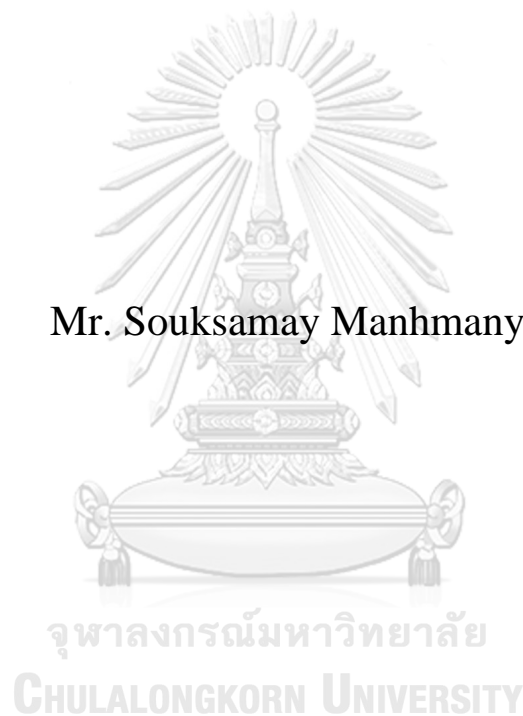


Strengthening local government to enhance flood risk
management:A case study of Xay district, Lao PDR.

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A Dissertation Submitted in Partial Fulfillment of the Requirements
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GRADUATE SCHOOL

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เขตอำเภอเมืองไซ สปป ลาว เป็นเมืองที่อ่อนไหวต่อภัยน้ำท่วมอย่างยิ่ง ทั้งนี้เนื่องจากพื้นที่เกือบ 80% ปกคลุมไปด้วยภูเขา แม่น้ำและแม่น้ำสาขา ขณะที่มศึกษภาพการจัดการที่จำกัด งานวิจัยนี้จึงมุ่งเน้นศึกษาแนวทางการเสริมสร้างความเข้มแข็งขององค์การบริหารท้องถิ่นเขตอำเภอเมืองไซเพื่อการบริหารจัดการความเสี่ยงภัยน้ำท่วม โดยมีวัตถุประสงค์หลัก 4 ข้อ การสืบค้นข้อมูลจากเอกสาร การสังเกตการณ์ภาคสนาม การสัมภาษณ์ เชิงลึก และการจัดเสวนาผู้เชี่ยวชาญ ผลการศึกษาพบว่า คนในพื้นที่มักประสบน้ำท่วม ในเขตอำเภอเมืองไซ แทบทุกปี เพราะเขตนี้ตั้งอยู่บนภูเขาสูงที่ล้อมรอบด้วยลำคลองและมีประชากรอาศัยอยู่หนาแน่นตามริมฝั่งแม่น้ำทั้งกลางน้ำและปลายน้ำ รัฐบาลท้องถิ่นไม่มีอำนาจและความสามารถในการจัดการ ความเสี่ยงจากน้ำท่วม การกระจายอำนาจควบคู่กับการเสริมสร้างขีดความสามารถของข้าราชการท้องถิ่นจึงเป็นอย่างยิ่ง ผล การศึกษาพบว่าชี้ให้เห็นว่ารัฐบาลท้องถิ่นอาจปรับปรุงปัจจัย แนวคิดการจัดการความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืน ในท้องถิ่น ทั้ง 26 ปัจจัยในเขตอำเภอเมืองไซ (โดยเฉพาะปัจจัยที่ขาดหายไป 8 ปัจจัย และปัจจัยที่อ่อนแอ 22 ปัจจัย) การศึกษาแนะนำวิธีการเสริมสร้าง 26 ปัจจัย การจัดการความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืนในท้องถิ่น ที่ครอบคลุมทุกด้านทั่วเขตอำเภอเมืองไซ นอกจากนี้ รัฐบาลท้องถิ่นยังได้จัดทำแผนและนโยบายเฉพาะ วิธีการเชิงโครงสร้าง (โครงสร้างพื้นฐานเพื่อเพิ่มความสามารถในการระบายน้ำ ทางลัดที่คดเคี้ยวของน้ำ และอ่างเก็บน้ำ) และวิธีการที่ไม่ใช่ โครงสร้าง (การวางผังเมือง การบังคับใช้กฎหมาย และระบบเตือนภัยล่วงหน้า) การศึกษานี้แสดงให้เห็นถึงผลงาน ผลงานแรก ความสำคัญการสนับสนุนทางทฤษฎีคือการปรับปรุงทฤษฎีที่มีอยู่และแนะนำแนวทางปฏิบัติเพื่อเสริมสร้าง แนวคิด การจัดการ ความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืนในท้องถิ่น ผลงานที่สอง การสนับสนุนนโยบายส่งเสริมความรับผิดชอบ และ การกระจายอำนาจของการจัดสรรเทคโนโลยีเพื่อปรับปรุงการฝึกอบรมในระดับท้องถิ่น ผลงานที่สาม โมเดลของ การจัดการ ความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืนในท้องถิ่น สำหรับแนวทางปฏิบัติที่ยั่งยืนโดยรัฐบาลท้องถิ่นในเขตอำเภอเมือง ไซ สิ่งสำคัญคือต้องตระหนักถึงน้ำท่วมว่ากิจกรรมเตรียมความพร้อมของรัฐบาลท้องถิ่นมีส่วนช่วยเพิ่มระดับความพร้อมของ ชาวบ้านในเขตอำเภอเมืองไซ ผลงานที่สี่ การสนับสนุนการปฏิบัติโดยการสำรวจวิธีการที่เหมาะสมสำหรับ แนวคิด การจัดการ ความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืนในท้องถิ่น ในเขตอำเภอเมืองไซ ทำหน้าที่เป็นตัวแทนของหลายอำเภอของ สปป ลาว ที่มีความสามารถในการนำไปใช้และปรับตัวให้เข้ากับสภาพที่คล้ายคลึงกัน การศึกษาเสนอแนะแนวทางปฏิบัติ 6 ประการก่อนเกิดน้ำท่วม 8 ประการในช่วงน้ำท่วม และ 6 มาตรการหลังจากน้ำท่วมจากแนวปฏิบัติของรัฐบาลท้องถิ่นสำหรับ แนวความคิด การจัดการความเสี่ยงจากน้ำท่วม และ การฟื้นฟูแบบยั่งยืนในท้องถิ่น

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Souksamay Manhmanyong : Strengthening local government to enhance flood risk management: A case study of Xay district, Lao PDR.. Advisor: Assoc. Prof. Suwattana Thadaniti, Ph.D. Co-advisor: Assoc. Prof. Rostam Yaman, Ph.D.

The Xay district of Lao PDR is vulnerable to flooding because around 80% of the total geographic area consists of mountains, rivers, and tributaries. While the district has limited coping capability. Therefore, strengthening the local government to enhance flood risk management was investigated in the present study with the following four objectives. Desk research, on-site observation, in-depth interviews, and expert focus group were used for data collection. The study found that local people always suffer from flooding in the Xay district almost every year because the district locates on a high mountain surrounded by canals and a high population along the riverbank both midstream and downstream. Local government has no authority and capability to manage flood risk. Decentralization together with capacity building for the local government officers is highly recommended. The finding suggested that the local government may improve all 26 LRFRM factors in the Xay district (especially for eight missing factors and twenty-two weak factors). The study suggested how to strengthen 26 LRFRM factors that cover all aspects throughout the Xay district. Moreover, the local government provided specific plans and policies, structural methods (infrastructure to improve discharge capacity, meander shortcuts, and reservoirs), and non-structural methods (urban planning, law enforcement, and early warning systems). This study showed four contributions. First, this theoretical contribution's significance is how it updates existing theory and introduces practices to strengthen the LRFRM. Second, the policy contribution encouraged accountability, and decentralization of the allocation of technology to improve training at the local levels. Third, (LRFRM)'s model for sustainable practices by the local government in Xay District. It is important to flood awareness of how the local government-based preparedness activities contribute to an increase in locals' readiness levels in the Xay district. Fourth, the contribution to the practice by exploring the suitable methods for LRFRM in the Xay district. Acts as a representative for many districts of Lao PDR that have the capacity to adopt and adapt to similar conditions. The study suggested the recommendation of six actions before the flood, eight actions during the flood, and six actions after the flood of local Field of Study:

Environment,	Student's Signature
Development and
Sustainability	
Academic	2022
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	Co-advisor's Signature

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Souksamay Manhmanyong

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LIST OF ABBREVIATIONS

ADB	-	Asian Development Bank
ADPC	-	Asian Disaster Preparedness Center
ASEAN	-	Association of Southeast Asian Nations
CBDRR	-	Community Based Disaster Risk Reduction
CBDRM	-	Community Based Disaster Risk Management
DDMCC	-	Department of Disaster Management and Climate Change
DDPCC	-	District Disaster Prevention and Control Committee
DMH	-	Department of Meteorology and Hydrology
DMRH	-	Disaster Management Reference Handbook
DoW	-	Department of Waterway
DPWT	-	Department of Public Works and Transport in Province
DRM	-	Disaster Risk Management
DRR	-	Disaster Risk Reduction
EI	-	Expert Interview
EOC	-	Emergency Operations Center
EWS	-	Early Warning System
FDI	-	Foreign direct investment
FPP	-	Flood Protection Practice
FRM	-	Flood Risk Management
GDP	-	Gross domestic product
GoL	-	Government of Lao
IEAT	-	Industrial Estate Authority of Thailand
II	-	Individual Interview
IPCC	-	Intergovernmental Panel on Climate change
IUCN	-	International Union for Conservation of Nature
IWA	-	International Water Association
JICA	-	Japan International Cooperation Agency
Lao PDR	-	Lao People's Democratic Republic
LDC	-	Least Developed Country
MDGs	-	Millennium Development Goals
MLSW	-	Ministry of Labour and Social Welfare

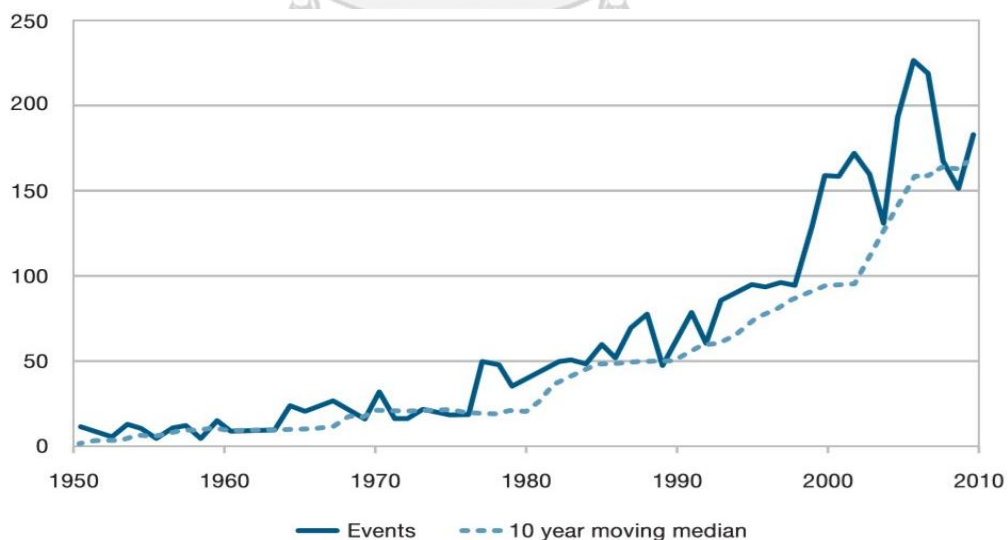
MoFA	-	Ministry of Foreign Affairs
MoF	-	Ministry of Finance
MoNRE	-	Ministry of Natural Resources and Environment
MPI	-	Ministry of Planning and Investment
MoU	-	Memorandum of Understanding
Mph	-	Miles per hour
MPWT	-	Ministry of Public Works and Transport
MRC	-	Mekong River Commission
NDPCC	-	National Disaster Prevention and Control Committee
NGOs	-	Non-Governmental Organizations
NDPCC	-	National Disaster Prevention and Control Committee
NSEDP	-	National Socio-Economic Development Plan
NSPDM	-	National Strategic Plan on Disaster Management
ODA	-	Official Development Aid
PDPC	-	Provincial Disaster Prevention and Control Committee
PM	-	Prime Minister
PMT	-	Protection Motivation Theory
RFRM	-	Resilient Flood Risk Management
SDGs	-	Sustainable Development Goals
UN	-	United Nations
UNDP	-	United Nations Development Programme
UNISDR	-	United Nations International Strategy for Disaster Reduction
US	-	United States
USD	-	United States Dollar
VDPC	-	Village Disaster Prevention and Control Committee
VDPU	-	Village Disaster Prevention Units
WB	-	World Bank
WFP	-	World Food Program
WMO	-	World Meteorological Organization

CHAPTER I

GENERAL INTRODUCTION

1.1 Background

Around the world, floods occur due to excessive rainfall, natural stream blockages, rapid snowmelt, tidal waves, windstorms over lakes, or any combination of such conditions (Oubennaceur et al., 2019). Flash floods, storm floods, tsunami (earthquake wave) floods, dam breaks, and river floods are several types of floods. (Few et al., 2016). The growing susceptibility to various flood risks and frequent climate change has led to increased experience with flooding and consequent increased preparedness among local settlements (Abunyewah, 2020). The flood risk to cities has increased due to poorly planned infrastructure growth and land-use changes, which is likely due to continual increase in the local populations (Govindarajulu, 2020). In Asia, floods have become more frequent, triggered by unpredictable rainfall conditions, human activities, and policy realignments, and have caused widespread devastation and loss of human lives. For example, the 2018 floods in Southwestern Japan, caused by successive heavy downpours and storms, resulted in devastating floods and mudslides. Two hundred and twenty-five people were confirmed dead across 15 prefectures, with a further 13 people reported missing (Sankei Shimbun in Japanese, 2018). In Asia, in 2010 alone, 178 million people were affected by floods. The total losses in exceptional years such as 1998 and 2010 exceeded US\$40 billion (Abhas K Jha, 2011) as shown in Figure 1.1:



(Source: based on EM-DAT/CRED).

Figure 1.1: Number of reported flood events in Asia.

1.2 Statement of problem

Lao PDR is prone to disaster risks and significant climate change. In particular, floods frequently occur during the rainy season, and, over the last decade, have damaged infrastructure, caused more significant economic losses, and affected the most people as compared to all other hazards. Seasonal rain flooding occurs each year during the southwest monsoon season from May to October. For example, Lao PDR experienced significant typhoons in 2009 (Ketsana) and 2011 (Haima), resulting in damage estimated at over US\$121 million. Several floods in 2013 caused damage estimated at more than US\$270 million, affecting 350,000 people in 12 (out of a total of 18) provinces. The frequency of floods points to intensification in the future, underscoring the need to improve flood risk management. Lao PDR is currently undergoing fast urban spatial expansion; the urban population has doubled during the 2010-2018 period. Urbanization can lead to an increasing number of people and assets in flood risk areas, contributing to urban flooding, and creating significant social problems, especially in combination with inadequate urban planning and implementation for such things as sewage and waste disposal services, (DoW, MPWT, 2018). From the standpoint of human activities, the priority is the local government's role in making district policies and strategies to help the locals mitigate or minimize risks from flood risk situations.

The current case study looks at the Xay district, which is the capital district among a group of 7 districts belonging to Oudomxay province in northern Laos. The Northern part of Lao PDR is one of the most beautiful natural tourism districts to be found. Located in the northern region, far from Vientiane Capital, the capital of Lao PDR, at distance around 584 Km, Xay district has a total area of 2,817 Km². The district is 85% Upland Mountain, with an average rainfall ranging between 1,400-1,600 mm/year, with cold weather year-round. The land is suitable for agriculture and animal husbandry. The districts of this area are connected by National Road No. 2W to Thailand, National Road No. 2E to Vietnam, and National Road No. 13 north to China. There are a total of 15,418 households, and a population of 71,139 people (35,153 females; 35,986 males) with population density of 25 people/km² (Source: Office of Interior in Xay district, 2018).

- Gaps in the Xay district

There are a number of gaps in the district's Flood Risk Management:

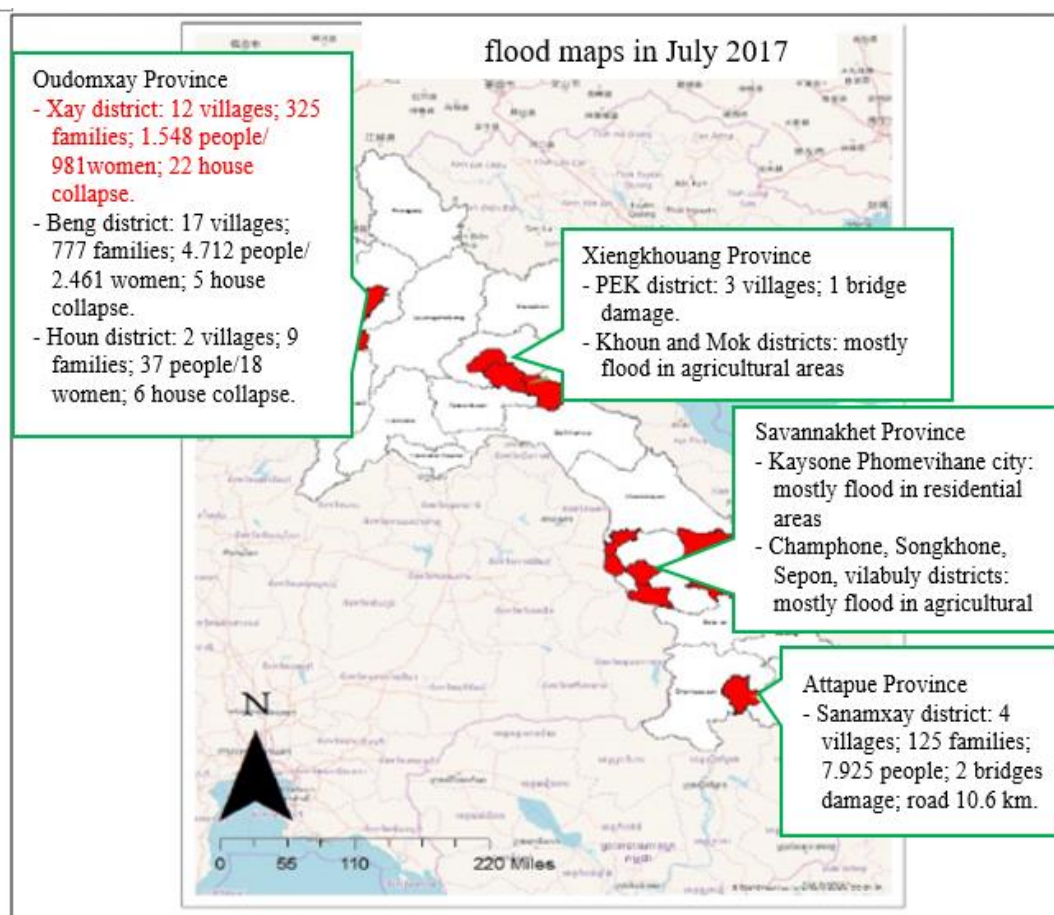
- 1). Gaps in the policy framework (urban management policies, sub-sector strategies, and implementation plans), weak inter-sectoral coordination, and individual capacity for flood risk assessment related to land-use change.

2). The district's local government tends to wait for central government support; the district has limited human resources and suffers from inadequate budget, equipment, and other resources.

3). The local government needs to develop an effective, timely response to reduce adverse flooding impacts through a precise response mechanism, warning systems, clear identification of roles, coordination, shared information, and defined responsibilities between local, provincial, and central levels of government.

4). Floods are frequent because most locals work in the agriculture sector. The local governmental policy on extraction of natural resources also increases flood risks while causing environmental degradation and deforestation. The vulnerable locals are heavily affected by flood events.

5). Mountainous terrain and poor infrastructure can limit the ability to get help to flood victims in time.



(Source: DoW-MPWT, 2018)

Figure 1.2 : Lao PDR flood map in July 2017.

- Limitations faced by Xay district

Closely related to these gaps, the Xay district also faces limitations in its ability to cope with flood risk, which include:

- The high risks and vulnerability, particularly in the district's urban area where several floods have occurred annually.

- Lack of budget, equipment, volunteers and local community participation adequate to cope with the flood risk management (before, during, after).

- Most of the local people in this district are settled along the main national roads of the upland mountains, and risk-prone areas are along rivers and tributaries. Thus, they are affected by floods every year.

For example, in 2017, floods affected and damaged 12 villages, 325 families, 3,548 people/2,981 women, and two houses collapsed in the Xay district (shown in Figure 1.3).



(Source: DPWT in Oudomxay province, Lao PDR).

Figure 1.3: flooding in Xay district, 2017.

There are lessons to be learned from neighbouring Thailand's experience with decentralization. During the great flood of 2011, the Thai government faced limitations in efforts to overcome obstacles to effective flood control policymaking and planning. In the aftermath, it was found that 1) discontinuity of plans and policies existed in the bureaucracy, and 2) policies and plans tended to target mitigation rather than prevention and preparedness (Tanwattana, 2018).

- Gaps of knowledge

There are many ways in which non-structural methods and structural engineering methods have been utilized for flood risk management. Nevertheless, few researchers have studied rural areas in the least developed countries to assess the level of proper management and effectiveness of local government authorities' policies and practices. It is essential for local governments to be knowledgeable about the use of modern tools in order to make effective use of management and information about local people in the periods between, before, during, and after flood events. Of course, improvement is necessary when existing flood risk management standards are no longer effective, as is the case in the Xay district. The primary reason for this lack of effectiveness is that the Xay district government tends to wait for the central government to provide help and support, particularly with the district's limited various resources.

1.3 Objectives of the study

The objectives of this study are:

- 1) To study the nature of the flood threat experienced in the Xay district, Lao PDR;
- 2) To review the current local government practices in the Xay district;
- 3) To assess the local government practices for the strengths and weaknesses in this district;
- 4) To strengthen and apply opportunities for improvement of local government practices using Local Resilience and Flood Risk Management (LRFRM) in the Xay district, Lao PDR.

1.4 Research questions

The research considers four questions:

- 1) What is the nature of the flood threat experienced in the Xay district, Lao PDR?
- 2) What is the current flood risk management practice of the Xay district?
- 3) What are the strengths and weaknesses of the local government's current flood risk management practices in the Xay district?
- 4) How can the local government practices in Xay district be strengthened by implementation of Local Resilience and Flood Risk Management (LRFRM)?

1.5 Scopes of the study

The scope of this study is:

- 1.5.1 The study focuses on the flood risks, and particularly on flood prevention and management of local governments, that affect locals in Xay district, Lao PDR. The selected local case studies are three villages for sample-specific cases near the Kor River. These villages are all affected by flood risks and have extensive experience with flooding. The selected case studies are Kor Noy Village up stream, Thin Village midstream, and Long Kor Deua Village downstream.
- 1.5.2 Semi-structured interviews were conducted with two groups of respondents that were chosen using specific sampling method, in accordance with their responsibilities and roles related to dealing with flood relief for affected residents, flood risk management, and flood prevention. The respondents comprised:
 - 1). Leaders of local governmental agencies (Governor and vice governors of the district, the district's public administration authority, the district disaster prevention and control committee office, the district's public

works and transport office, the district's natural resources and environment office, the district's social welfare, and the labor office).

