforms, 39*(1), 26–37. https://doi.org/10.1002/esp.3419

Chambers, R. (1994). Participatory rural appraisal (PRA): Challenges, potentials and paradigm. *World Development, 22*(10), 1437-1454. https://doi.org/10.1016/0305-750X(94)90030-2

Chantha, O., & Ty, S. (2020). *Assessing changes in flow and water quality emerging from hydropower development and operation in the Sesan River Basin of the Lower Mekong Region*. Springer. https://doi.org/10.1007/s40899-020-00386-8.

Chen, X., Zheng, Y., Xu, B., Wang, L., Han, F., & Zhang, C. (2020). *Balancing competing interests in the Mekong River Basin via the operation of cascade hydropower reservoirs in China: Insights from system modeling, 254*, https://doi.org/10.1016/j.jclepro.2020.119967

Cornwall, A. (2008). Unpacking 'Participation': Models, meanings and practices, *Community development journal, 43*(3). 269-283. https://doi.org/10.1093/cdj/bsn010

Costa-Cabral, M. C., Richey, J. E., Goteti, G., Lettenmaier, D. P., Feldkötter, C., & Snidvongs, A**.** (2008). Landscape structure and use, climate, and water movement in the Mekong River Basin. *Hydrological Processes, 22*(12), 1731–1746. https://doi.org/10.1002/hyp.6740

Cutter, S. (2011). *Disaster resilience: A national imperative, committee on increasing national resilience to hazards and disasters*. The National Academies Press.

Cutter, S. L., & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences, 105*(7), 2301-2306. https://doi.org/10.1073/pnas.0710375105

Cutter, S., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., . . . Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global environmental change, 18*(4). 598-606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

Davoudi, S., Shaw, K., Haider, L. J., Quinlan, A. E., Peterson, G. D., Wilkinson, C., . . . Davoudi, S. (2012). Resilience: A bridging concept or a dead end?. *Planning Theory & Practice, 13*(2), 299-333. https://doi.org/10.1080/14649357.2012.677124

Delgado, J. M., Merz, B., & Apel, H. (2012). A limate-flood link for the lower Mekong River. *Hydrology and Earth System Sciences, 16*(5), 1533–1541. https://doi.org/10.5194/hess-16-1533-2012

Dingwerth, K., & Pattberg, P. (2006). Global governance as a perspective on world politics. *Global Governance, 2*, 185-203. https://www.jstor.org/stable/27800609

Dong, L., Wang, Z., & Zhou, Y. (2023). Public participation and the effect of environmental governance in China: A systematic review and meta-analysis. *Sustainability, 15*(5), 4442. https://doi.org/10.3390/su15054442

Eakin, H., Webhe, M., Ávila, C., Torres, G. S., & Bojórquez-Tapia, L. A. (2006). *A comparison of the social vulnerability of grain farmers in Mexico and Argentina*. The AIACC Project Office.

Eastham, J.,Mpelasoka, F., Mainuddin, M., Ticehurst, C., Dyce, P., Hodgson, G., Ali, R., & Kirby, M. (2008). *Mekong River Basin water resources assessment: impacts of climate change*. https://doi.org/10.25919/z6mm-z569

Evers, J., & Pathirana, A. (2018). Adaptation to climate change in the Mekong River Basin: introduction to the special issue. *Climatic Change, 149*, 1-11. https://doi.org/10.1007/s10584-018-2242-y

Ferguson, J. (1990). *The anti-politics machine: "development," depoliticization, and bureaucratic power in Lesotho*. Cambridge University Press.

Fiorino, D. J. (2006). *The new environmental regulation*. MIT Press. https://doi.org/10.1017/S1537592707072428

Ford, J. D., Smit, B., & Wandel, J. (2010). Vulnerability to climate change in the Arctic: A case study from Arctic Bay, Canada. *Global Environmental Change, 16*(2), 145-160.

Freire, P. (1970). *Pedagogy of the oppressed*. Continuum.