2). Village leaders of Kor Noy Village up-stream, Thin Village mid-stream, and Long Kor Deua Village down-stream of the Kor River, and some private sector entities (business groups, non-governmental organizations).

1.5.3 The collection of secondary data includes:

1) Risks, impacts, and management of flooding, including coordination, relief, preparedness, recovery, and climate-rainfall (2008-2017).

2) Urban land-use plans and practices, geography and deforestation.

1.5.4 Primary data (direct observation in the field and interviews of two groups) are summarized and analyzed to address any flood risks to the people of Xay district, and assess flood risk management and prevention.

1.5.5 The existing practices and flood risk management of the local government agencies are analyzed based on factors affecting these practices and prevention measures.

1.5.6 The conceptual framework focuses on strengthening the local government's own policy towards resilience and flood risk management affecting local government and residents in Xay district.

1.6 Operational definitions of this study.

Risk	Vulnerability to the likelihood of the flood events and their potential consequences (such as loss, and harm). Risk determines flood risk.
Local government	Organization for decision making and operation of measures within a restricted area inside a whole district. Concentration broadly means that some of the functions have been decentralized from a central government to local level administration on the spot in order to have a convenient public administrative body managing a small geographic area, such as a district. For example, the district's governor, the local government office of Xay district, has roles and responsibilities related to the management of flood risks.
Flood prevention	The preventive measure against a flood's harmful effects or preventing people from being harmed or damaged by floods and minimizing the occurrence of floods.
Local Resilience & Flood Risk	To learn more about management based on risks and experiences from the past. It involves adopting, adapting, mitigating, building back better, and preventing mishaps in Xay district in the future. For

Management example, Local Resilience and Flood Risk Management emphasizes assessment of the resilience of risk areas, and the ability of local flood prone areas to build back better and sustain effective flood prevention in the Xay district.

Strengthening More substantial local government practices for flood risk management based on flood risk checklists and necessary measures which local government can administer better than centralized (national) management and control.

1.7 Expected outcomes.

To best understand the flood risks of local government practices, it is necessary to understand how the livelihoods of local residents and current flood risk management of local government are affected, along with strong and weak points, and opportunities to strengthen for future improvements.

The expected outcome is a recommendation to local government practices through adoption of Local Resilience and Flood Risk Management (LRFRM) in Xay district. It is expected that this will add benefit to the public, society, and all stakeholders in the Xay district, Lao PDR, and other district with similar conditions.

1.8 The conclusion of Chapter I: the Introduction.

Flooding is a global concern, and the Asian continent has higher than average flood risks for various reasons. Pertaining to this study, the past flood events in the Xay district indicate gaps in prevention related to the occurrence of natural events and limitations of man-made efforts, with weaknesses in urban management policies, combined with inadequate budget allocations and equipment, and a lack of local community participation.

The study aims to focus on four objectives: the nature of the flood threat experienced in the Xay district, assessment of the current local government practices, assessment the local government practices for the strengths and weaknesses in this district and to strengthen and apply opportunities for improvement of local government practices using Local Resilience and Flood Risk Management in the Xay district. These objectives lead to four main research questions (and various sub-research questions from interviews) for this study. The scope and operational definitions that will be used in the pursuit of evidence of this study have also been detailed.

The main consideration in this study is to identify ways in which the local government can most effectively implement practices to manage flood risks. Therefore, the focus is on the local government needs, considerations, and the ability of all stakeholders to support the proposed changes and promote the strengthened measures.

The study is needed to better understand the impact of flood risks on local livelihood and the effectiveness of local government flood management practice. Furthermore, the recommendation to strengthen and apply opportunities for improvement the local government practice using Local Resilience and Flood Risk

Management (LRFRM) in the Xay district will contribute knowledge that will be valuable to other stakeholders and districts.



CHAPTER II

LITERATURE REVIEW

2.1 Framework of Flood Management: Risk, Impact, and Prevention.

In the Asia-Pacific region, floods are the most frequent type of natural disaster. The key risk drivers are increasing population, rapid urbanization, climate change, and a history of poor planning by multi-level governments (top-down). The various trans-boundary risks pose additional challenges to flood risk management. The Sendai Framework (2015) which aims to achieve a substantial reduction of disaster risk and loss of lives, livelihoods and health recognizes that the state has the primary responsibility for disaster risk reduction, and that this responsibility should be shared with other stakeholders. The Sendai Framework aims for a substantial reduction in flood losses resulting from both man-made and natural hazards. It lists priority areas for action, such as understanding, strengthening, managing, and investigating flood risk reduction for resilience management. Also, it aims for enhance readiness for effective response and the post-flood “Build Back Better” concept in quick recovery and reconstruction (UNISDR, 2017). With respect to the above mentioned, for at least the last decade, the changing climate has been related to floods disasters in Lao PDR, along with man-made (intentional or unintentional) factors that need consideration.

- Risk Condition

The Lao PDR is a flood-prone country that experiences regular flooding due to the locations of major rivers. The causative factors for floods in the country include insufficient and inadequate protective dykes along with critical points, poorly functioning water control gates when inundation occurs, with small and shallow natural channels to drain floodwater. This all results in increasing and rapid concentration of runoff, reclamation of wetlands, low-lying areas, and poor land-use planning. Furthermore, climate change and rapid deforestation in the country have led to frequent and severe floods in the country. For example, if more than 200 mm of rain falls in two days, floods occur. In fact, a number of the reported floodings were triggered by storms (ADPC, 2010). In neighbouring Thailand, flooding risk has been exacerbated by rapid urbanization, deforestation in the uplands (Tanwattana, 2018), reflecting the broader aspects of the flood management system. In another example, in Myanmar, the Community-based Disaster Risk Reduction Initiative was implemented by supporting the development of Township Disaster Management Plans, with attention to structural mitigation measures to reduce flood risk (Few et al., 2016).



Figure 2.1: Risk definition

Risk is the combination of exposure, threats, and vulnerability. The threat is the probability of natural hazards. Exposure is a measure of the assets and population at risk. Vulnerability measures potential loss exposure (damage and fatalities), if a flood event occurs.

- Review the flood risk checklist

The table below has been adapted from a previous study in order to get related data and relevant information.

Table 2.1: Flood risk requirements checklist

Flood risk requirements	Have	No have	Strength	Weak
1. Definition of the Flood risk				
a. What sources of flooding risk could affect the district?				
b. For each identified source in box 1a above, can it describe how flooding would occur? Reference any historical records where these are available				
c. What are the existing surface water drainage arrangements for the district?				
2. Factors for flood risk management				
a. Human resources				
b. Budget				
c. Equipment, technology				
d. Climate pattern				
e. Rainfall pattern				
f. Geography characteristics				
g. Deforestation activity				
h. Urban plan practices				
i. Land use patterns				
j. Information sharing				
k. Experiences				
l. Time				
m. Coordination				
n. Early warning systems				
o. Education, training				
p. Legislation, policy, regulations				

q. Risk and vulnerability				
r. Stakeholder practices				
s. Infrastructure				
t. Various vulnerabilities				
3. Flood Risk Management Measures				
a. How will the district prevent flooding, including the potential risks of flood risk management factors mentioned above?				
4. Residual Risks				
a. What flood-related risks will remain after measures to prevent the site from flooding have been implemented?				
b. How, and by whom, will these risks be managed over the lifetime of the development? (e.g., flood warning and evacuation procedures)				
5. Probability				
a. Which Flood Zone is the district? (As a first step, check the Flood Map for Planning)				
b. What is the probability of the site flooding, considering the flood risk maps from rivers and surface water, and any further flood risk information for the site?				
c. If known, what (approximately) are the current rates and volumes of surface water runoff generated by the site?				
6. Development Description and Location				
a. What type of development is proposed (e.g., new development, an extension to existing development, a change of use, etc.), and where will it be located?				
b. What is its flood risk vulnerability classification?				
c. Is the proposed development consistent with the Local Plan for the area? (Seek advice from the local plan agency if you are unsure about this)				
d. Will its proposal increase overall the number of occupants and users of the building/land, or the nature or times of occupation or use, such that it may affect of flood risk to these people?				
7. Detailed Development Proposals				
a. Where appropriate, are they able to demonstrate how land uses most sensitive to flood damage placed in areas within the site that are at least Risk of flooding (including providing details of the development layout)?				
8. Off-site risks				
a. How will it be ensured that the proposed development and the measures to prevent its site from flooding will not increase flood risk elsewhere?				

b. How will runoff from the completed development be prevented to avoid causing adverse impact and risks elsewhere?				
c. Are there any opportunities offered by the development to reduce flood risk elsewhere?				

Source: Adapt from (Cambridgeshire Council, 2017)

- Impact

Impact from floods can lead to injury or death to the local population and animals. Moreover, floods damage houses, property and essential possessions such as furniture, electrical appliances and other belongings, and adversely affects people's livelihoods because floods destroy crops, farmlands, and livestock, and cause food shortages. Long-lasting floods can disturb the regular cultivation pattern. They can also damage infrastructure and facilities like hospitals, schools, roads, telephone lines, or the electricity supply. Impacts to clean water supplies and contamination of sources of water can also occur, which can subsequently lead to the spread of diseases. A flood's impact on a person also depends on that individual's past experiences with crisis, and how well prepared that individual is, both physically and mentally, for such flood events (GTZ-Germany, 2008).

- Prevention

Flood prevention relies on a prepared, dimensional analysis and critique of a prevention theory, such as protective factors. For the pre-flood period, both the local government and local residents participate in surveying and reviewing past impacts, risk areas, safe areas, evacuation routes, and storage areas for food and drink, while time is spent preparing rescue resources, resuscitation devices, first aid kits, and emergency communication devices. Then, the readiness of the plan is assessed, including the ability of the plan to prevent or solve flooding problems, and to establish operations centers. During the emergency period, the Operation Center plan for rescue operations established before the flood occurrence is put into action. In the early recovery period, the flood relief unit administers first aid and looks after flood victims, helping them to survive the challenges of daily living. After the flood (or during the long-term recovery period), the local people's livelihoods are recovered, occupations are promoted, and families supported as things return to normal. Food risk management is often required to determine a cost-efficient prevention strategy (Postek et al., 2019). The Safer Schools project in Mozambique and Ethiopia is an interesting case where programs had evolved towards flood risk prevention through the project's partnership approach. This more holistic approach addresses long-term recovery, prevention, and mitigation needs. The program developed hazard maps to guide risk assessments, disaster-resilient school building codes, guidelines on school safety, and recommendations were produced for effective implementation (Few et al., 2016).

2.2 The resilience concept used for this study

This study adapted the conceptual framework and core theory of resilient perception in "Build back better" (UNISDR, 2015) for flood risk management, with emphasis on the specific conditions related to the Xay district. The adapted concepts are developed into 'Local Resilience and Flood Risk Management' for Xay district policy development.

The origin concept of resilience (Holling, 1973) applied the concept to the social-ecological system. The resilience idea has evolved over time. Nowadays various aspects can be applied, even in disaster and flood risk management. The concepts are summarized in Table 2.2.

Table 2.2: Resilience concept from 1973 - 2015

<u>Authors</u>	<u>Definition of Resilience</u>
(Holling, 1973) (p.14-17)	Persistence of system and their ability to absorb change and disturbance
<u>Organizations</u>	<u>Resilience</u>
The United Nations International Strategy for Disaster Reduction (UNISDR, 2009)	The ability of a system, community, or society that is exposed to hazard to resist, absorb, and accommodate or recover from a hazard's effects in a timely and efficient manner, including preservation.
Sendai Framework for Disaster Risk Reduction, (UNISDR, 2015)	- Build back better concept

Table 2.3: Applications of the resilience concept

Field	Core concepts	Applications
Human development	Individual resilience, Human well-being, Capacity agency	Coping and thriving in times of adversity, individual responses to crises, poverty traps
Planning	Urban resilience	Urban and regional planning for resilience
Other disasters and disaster risk reduction (Includes floods)	Community resilience	Minimizing risk, support quick recovery, and building back better

Source: (Brown, 2013)

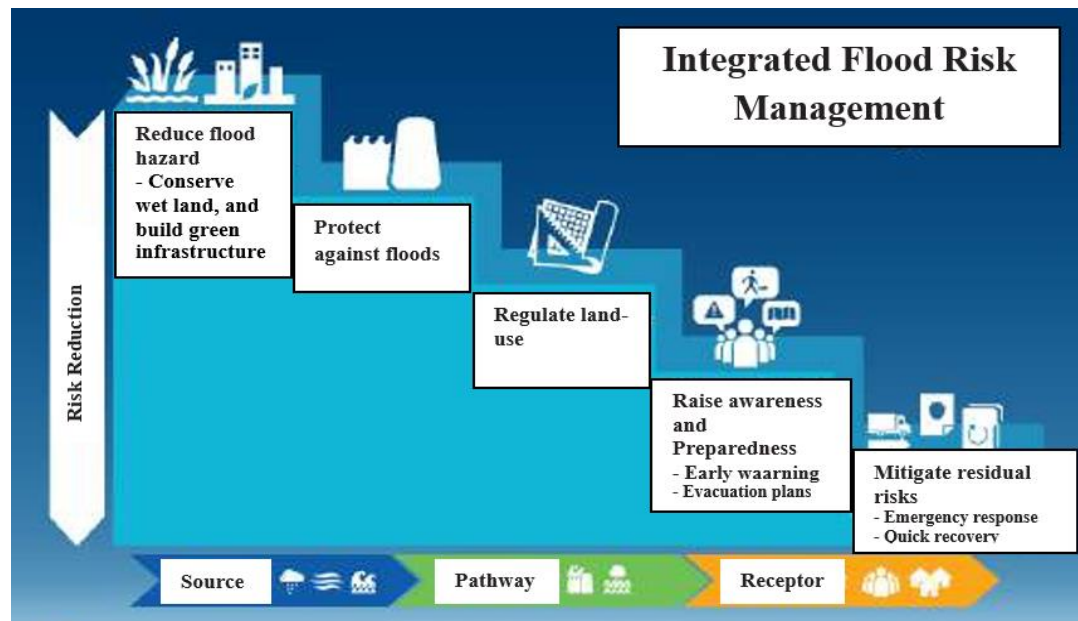
The research on flood management has demonstrated the critical nature of rebuilding back better for the notion of resilience. Thus, this study concentrated on the concept of Local Resilience and Flood Risk Management (LRFRM) for the Xay

District's policy development and future preparations. Sustainable development seeks to meet needs, but it cannot be successful without enabling societies to be resilient with respect to natural hazards and ensuring that future development does not increase vulnerability. As appropriate, risk management needs to be integrated into policies, plans, programs and budgets at all levels and considered within relevant future frameworks to provide adequate, timely and predictable resources for flood risk reduction in order to enhance the resilience of cities and communities to floods, according to their own circumstances and capacities. The goals are to mitigate future harm, deal with effects of the natural disaster, and seize the opportunity to improve flood risk management.

The resilience concept (Brown, 2013) and (UNISDR, 2015) can be applied in order to minimize flood risks before occur, support quick response and recovery during the flood, and build back better after floods in Xay District. The selection of appropriate flood risk management practices is crucial in the Xay district; with its specific condition that is concerned to solve the existing factors.

Resilience in flood management aims at minimising flood impacts and enhancing the recovery from those impacts (IPCC, 2013). The concept of being resilient was framed as, "The capacity of social, economic and environmental systems to cope with flood events, and responding in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for built back better, resistance, and transformation" (Gourbesville, 2014). Building urban resilience is essential for cities (Govindarajulu, 2020). Through capacity, it provides for moving beyond a focus on flood risk management – that is, on readiness and emergency management -- to constructing capacity in flood prevention, long-term recovery, and integrating extreme weather dynamics into the description to further support the shift in approach to the concept of resilience. For example, in the Philippines, the Disaster Risk Reduction and Management Capacity Enhancement Project produced training modules related to the four thematic areas set out in the disaster risk management law for following the processes of disaster prevention, mitigation, preparedness, response, and recovery (Few et al., 2016). Flood risk management and resilience aim to minimize the potential impacts of flood events and local communities' vulnerability. Specifically, flood resilience is the acceptable level of flood impact to which an urban system can adjust and continue to function, such as during and after a flood (Kittipongvises et al., 2020).

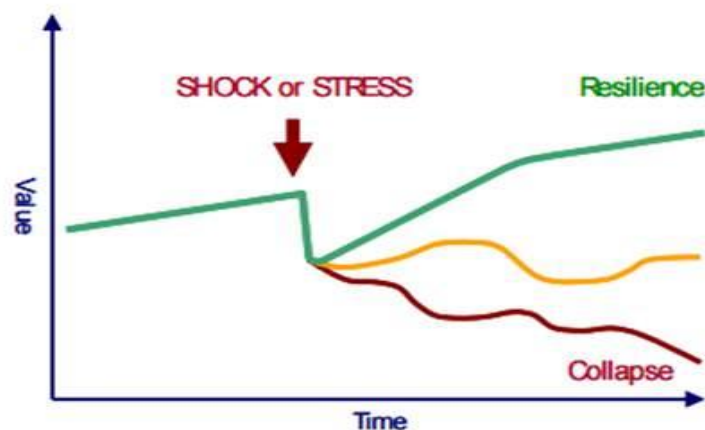
This concept of resilience includes different forms of action depending on the type of flood. These measures are typically organized in a cascade, ensuring that all the possible types of measures are evaluated. As illustrated in Figure 2.2, the cascade elaborates several guiding principles for groups of measures. Furthermore, for each form of measure, there is frequently a corresponding policy and management field. It should be noticed that integrated flood risk management creates relationships and agreements between measures and policy development, resulting in a well-balanced policy for integrated flood risk management.



(Source: (WMO, 2007))

Figure 2.2: The Cascade with Integrated Flood Risk Management measures, corresponding policy, and management field.

The concept of local community resilience in flood risk areas seems a critical component of flood risk management. Strengthening community resilience can balance structural measures for flood prevention and, in some circumstances, can be more effective than engineering solutions. Community resilience is measured as the scope to which local communities can respond to and improve after such flood events (Figure 2.3).



Source: (Torrens Resilience Institute, 2015)

Figure 2.3: Measuring community resilience.

The conclusion for study's concept is by focusing on the Local Resilience and Flood Risk Management (LRFRM)'s for Xay district. According to literature related to resilient concept, it defines how to severe flood management of last update to build back

better concept (UNISDR, 2015) and can had better prepare for the future. This aim of becoming more self-resilient needs to find its own way or local way on flood risk management policies. Local Resilience and Flood Risk Management (LRFRM) will minimize potential damage, cope with the consequences of the risk and take advantage of the opportunity to change something better from the past in the local level of the case study.

2.3 Role of local government engaged in flood

According to Xay district disaster management plans, only a small percentage of the 2018 fiscal budget was allocated for to enhancing the competences of human resources. The local government budget was earmarked primarily for infrastructure, road and bridge construction, and waste management in an effort to promote tourism activities, and district linkage with commercial services. Simultaneously, the local government was not continuing the work of capacity building by exploring and identifying a framework of principles that can serve to underpin adequate support in flood management (Few et al., 2016). Also, good governance is a key principle in flood risk management that is an essential component of the effort to enhance a country's risk management capabilities, and empower the institutions responsible for carrying out flood management tasks (Albris et al., 2020). (Ruiz-Rivera & Melgarejo-Rodríguez, 2017) argued that the capacity of local government to reduce the flood risk in a decentralized system is influenced by internal politics regarding financial, normative, and operative resources. The political conditions that underlie planning and emergency response, however, were overlooked in this analysis. Even though flood risk prevention is seen as part of a local government's priorities, only a minority of works in the field of flood risk reduction have addressed political and institutional capacity for reducing risks (UNDP, 2008).

It is important for local government to have modern tools that enable the effective use of its natural hazard risk information. Relevant actors see the value and the capability of flood risk modeling software in the use of flood risk modeling related to communication, decision-making, planning, and emergency response. However, flood risk modeling can also become an effective tool to communicate flood hazard risk and better inform flood hazard policy (Crawford et al., 2018). For example, communicating information of public concern can result in people changing their perceptions, and attitudes, leading to positive actions related to flood preparedness and mitigation of flood damage (Abunyewah, 2020).

Local government mechanisms, such as significantly developing land-use planning and regulating urban improvement with attention to each town's relevant floods and risks, are significant tools for building urban resilience. Institutional assessment, however, has displayed gaps in understanding flood risk for prioritizing programs and regulating land-use change and urban enlargement in cities like Surat City in India (Govindarajulu, 2020). Despite the increasing roles required of local

government agencies with respect to flood management practices in many developing countries, many of them are simply trying to deal with relief and response to floods rather than dealing with fundamental risk conditions that lead to floods. Among actions required are risk assessment, capacity enhancement, and vulnerability reduction (KUSUMASARI et al., 2010).

According to (EWINS et al., 2006), there is a risk of corruption in local government action following floods, with the potential of the government unfairly benefiting some specific parties.

It is important for local governments to understand the reasons for different groups' vulnerability in a local area. Further, it is necessary to understand the risk posed by floods to better prepare for the future. The local government needs to find multiple resources for this purpose. For example, local knowledge, policies, flood reduction programs, technical institutions, equipment, and social networks can all be part of the local government strategy and practice, while challenges need to be identified and lessons learned from prior experiences of responding to floods.

These different local government levels have different capacities regarding technical, operational, financial, and legal aspects. It is essential to understand the capacities available with these different local government levels because the commune and sub-district levels have fewer technical and financial resources than the district local governments. However, in comparison, the commune and sub-district levels have much stronger ties with the local communities (ADPC, 2006). Moreover, it is also important to analyze the resources of the private sector, including organizations like teachers' associations, women unions, and youth unions in an effort to encourage them to support and participate in flood risk management.

The local governments alone cannot achieve tremendous success in flood prevention, preparedness, and response without the active involvement of local residents. Effective flood risk prevention requires action by all stakeholders. In particular, local government technical, human, and financial resources are limited, and not sufficient to implement flood risk prevention activities amongst all vulnerable communities. Therefore, the local government needs to mobilize support from various civil society institutions, and involve larger communities that can play act as facilitators and resource providers in encouraging the locals to participate in the flood risk preparedness.

Facilitating local government action through interventions and initiatives involves establishing policies as per the local level needs, identifying and prioritizing the most vulnerable communities, conducting local level risk assessment, documenting local coping mechanisms, and facilitating development of local flood protection and preparedness plans. This facilitation of community-level preparedness planning includes the establishment of local and community level early warning systems, and capacity enhancement of community volunteers and groups, such as, for example, training in search and rescue, first aid, swimming, evacuation drills, and risk assessment. It also involves providing resources like medicine, kits, warning equipment, evacuation equipment such as boats and transport to community volunteers

and groups. In addition, it is necessary to establish safe storage of essential items near vulnerable locations that includes food, rescue equipment, and earthmoving machinery, as well as establishing temporary shelters at vulnerable locations to host affected people. Other needs include resources for damage assessment, relief distribution teams, and the local level emergency response teams comprised of community members and local government officials (ADPC, 2006).

A study by (UNISDR, 2010) mentioned five critical opportunities and challenges that should be of concern to the local government.

1). The lack of capacity and interest of the local government agencies need to be recognized and addressed.

2) Local people's risks and vulnerabilities need to be understood. Even though the local government knows the local areas very well, it often lacks sufficient knowledge about floods vulnerabilities and risks, communities, and suitable management to prevent floods.

3) It is important to continually manage the repair and improvement of critical infrastructure. While the local governments were accountable for building infrastructures, the investment, design, and practices to make them resilient were often not visible.

4) Management of long-term processes is so tricky that flood risk prevention and reduction initiatives often suffer from human resource changes and unequal interest among the key decision policymakers.

5) Learning from various past flood events is essential. The study found that local people primarily oriented towards short-term, visibly quick recovery works. However, understanding of the past can provide a catalyst for changes and engagement of local government, local people, and villages in long-term planning.

The local government agencies involved in the risk management system may also use a crisis to transform the local government structure and practice into something more desirable. The following sections analyze the local government structure of Xay district in terms of institutional responsibilities of prevention, detection and warning. At the local level, policy-making systems involve the private sector, local people, and academic institutions in providing assistance and taking responsibility for flood risk management.

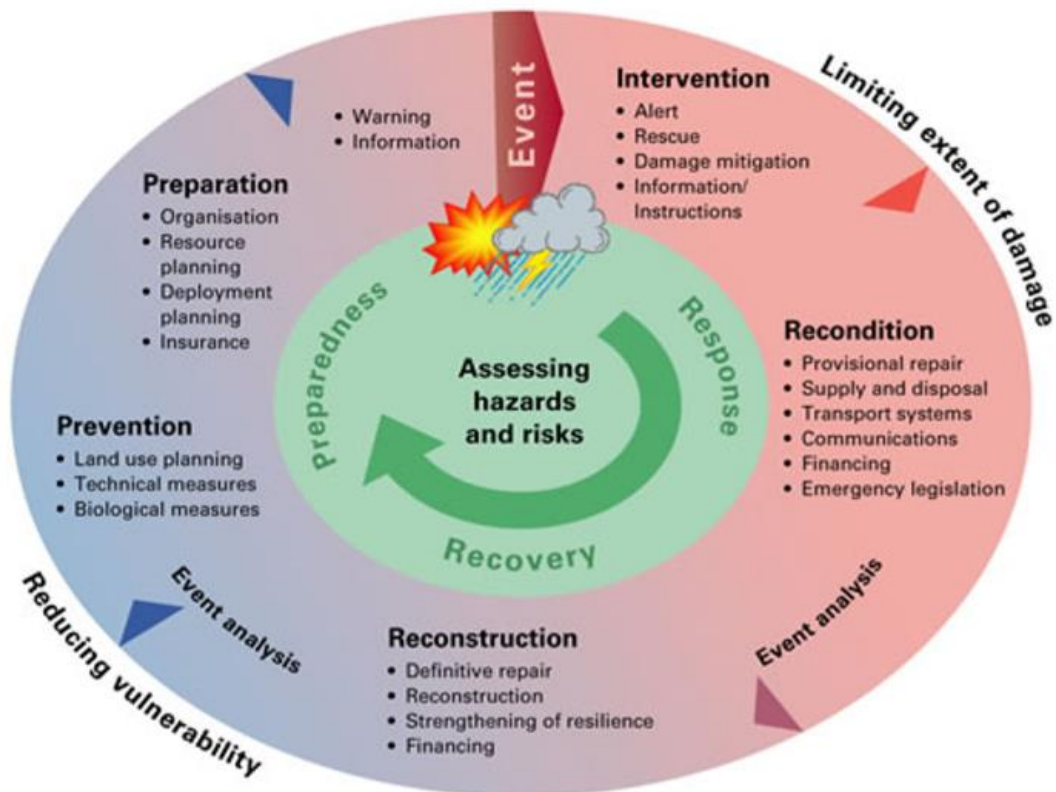
2.4 Role of local community participation

The local community can bring local residents' livelihoods and conditions back to normalcy if it has strengthened its flood prevention and recovery capacity. Village disaster prevention committees have been set up to enhance local awareness about how to act and what to do before, during, and after floods. Some villages have provided local community based early warning systems, while others have adapted their livelihood practices with a focus on being more resistant to floods (CBDRR, 2016). A number of programs have shown innovation and inspiration in linking flood management activities with the local principles (Few et al., 2016). However, this positive consequence has

primarily occurred when local community involvement has been integrated into the information dissemination process of flood risks (Abunyewah, 2020). The urban flood dealing, multi-danger zoning, and effective flood risk communication are all urgently needed to improve flood control and response. Notably, all local communities and villages can become achieve the imperative of flood reduction by enhancing their flood resilience ability (Kittipongvises et al., 2020). The participation of local people provides more resources to local governments to help them find solutions to flooding. Moreover, allocation of authority needs to be carried out based on assignment of roles that contributes to effective, efficient, and sustainable activities. Developing and encouraging the active participation of local residents begins at the stage of activity planning and continues up to the construction, operation, maintenance, evaluation and monitoring stages (CBDRM, 2014). In Thailand, it has been found that spontaneous community disaster management organization exists and can sometimes occur in some Thai communities; however, progress in organizing the community is slow and limitations in disaster risk reduction have been revealed (Tanwattana, 2018). Another study by (Shaw & 1, 2012) rightly pointed out that flood management should not be treated as one single issue but should be incorporated into local socio-economic activities.

Experience from flood-prone regions in South Asia Countries indicates that the establishment of community flood management committees with clearly defined institutional structures, roles, and responsibilities for before, during, and after a flood can be an effective platform for the participation of those most affected (WMO, 2008). Even though this experience shows local community participation, mostly in affected areas, a model with individual variations can also apply in urban and rural areas. These committees perform various functions which include: 1) assessing the needs and capabilities of the local community, 2) making provisions for emergencies, 3) raising awareness, 4) managing information for future reference, 5) training and capacity building, 6) networking, monitoring, and reporting, 7) planning and interfacing with government institutions, and 8) resource mobilization.

Local community participation plays an essential role in every step of Flood Risk Management (FRM) and is a key to preparedness for responding to and recovering from flooding in the area. It is noted here that participation in flood risk assessment, along with planning and implementation of management measures, is a key to the success of FRM plans.



Source: (WMO, 2008)

Figure 2.4: Local community involves flood management.

The researcher adopted the concepts illustrated in Figure 2.4 in this study, especially the cycle of flood management, starting from the intervention period, through reconditioning, reconstruction, and prevention until reaching the stage of preparing for resilient flood risk management in the future.

Resilient communities can sustain critical systems under stress; they familiarise themselves with changes in the physical, economic or social environments. They can be self-reliant if external resources are limited, and they learn from experience to recover over time. Flood resilience has four components: community connectedness, risk and vulnerability, planning and procedures, and available resources (Figure 2.5).



Source: (Torrens Resilience Institute, 2015)

Figure 2.5: Model for community resilience

2.5 Relate with urban plan practice

Through human history, half of the world's population has lived in urban areas, with 2/3 of this in middle-income and low-income countries. Urbanization, is a meaningful feature of the global demographic, as the world's population grows continually denser. This has implications for various activities related to flood risk areas. Urban areas at risk from floods have been impacted particularly hard across the world, and predicted flood risk levels gave urgency to calls for flood risk prevention and monitoring in the local urban settlements. Low-lying cities are exceptionally high-risk areas for climate-related hazards due to their often-large populations and complex socio-economic systems (Nicholls, 2007). Urban planning is one of the fundamental requirements in FRM. It is critical to understand the relationships between city population growth, human activities and physical demands of settlement, along with more extended, middle-short term economic trade-offs, and the most suitable land-use change available. In turn, the local government's increased role under decentralization is expected to create a need for more citizen involvement, increased efficiency and knowledge, improved governance from a bottom-up approach, combined with an interactive top-down approach (JÜTTING et al., 2005). Land-use planning, weather forecasting systems, and city infrastructure also affected the risk of extreme weather events. Urban flood management planning is linked to a large number of factors such as economic, political, and social development, and environmental and geographical issues. The constant increase in urban development has intensified the continued

destruction of the surrounding protective marshlands and amplified residents' flood vulnerability (Mooney, 2015).

- Trends in development and urban planning management of Xay district in 2014.

The urban development and administration office aims for a safe, clean and beautiful city through its development activities. Waste transported from 13 Villages totalled 23,767 tonnes, an increase of 7.8 times from 2009. Also, 1,399 flowers and trees were planted. Residential and infrastructure development continued, with 276 housing and construction projects along with 45 road construction and maintenance projects. However, there was still 2.5km of drainage design to be implemented (Xay Districts Revolutionary Party Meeting Report, 2014).

2.6 Relate with Sustainable Development Goals (SDGs) 2015



Figure 2.6: Sustainable development goals

The 17 sustainable development goals (SDGs shown in Figure 2.6) compete with many deeply ingrained societal values, and progress towards achievement of these goals has been slow. All 17 goals are relevant when discussing disaster risk management. The SDGs represent long-term strategies, policies, planning, and policy benefits. They can continue to influence global development through greater collaboration and integration into the transition toward decentralization. This creates opportunities and challenges to which are no simple answers. Leadership, planning, monitoring, implementation, participation, and coordination are all competencies and practices that need to be developed. In some countries, an experience base of many years exists to support learning and implementation of flood risk management. There is substantial overlap between resilient risk management and prevention and sustainable development goals, mostly related to research topics such as:

(a). Goal 11: This goal focuses on making cities and human settlements inclusive, safe, resilient, and sustainable.

(b). Goal 4: Ensuring inclusive and equitable quality education, and promoting lifelong learning opportunities for all.

(c). Goal 13: Taking urgent action to combat climate change and its impacts.

(d). Goal 16: Promoting peaceful and inclusive societies for sustainable development; providing access to justice for all, and building effective, accountable and inclusive institutions at all levels (UNDP, 2015).

2.7 Guideline development on flood prevention and resilience management

Strengthening Flood Risk Management (FRM) is critical for pre, during, and post-flood processes that reduce risks, using the concept of "build back better" and producing sustainable development benefits. However, a review of the Lao PDR's FRM performance during several floods reveals the need to strengthen the current system at all government levels, especially the local levels of government. Initial steps toward strengthening flood risk reduction involves program development, including a national working group on FRM with cross-ministerial representation to propose joint operation measures. At the local level, functional capacity improvement can increase abilities of local authorities to plan, prioritize activities, and manage funds for the public purpose of FRM. For example, in neighbouring Myanmar, disaster risk management mechanisms are expected to be developed as part of action plans at all governmental levels, including villages (Few et al., 2016). One aspect of this type of functional strengthening can include raising the broader political circumstances required to advance FRM as a priority, and giving attention to emerging incentives for local institutional staff and local communities to participate in effective FRM (UNDP, 2008). In India, the local government improved its revenue generation channels for part funding the grants received from the National Government and other organizations. The Green Climate Funds recognized "Resilient infrastructure and built environments to disaster threats" as one of the core sectors for funding since institutional mechanisms for resilience structure, particularly for land-use planning and development regulations, need to be strengthened (Govindarajulu, 2020).

- Prerequisites for Local Government

To achieve the local government's goals, there are obstacles to be overcome. A set of prerequisites is needed for integration to deal with these challenges, as shown in Figure 2.7.

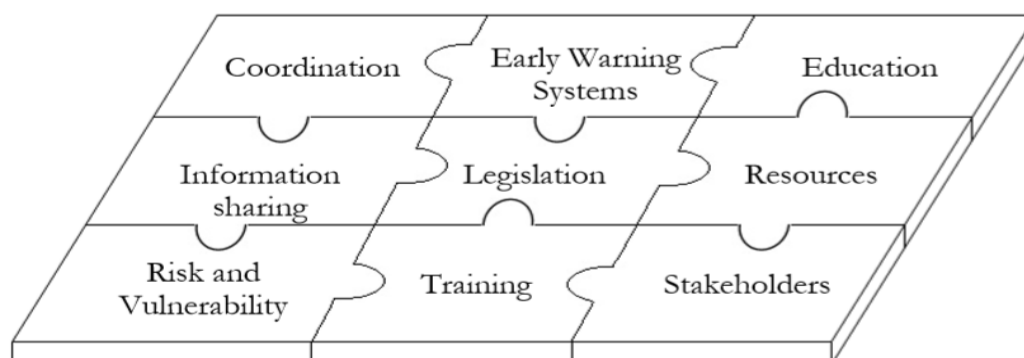


Figure 2.7: Prerequisites for well-functioning implementation of local government

Table 2.4: Prerequisites' explanation for Local government needed to do

No	Factor	Context
1	Communication and Coordination	It was the most crucial tool for achieving proper coordination. It is essential to identify and establish different channels of communication (Shaw & 5, 2012)
2	Early Warning Systems (EWS)	In risk-prone areas, it is crucial to have practical EWS. According to (Pineda, 2015). EWS should deliver information to the concerned population.
3	Education	It is essential for local government and local communities. Teach the local residents and other stakeholders the importance of flood risk reduction and increase risk awareness (Shaw & 1, 2012)
4	Information sharing	It can be in the form of booklets, media, or education. It is an essential tool for increasing risk awareness (AMDI, 2013).
5	Legislation	Policies and legislation, the importance of combining a top-down and bottom-up approach become more evident (Shaw & 1, 2012)
6	Resources	There are usually donors that make the plan, project, and program possible, but the aftermath and maintenance of the program are often not thought of or budgeted (Izumi & R, 2012).
7	Risk and Vulnerability Assessment	Assessments are made together with the affected population and external actors to prepare for efficient actions (FMMP, 2006)
8	Training	This provides a way of making the local governments aware of the shortcomings of existing plans and possible measures for enhance them (Ishiwatari, 2012)
9	Stakeholders	All stakeholders need to have clear roles and responsibilities to enhance leadership and communication within the program. The local governments comprise the first responders to implement efficient flood risk measures (Izumi & R, 2012)

- Challenges

The budget needs to support the district and village plan implementation. The local government plan relies on financial support for FRM. At the local level, achieving the integration of FRM with comprehensive development planning can provide more reliable support for financial and resource mobilization. Linking sustainability of

initiatives to broader local development processes is an essential consideration (CBDRR, 2016).

Table 2.5: Identify the functions of the Local communities in flood situations

Before	During	After
<ul style="list-style-type: none"> - District flood risk management plan is developed and updated annually, and information is shared with all villagers - Regular inspections around the district to identify places at risk and warn local people living in risk-prone areas to implement flood risk reduction measures. 	<ul style="list-style-type: none"> - Follow up weather forecast information through available multi-media channels and issue warnings within the district and villages using proper procedures. - Order every local villager to stand by to take immediate action, if the situation deteriorates. 	<ul style="list-style-type: none"> - Facilitate the local community's social, economic, and physical rehabilitation to understand concepts better. E.g., livelihoods, health counselling, reconstruction of houses, and infrastructure. - Coordinate with all stakeholders and aid agencies to receive assistance in quick repair and reconstruction.

In another example from Europe, to reduce the flood risk in the Netherlands, the Dutch government invested in new flood protection infrastructure. The participatory approach to its implementation resulted in a network of knowledgeable governmental authorities and citizens, while the flood defenses diminished the chance of flooding. The social capacity in the Netherlands is conceptualized as five dimensions: knowledge, participation, motivation, finance, and networks (de Voogt et al., 2019).

In Southeast Asia, the great flood of 2011 in Thailand made it clear that flood risk management needed to be a priority for the future of all government levels (Sriariyawat, 2018), such as below:

- Flood Prevention and Mitigation Principles (for short term planning)

Flood prevention makes use of existing structures and gives consideration to local characteristics in each area such as enhanced storage and drainage capacity, preventing flooding in community and economic zones, and support for measures (facility, recovery, data/warning, and based community management, volunteer) intended to reduce loss. Further measure includes such things as repairing the main gates to protect from overflow, drainage capacity alignment and enhancement (dredging, pumping, dyking), controlled floodwater in the upper area, utilizing storage capacity (middle area), drainage zoning (lower areas), and flood warning system.

- Flood Prevention and Mitigation Principles (for long-term plan)

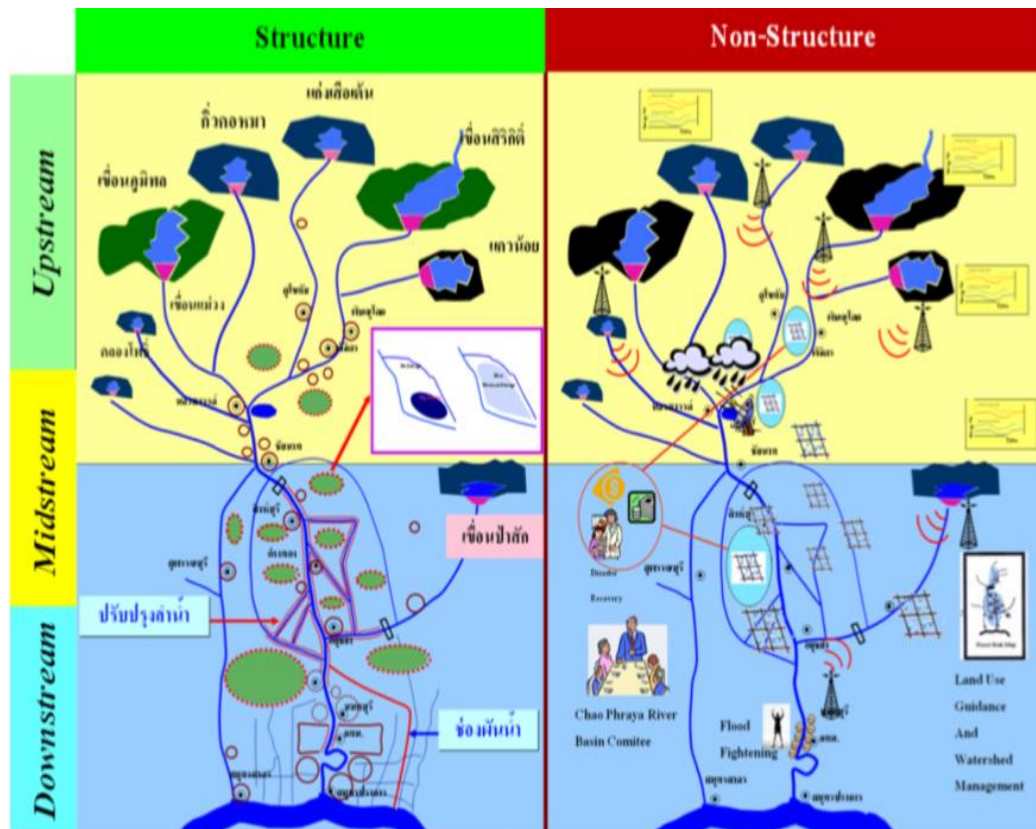


Figure 2.8: Typical of long-term measures for flood prevention in ChaoPhraYa river basin.

Major component 1	
Upstream areas	<ul style="list-style-type: none"> - Forest and Land Rehabilitation, Conservation. - More Reservoirs - Land Use/Development Regulation.
Midstream areas	<ul style="list-style-type: none"> - Protected Provincial, District Areas - Absorb Flood Peak and Increase income in the irrigated floodplain. - Land Use/Development Regulation
Downstream areas	<ul style="list-style-type: none"> - Protected critical economic zones - Floodways' through/around the areas - Land use/Development Regulation
Major component 2	
- Developed database, prediction, and early warning systems	
- Developed practical and realistic regulations and compensation regime	
- Establish a "single command authority"	
- Promote public awareness, participation, and support	

In a study of the flood risk management of (Frisco Project, 2019), controlling or reducing was carried out by implementing so-called flood protection

measures, which were divided into non-structural and structural prevention measures, as follows:

- The Non-structural measures included creating policy, strategies, plans and programs, e.g., flood guidelines, methods of forecasting floods, and planting vegetation for riverbank erosion protection.

- The Structural measures included technical knowledge, hard engineering (mainly based on the natural sciences) and civil engineering, which play a dominant role in flood protection provided by engineering techniques, e.g., the construction of high-water embankments.

The Frisco project joined a research project in Slovenia and Croatia, in which a set of 20 types of flood prevention measures was prepared that reduced and prevented the emergence of additional flood risks. The types of flood prevention measures was extensive: 1) Determined the flood areas, 2) Identified, established, and preserved high water overflow surfaces, 3) Adapted land use in river basins, 4) Implemented hydrological and meteorological monitoring, 5) Established and managed flood risk data, 6) Educated and raised awareness, 7) Planned and constructed structural flood protection measures, 8) Implemented individual (self-prevention) flood prevention measures, 9) Regular verification of the effectiveness of existing (structural) flood prevention arrangements, 10) Regular maintenance of watercourses, and water facilities, 11) Implementation of river control, 12) Flood protection, management of water facilities, 13) Financial resources provided for implementing the public utility service of water management, 14) Flood protection and rescue plans prepared, 15) Flood prediction, 16) Flood warning, 17) Intervention action during floods, 18) Assessment of damage and implementation of post-flood rehabilitation, 19) Documentation and analysis of flood events, and 20) Systemic, normative, and financial.

These individual flood prevention measures had very different effects. While structural flood prevention measures were most effective, they also posed the most significant risk to the environment (positive for human health and sometimes a little less favorable for nature). Overall, the 20 types of flood prevention measures were combined into five steps of the entire flood risk management cycle, namely:

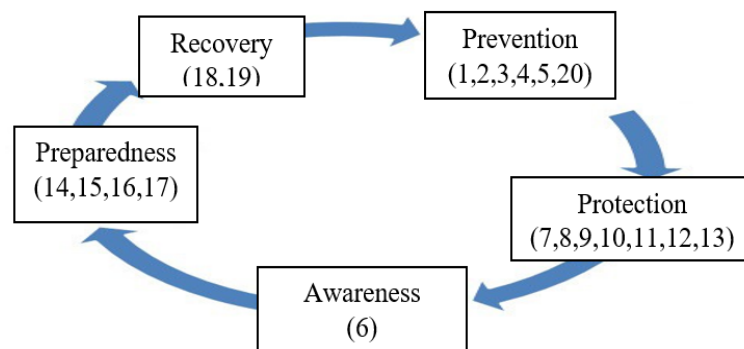


Figure 2.9: Individual flood prevention measures in the flood risk management cycle

Some response guidelines, e.g., recovery, prevention, and preparedness for disaster management, were refined into the so-called SHIELD model, comprising a set of strategic suggestions across six key subjects: 1). Shared knowledge, 2). Harmonized capacities, 3). Institutionalized coordination, 4). Engaged stakeholders, 5). Leveraged investments, and 6). Developed communication (Albris et al., 2020).

- Green infrastructure

Green infrastructure can help filter, absorb, and reduce the speed of stormwater runoff, which mitigates urban flooding and leads to upgraded water quality. Table 2.6 displays the strategy of green infrastructure as a sub-section of natural capital and natural-based solutions.

Table 2.6: Diagram of the Green Infrastructure

Natural capital	Nature-based solutions	Green Infrastructure
The planetary resources (e.g., plants, air, water, soil, animals, and minerals) sustain life and well-being. Natural capital underpins water, clean air, shelter, energy security, medicine, and more. Natural capital concepts to keep track of society's dependence on these vital resources.	An umbrella term for actions that manage, protect, and restore natural capital in ways that address societal tests effectively and adaptively. These include structural and non-structural actions, reaching from ecosystem restoration to integrated resource management and green infrastructure.	A subset of nature-based solutions that intentionally and strategically preserves, enhances, or restores a natural system's elements to produce higher quality, more resilient, and lower-cost infrastructure services. Infrastructure service providers can integrate green infrastructure into building systems.