Google Maps. (2024a). *Chiang Khong District*. https://maps.app.goo.gl/EU8XV1EYjBZZTksW8

Google Maps. (2024b). *Wiang Chiang Khong Sub-District*. https://maps.app.goo.gl/hWrhn1dVrzAAm2Er5

Gustafson, S., Cadena, J. A., Ngo, C.C., Kawash, A., Saenghkaew, I., & Hartman, P. (2018). Merging science into community adaptation planning processes: A cross-site comparison of four distinct areas of the Lower Mekong Basin. *Climatic Change, 149,* 91-106. https://doi.org/10.1007/s10584-016-1887-7

Heckmann, T., Haas, F., Abel, J., Rimböck, A., & Becht, M. (2017). Feeding the hungry river: Fluvial morphodynamics and the entrainment of artificially inserted sediment at the dammed River Isar, Eastern Alps, Germany. *Geomorphology, 291*(15). 128-142. https://doi.org/10.1016/j.geomorph.2017.01.025

Hirsch, P. (2010). The shifting regional geopolitics of mekong dams. *Political Geography, 29*(8), 405-415. https://doi.org/10.1016/j.polgeo.2010.09.001

Hoang, L. P., Lauri, H., Kummu, M., Koponen, J., van Vliet, M. T. H., Supit, I., . . . Ludwig, F. (2016). Mekong River flow and hydrological extremes under climate change. *Hydrology and Earth System Sciences, 20*(7), 3027-3041. https://doi.org/10.5194/hess-20-3027-2016

Hoanh, C., Jirayoot, K., Lacombe, G., & Srinetr, V. (2010). Comparison of climate change impacts and development effects on future Mekong flow regime. In *International congress on environmental modelling and software*. Modelling for Environment's Sake.

Jia, H., Chen, F., & Du, E. (2021). Adaptation to disaster risk—An overview. *International Journal of Environmental Research and Public Health, 18*(21), 11187. https://doi.org/10.3390/ijerph18211187

Jordan, A. J., Huitema, D., van Asselt, H., Rayner, T., & Berkhout, F. (Eds.). (2010). *Climate change policy in the European Union: Confronting the dilemmas of mitigation and adaptation?*. Cambridge University Press.

The Institute of Company Secretaries of India (ICSI). (2003). *Corporate governance from compliance to excellence (handbook on best practices) version 2.0*. https://www.icsi.edu/media/webmodules/03082022_SamplePages.pdf

Kapucu, N. & Rivera, F. (2015). *Disaster vulnerability, hazards and resilience: Perspectives from Florida*. Springer.

Kingston, D. G., Thompson, J. R., & Kite, G. (2011). Uncertainty in climate change projections of discharge for the Mekong River Basin. *Hydrology and Earth System Sciences, 15*(5), 1459–1471.

Kondolf, G. M., Rubin, Z. K., & Minear, J. T. (2013). Dams on the Mekong: Cumulative sediment starvation. *Water Resources Research, 49*(10), 1-12. https://doi.org/10.1002/2013WR014651

Kondolf, G. M., Schmitt, R. J. P., Carling, P., Darby, S., Arias, M., Bizzi, S., . . . Wild, T. (2018). Changing sediment budget of the Mekong: Cumulative threats and management strategies for a large River basin. *Science of The Total Environment, 625,* 114-134.

Kondolf, M. (1997). Hungry water: Effects of dams and gravel mining on river channels. *Environmental Management, 21*(4), 533-551.

Kummu, M., Koponen, J. & Sarkkula, J. (2005). Modelling Sediment Transportation in Tonle Sap Lake for Impact Assessment. In V. Kachitvichyanukul, U. Purintrapiban & P. Utayopas (Eds.), *Simulation and modeling: Integrating sciences and technology for effective resource management* (pp. 369-377). Asian Institute of Technology.

Lamberts, D., & Koponen, J. (2008). Flood-pulse alterations and productivity of the Tonle Sap ecosystem: A model for impact assessment. *Ambio, 37*(3), 178–184.

Lazzari, N., Becerro, M. A., Sanabria-Fernández, J. A., & Martín-López, B. (2021). Assessing social-ecological vulnerability of coastal systems to fishing and tourism. *Science of the Total Environment, 784*, 147078. https://doi.org/10.1016/j.scitotenv.2021.147078

Lauri, H., de Moel, H., Ward, P. J., Räsänen, T. A., Keskinen, M., & Kummu, M. (2012). Future changes in Mekong River hydrology: Impact of climate change and reservoir operation on discharge. *Hydrology and Earth System* Sciences, 16(12), 4603-4619. https://doi.org/10.5194/hess-16-4603-2012

Leach, M., Scoones, I., & Stirling, A. (2010). *Dynamic sustainabilities: Technology, environment, Social Justice*. Routledge.