(Sources: Adapted from (Cohen-Shacham et al., 2016))

A study from Japan showed underground facilities – and particularly, the Tokyo Metropolitan area outer underground discharge channel -- were protecting the city from flood damage. The facility, which is 6.3 kilometers long, is located 50 meters (164 feet) below the metropolitan area's trunk road, as shown in Figure 2.10. When heavy rain falls, the system prevents flooding by temporarily storing vast amounts of rainwater and discharging it to remote rivers. It is an immense facility that includes flood flow inlets, water flow control mechanisms, and high-powered pumps to discharge the stored water to the rivers after the flooding has subsided. It has resulted in dramatically less flood damage in the 987-square-kilometer river basin surrounding Tokyo (Japan, 2015).

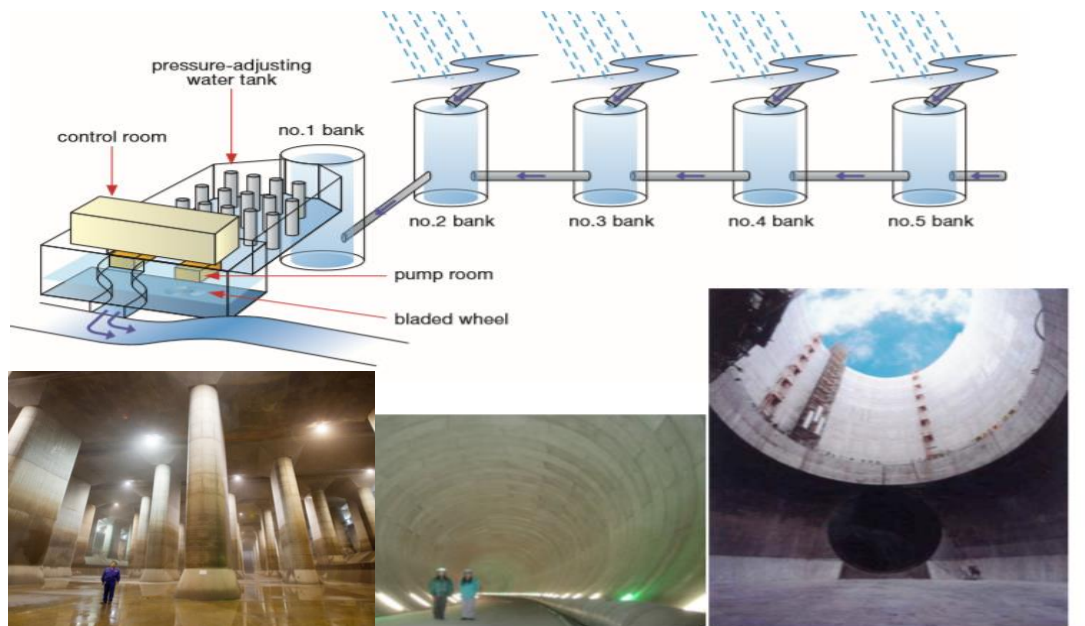


Figure 2.10: The Tokyo Metropolitan area outer underground discharge channel

- Data collection and analysis for flood risk management in the Lao National Government.

The UN-ASIGN is a free application to provide crisis response and disaster risk reduction. The application permits individuals to gather data, to assemble and distribute crowd obtained photos and report approximately the conditions in a given area during a natural flood emergency.

The Lao Di system for recovery and reconstruction and several other disaster information systems were established for the Lao PDR application. The Lao Di is based on the UN's Disaster Information Management System (Desinventar Application), and was developed in partnership with the Lao national government, involving groups such as MoLSW, MONRE under the United Nations Integrated Disaster and Climate Risk Management Project in Lao PDR, and is expected to become the primary source for disaster information. It is an instrument that helps to analyze disaster developments and their effects in a systematic manner to facilitate improved planning for prevention, mitigation, and preparedness measures to reduce the harm of flood disasters on communities. It is still in the primary stages of improvement, and its effectiveness is presently limited because of the lack of data existing in the database. In the short term, the Lao Di system will be utilized best as a resource and aid to decision-making in Xay district. Its use should lead to better systematic information and discussion among the locals and the local government in Xay district, who are responsible for dealing with the database. There are also many Flood data apps, and smartphone applications recently developed for data collection.

2.8 The conclusion of Chapter II: Literature Review

The concept of resilience has its foundation in the “build back better” philosophy, with its proponents believing that resilient capacity makes an area better prepared for the future. This study is aimed at identifying how Xay district can become more resilient and find solutions from flood risk management. The LRFRM concept is summarized by five related key phrases as stated below:

1) Risk from floods

The level of risk from flooding is affected by many factors or related risks (e.g., risk from climate-rainfall, geography, deforestation, land use change-urban plan practice, and others), and these can be man-made or natural conditions. Floods are still occurring frequently in Xay district and nearby high flood risk areas. These risks need to be fully considered and effectively dealt with. This concerns the first research question of this study: What is the nature of the flood threat experienced in the Xay district, Lao PDR?

2) Local government

Local government crucial because it has the power of legislation to deal with the FRM. Hence, here is where we look for the answers to the second research question and third research question about this study: What is the current flood risk management practice of the Xay district?. What are the strengths and weaknesses of the local government's current flood risk management practices in the Xay district?

The local government needs to understand the current risks in flood prone areas under its authority, and it needs to create policies, and strengthen plans for real action. The local authorities must solve the confused mechanism of local government structure, and encourage the knowledge-capacity of human resources in Xay district for the short-, mid- and long-term, while attempting to push all stakeholders forward together with a broad sectoral approach throughout the district. However, the effort needs to be supported with more substantial budget allocations, and more modern technological equipment to help the locals. Moreover, it is important to avoid corruption and encourage local villagers and the local community to participate in all FRM measures. The focus needs to be towards the readiness of flood prevention and resilient management, instead of the traditional focus of mitigation during flooding events.

3) Flood prevention

As in previous content analysis, a great deal of effort has been put into finding answers to the weaknesses in the local government's current flood risk management practices in Xay district. Flood prevention is needed for strong preparedness, and to support all requirements to all stakeholders needs in an effort to enhance participation and motivation for prevention before, during, and after flooding events. The issues and risks conditions are as follows:

- Prevention: activities reducing flood risks and promoting appropriate land-use, urban plan management, agricultural land management, and forest management.
- Awareness: informing the local government agencies and the local residents of flood risk and taking timely and appropriate action in a flood emergency.
- Preparedness: the early warning system, the alert system, an emergency response, mitigation, relief action in Xay district.

4) Resilient management

Resilient management is to the concept behind the fourth research question: How can the local government practices in Xay district be strengthened by implementation of Local Resilience and Flood Risk Management (LRFRM)?

According to the concept of SDGs, local governments have the primary role in leading the effort toward resilient flood risk management. It is important to have full participation from all stakeholders, including policy decision-makers, governments, local residents, social groups, academic researchers, and NGOs in order to effectively develop preparedness, rapid responses, recovery, event analysis, reconstruction, and prevention practices. Understanding the "build back better" concept of resilience should help motivate all these stakeholders to take action.

The action needed from these related stakeholders includes sharing opinions, data collection, analysis of flood risks to the policies, strategies, plans, projects, programs for prevention, quick recovery, and build back better concept before, during and after flooding events. It is also necessary to disseminate updated laws, legislation, and regulations to villages, communities, and locals to encourage them to understand and participate in flood prevention. Hence, the affected stakeholders will know the risks in their areas all the time. The local governments need to monitor the situation and organize campaigns via local television, radio, newspaper, and social media, so that the locals are kept informed about the state of climate change, extreme weather events, and early warning systems for floods that may occur in all population areas throughout the Xay district.

Regular meetings should be standard, but in cases of actual flooding, all the stakeholders need to meet urgently and report to high-level leaders for decision-making in order to identify the appropriate methods to solve problems, and initiate assessment to support the victims of the flooding.

Resilient management will make for fast restoration under the build back better concept, and after the flood event, the data analysis, consideration of new findings and performance are necessary to enhance preparedness for future flood risks. Furthermore, it requires annual review meetings aimed at finding important and weak points of flood situations and making plans for future sustainable resilient management that considers plans and actions for before (readiness), during (mitigation), and after (build back better concept) flooding events.

5) Strengthening of Local Resilience and Flood Risk Management (LRFRM) for local government practice.

Based from the four research questions discussed above, recommendations were developed for policies that address every risk. This body of practices results from literature review, content analysis, and consideration of local, national and international factors that affect Xay District, Lao PDR. Together the body of practices is known as LRFRM (Local Resilience and Flood Risk Management).

LRFRM also relies on participation by all related stakeholders. The implementation of short, medium and long-term plans for flood risk management requires readiness and preparedness before a flood occurs; during flooding, the need is for assessment and a quick recovery process, while post-flood activities should focus on the building back better concept. The strengthening factors produce multiple benefits for development of sustainable flood management practices.

The priority areas for action include understanding the flood risk areas that must be addressed in order to achieve these goals. Therefore, a robust legal and institutional framework are needed and involve different stakeholders, with dedicated financial, technical, and human resources as follows:

- Legal and institution framework is disseminated throughout the district;
- Strict laws, policies, and plans for flood risk management;
- Focused on strengthening the development of human resources for resilience management for flood risks;
- Better management of urban plan practice for flood prevention;
- Education and training programs for all stakeholders, from primary school children to actors at high levels;
- Improved flood preparedness, and response;
- Modern technologies applied;
- Early warning systems that are easy to understand and access;
- Sufficient budget allocation to support all stages of the flood risk cycle before, during, and after the event, and including short-, mid-, and long-term measurement.

2.8.1 Identifying and summarizing strength points from literature review

Researchers have studied flood risks throughout the globe, many remain interested in studying the causes and risks of various floods, specific areas, and effective flood prevention. Much of this research, however, has been focused on developed countries and relies on modern early warning systems that link internet central control headquarters to alarms for locals, accurate modern program support, and update technologies. There have been attempts to update theories, methods, and technologies that suit specific prevention methods appropriate to different areas. One such attempt at updating approaches to flood management (UNISDR, 2017) was taking action voluntarily, which recognizes the primary role of local government in flood risk

prevention, but it has become clear that responsibilities should be shared with all stakeholders.

Moreover, it has become clear that sufficient budget allocations are required for modern flood risk management (Postek et al., 2019). Whereas investment in infrastructure engineering method is necessary and affect economic-social development, further useful flood risk management methods need to be considered in specific areas. Non-structural method like laws, policies, and updating out-of-date plans must be part of enhancing flood preparedness, and responsibility for several national policies have been re-assigned to the local level through decentralization. Some studies have suggested integrating many components such as communication-coordination, early warning systems, education, information sharing, legislation, various resources, risk-vulnerability assessment, and training, in consultation with all stakeholders. In addition, accompanying policies, strategies, plans, programs, and projects and in the short-, mid- and long-term are critical. In an example of why responsibility for flood management should reside with local authorities, (Bae & Chang, 2019) argued that politics could influence good urban planning before the land-use changes to stricter building code control can reduce flood risks. This type of varying development levels may lead to differences in flood risk and damage even under similar environmental conditions, making local government the best choice for flood risk management.

2.8.2 Identifying and summarizing weak points from literature review

According to the review of previous literature, some weak points need further study. Not much research has been focused on the least developed countries and developing countries, where flooding is often more common. It has been difficult for local communities in these countries to adapt, practices, developed for modern technologies, less budget for their countries. Such as flood risks from many factors (i.e., from natural disaster conditions or human activities) in the study area. Whatever various risks are posed, additional challenges to flood risk management (UNISDR, 2017), like those mentioned above about the Xay district and other areas in Lao PDR, make it clear that additional research is needed to update existing theories for effective use in different places in many countries around the world. The case study area has had very little attention from internal and international researchers; hence the need for this study, focusing on the Xay district.

The first research question focuses on the nature of the flood threat experienced in Xay district. The second research question and third research question assess the current local government practice, along with its strengths and weaknesses. Finally, the fourth research question concentrates on how the local government practices in Xay district can be strengthened by implementing Local Resilience and Flood Risk Management (LRFMR) in Xay district.

The expected result could help update some academic knowledge and contribute to other places with policies and action. Nonetheless, floods are difficult to forecast. However, local government action is one significant factor that can lead to

improvement, and further studies that focus on causes, limits, and factors from human activities to fill research gaps can benefit all local government members and enhance the structure needed for strengthening systems and practices. In studying the past, results have shown that flood risk management approaches have mostly focused on mitigation. The better approach is to provide immediate relief from flooding, followed by assessment and enhanced readiness for the next flood to come.



CHAPTER III

RESEARCH METHODOLOGY

3.1 Research framework

The four research objectives of this study were mentioned in Chapter one, section 1.3. Procedures for conducting the study relied primarily on (Creswell, 2007)'s approach. The first step was to determine the scope of the research, including study risks and factors affecting the flood management based on the local government collaboration or conflict. The study needed to look at the local government side or (public side) in its principal analysis, followed by consideration of the impact on and participation of local people (private side).

On the local government side, study risks and factors from their practices for strengthening were significant to flood risk management on this case study, and included the ability of local government agencies. Simultaneously, the study focused on factors such as previous flood risk, experience, risk attitudes, urban planning practices, socio-economic development, and other conditions that influence flood issues such as rainfall-climate data, river tributaries, and terrain characteristics of the Xay district studied through multiple sources.

On the local side, flood risk prevention opinions were sought from the local community residents, including the leaders of the three villages (the up-, mid- and down-stream villages for specific case study samples). Additionally, some businesses and an NGO were studied.

The research methodology also included four methods or sources: 1) documents from desk study, 2) field direct observations, 3) interviews, and 4) focus group discussion, used to explore a possible participation practice of flood management and strengthening between the two groups.

Operationalization was often used in the social sciences and this study as part of the scientific method. Particular concerned about operationalization arise in cases that deal with complex concepts of flood risk management where unique threats to validity of operationalization were believed to exist (Lukyanenko et al., 2014).

Focusing on the strengthening of the local government practices to cope with flood risk management is presented in Figure 3.1: The conceptual framework of the study.

From figure 3.1 above. The Conceptual Framework of this study started with the local government practice assessment, and the local community practice interacts with the participation line or obstruction line, which means the Local government practice assessment did obstruct with the local people with the obstruction line. Then, the obstruction line went to the risk conditions and unsustainable flood prevention.

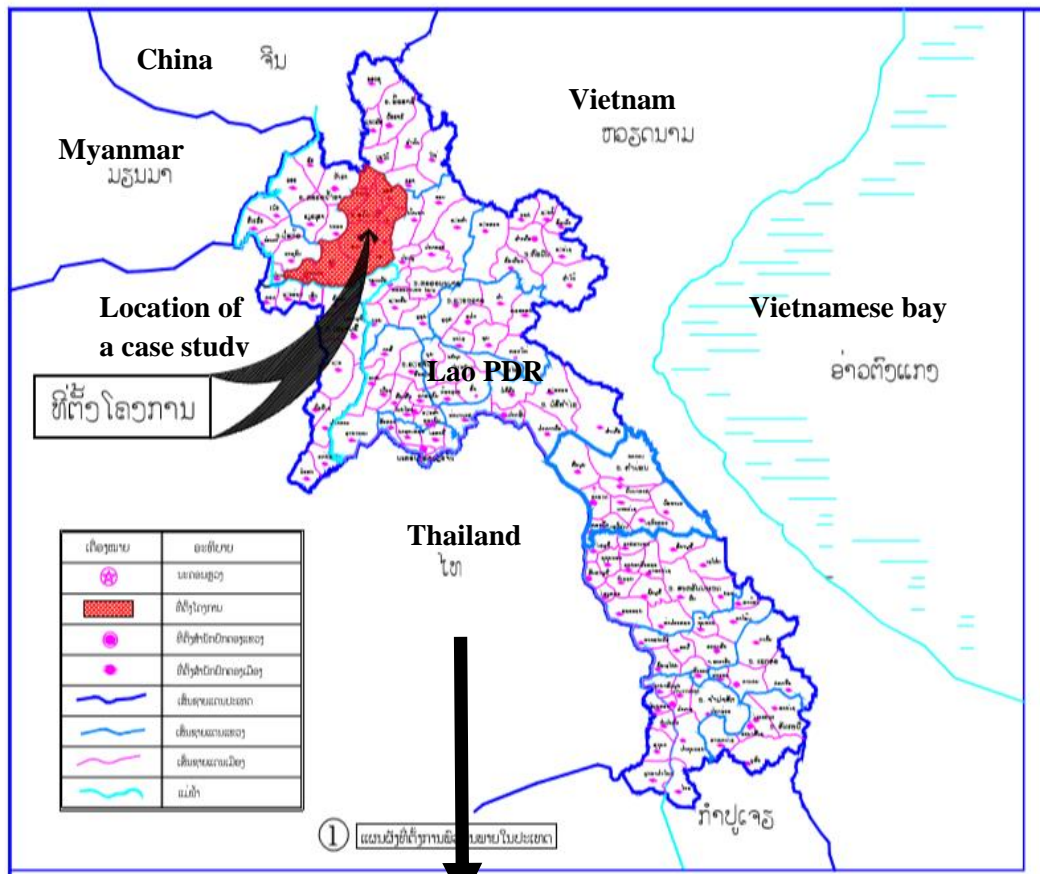
If the local government and the local community went to accompanied by the participation line. Local government practice assessment and Local community practice went to check and analyze with the strengthening 26 factors of LRFRM to all stakeholders' practice such as human resources, budget, technology, and other factors in the Xay district. So, in this section was the input of data.

Furthermore, local government and local community participated with the line go to local resilience and flood risk management analysis of (before, during, and after) flood occurs. Thus, in this section was the output of data.

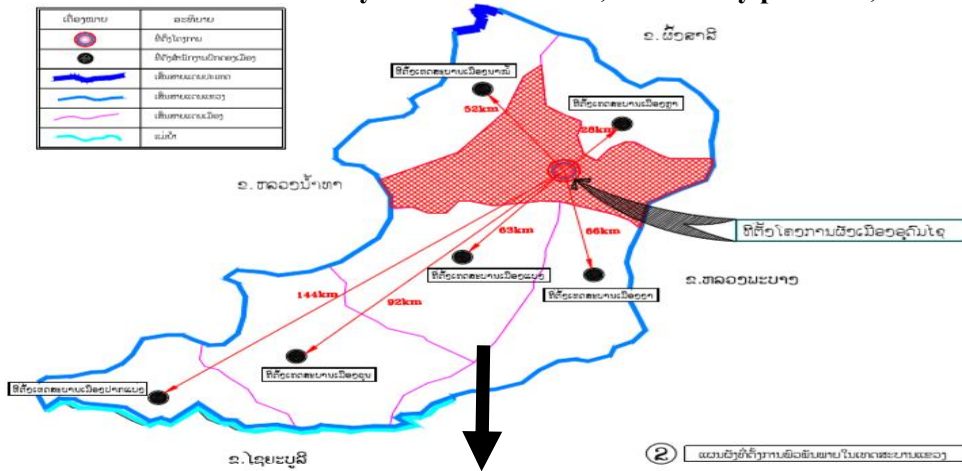
The outcome section concerned the local government practice and local community link with the policies of strengthening local government practice and the local community practice, or two sides (the local government and the local community) stilled the unsustainable flood prevention from many factors. Nevertheless, the Conceptual framework of this study combined data from the input section and data from the output section. Then, the conceptual framework analyzed the strengthening of Local Resilience and Flood Risk Management in local government practice. Thus, this section was the outcome of data link with the conceptual framework of this study.

3.2 The Study area

Xay district, in Oudomxay province, is located in the northern part of Lao PDR. The study area consisted of the three villages (samples of the case study) located along the main river (Kor River). They were Kornoy village (up-stream), Thin village (mid-stream), and Longkordeua village (down-stream). The locations of the province, Xay district, and the three villages were shown in several maps in Figure 3.2. These villages were selected based on locations, flood impact experience, systematic risks, geographical characteristics, and governance administration.



Xay's district location, Oudomxay province, Lao PDR



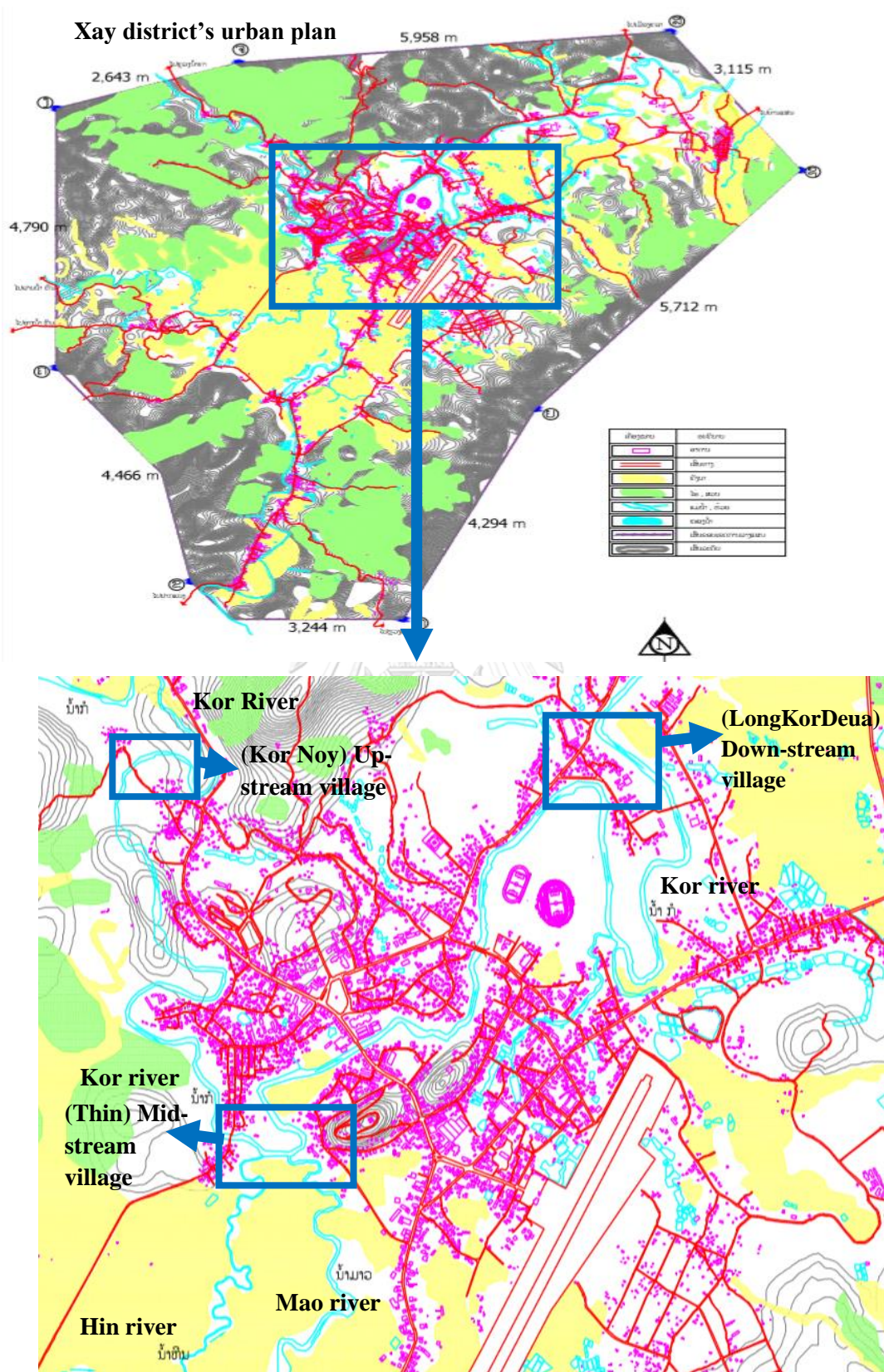


Figure 3.2 : up, mid and down-stream villages in Xay district.

Table 3.1: The criteria used to select the suitable case study areas.

Characteristics	Xay district	(Kor Noy village) Up-stream village	(Thin Village) Mid-stream village	(LongKorDeua Village) Down-stream village
Location	Northern part of Lao PDR	In the northwest of district	In the south of district	In the northeast of district
Urban plan	District link, capital district of province, capital administrative, trade, service, education, etc...	Agricultural village. Some of service activities.	Variety servicing village in Urban area. Two tributaries' rivers flow down to main river.	Servicing village, some agricultural area in village. Total area is 250 hectares.
The geography	Plateau and mountain, hill, valley surrounding, and low-lying area in Urban.	Mountain, Upland area Up-stream village	Plateau and low-lying areas, Mid-stream village	Low-lying areas, Down-stream village
The administrative organization	capital district of province	Village belong district	Village belong district	Village belong district

Source: Department of public works and transport in Oudomxay province (DPWT), 2019, and each village, and field visited by the author, 2019.

3.3 Two groups on interview respondent

Two groups of respondents of this research were selected by the specific sampling method (Creswell, 2007) for the qualitative research. These respondents had relevant roles and responsibilities; they comprised individuals work in the Xay district administrative organization at the local level, and leaders of three villages (up-, mid- and down-stream).

- First group of Individual Interviews (II)

The study selected 25 respondents to represent local government agencies for the purpose of assessing flood risk management practices. Those respondents included the Governor, Vice Governor, and members of local government agencies in Xay district. Furthermore, leaders of three villages near the Kor River affected by previous flood experiences and with familiarity with the flood risk-prone area in the case study also participated.

Qualitative research, including semi-structured interviews and in-depth discussions, was conducted (public side and private side).

1). (Public side) or local governmental agencies (Governor and vice governors of the District, District's public administration authority leaders, District's disaster

prevention and control management committee leaders, leaders of many office lines, and others.

2). (Private side) or three village leaders (upstream, midstream, and downstream of the Kor River) and some (business groups and NGO).

All sampling respondents were chosen from the finite population by purposive selection in order to reach a confidence level of 100%. The numbers of **Individual Interview (II)** respondents by category were shown in Table 3.2.

Table 3.2: Category of Individual interview respondents

No	Target population	Sample	Number
1	Local government at the district level (Or public side)	Governor of the district	1
		Vice Governor of the district	1
		District's public administration authority	1
		Vice Governor of district and Head of District's Disaster Prevention and Control Committee (DDPCC)	1
		Head of District's Labour and Social Welfare Office and Deputy Head of (DDPCC)	1
		Head of District's Soldier's Headquarters and Deputy Head of DDPCC	1
		Head of District's Police Headquarters and Deputy Head of DDPCC	1
		Head of Agricultural and Forestry Office and Deputy Head of DDPCC	1
		Head of District's Public Works and Transport Office	1
		Deputy Head of District's Public Works and Transport Office	1
		Head of District's Natural and Environmental Office	1
		Head of District's Financial Office	1
		Head of District's Health Office	1
		Head of District's Educational and Sport Office	1
2	(Local residents' side) such as Village Leaders and some business groups and the NGO.	Leaders of Kor Noy (Up-stream village)	2
		Leaders of Thin (Mid-stream village)	3
		Leaders of LongKorDeua (Down-stream village)	3
		Some Business groups (President and vice presidents of business association)	2
		The NGO (World Food Program) in the Xay district.	1
Total Respondents			25

(Source: Office of Interior in the Xay district, and field visit by the author, 2020)

- Second group of Expert Interviews (EI)

The second group of interview subjects was focused on 14 expert interview respondents selected as samples from national, provincial government respondents, academic experts, international organization staff, and international-national consultants who all had roles in dealing with several floods management issues at different levels. This objective of this interview was to gather information to explore the perspective of strengthening flood prevention and resilient risk management of local government practices in the case study (Xay district, Lao PDR, or other good practice from many sources). Therefore, all sampling respondents were chosen from the finite population by purposive selection in order to reach a confidence level of 100%. The numbers of **Expert Interview (EI)** respondents by category were shown in Table 3.3.

Table 3.3: Category of expert interview respondents.

No	Target population	Sample	Num-ber
1	National central government	1.1 National Disaster Prevention and Control Committee	1
		1.2 National Public Works and Transport Research Institute	1
		1.3 National Meteorological and Hydrological Department	1
		1.4 National Social Welfare and Relief Department.	1
2	Provincial government	2.1 Provincial Disaster Prevention and Control Committee	1
		2.2 Provincial Public Works and Transport Department	1
		2.3 Provincial Meteorological and Hydrological Department	1
		2.4 Provincial Social Welfare and Relief Department.	1
		2.5 Provincial Water Management Section	1
		2.6 Head of Urban Development Project in Oudomxay province	1
3	National consultant	3.1 National consultant for urban development project in Oudomxay province	2
4	International consultant	4.1 International consultant of urban development project in Oudomxay province.	1
5	Education Academy	5.1 Expert from the Water Resource Management faculty under the National University of Laos	1
Total of Respondents for Expert interviews			14

3.3.1 Information on Individual Interviewees

This objective of **Individual Interview (II)** was to gather information about previous floods, local government's current practices and strength factors, weak factors, and others. For example, interviewees provided information on how to strengthen these practices to increase local resilience for flood risk management at the district and village levels.

The first group was interviewed with semi-structured questions number.1.1.1, 1.1.2, 1.1.3, and 1.1.4 in part 1 of Question details and detailed data collection results were given in Appendix A, along with key information, and questions for the semi-structured individual interview (first group) from the general part of information respondents.

The average age of all respondents of Individual Interview (II) was 52 years old. This data indicated that they had sufficient experience to share ideas about the past impact of floods, and make suggestions about policies for managing these flood risks. The 25 respondents had spent an average of 35.08 years of their lives in Xay district, ensuring that they had extensive local knowledge. The average number of years spent working in the current position was 10.04 years, indicating again that they had the requisite knowledge and authority to be job-relevant with respect to flood risk management. The details of the (II) results were shown in Figure 3.3:

Legend - "II" mean Individual Interviewee.

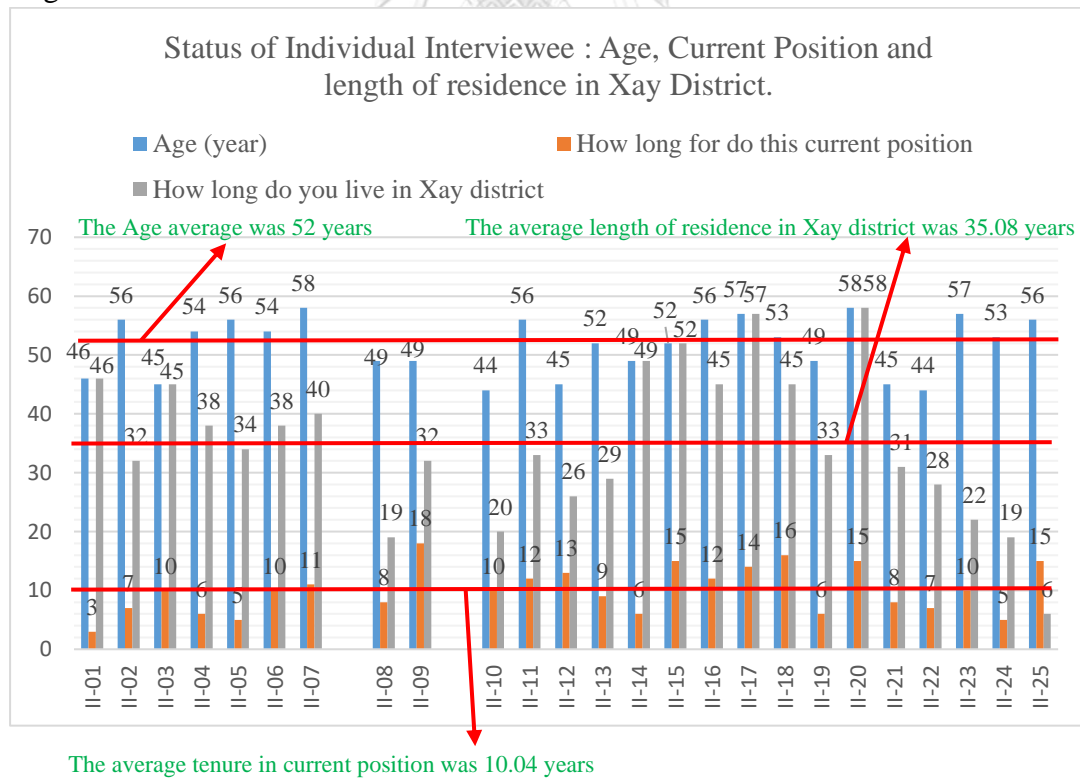


Figure 3.3: Status of Individual Interviewee: age, tenure in current position, length of residence in Xay District.

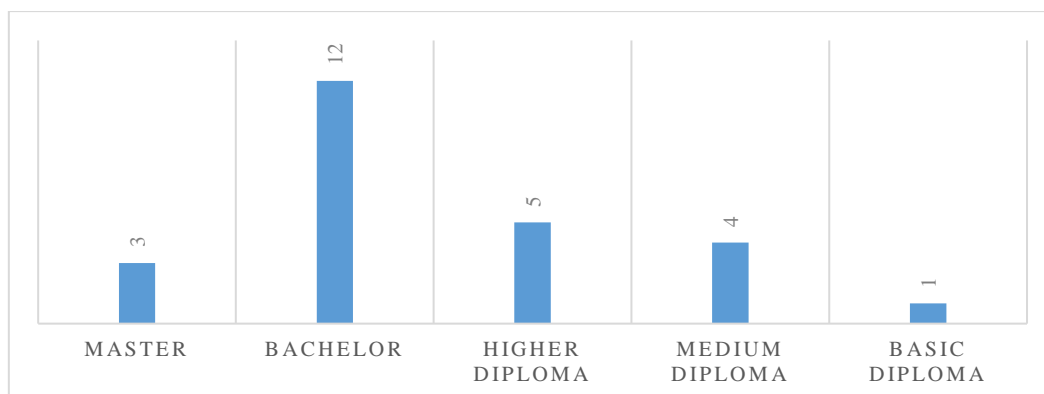


Figure 3.4: Highest educational attainment of individual interviewees.

Furthermore, the highest level of education attained by individual interviewees comprised three masters' degrees, twelve bachelors' degrees, five higher diplomas, four medium diplomas, and one basic diploma. However, the level of education did not provide assurance that Xay district's policymakers can effectively manage the flood risk. By way of example, the Xay district Governor graduated with a master's degree in public administration and politics. He worked for three years in this position. This information did not confirm that the Governor had specific knowledge in the hard engineering for flood management combined, especially in light of the relatively few years spent working in this district.

3.3.2 Information about Expert Interviewees

The expert respondents from the national and provincial governments, academia, international organization staff, and the international-national consultant all had the roles in dealing with flood risk management over time at different levels. This **Expert Interview (EI)** was to gather opinions about strengthening flood prevention and local resilience and flood risk management of local government practice in the Xay district of Lao PDR. However, other good practices from many sources contributed to the development of guidelines adapted for the Xay district.

The 14 expert respondents were interviewed and discussed semi-structured questions no.1.1, 1.2, 1.3, and 1.4. Question details and detailed data collection results were given in Appendix B, along with key information, and questions for the semi-structured expert interview (second group) from the general part of information respondents.

The average age of all respondents of Expert Interview (EI) was 50.29 years old. This indicated that they had sufficient experience to share ideas about the past impact of floods and make suggestions about policies from a broad perspective. Out of the 14 expert respondents, some respondents knew more about the Xay district, and some respondents were less experienced. Overall, they had spent an average of 14.79

years of their lives in the Xay district. The average number of years spent working in the current position was 9.86 years, indicating that they had the requisite knowledge about flood issues, water resources management, and monitoring.

Detailed results of the expert interviews were result shown in Figure 3.5.

Legend - “EI” mean Expert Interview.

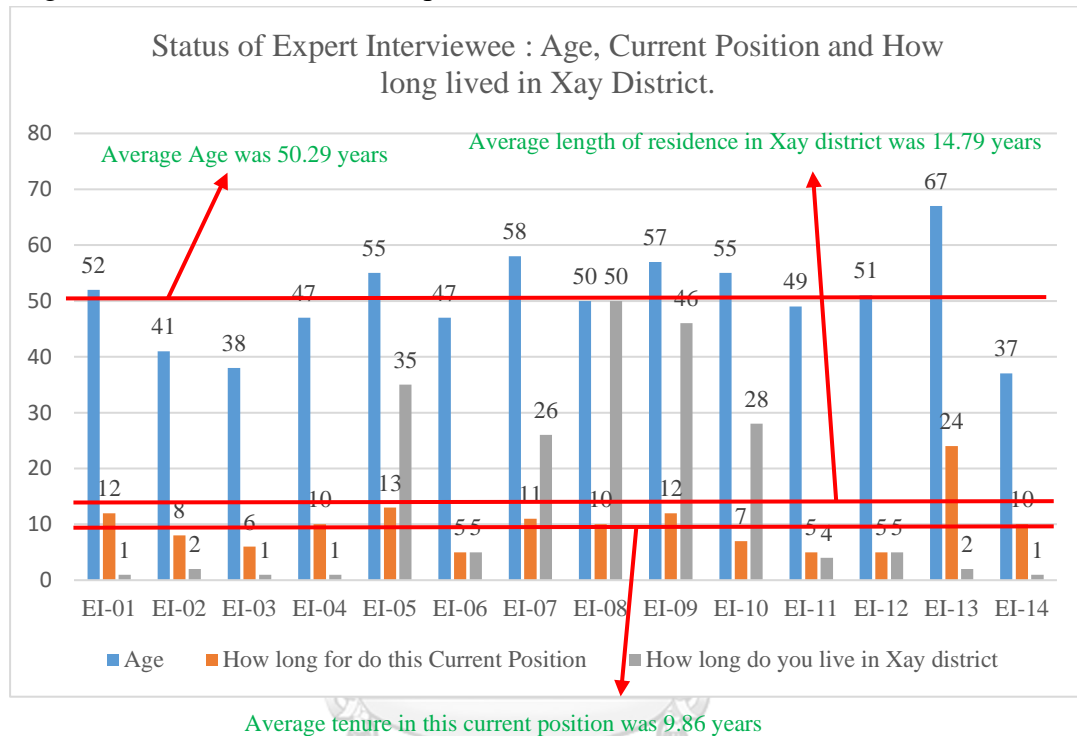


Figure 3.5: Status of Expert Interviewees: age, length of residence in Xay district, length of tenure in current position

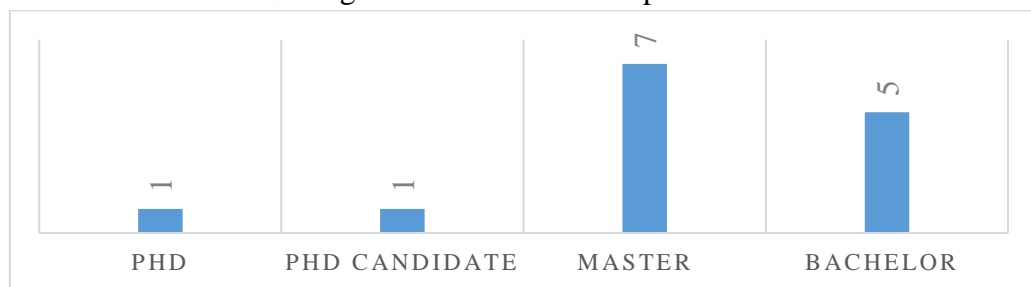


Figure 3.6: Highest educational attainment of the expert interviewee.

Furthermore, the highest level of education attained by expert interviewees comprised one Ph.D. degree, one Ph.D. candidate, seven masters’ degrees, and five bachelors’ degrees, which reveals the high levels of academic achievement, and the ability to offer useful information and advice about flood risk management in this case

study, along with knowledge from other domestic and foreign cases with relevance to the situation in Xay district.

3.4 Data collection

The techniques employed in this study include four methods:

- 1) Documents from Desk review;
- 2) Direct observations in the field with both non-participatory and participatory approaches;
- 3) Semi-structured questions and in-depth discussions with both groups;
- 4) Focus group discussions.

Table 3.4: Summaries data collection use in the study

Data collection techniques	Types of collected data	Sources of data
1) Desk Study	- Flood management plan and strategy	- The data from disaster relief, welfare and national disaster management committee and Xay's disaster management office. (2019)
	- The daily record of climate includes maximum, mean and minimum rainfall.	- The quality-controlled data set from Department of Meteorology and Hydrology in Lao PDR and Xay's meteorological and hydrological station. (2019)
	- Urban plan and land use plan include local governmental plan and human activities.	- From assessing urban plan and land-use planning base increase locals and housing build's approval (Office of Public Works and Transport in Xay district) (2019)
	- Geographical characteristic in the case study area	- Geographical characteristics of this district, main and tributary rivers from Xay district's interior office (Terrain map) and Google earth map (2019)
	- Deforestation in the case study area. And forestry management in this district	- Assess the deforestation of local people activities (Xay district's agricultural and forestry office) (2019)
2) Direct observations in the field	- Physical existing problems such as destruction after flood problems of heavy	- Direct observation in Xay district and sample specific villages ((Kor Noy) Up,

	rainfall, human activities for recovery practice and future prevention	(Thin) Mid and (LongKordeua) Down-stream villages)
3) Semi-structured in-depth discussion for both interviews.	<ul style="list-style-type: none"> - Risks of local people, flood risk management, flood impacts, urban plan, land use plan, geographical characteristics, on flood prevention practice - Develop strengthening for flood risk prevention and management. 	- Both groups of interview respondents on factors affecting their management for resilience on floods, and follow the conceptual framework of study.
4) Focus groups discussion	<ul style="list-style-type: none"> - Open questions to share their opinion, previous flood risks-impacts experiences in a case study. - Develop strengthening for flood risk prevention and management. 	- Discussion from groups (Local government, local people, and expert sides) of respondents and who interest, experience, knowledge to help the flood risk management activities

The goals of data collection were to study flood risk management factors and assess the current practices of the local government in managing and controlling these risks, and strengthen local government practices in the future.

- Data sources: two types of data sources were used, as follows:

1). Secondary data:

The documents from desk review included various resources such as literature review, books (both external and internal to Lao PDR), several reports about the Xay district, the internet, newspapers, and other media sources. These sources helped the researcher understand deeply about the background of flood risk management of the local government, previous impact experience, risk attitudes, urban planning practices, and socio-economic characteristics, as well as understanding the relevance of these issues in the Xay district. Details were shown in Table 3.5.

Table 3.5: Summaries secondary data collection used in this study

Item	Types of collected data	Sources of data	Used in this study
Secondary data	Early warning systems and prediction equipment (signs, signals, and networks)	(Department of Natural Resources and Environment in the Oudomxay Province, 2020)	Data collection and analysis for how the local governments can warn about and respond to flood events, coordination, plans, and emergency rescue teams help the flood victims.
	Flood awareness, information, and other dissemination. Public participation of all stakeholders	(National Disaster Prevention and Control Committee, 2020)	Data collection and analysis of response to floods and other challenges. Teams working to strengthen flood risk management.

Secondary data			Flood awareness in local governments. All information measurements.
	Eco river analysis factors	(Department of Public Works and Transport in Oudomxay province, 2020)	Eco-river restoration patterns, overlapping site analysis for supporting Eco-green infrastructure elements; trying to provide a clear basis for the important factors for land-use planning, economy, and others. Based on a comprehensive analysis applied to the rivers.
	Changing river patterns of development	(Department of Public Works and Transport in Oudomxay province, 2020)	The river is now widely recognized as a critical factor for the restoration of the urban environment and getting more interest as a new open space for urban amenity improvement and flood risk prevention.
	Period of the procedural process during flooding	(The Xay district Disaster Prevention and Control Committee Office, 2020).	During the flood, assessment of emergency response time local government action, emergency rescue, or waiting time to implement measures to help affected people.
	The Xay district conditions	(A report of district Xay's Revolutionary Party meeting, 2020).	Analysis of mountain conditions surrounding the Kor River Basin. The area has a tropical monsoon climate.
	A report relating to Xay district and urban development plan	(The Department of Public Works and Transport in Oudomxay Province, 2020)	Data collection and analysis of types of floods, and natural characteristics of floods.
Secondary data	Data collection, input, and analysis for the HEC-RAS program	(Department of Public Works and Transport in Oudomxay province, 2020) and (ISAN consultant, 2020) for Oudomxay's urban development program.	Data collection and analysis of how to simulate results after installation of shortcut. Shows flooded area and reduction of water levels in the flooded area in the Kor River meander. Contributes to rapid flood discharge from the urban area.
	A paper for strengthening the information deficit model for disaster preparedness	(Abunyewah, 2020)	Data collected for this positive consequence occurred when local community involvement was integrated into the information dissemination process of flood risks.
	A paper on resilience in flood risk management: a new communication tool	(Govindarajulu, 2020)	Resilient infrastructure and built environments. The strengthened capacity of institutions and actors in flood management.
Secondary data	Experiences in flood impact from the past in Xay district	(The Xay district Disaster Prevention and Control	The great floods that have occurred in Xay district, with severe damage to properties and loss of life in 1985,

Secondary data		Committee Office, 2020).	2008, 2013, and 2017. Pluvial floods frequently occur at various times.
	The daily climate record, including maximum, mean, and minimum rainfall statistics 2008-2017	Xay's Meteorological and Hydrological Station. (2019)	Abnormal weather, heavy rainfall, and statistical analysis for 10 years, and flood risk management.
	(Upstream village) Kor Noy overview report, (Midstream village) Thin overview report, and (Downstream village) Longkordeua overview report	Kor Noy village (2019), Thin village (2019), and Longkordeua's overview report (2019)	Analysis of village economic and social development plan, specific conditions, demography. The village topography-related flood risk management. Village risk conditions, impact experiences, flood management of village conditions.
	A report of an urban development plan. A report of low-lying areas, in Climate Change 2007. Impacts, Adaptation, and Vulnerability	(The Xay district's Revolutionary Parties report), DPWT in Oudomxay province, Lao PDR (2019), (Nicholls, 2007), (Mooney, 2015).	Assessment and analysis of risk and impact information from past-related urban management in the Xay district. Urban plan practices for low-lying areas which are high-risk areas for climate-related hazards.
	The data from Xay district's disaster management plan from 2015-2019.	The Xay's District Disaster Prevention and Control Committee (DDPCC) office. (2019).	Data collection and analysis on managing the flood risk plan, and making the resilience plan. Urgent meeting to address disaster relief and report to high-level leaders who were decision-makers to find sensible solutions. To make policies, strategies, and programs for prevention in every period.
	A report of Land use plan	DPWT in Oudomxay province, Lao PDR (2019)	Assessment of the local government and residents' use the land for flood risk management. Most locals and villages settled with high density near flood-prone areas beside the Kor River (Main River) and Mao and Hin rivers (tributaries).
	Secondary data	Geographical characteristics in the Xay district	(The report of district Xay's Revolutionary Party meeting, 2014), and Google Earth map (2019)
A report on deforestation and forestry management in Xay district		(Xay district's Agricultural and Forestry Office, 2019), and (Forests & D, 2013)	Deforestation from locals' activities over the past years. Agricultural lands were replaced by urbanization, land-use change to agricultural fields, other crops.
Xay district's urban plan and land use plan, including local		(Office of Public Works and Transport in Xay district, 2019)	For assessing urban plan and land-use planning based on increasing local housing building approvals in the Xay district.