Lebel, L., Manuta, J. B., & Garden, P. (2009). Institutional traps and vulnerability to changes in climate and flood regimes in Thailand. *Regional Environmental Change, 9*(1), 45-58. https://doi.org/10.1007/s10113-008-0054-4

Lemos, C. M., & Agrawal A. (2006). Environmental governance. *Annual Review of Environment and Resources, 31*, 297-325. https://doi.org/10.1146/annurev.energy.31.042605.135621

Liangyu. (2019). *Laos seeks to become a regional hub for electricity transmission by 2025*. http://www.xinhuanet.com/english/asiapacific/2019-02/14/c_137821006.htm

Wiang Chiang Khong Municipality. (2023). *Local development plan.* https://www.wckmunic.go.th/pdf/2021/%E0%B9%81%E0%B8%9C%E0%B8%99%E0%B8%9E%E0%B8%B1%E0%B8%92%E0%B8%99%E0%B8%B25%E0%B8%9B%E0%B8%B5/%E0%B9%81%E0%B8%9C%E0%B8%99%E0%B8%9E%E0%B8%B1%E0%B8%92%E0%B8%99%E0%B8%B2%E0%B8%97%E0%B9%89%E0%B8%AD%E0%B8%87%E0%B8%96%E0%B8%B4%E0%B9%88%E0%B8%99%20(%E0%B8%9E.%E0%B8%A8.2566%20-%202570).pdf

MacKinnon, D., & Derickson, K. D. (2013). From resilience to resourcefulness: A critique of resilience policy and activism. *Progress in Human Geography, 37*(2), 253-270. https://doi.org/10.1177/0309132512454775

Maikhuri, R. K., Nautiyal, A., Jha, N. K., Rawat, L. S., Maletha, A., Phondani, P. C., . . . Bhatt, G. C. (2017). Socioecological vulnerability: Assessment and coping strategy to environmental disaster in Kedarnath valley, Uttarakhand, Indian Himalayan Region. *International Journal of Disaster Risk Reduction, 25*, 111-124.

Manpati, T. (2022). *Mekong community resilience in the face of dam development, environmental degradation and climate change. Heinrich-Böll-Stiftung.* https://th.boell.org/en/2022/10/14/mekong-community-resilience

Mavelli, L. (2019). Resilience beyond neoliberalism? Mystique of complexity, financial crises, and the reproduction of neoliberal life. *Resilience, 7*(3), 224-239. https://doi.org/10.1080/21693293.2019.1605661

Mekong River Commission. (2010). *State of the Basin report 2010*. Mekong River Commission, Vientiane, Lao PDR.

Mekong River Commission (MRC). (2019). *Lower Mekong water quality monitoring report*. Mekong River Commission.

Mekong River Commission (MRC). (2019). *Annual Mekong hydrology, flood and drought report 2019: Drought in the lower Mekong Basin*. MRC Secretariat.

Mekong River Commission (MRC). (n.d.). *Natural resources*. Retrieved December 15, 2023, from https://www.mrcmekong.org

Mendoza, A. M. (2015). Reinsurance as governance: Governmental risk management pools as a case study in the governance role played by reinsurance institutions. *Connecticut insurance Law Journal, 21*(1). 53-147.

Miraftab, F. (2004). Invited and invented spaces of participation: Neoliberal citizenship and feminists' expanded notion of politics. *International Planning Studies, 9*(4), 229-243.

Missingham, B. (2003). *The assembly of the poor: From local struggles to national protest movement*. Silkworm Books.

Mohamed, M. I. (2017). Khartoum and hybrid disaster. *Disaster Management and Human Health Risk, 173*, 195-206. https://doi.org/10.2495/DMAN170191

Najam, A., Papa, M., & Taiyab, N. (2006). *Global environmental governance: A reform agenda*. International Institute for Sustainable Development (IISD).

Ness, B., Anderberg, S., & Olsson, L. (2010). Structuring problems in sustainability science: The multi-level DPSIR framework. *Geoforum, 41*(3), 479-488. https://doi.org/10.1016/j.geoforum.2009.12.005

Newig, J., Jens, G., Dirk, D., Pahl, W., Claudia C. (2010). Synapses in the network: Learning in governance networks in the context of environmental management. *Ecology and Society, 15*(24). https://doi.org/10.5751/ES-03713-150424

Nguyen, K. V., & James, H. (2013). Measuring household resilience to floods: a case study in the Vietnamese Mekong River Delta. *Ecology and Society 18*(3), 13. http://doi.org/10.5751/ES-05427-180313

Organisation for Economic Co-operation and Development (OECD). (1999). *DAC criteria for evaluating development assistance: Relevance, effectiveness, efficiency, impact, and sustainability*. OECD Publishing.