Secondary data	governmental plans and human activities		
	A report about strengthening the capacity of ASEAN to design and implement risk-informed and shock responsive social protection systems for resilience: Lao PDR case study.	(WFP, 2019)	Data collection of the Lao PDR is highly vulnerable to floods. (DDPCC) office representative related that the office was responsible for overall coordination, including the declaration of a district of the emergency plan for flood response.
	A paper on urbanization and floods in the Seoul Metropolitan area of South Korea	(Bae & Chang, 2019)	It had suggested integrating many components such as communication coordination, early warning systems, information sharing, legislation, various resources, risk-vulnerability assessment, training, and stakeholders.
	A paper on Adjustable robust strategies for flood protection	(Postek et al., 2019)	It suggested allocating a sufficiency budget with modern flood risk management.
	Participatory social capacity building: Conceptualisation and experiences from pilots for flood risk mitigation.	(de Voogt et al., 2019)	Social capacity is conceptualized as five dimensions: knowledge, participation, motivation, finance, and networks for flood risk mitigation.
	A report of flood protection measure types.	Frisco (Frisco Project, 2019)	Resilient flood risk management for control or reduction was carried out by implementing so-called flood protection measures, divided into nonstructural and structural prevention measures.
Secondary data	A paper of Systematizing Community-Based Disaster Risk Management (CBDRM): Case of an urban flood-prone community in a Thailand upstream area.	(Tanwattana, 2018)	Support for the idea that discontinuity of local government practices in Thailand and in Lao PDR were the same. The local governments practice emergency response more than readiness before floods occur.
	The Sendai framework and annual UNISDR report of 2017	(UNISDR, 2017)	Applying the Sendai framework and building back a better concept, and analyzing how to adapt them for the Xay district.
	Lao PDR Disaster Management Reference Handbook	(DMRH, 2017)	Floods happened during the monsoon season from (May to October) due to the torrential rain. If the rainfall was more than 200 mm of rainfall accumulation in 2 days, it led to flooding in risk areas.
	A report was of Cambridgeshire flood and water supplementary. The	Council, 2017	Assess flood risk management factors and requirements checklist can be applied and adapted for the Xay district.

Secondary data	flood risk requirements checklist.		
	A Report on the Community-Based Disaster Risk Reduction (CBDRR) Manual in Lao PDR.	(CBDRR, 2016)	Data about the village's conditions can provide by local community-based early warning systems. In contrast, other villages had adapted their livelihood practices to be more resistant to floods. It was an essential consideration for the sustainability of initiatives by linking them to broader local development processes.
	A paper on strengthening capacities for disaster risk management	(Few et al., 2016).	An action plan for disaster risk management mechanisms is expected to be developed at all governmental levels, including villages. Capacity enhancement can lead to sufficient flood readiness.
	Many academic works such as Resilience and stability of ecological systems. The Build Back Better concept.	(Holling, 1973), (IPCC, 2013), (Gourbesville, 2014), (UNISDR, 2017).	Resilient concept analysis and how-to applications, ability to withstand shock, capacity to cope with flood, Build back better for Local Resilience and Flood Risk Management for the Xay district.
Secondary data	Papers on Political inequality and local government capacity for disaster risk reduction modelling as a tool to support natural hazard risk management in New Zealand. Local government, strengthening institutional and financial mechanisms for building urban resilience.	(UNDP, 2008), (KUSUMASARI, 2010), (UNISDR, 2010), (Institute., 2015), (Ruiz-Rivera & Melgarejo-Rodríguez, 2017), (Crawford et al., 2018), (Govindarajulu, 2020).	Analysing the role of local government's engagement in flood management from many factors and conditions. The resilience in flood risk areas is seen as a critical component of flood risk management. Strengthening community resilience can balance structural measures for flood prevention.
	A report on nature-based solutions to address global societal challenges. Natural infrastructure for water management.	(Cohen-Shacham et al., 2016)	Green infrastructure can help filter, absorb, and reduce the speed of stormwater runoff, which reduces urban flooding and upgrades water quality-related natural capital, nature-based solutions, and green infrastructure.
	Lao socio-economic development plan for 2016-2020	(MoPI, 2016).	Integrated and linked into the current 8th NSEDP (2016-2020) to ensure every step of development and prevent floods.
	In a report about SDGs in 2015, leaders from 193 countries of the world came together to face the future.		With long-term strategies, policies, and planning continuing through greater collaboration with SDG Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
	A report on disasters without borders	(UNESCAP, 2015)	Lao PDR national disaster management system was guided by a
Secondary data			

Secondary data			high-level inter-ministerial coordination mechanism from top-down interaction.
	A report on Disaster prevention in Japan, 2015 edition.	(Japan, 2015).	Underground facilities were protecting the city from flood damage; structures such as river levees and dams were critical in protecting residents from flood damage.
	A report about empowering communities and strengthening resilience	(Aslam et al., 2015)	Lao PDR was increasingly decentralized to the local level. This was in line with an increased focus on local government and community-based disaster risk management.
	The community-based disaster risk management (CBDRM) guidelines.	(CBDRM, 2014)	Data analysis for local residents' participation begins from activity planning to the construction, operation, maintenance, evaluation, and monitoring stages.
	The Lao PDR national assessment report on disaster risk reduction.	(ADPC, 2012).	Under this disaster management plan, legislation and disaster risk management were improved and developed at national and local levels.
	A report about cities and flooding-a guide to integrated urban flood risk management for the 21st century	(Abhas et al., 2011).	It was essential to reflect vulnerable groups, gender, ethnicity, and the economy in the policy, flood preparedness, and response activities to develop solutions to gaps and risks.
	A report on organizing community participation for flood management. A tool for integrated flood management.	(WMO, 2008).	Countries indicated that the establishment of a Community Flood Management Committee. Local community participation played an essential role in flood risk management, preparedness for response and recovery.
	A report about capacity development practice notes	(UNDP, 2008)	A priority to develop incentives for local institutional staff and local communities to participate in effective flood risk management
	Overview reports about the community-based corporate community, Government roles, Role of NGOs, Manual on flood preparedness for district-level authorities in the lower Mekong basin countries.	(Shaw, 2012a), (Shaw, 2012b), (Pineda, 2015), (AMDI, 2013), (Izumi, 2012), (FMMP, 2006), (Ishiwatari, 2012).	There are desk studies, data collection, and analysis for prerequisites for the well-functioning local government implementation for flood risk management.
A report about selecting measures and designing strategies for integrated flood management	(WMO, 2007)	Discussed integrated flood risk management. It included the action of different forms of measures depending on the type of flood.	
A report of the 4th Edition Research Design, Qualitative, Quantitative, and Mix Methods Approaches	(Creswell, 2007)	Procedures for conducting the study relied primarily on a qualitative approach.	

	Lao regime system	(UNDP, 2005)	The system of the local-level management and control was issued as a first step in reversing the "de-centralization of districts to planning and budgeting units and villages is implementation units."
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2). Primary data:

The information on flood risk management and prevention at Xay district was collected by field study, as follows:

Direct observation in the field used both non-participatory and participatory approaches led to interaction and familiarity with the local government practices and local people involved in flood management activities. Additionally, the researcher saw how all of the stakeholders interacted in the field. The primary data survey involved visiting and taking photos of the study area to explore flood risk management activities.



Figure 3.7: The field direct observation with the participatory approach



Figure 3.8: The field direct observation with the non-participatory approach



Figure 3.9: Camera use for field direct observation.

After collecting the preliminary data, a qualitative method was designed to obtain data on flood risk management in order to cover the objectives, research questions, and contents of this study. An in-depth interview using semi-structured questions with individual respondents and expert respondents for the specific key performances was classified as follows:

- Mainly focus on local governmental agencies (Governor and vice governors of the district, leaders of the district's public administration authorities, leaders of the district's Disaster prevention and control Committee, leaders of the district's Public Works and Transport Office, the district's Natural and Environmental Office leaders, and leaders of district's Social and Welfare Office).
- Opinions from local people and village leaders of (up-stream, mid-stream, and down-stream) rivers and some business groups and an NGO.
- Three sets of questions were administered (all questions in the appendix).
 - Set 1: explored the perspectives of local people about risk of previous floods in the Xay district.
 - Set 2: assessed the current local government's flood risk management practices. Furthermore, strong and weak points of local government practice.
 - Set 3: explored the strengthening of prevention and application of Local Resilience and Flood Risk Management (LRFRM) by the local government in Xay district. Therefore, this question set aimed to contribute some knowledge of the various aspects.



Figure 3.10: Interviewed with village leaders.

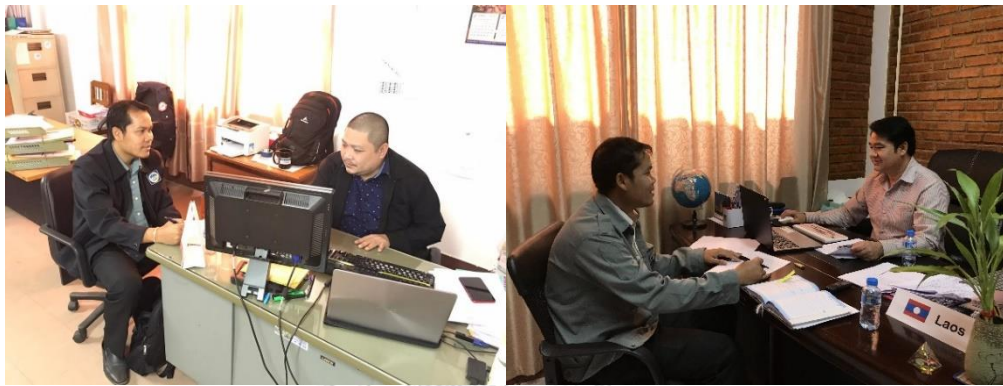


Figure 3.11: Interviewed with experts



Figure 3.12: Voice Record use for both group interviews

- Focus group discussion

It used three focus group discussions for this study as follow:

The first focus group discussion (FGD) meeting was held on 21 February 2020, with 43 total participants (15 female) and a total duration of one and a half hours. It was

a quite big focus group discussion. Then, the researcher reported the information on data collection summaries and performed data analysis from the desk study, direct observations in the field, and interviews with sample respondents, mainly focusing on local governmental agencies, including the governor and vice governors of the district, leaders of the district's public administration authorities, leaders of the district's natural disaster management committee, leaders of the district's public works and transport office, leaders of the district's natural and environmental office, and leaders of the district's social and welfare office. The researcher wanted to obtain the opinions of local residents and village leaders located in upstream, midstream, and downstream areas of rivers, as well as those of leaders of some business groups and an NGO in order to visualize and understand the objectives. Many respondents answered open-ended questions related to Local Resilience and Flood Risk Management (LRFRM) activities during the discussion. The Xay district relied on the District Disaster Prevention and Control Committee to take responsibility for disaster prevention and control tasks, which included floods and other types of disaster. However, the budget to deal with any floods or other disasters was an issue as it is impossible to predict from year to year when disasters will occur. The participants discussed some of the good methods that were sensible for Xay District to adapt and adopt. Most of the participants (95%) agreed with the data analysis report. Only a few respondents suggested improvements to some points.

In the second time, a focus group discussion was organized on Thursday, 4 November, 2021 with a narrowed down group of participants. There were eight participants interested in discussing the flood risk management in Xay district, although they were affected by some cases of the COVID-19 pandemic. This group was an interesting group of provincial and local government staff from the education sector, two public works staff and staff of the transport sectors at the provincial level, a labourer, and social welfare sector employee, an officer from Xay district's development and management authority, a member of the natural resource and environment sector, and two contractor staff of a riverbank protection project.

The researcher explained to all eight participants about the result from the data collection, data analysis, and opinions received from stakeholders of the first focus group discussion. All eight participants agreed on the result and the method of data analysis; therefore, they just wanted to add suggestions that would affect the finished research. They expressed commitment to sharing the outcome and output from the workshop with all local government staff and residents in Xay district in order to encourage them to support the local government. There was recognition that, at the same time, the local government needs to understand where weaknesses exist, and work to improve them. Nonetheless, plan to share the results with the education sector with the expectation that the education sector would help to further disseminate the results to support the flood risk management in the Xay district was encouraging. The participants agreed that the local government had effectively implemented plans during

the occurrence of flooding in the past, but that with respect to actions taken before and after the flood, improvement and support was needed from all levels and from external sources. They supported the result analysis, if the Xay district had many knowledgeable staffs and sufficient budget those promoted the LRFRM action. They suggested maintaining contact via social media platforms like a *WhatsApp* group for the purposes of sharing information, further discussion, and mutual support. An example of this communication application is shown in Figure 3.13.

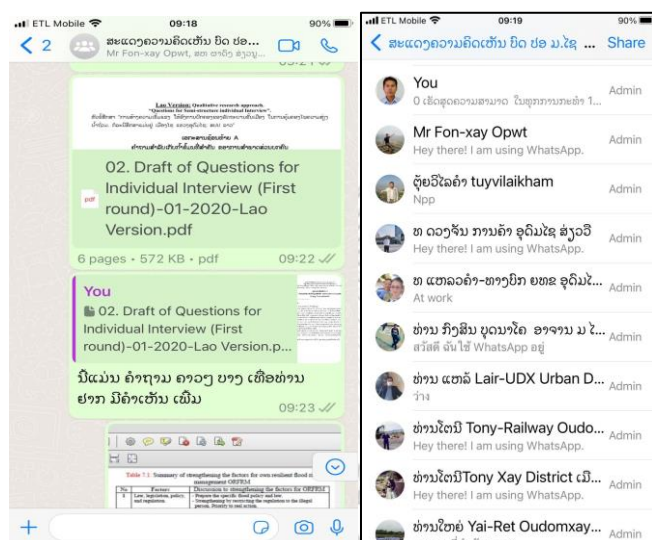


Figure 3.13: The WhatApps group for further focus group discussion

The third-time focus group discussion was organized as a small group discussion on Friday, 19 November, 2021. Four participants from the Thin Village (mid-stream of the Kor River) in the Xay district had lived through the effects of the last big flood in 2018. Two participants from the Longkordeua village (downstream of the Kor River) in the Xay district were affected by the 2018 flood as well. Participation was affected by some cases of COVID-19.

The participants discussed the impact of the flood in the Thin Village, located at the point where the Mao and Hin rivers flow into the Kor River, which is a high-risk area for floods to occur. Before the 2018 flood arrived at the village, the local government in Xay district had informed residents to prepare for flash floods by evacuating family members and property to higher ground, or moving temporarily to live with relatives before the start of the rainy season. However, when the real flood occurred, many residents could not move in time as some houses were not as prepared as others. Because of data analysis and the results. The participants confirmed and agree due the data had already passed many local government offices. The local government needs to assist local residents, who did not have much money to allow them to take action by themselves. Nevertheless, the locals agreed to provide labour to assist with flood risk management follows the local government order.



Figure 3.14: all stakeholder’s focus group discussion in three times.

Table 3.6: Summaries primary data collection used in this study

Item	Types of collected data	Sources of data	Used in this study
Primary data	The location, urban plan, geography, and deforestation activities	Field direct observation in (Kor Noy (Upstream), Thin (Midstream) and LongKordeua (Downstream) villages, and in Xay district	Collected data and analysis of locations, urban plan, the geography, and deforestation activities of the administrative organizations in 3 sample villages and the Xay district. Existing physical problems, heavy rainfall, human activities, recovery practice, and future prevention.
	Opinions of first group -- Individual Interviewees	Interview, Field visits to Xay district. The study selected 25 respondents as representatives of local government in the Xay district. Leaders of 3 villages	Interview, data collection, and analysis. There were 25 Individual respondents; the objective of the Individual Interview was to gather information about previous flood risks, local government's current practices, with strength factors, weakness factors, and others, for strengthening resilience and

Primary data		near the Kor River affected by previous floods. Private sector and an NGO.	flood risk management in the district and villages.
	Opinion of the Second group -- Expert Interviewees	Interview, Field visits to Xay district 14 expert interview respondents selected who had dealt with several floods management issues at different levels.	Interviews, data collection, and analysis. The expert respondents from the national, provincial government, academic experts, international organization staff, and the international-national consultant had roles in dealing with risk management with several past floods at different levels.
	Semi-structured and in-depth discussion for both interview groups	Both groups of interview respondents. On factors affecting local government management for resilience with respect to floods, and following the study's LRFRM conceptual framework.	Flood risk management, flood impacts, urban plan, land use plan, and geographical characteristics. Strengthen flood risk prevention and management.
	Focus group discussion	Open-ended questions to elicit all stakeholders' opinions, previous flood risk-impact experiences.	Discussion from groups (Local government, local people, and experts) of respondents whose experience & knowledge can help enhance flood risk management activities. Strengthen flood risk prevention and management in the Xay district.
	Types of floods	First group of Individual Interviewees (Research Question no. 1)	Data collection and analysis, such as type of flood, flood natural characteristics and River conditions related to the Xay district.
Primary data	The main cause of flood risk	Direct field observation, and interviews of both groups, focus group discussion (Research Question no. 1)	Extreme weather, heavy rainfall by climate change, top sources of upstream river management, the Kor river's discharge capacity, and tributaries . The urban area's drainage capacity, bank erosion of rivers, and lack of river management in the Xay district.
	The practice of local government created flood risks	Individual interviews (Research Question no. 2)	Data collection, analysis, and assessment of the local government's specific practices that create flood risks that affect locals; assess weak points, and improve flood risk management.
	Current practice, weakness and strength factors of the local Xay district government for flood risk management. SWOT analysis	Direct field observation, and interview of both groups, focus group discussion (Research Questions no. 2 and 3)	Total factors assessed for implementation of Local Resilience and Flood Risk Management (LRFRM) of local government practice in the Xay district. Suppose the local government wanted sustainable management.

Primary data	Local community, villages, stakeholders (Academy, NGO, Business, volunteers) for participation in flood risk management	Interview of first and second groups (Research Question no. 3)	Opinions of local residents assessed; participation by local community and private sector in flood risk management encouraged.
	Local government practices to deal with stages of flooding (before floods occur, during flood, and after) in Xay district	Direct field observation, interview of both groups, and focus group discussion (Research Question no. 4)	Data collection and analysis of preparedness and FRM practices already in place; inform local residents about the early warning system for locals living in flood risk. How to respond to flood issues during the flood; flood victim relief. Also, after the flood, how to the local government practice is focused on recovery, improvement, and a building back better approach.
	The opportunities improve local government practices of the Xay district's flood risk management	Interview of both groups, focus group discussion (Research Question no. 4)	Data collection and discussion to strengthen Local Resilience and Flood Risk Management (LRFRM) of local government practice in the Xay district. Suppose the local government needs to strengthen sustainable flood risk management to improve practices for the future.
Primary data	Plans for the local government about the structural method for flood risk prevention	Interview of both groups, focus group discussion and mix with Department of Public Works and transport in Oudomxay province, 2020 (Research Question no. 4)	Data collection and analysis of opinions on how to solve discharge capacity issues and management of the Kor River, the drainage capacity of urban areas, and the existing riverbank conditions. The Kor River shortcut plan in the downstream villages of the local government, and potential reservoirs. Riverbank protection in the Xay district.
	Plans for the local government about the non-structural method for flood risk prevention	Interview of both groups, focus group discussion and mix with Department of Public Works and transport in Oudomxay province, 2020 (Research Question no. 4)	Data collection and analysis of other plans, such as flood control plan, drainage system improvement plan, and flow allocation plan for flood reduction, urban planning, flood zoning, law-regulation enforcement, the Kor River retention option, green infrastructure, and early warning systems of the non-structural measures in the Xay district.
	Process for flood risk management before the flood occurs. For adequate preparedness before the flood, during, and after the flood event.	Interview of both groups, focus group discussion (Research Question no. 4)	Data collection for Local Resilience and Flood Risk Management (LRFRM) in all flood life cycles in the Xay district.

Primary data	Opinions of all stakeholders about flood risk management.	Interview of both groups, focus group discussion (Research Question no. 4)	Opportunities, conclusion, and recommendation for strengthening local government practices of the Xay district's flood risk management. Suggest a conceptual framework of this study.
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3.5 Qualitative data analysis

The researcher followed four research questions that are mentioned in (Chapter 1, section 1.4), and relied on qualitative narrative analysis that was all about listening to and recording the flood stories of the governor and vice governors of the district, leaders of the district's public administration authorities, leaders of the district's disaster prevention and control committee, leaders of the district's public works and transport offices, leaders of the district's natural and environmental office, and leaders of the district's social and welfare office. The researcher was able to obtain the opinions of the local residents and village leaders living in the upstream, midstream, and downstream areas of the river, as well as members of some business groups and an NGO. This involved the analysis of stories about flood risk management to derive meaning. The stories served the functional purpose of helping the researcher to make sense of flood risk management. The local government in Xay district was able to gain insights into alternative approaches to flood risk management, and make progress by analyzing their strengths and weaknesses.

The researcher analyzed data periodically during the fieldwork, with concern for the following details: data from desk review of documents, direct observation in the field and semi-structured with in-depth interviews and focus group discussions. There were data reviews organized and classified to discover the diversity of phenomena within Xay district and three sample villages. The data display was categorized in terms of comparison of differences, phenomena, and similarities, with supporting reasons revealed by informants, according to the conceptual framework of this study. Result conclusion concerned with concluding, and analyzing the Local Resilience and Flood Risk Management (LRFRM) of local government practice in Xay district. This also included interpreting the research according to the research questions and objectives (shown in Table 3.7 and Figure 3.15), and then applying the conceptual framework and concepts of this study to explain the result findings.

Table 3.7: summaries methods of the data analysis

Research Question	Item	Data analysis	Methods				Expect result
			1). Desk Study	2). Direct Observation	3). Individual Interview	4) Focus groups discussion	
RQ 1	Risks						
	- Flood risks of local government practices	Flood risk analysis from past to present by data comparison differences and display.	✓	✓	✓	✓	Answer first objective
RQ 2 and RQ 3	Assessment the current local government practice for flood risk management						
	- Local government practice	analysis of comparison differences, phenomenon, and similarities. And description results.	✓	✓	✓	✓	Answer second and third objective
	- Local people participation		✓	✓	✓	✓	
	- Human Resources		✓		✓	✓	
	- Budget		✓			✓	
	- Technology		✓	✓	✓	✓	
- Other.							
RQ 4	Flood prevention analysis						
	- Non-structure methods	analysis of comparison differences, phenomenon, and similarities. And description results.	✓	✓	✓	✓	Answer fourth objective
	- structure methods		✓	✓	✓	✓	
	Local Resilient and Flood Risk Management analysis						
	- Pre: Readiness	analysis of comparison differences, phenomenon, and similarities. And description results.	✓	✓	✓	✓	
	- During: Mitigation		✓	✓	✓	✓	
	- Post: Build Back Better		✓	✓	✓	✓	
Strengthening for resilient flood risk management of local government	Summarise the input, output, description from above. And recommendation results.	✓	✓	✓	✓	Answer fourth objective	

(Source: the author., 2019)

Operationalization was often used in the social sciences with this flood management study. Operationalization defined a fuzzy concept. So as to make it clearly

distinguishable, measurable, and understandable by empirical observation. So, the researcher did repeat with four methods, especially, for focus group discussion and continue with chat group of focus group discussion who concern the local resilience and flood risk management (LRFRM) in the Xay district.