Offe, C. (2009). Governance: An "Empty Signifier"?. *Constellations, 16*(4). 550-562. https://doi.org/10.1111/j.1467-8675.2009.00570.x

Onyango, P. O., & Jentoft, S. (2010). Assessing poverty in small-scale fisheries in Lake Victoria, Tanzania. *Fish and Fisheries, 11*(3), 250–263. https://doi.org/10.1111/j.1467-2979.2010.00372.x

Open Development Mekong. (2015). *Hydropower dams*. Open development Mekong. https://opendevelopmentmekong.net/topics/hydropower/#_edn3

Osborne, M. (2009). *The Mekong: River under threat*. Lowy Institution.

Ostrom, E. (2002). Chapter 24 Common-pool resources and institutions: Toward a revised theory. *Handbook of Agricultural Economics, 2*(Part A), 1315-1339. https://doi.org/10.1016/S1574-0072(02)10006-5

Pelling, M. (2003). *The vulnerability of cities; natural disasters and social resilience*. Earthscan.

Pelling, M., & Manuel-Navarrete, D. (2011). From resilience to transformation: The adaptive cycle in two Mexican urban centers. *Ecology and Society, 16*(2), 11. https://doi.org/10.5751/ES-04038-160211

Pfefferbaum, B., Van Horn, R. L., & Pfefferbaum, R. L. (2017). A conceptual framework to enhance community resilience using social capital. *Clin Soc Work, 45*, 102-110 https://doi.org/10.1007/s10615-015-0556-z

Potoski, M., & Prakash, A. (2005). Green clubs and voluntary governance: ISO 14001 and firms' regulatory compliance. *American Journal of Political Science, 49*(2), 235–248. https://doi.org/10.1111/j.0092-5853.2005.00120.x

Porter, I. C, & Shivakumar, J. (2011) *The Lao People's Democratic Republic and the story of the Nam Theun 2.* The World Bank.

Pretty, N. J. (1995). Participatory learning for sustainable agriculture. *World Development, 23*(8). 1247-1263. https://doi.org/10.1016/0305-750X(95)00046-F

Reed, S. M. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation, 141*(10). 2417-2431. https://doi.org/10.1016/j.biocon.2008.07.014

Ribot, J. C., Agrawal, A., & Larson, A. M. (2006). Recentralizing while decentralizing: How national governments reappropriate forest resources. *World Development, 34*(11), 1864-1886. https://doi.org/10.1016/j.worlddev.2005.11.020

Santasombat, Y., Hengsuwan, P., Anprasert, W., & Chanta, S. (2009). *The river of life*. Faculty of Social Sciences, Chiang Mai University.

Schmink, M., Duchelle, A. E., Hoang, M. H., Le, H. D., & Seymour, F. (2019). Forests, people, and governance: Policy recommendations from the field. *Conservation and Society, 17*(2), 216-228. https://doi.org/10.4103/cs.cs_18_85

Schlosberg, D. (2004). Reconceiving environmental justice: Global movements and political theories. *Environmental Politics, 13*(3), 517-540. https://doi.org/10.1080/0964401042000229025

Secretariat of the Convention on Biological Diversity Montreal. (1992). *Convention on biological diversity*. https://www.cbd.int/doc/legal/cbd-en.pdf

Shaluf, I. M. (2007). "An overview on disasters" disaster prevention and management. *An International Journal, 16* (5), 687-703.

Shrestha, B., Shreedhar, M., Babel, S. M. Griensven A., & Uhlenbrook, S. (2018). Sediment related impacts of climate change and reservoir development in the Lower Mekong River Basin: a case study of the Nam Ou Basin, Lao PDR. *Climatic Change, Springer, 149* (1), 13-27.

Smajgl, A., Toan, T. Q., Nhan, D. K., Ward, J., Trung, N. H., Tri, L. Q., . . . Pearn, S. M. (2015). Responding to rising sea levels in the Mekong Delta. *Nature Climate Change, 5*(2), 167-174. https://doi.org/10.1038/nclimate2469

Smit, B., & Wandel, J. (2006). Adaptation. adaptive capacity and vulnerability. *Glob Environ Change Hum Policy Dimens, 16*, 282-292.