Furthermore, Researcher introduced the Operationalization Approach to use for study of these 26 factors of LRFRM:

Table 3.8: the Operationalization approach to use for these 26 factors of LRFRM.

Concept	Variables	Operational Approach
Local Resilience and Flood Risk Management (LRFRM)	1. Law, legislation, policy, and regulation.	<ul style="list-style-type: none"> - Interview the individual respondents in the Xay district. - Review the laws, legislations, policies, and regulations related to flood risks from the Top-Down approach and Bottom-Up Approach. - Review the dissemination and enforce the laws and regulations to local people.
	2. Human resources development	<ul style="list-style-type: none"> - Review the Xay report on the revolutionary party meeting about local government staffs' development; - Review the local government staffs how to use the modern technology for weather forecast, major to graduation, the degree to graduation, how long for experience to works and live in the Xay district; - Review how to share the knowledge from local government to local people. - Interview the individual respondents in the Xay district (primary data) and review the secondary data.
	3. Budget allocation	<ul style="list-style-type: none"> - Review the secondary data from Provincial and Xay district documents; - Persuade the grant from the central government, Provincial government, and other organizations to support. - Interview the individual respondents in the Xay district (primary data).
	4. Equipment, technology preparedness. Such: - Preparing rescue resources. - Resuscitation devices. - First aid kits. - Emergency communication devices	<ul style="list-style-type: none"> - Review the report of DDPCC in the Xay district. - Interview the individual respondents from all stakeholders, secondary data, and direct observation in the field (Xay District)
	5. Rescue Vehicles. Such as: - Boat. - Helicopter - Truck, etc.	<ul style="list-style-type: none"> - Review the report of DDPCC in the Xay district. - Interview the individual respondents from all stakeholders, secondary data, and direct observation in the field (Xay District)
	6. Meteorological and Rainfall pattern assessment	<ul style="list-style-type: none"> - Documents of desk study (secondary data); - Direct observation in the field (Xay district); - Interview to both groups of Individual respondents and Expert respondents;

Local Resilience and Flood Risk Management (LRFRM)		<ul style="list-style-type: none"> - Review the report of DDPCC in the Xay district; - The report of Office of Natural Resources and Environment in Xay district (local level) and Department of Meteorology and Hydrology (central level); - The Document of Average rainy day in Xay district of the year 2008-2017.
	7. Geography characteristic assessment	<ul style="list-style-type: none"> - Review maps from Google Earth; - The knowledge of local people; - The Report from the Department of Public Works and Transport in Oudomxay Province; - Direct observation in the field (Xay district); - Documents of GIS data.
	8. Deforestation activity assessment	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - The report from the Office of Agriculture and Forestry in Xay district. - Interview the individual respondents.
	9. Urban plan practice assessment	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Interview the individual respondents (include the opinion of Governor of Xay district). - The report of Xay district's revolutionary party meeting; - The report of Xay district's Urban plan (version 2014); - The report of Economic and Socio Development Plan in the Xay district.
	10. Control the population increasing	<ul style="list-style-type: none"> - Population density aspect of the Xay district; - Control plan for the external population; - The report of the police office about immigration action; - Direct observation in the field (Xay district); - Opinion and interview the individual respondents.
	11. Land-use change pattern assessment	<ul style="list-style-type: none"> - The report of Office of Natural Resources and Environment in Xay district (local level); - Direct observation in the field (Xay district); - Interview the individual respondents (include the opinion of Governor of Xay district). - The report of Xay district's revolutionary party meeting; - The report of Xay district's Urban plan (version 2014); - The report of Economic and Socio Development Plan in the Xay district.
	12. Assessment experiences, risks, and impacts from the past.	<ul style="list-style-type: none"> - Review the previous flood data, the impact of the flood; - How to improve the data system; - Interview the flood victims and local village leaders.
	13. Time assessment (before, during, after) to prevent a flood, rescue, and recovery on time or not?	<ul style="list-style-type: none"> - Check with fast action when flooding or slow action of the rescue team, and who were deployed to help the flood victims; - Interview the flood victims and local village leaders; - Documents of desk study (secondary data).

Local Resilience and Flood Risk Management (LRFRM)	14. Early warning systems and prediction types of equipment (sign, signal, network)	<ul style="list-style-type: none"> - Readiness to send the information of the early warning system and tools to share the information; - efficiency of prediction tools; - Direct observation in the field (Xay district); - how to use the technology to the flood prediction; - Human resources teams for the early warning system.
	15. Flood awareness, education, training, information sharing, dissemination (TV, Radio, newspaper, social media, etc.)	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview of local government staff - Opinion and interview of the local community and local people about the flood awareness; - Methods to dissemination and information to local people; - Time to send the flood awareness; - who will get benefit from dissemination; - Participation with local government and local people.
	16. Flood Data collection, data analysis	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Review the flood data statistic; - How to data collection and how to apply the data; - Who will do the data collection.
	17. Flood map documents or flood map for analysis	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Review the previous flood map (flood zone and flood risk areas); - How to analyze the flood map; - How to make the new map to flood prevention; - Prediction for future preparedness.
	18. Infrastructure monitoring and maintenance (dike, erosion protection, road, bridge, electricity, water supply, etc.)	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Methods to maintain the infrastructure; - Budget to support for maintenance; - Plan to maintenance; - Alternative of hard engineering construction or soft engineering construction.
	19. Clean the canal, watercourse, or drainage system in routine.	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Plan to clean the canal and drainage; - Waste management to the canal; - Budget to support the plans; - Awareness of local government and local people.
	20. Pumping stations or mobile pumping	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Check the Xay district have the pump station or not.

Local Resilience and Flood Risk Management (LRFRM)	21. Flood zones or flood plains. Flood bypass.	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Review the urban plan and Land-use plan; - Check and share the suitable information to local people to understand the regulations; - Measure the degree of flood level.
	22. Evacuation procedures, surveying evacuates routes	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - Determine the place to use for evacuating center, and suitably high level; - Efficient vehicles and support for evacuation; - Opinion of local people combine with local government.
	23. Storing food and water drinking	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents. - How does the local government have the flood and water drinking in emergency cases; - Where does the local government find the food and water drinking; - Any other people and organization support; - The local government plans for food and water drinking storage and stockpiles.
	24. Flood shelter and victim center	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - How the local government prepares the flood shelter efficiency or other building to support; - How the local flood victims go to the shelter; - It is safe enough for all flood victims.
	25. Establish the various teams (medical, relief, security, transport, and recovery with a resilient concept for Build back better)	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - The local government set up teams or not; - How many rescue teams for help the local flood victims, enough teams to take action and help; - Who is the key team; - The team can support on time or late; - any external team to help.
	26. Overall risks regular inspection, measurement, monitor.	<ul style="list-style-type: none"> - Direct observation in the field (Xay district); - Opinion and interview the individual respondents; - This factor includes 25 factors to mention above; - How to implement for flood risk management; - How the local government inspection and monitor in the regular; - How does the local government share the information from inspection and monitor; - How the local government prepares for the future.

Four data analysis processes, which were related with various data support from desk research, direct observation in field, interviews with two groups, and focus group

discussion. They were carried out until all data has been fully analyzed, leading to conclusion and results. This set of processes and data support was detailed in Figure 3.15: Summary data analysis methods.

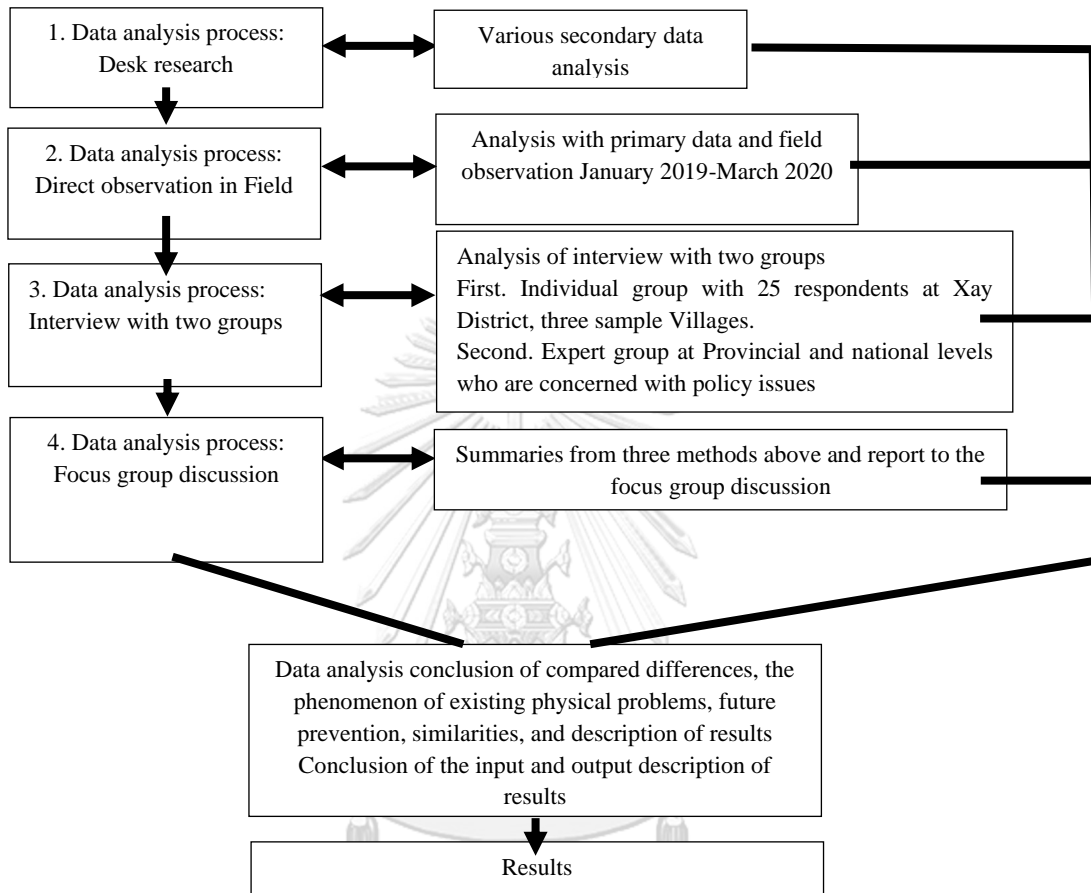


Figure 3.15: Summary of methods of the data analysis until to results

3.6 The conclusion of Chapter III: the Research Methodology.

This study employed a qualitative approach (Creswell, 2007) Based on four methods of data collection: documents from desk review, non-participatory and participatory direct observations in the field, semi-structured interviews with individuals and expert respondents, and three focus group discussions between February 2019 and November 2021. The information gathered from these investigations were used, following this study's conceptual framework to investigate the research questions, as shown in Figure 3.1. Then, many secondary and primary data sources from Xay district's local government practices and three sample villages in Xay district were collected and analyzed. This includes the information gathered from the first group of 25 individual interviews, which included local governmental authorities, local village leaders, and an NGO, and the second group of 14 expert interviews from national, provincial, and local levels. This data was analyzed for age, interviewees' tenure in current position, and length of residence in Xay District in an effort to evaluate their fitness to share their experiences about the flood risk management. The collected

data was categorized in terms of comparison differences, phenomena, and similarities with support of reasons, and then qualitative data analysis was employed to find evidence to answer the research questions. Then, data was analyzed using the processes detailed in Figure 3.15 in order to reach conclusions and results.



CHAPTER IV

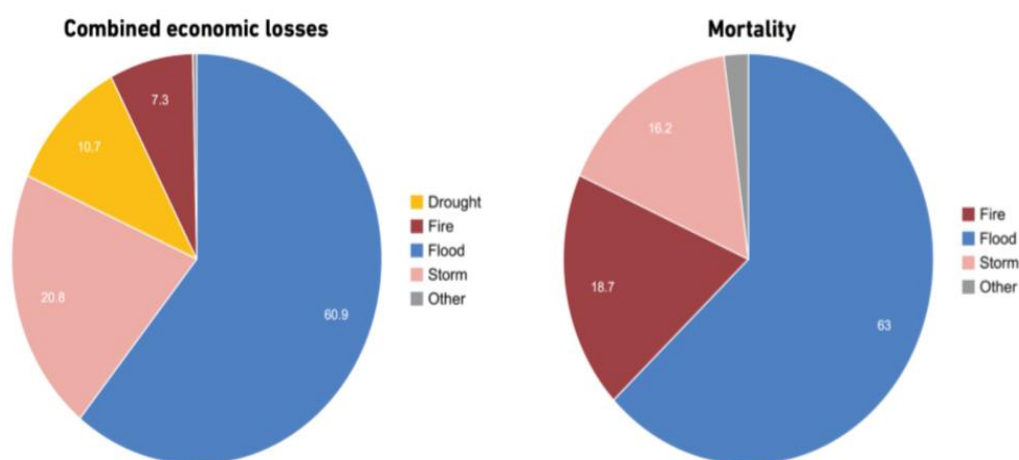
RESULT 1- XAY DISTRICT CONDITIONS AND ITS FLOOD RISKS

4.1 Floods and their risks

Research question no. 1 (from Chapter 1) leads to an assessment of the nature of the flood threat experienced in the Xay district. Lao PDR is a flood-prone nation, with specific degrees of severity in different regions. Among those hazards, flooding from storms has been the most significant natural hazard, and has led to both economic and social losses (CBDRR, 2016).

- Flood risks to the population

For at least the last decade, several floods have adversely affected the local population within Lao PDR, and the negative impacts of these floods are exacerbated by natural conditions, human activities – due to both intentional and unintentional factors. Due to the mortality and property loss risks of floods, they are of urgent concern (see Figure 4.1).



Source: (DMRH, 2017)

Figure 4.1: Laos disaster and risk profile in 2017.

Because the livelihoods and local economies of the local residents are primarily based on agricultural production and depend on natural resources, they are highly vulnerable to natural disasters. It is a fact that floods have always been a fact of life for these people, and that the consequences of flooding are not new. However, it is important to understand that the inevitability of flooding does not invalidate the idea that severity can be affected (both positively and negatively) and that post-flood response can have a major impact on future preparedness. It is essential that government policy be shaped to optimize flood preparedness and response activities by finding solutions to existing gaps and protecting the vulnerable individuals and groups in the

affected local populations. In particular, several flood events have created undue risks for the poor and socially disadvantaged, particularly women and children (Abhas K Jha, 2011). In short, Lao PDR is highly vulnerable to floods, lack coping capacity (WFP, 2019), and this situation must be improved, using methods that are suitable to the country and local people.

Over the past 30 years, Lao PDR has experienced severe floods, on average, every 1.4 years. Sometimes multiple floods have occurred in the same year, but in different provinces. Floods are most common in the more mountainous region, and during the monsoon season from (May to October), when the torrential rain increases the amount of water in the rivers. Then, the forest and topsoil in the mountain become more saturated, and the water levels of the tributary rivers rises, causing flooding.

Table 4.1: Some flood impacts on Lao PDR

Context	year	Name of typhoons/storms	Killed	Affected population	Damage (000 US\$)
floods	2008	tropical typhoon Kammuri	12	220,000	2,480
	2009	Typhoon Ketsana	-	240,000	121,000
	2011	Five tropical storms (Nockten and Haima, etc.)	26	300,000	100,000
	2013	Several floods	-	350,000	270,000

Source: (DMRH, 2017)

- The Risk from poor infrastructure

The various flood risks and impacts apply to both urban and rural areas in Lao PDR. Floods damage communication-transportation networks, electricity, telecommunications, hospitals, schools, and others. Climate conditions in Laos are also of concern; the consequence of an increase in precipitation are floods and flash flooding caused by slope failures, and resulting in blocked road access and roadside cuttings. This is often caused by rising groundwater during the wet season, and some floods are combined with the erosion of riverbanks.

- The Risk from climate-rainfall

While there are transition periods between the two tropical monsoons, during which wind currents are variable and light, the Lao PDR's climate system is dominated by the Asian tropical monsoon, with the north tropical monsoon from November to April (dry season), and the south tropical monsoon from May to October (rainy season). During the South tropical monsoon, widespread storms and typhoons from the South China Sea cover the land to affect the country, resulting in widespread heavy rain, and several floods (DMRH, 2017). The Lao PDR is listed as the 42nd most vulnerable country in the world to events such as floods and flash flooding. Moreover, the high

rate of local subsistence population without alternative livelihoods results in a lower capacity for coping with weather extremes (UNDP, 2013).

La Niña and El Niño systems of tropical monsoons create risks and have consequences for the climate of the country. Furthermore, climate variability has resulted in the rising frequency of floods. The high dependence of most impoverished people in rural areas on natural resources, livestock, and agriculture also has continued to perpetuate gaps in prevention, and heightened risk exposure to the effects of floods. Generally, the average annual rainfall ranges between 2500 mm and 3500 mm over the country's northern region. However, historically, if more than 200 mm of rainfall accumulates in 2 days, this has led to several floods in risk areas.

- The Risk from Geography.

Most of the Lao PDR's geography is characterised as hilly and mountainous, with many valley areas in the northern parts like Xay district, and lowland plains in the central and southern parts. Some areas are characterized by sharp crests rising to between 1,000-2,000 m above sea level, with steep slopes. Due in part to this problematic geography, infrastructure development and urban planning management in remote areas has been limited. Rural roads become restricted during the rainy season, and floods and flash flooding occur frequently (ADPC, 2010), making it difficult to access the villages of local flood victims (Brahmi, 2002).

- The Risk from deforestation

Lao PDR has lost about 1/3 of its forests over the past 40 years. This has been due to urbanization, land-use change to agricultural fields, other crops, and, mainly, to destruction from booming black markets for logging trade and smuggling logs across the border. Consequently, the risks from deforestation, are accompanied by further reduction in natural resources for local peoples' livelihoods, reduced biodiversity, and for a reduction in natural flood protection (Forests & D, 2013).

4.2 Xay district and its main river (Kor River)

Xay district is the capital district of Oudomxay province, situated in the northern part of the province, and it covers an official area of 399 km². However, most of the population lives within an urban area of 72.5 km². The town is located in Xay District, which borders Namong district to the northwest, La district to the northeast, Nambak district of the Luang Prabang Province to the east, and Nalae Districts of the Luang Namtha Province to the west.

This Xay district area covers the Kor River and its tributaries, as shown in Table 4.2, and it is surrounded by the scenic mountains of the Kor River Basin. Roughly 80% of the total land area is covered by mountains, hills, valleys, and the channels of stream rivers. The height of the mountains varies from the lowest, at 458 meters, to more than 1,800 meters above mean sea level.

The climate of the Xay district is dominated by tropical monsoon. The average annual precipitation is 1,833 mm. Most of the rainfall (90%) occurs in the wet season

months from April to September, with the highest peaks in July and August (Source: Report of district Xay's revolutionary party meeting, 2020).

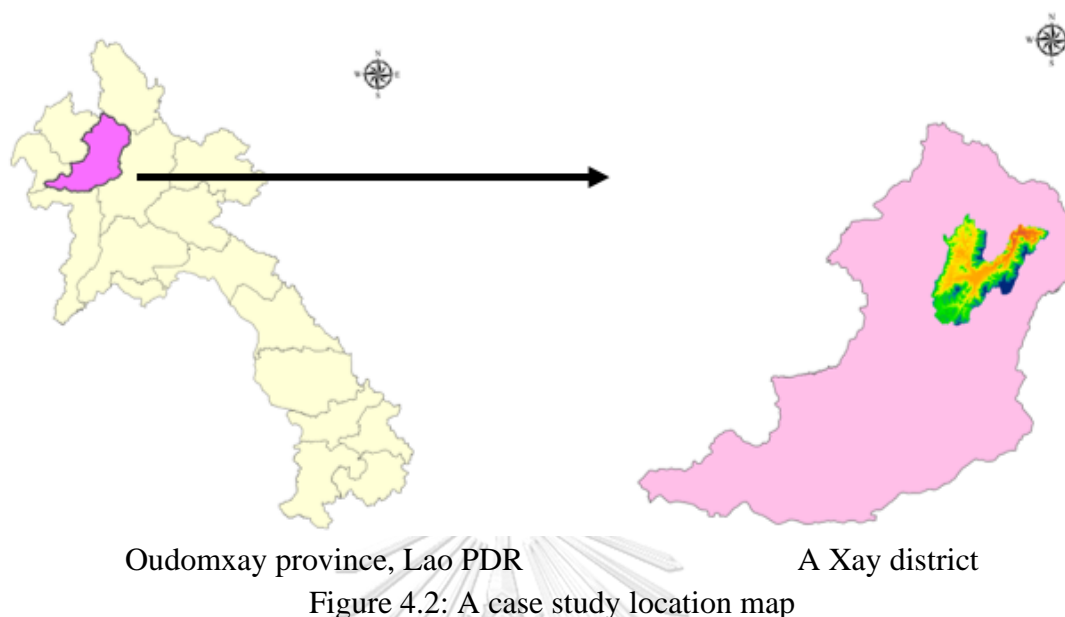


Figure 4.2: A case study location map

- Its main river (Kor River)

The Kor River flows for about 74.2 km from its source to the Pak River, draining into a total catchment area of 920.2 km². The Kor River passes through the urban area of Xay district. The Kor River is divided into the main channel and its tributaries, e.g., one of the tributaries is the Mao River; another is the Hin River, and many canals flow down to the main Kor River.

Xay district's hydrology features a wealth of water resources in three primary watersheds, with approximately 66 small and large rivers. The Xay district area is confined between three mountains, with the upper Kor River Mountain to the north, and the upper Hin River Mountain and the upper Mao River Mountain to the south. The elevation of the Kor riverbank is approximately 636-640 meters above sea level.

Table 4.2: Composition of the Kor River Basin

Division	Kor river	Mao river	Hin river	Total
Area (km ²)	563.2	214.6	142.4	920.2
Portion (%)	61.2	23.3	15.5	100.0

4.2.1 Upstream of the Kor River (Kor noy village)

Upstream of the district, the Kor noy village is located in the northwest of Xay district, as shown in Figure 4.3. The village's total population is 1,116 people (female 578 people) comprising five ethnic groups: Lao-Tai, Hmong-Idmian, Phou noy, Chinese-Tibet, and Hor. The geography of the villages comprises mountainous areas and with many canals. 56% of the local villagers practice farming, clearing the land and removing vegetation for food plantation along the Kor River and surrounding lands. According to the village report, only around 40% of the forest remains. There has been

vast flash flooding impact in 2008, 2013, and 2017 to the Kor noy village, with significant damage to local people who lived along the Kor riverbank (Source: The Annual Report of Kor noy village, 2019).