Sok, S., Lebel, L., Bastakoti, C. R., Thau, S. & Samath, S. (2011). Role of villagers in building community resilience through disaster risk management: A case study of a flood-prone village on the banks of the Mekong River in Cambodia. In M. A. Stewart & A. Peter (Eds.), *Environmental change and agricultural sustainability in the Mekong Delta* (pp. 241-255). Springer Dordrecht. https://doi.org/10.1007/978-94-007-0934-8_14

Soukhaphon, A., Soukhaphon, G. I., & Hogan, S. Z. (2021). The impacts of hydropower dams in the Mekong River basin: A review. *Water, 13*(256). 1-18

Thakur, R., & Van Langenhove, L. (2006). Enhancing global governance through regional integration. *Global Governance: A Review of Multilateralism and international organizations*, *12(*3), 233-240. https://doi.org/10.1163/19426720-01203002

United Nations Development Programme (UNDP). (1997). *Governance for sustainable human development*. UNDP. https://digitallibrary.un.org/record/492551

United Nations Development Programme (UNDP). (2011). *Towards human resilience: Sustaining MDG progress in an age of economic uncertainty (Chapter 8)*. https://www.undp.org/sites/g/files/zskgke326/files/publications/Towards_SustainingMDG_Web1005.pdf

United Nations Disaster Risk Reduction (UNDRR). (2015). *Sendai framework for disaster risk reduction 2015-2030*. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

United Nations Disaster Risk Reduction (UNDRR). (2017). *What makes people vulnerable?*. https://www.undrr.org/terminology/vulnerability

United Nations Environmental Programme (UNEP). (2017). *Introduction to environmental governance*. https://globalpact.informea.org/sites/default/files/documents/International%20Environmental%20Governance.pdf

United Nations Environmental Programme (UNEP). (2022). *Kunming-Montreal global biodiversity framework*. https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf

USAID Mekong Adaptation and Resilience Report. (2015). *Lessons on integrating scientific and community knowledge of climate change to develop adaptation plans in Lower Mekong Basin.* https://weadapt.org/wp-content/uploads/2023/05/lessons_on_merging_scs_ccs_final-2015.04.16-press.pdf

U.S. Environmental Protection Agency (EPA). (2024). *Ecosystem services research.* U.S. Environmental Protection Agency. https://www.epa.gov/eco-research/ecosystem-services-research

Uthai, S. (2018). Hydropower dams on the Mekong river: Changes in food security and Chiang Khong women's adaptation. *Journal of Mekong Societies, 14*(3), 125-147.

Västilä, K., Kummu, M., Sangmanee, C., & Chinvanno, S. (2010). Modelling climate change impacts on the flood pulse in the Lower Mekong floodplains. *Water and Climate Change, 1*(1), 67-86. https://doi.org/10.2166/wcc.2010.008

Vincente, M. C., & de Mesa, J. D. (2008). *Risk= Hazard X Exposure X Vulnerability: Risk mapping towards saving lives in Bicol.*

Vitasek, K., Ledyard, M., & Manrodt, K. (2012). *Vested Outsourcing: Five rules that will transform outsourcing* (2nd ed.). Palgrave Macmillan.

Wachhaus, A. (2013). Governance beyond government. *Administration & Society, 46*(5). 573-593. https://doi.org/10.1177/0095399712451889

Warner, K. (2010). Global environmental change and migration: governance challenges. *Glob Environ Chang, 20*(3), 402-413

Wild, T. B., & Loucks, D. P. (2014). Managing flow, sediment, and hydropower regimes in the Sre Pok, Se San, and Se Kong Rivers of the Mekong basin. *Water Resources Research, 50*(6), 5141–5157. https://doi.org/10.1002/2014WR015457

Williamson, T., Hesseln, H., & Johnston, M. (2012). Adaptive capacity deficits and adaptive capacity of economic systems in climate change vulnerability assessment. F*orest Policy and Economics, 15*, 160-166.

World Bank. (1994). *Development in practice governance, the world bank's experience*. https://documents1.worldbank.org/curated/en/711471468765285964/pdf/multi0page.pdf

Wynberg, R., & Kepe, T. (2014). Land reform and the new elite: Exclusion of the poor from communal land in South Africa. *Land Use Policy, 39*, 203-210. https://doi.org/10.1016/j.landusepol.2014.02.006

Young, O. R. (2002). *The institutional dimensions of environmental change: Fit, interplay, and scale*. MIT Press.

Zang, Z., Zou, X., Zuo, P., Song, Q., Wang, C., & Wang, J. (2017). Impact of landscape patterns on ecological vulnerability and ecosystem service values: An empirical analysis of Yancheng Nature Reserve in China. *Ecological Indicators, 72*, 142-152.

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