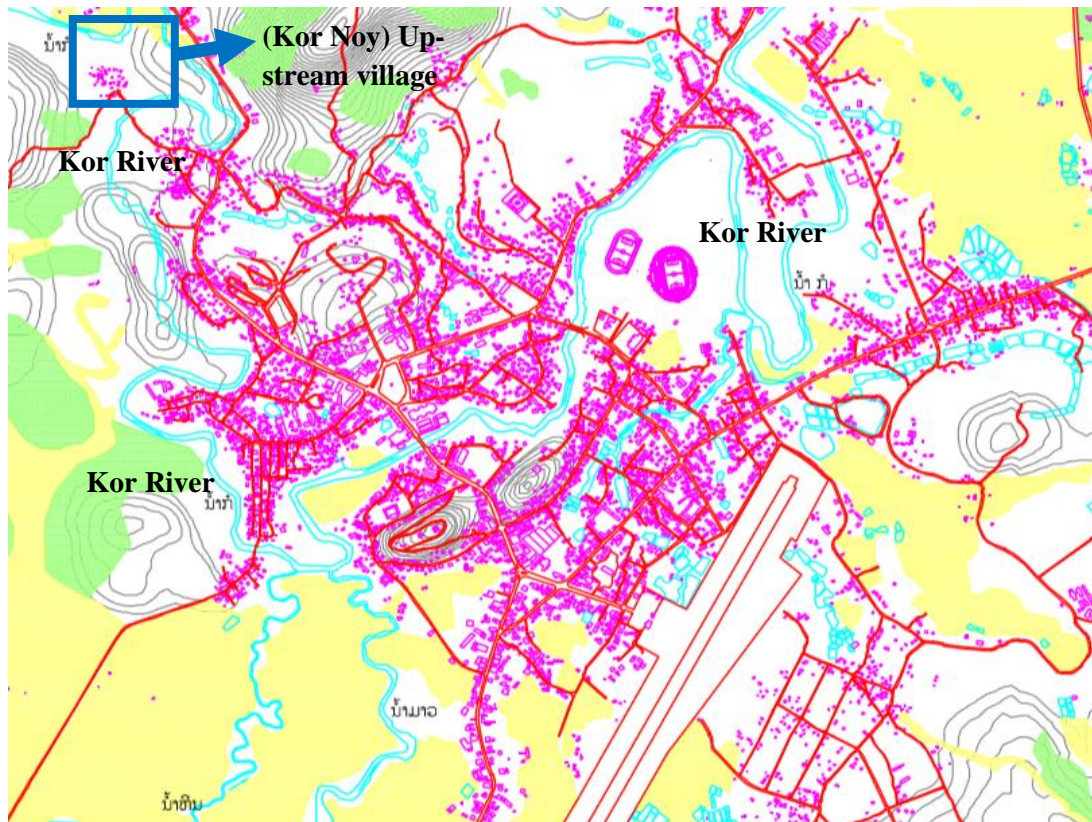


Figure 4.3: the Kor noy village location

Respondent II_15 said

“In the past, 2011-2016, This village had the Lao –Japanese agricultural and irrigation project to help support and encourage knowledge of the local people to plant the riverbank with tree and shrubs for protection. When the project finished, some villagers did not pay attention to tree plantation or clean the canals to maintain the excellent discharge capacity of the Kor River. That meant the need to continue local participation in the sustainable activity for flash flood risk management”.

With its location near the top source of the river, landslides frequently occur, so sedimentation collects in the riverbeds, creating a narrow river channel and reducing the discharge capacity of the Kor River.

Respondent II_16 said

“After the great flood in 2017, the local government set an early warning system sensor and equipment on the village's top before the main Kor River flows down to the village's central area. After that, the village leader knew the early flood

warning information and distributed it to the local villagers. The local villagers were able to prepare to move their families, and people could carry the critical things from the low area to high safety areas, since 2018. The local residents have adapted by using the previous experiences when coming of the rainy season. They know they need to prepare for flash flood mitigation and prevention”.

The early warning system sensors and equipment are still in place at 4 points. (The 1st point is at Kor Noy Village, upstream of the Kor River); (the 2nd point is at Thin Village, mid-stream of the Kor River); (the 3rd point is at the Hin River, at a point before the water flows down to the main Kor River), and (the 4th point is located at LongKorDeua Village, downstream of the Kor River) (Souce: The Department of Natural Resources and Environment in Oudomxay province, and direct observation in the field, 2019). Examples of this early warning system components are shown in Figure 4.4.



The early warning system sensor



The Village speaker

Figure 4.4: The early warning system sensor and equipment in the up-, mid- and down-stream areas, and Village speaker.



Figure 4.5: The Kor River, in the Kor Noy village.

4.2.2 Midstream of Kor River (Thin village)

Thin Village located in the center of Xay district, and midstream of the Kor River, as shown in Figure 4.9. The village's total population is 1,620 people, 296 households, and the village's population density is 60 people per/km². However, it has a developed infrastructure system, with many buildings, roads, water supply systems, markets, and service activities. Most of the villagers come from the five main ethnic groups of the area (Lao-Tai, Hmong-Idmian, Phou noy, Mon-khamer, and Hor) (Source: The annual report of the Thin village, 2020).

This is a high population density village, where the local people live near and along the riverbank near the center of the district, as shown in Figures 4.6, 4.7, 4.8 and 4.9.



Figure 4.6: The road status in the Thin village.



Figure 4.7: The houses along the Kor riverbank in the Thin village.



Figure 4.8: The highest flood level of the Thin village in 2017.

Respondent II_19 said

“Midstream, along the river stretch in the city center, there is little room for water, and the focus is on flash flood prevention by creating levee banks or dikes to prevent the flash flood from overtopping the river banks. Attention was paid to removing obstructions from the river course. So, the village's geography is a low-lying area, flat and composite with two tributaries such as the Mao River, Hin River, and many canals flow down to the Kor River. Furthermore, when the torrential rain occurred and made this complicated to this village had been a hazardous area for the face with flash flood damage”.

As shown in Figure 4.9.

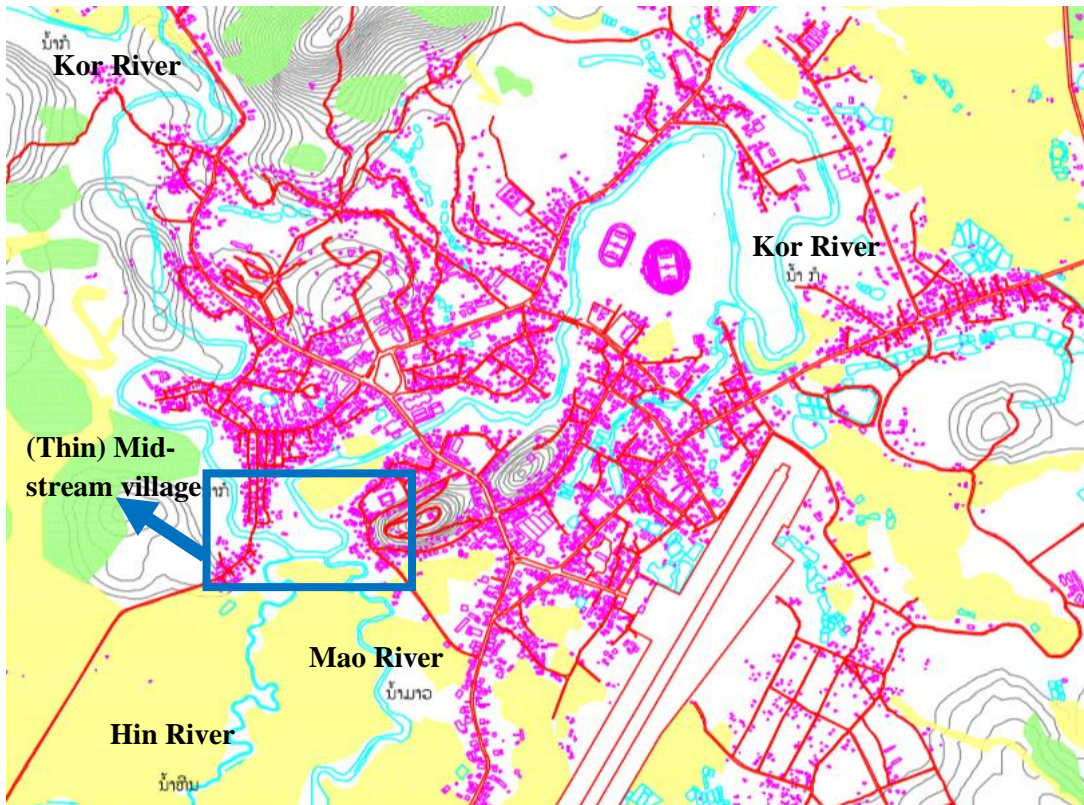


Figure 4.9: the Thin village location



Source: by author, 2020.

Figure 4.10: The flow down point of tributaries (Mao and Hin rivers) to the Kor River

The early warning system sensor and equipment set by the local government in Xay district to inform local people nearby the Thin Village and surround villages as shown in Figure 4.11 below (source: direct observation in the field, 2020)



Figure 4.11: The early warning system sensor and equipment at Thin village.

4.2.3 Downstream of Kor River (the Longkordeua village)

The Longkordeua village is located in the northeast part of Xay district with Kor River downstream flowing down through Xay district's urban area, as shown in Figure 4.12. The village's north is bordered by the Tho Mountain, the south is bordered by the Jeng and Donkeo villages, East bordered with Viengsa village, and the west is bordered by Mon Tai village; the total area is around 250 km². The village's total population is 1,292 people (female 656 people), 280 households, and the village's population density is 52 people per/km². The Longkordeua village has developed infrastructure systems such as roads, water supply systems, central market, and service activities. Most of the villagers come from four ethnic groups (Lao-Tai, Hmong-Idmian, Phou noy, and Mon-khamer) (Source: The annual report of the LongKorDeua village, 2019).

Because of the high population density in this village, and the limited area effect on the locals. So, the local government does not allow local people to live near and along the Kor Riverbank and the 2E National Road from Oudomxay province to the Phongsali province. The village condition is shown in Figure 4.13 and 4.14.

The village is surrounded by 75% mountain ranges, while the remainder is mainly lowlands, with many tributaries connecting to the Kor River. During torrential rains, the villages are faced with many hazards from flash flooding.

Respondent EI_13 said

“Downstream of the district, interventions focus on increasing the discharge leaving the urban center. Furthermore, river conveyance should be maximally

improved. An option that applies explicitly to the Xay district is short-circuiting the impressive river meander in the Kor River. The measures considered in the downstream section of the Longkordeua village include the river improvements and shortcuts”.

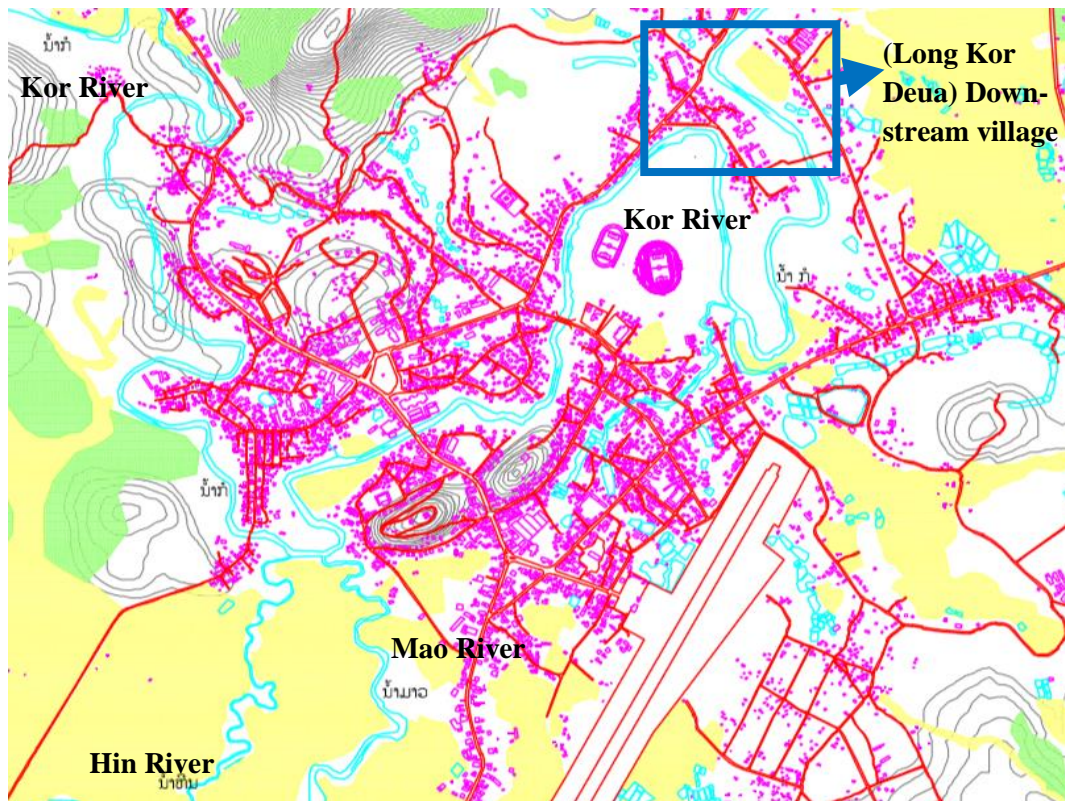


Figure 4.12: the Long Kor Deua village location



Figure 4.13: the houses along the Kor riverbank and 2E National Road in the Long Kor Deua village.



Figure 4.14: the drainage status in the Long Kor Deua village.

4.3 Population structure in Xay district

4.3.1 Demography

Xay district's population status are obtained from the Office of Interior in Xay district. For 97 villages and nine development village groups, the total population in

Xay district was 36,041 people, with 6,465 households and 5,384 families. There are 17,047 males and 18,994 females. The developed village groups and ethnic groups are divided into four different languages, such as Lao-Tai (28.50%), Mon-Kamair (50%), Hmong-Idmian (15.43%), and Chinese-Tibetan (6.07%). The average population density is 27 people/km². Figure 4.16 shows comparisons of population statistics from 2004, 2012, and 2018 which illustrate how the Xay district population has developed recently.

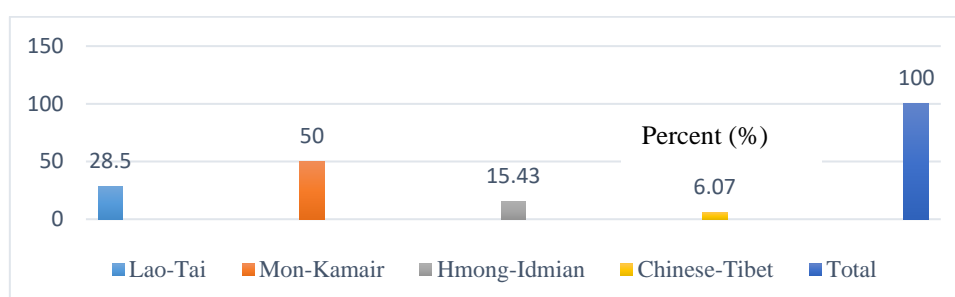


Figure 4.15: Ethnic group (race) in Xay district

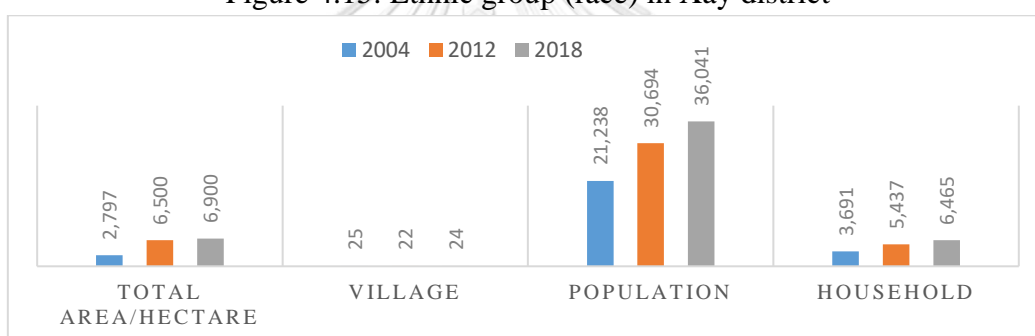


Figure 4.16: Compare demography in Xay's municipality of 2004, 2012, and 2018.

Source: Office of Interior in Xay district, (2019). Detailed data are in Appendix F.

4.3.2 Occupations

In 2019, Xay district had a total population of 36,041 people, covered 51.23% of the total population compared with five years ago increased 21.62%. There were 29,581 local residents working in the district (9,418 females), and 825 foreign labourers (169 females). Agricultural labour accounted for 31.83%, Industry comprised 15.78%, and the service sector equalled 49.66%. Furthermore, there were 470 retired governmental staff, 236 disabled people. Moreover, 3,549 natural disaster victims had received relief totalling 324 million Kip (Lao currency) (Source: a report of Xay district's labour and social welfare office, 2019).

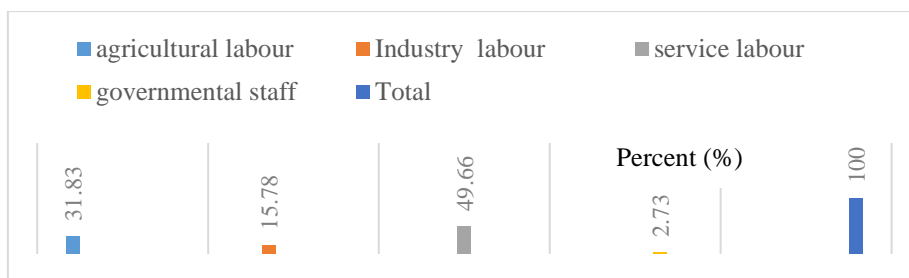


Figure 4.17: Types of labour in the Xay district



Figure 4.18: Labour in the Xay district.

The respondents noted that the careers of local people had changed recently. Since the Laos-China Railway Construction Project had started in 2018, many local people had changed their previous occupations to the construction labour sector and tourism service sector, as many Chinese people had started coming to Xay district.

4.4 Previous and current flood risks in Xay district

4.4.1. Flood natural characteristics and the main cause of flood risk on Xay district.

Research question 1, discussed in Chapter 1, is focused on the nature of threats created by floods in Xay District.

4.4.1.1 Flood natural characteristics.

The result from the individual interview's question no.1.2.2 (detail in appendix A).

Respondent II_01 said

“The nature of flooding in Xay district is like a flash flood, at the confluence of three rivers: the Kor, Hin, and Mao Rivers, locate upstream from the district. Because its geography features high surrounding mountains combine with lowlying urban area, which is relatively flat and frequently experiences heavy rain during the rainy season, the river basin in the more significant part of the mountain area experiences flash flooding in the Xay district urban area. To make matters worse, the lack of infrastructure to prevent flooding increases flood damage in the urban area. Hence, most district areas are flood risk areas due to the heavy rainfall and topographical characteristics; as a consequence, the large amount of water that collects in the urban area is difficult discharge. The flash flooding occurs rapidly, in 4-6 hours, yet drainage takes between 2-3

days, adversely affecting the urban area as it is slowly discharged to another district (Lar district in downstream of Kor River)."

1) Type of flood

Based on the experience of recent flood events, the type of flood damage in Xay district is classified as river and inland flood. The flood character types are as follows:

(a) River flood: Based on historical flood events, the frequency of river flooding is high, and when a river flood has occurred, it has caused significant damage in Xay district. One of the reasons for the river flood is the lack of discharge capacity in the river channel, and the other is the failure to share flood discharge in the downstream basin.

(b) Inland flood:

The inland flood is due to the small drainage capability. There is also a lack of planning and management for the urban drainage system in the district (Source: The Department of Public Works and Transport in Oudomxay Province, 2020).

2) River Conditions

(a). The Kor River

The Kor River's upstream area includes Kor Noy village. The location is relatively narrow; there are no facilities for flood control within the basin. The embankment of the Kor River shows some signs of erosion, and sediment resulting from erosion has been deposited at Xay district's downtown area, where the flow velocity is reduced. This could be attributed to insufficient cross-sectional flow in the downtown area.



Figure 4.19: Present condition at the upstream of the Kor River.

Respondents II_11 said

"The midstream and downstream areas of the Kor River, which flows through the Xay district urban area downtown, are adjacent to residential areas. Both sides of the river have unsecured areas, such as a levee and bank protection to prevent flash flooding. The mid and downtown districts are located at the confluence of three rivers: the Kor River, the Mao River, and the Hin River. The area also has flash flood-prone topographical features as bottlenecks."

The Kor River is shown in Figure 4.20.



Figure 4.20: Present condition at the downstream of Kor River Bridge 1.

(b). The Mao River (a tributary of the Kor River)

The Mao River is relatively wide and has a gentle slope compared to nearby rivers such as the Kor River and the Hin River. The Weir, which has a width of 25 m and crest elevation of 653.33 (mean sea level), is located just upstream of the De Yin Bridge in the middle part of the Mao River (Source: The Department of Public Works and Transport in Oudomxay Province, 2020). Figures 4.21 and 4.22 show the Mao River and the weir.



Figure 4.21: Present condition at the downstream of the Mao River Bridge



Figure 4.22: the Weir at the upstream before the Mao Bridge (De Yin Bridge)

(c). The Hin River (a tributary of the Kor River)

The Hin River's upstream area has a relatively narrow and a reservoir without a water-gate to control flooding. At the time of the study, the Laos-China railway project was currently under construction near the Hin River downstream (Source: The Department of Public Works and Transport in Oudomxay Province, 2020), as shown in Figure 4.23.



Hin River Reservoir

Rapid Railway Project under Construction

Figure 4.23: Present Conditions at the Hin River

4.4.1.2 Main cause of flood risk.

Both groups of respondents (first and second groups) were asked interview question no.1.2.3 (question detail in appendix A).

The primary and secondary data, along with the group discussions, showed that the main causes of flood risk in Xay District comprised both natural and human activities.

This was confirmed by respondent II_11, who said,

“The Xay district's area was considered of two types of pluvial flooding and river flooding”.

Pluvial, or inland flooding, occurs when high-intensity local storm events lead to flooding in urban areas with high population density. Two types of flood mechanisms cause local (urban) flooding: insufficient drainage capacity, and bottlenecks in the urban drainage system.

River flooding is caused by heavy rainfall in the upstream catchment, leading to high river discharges and rivers' overtopping. Many cases have been linked to the following causes and results:

a). Extreme weather, heavy rainfall associated with climate change

Significantly, some years have had more frequent torrential rain due to climate change.

Respondent EI_13 said

“The climate change by global warming has caused abnormal weather conditions, with large amounts of rainfall all at once. The river basin, the Xay district in northern Lao PDR, is not an exception. However, the Kor River that passes through the district lacks discharge capacity to protect from torrential rain caused by climate change. Therefore, a comprehensive approach is needed to reduce flash flood damage. It is also necessary to find an optimal measure by dividing the portion to be shared by many basins and the portion shared by the river channel.”

A more detailed analysis is in Chapter 6, section 6.1.1. Factors for flood risk management, and the sub-section-6/. Rainfall and meteorological pattern assessment.



Figure 4.24: Flood from heavy rainfall in 2017.

b) Top sources of upstream rivers

The deforestation activities from agriculture reduces water absorption into the ground; this, in turn, causes an increase in topsoil (vegetation and debris) run-off, water being discharged, and increased erosion. A more detailed analysis is in Chapter 6, section 6.1.1. Factors for flood risk management and went to the sub-section-8/. Deforestation activity assessment).

Respondent II_08 said

“If the rainfall occurs at 70 mm/an hour, then it is absorbed automatically into the soil, without having to worry about large amounts of surface water run-off. So, the point of natural absorption for solving was quite an important and natural underground tank in the top source on the mountain areas effect to high risk for flood into the Xay urban area.”

c). The discharge capacity of the Kor River and tributaries

Respondents EI_11 said

“River flooding was caused by heavy rainfall in the upstream catchment or basin, leading to high river discharges and rivers' overtopping. There were not many facilities such as dikes, embankments, and Watergates to prevent flooding of the high-water level in the Kor River and tributaries. As the erosion accumulated during the flood, the slope of the rivers also became more gradually gentle.”



Upstream section of the Kor River



Downtown section of the Kor River

Figure 4.25: Insufficient discharge capacity of the Kor River in the Xay district

d). The drainage capacity of Xay district's urban area

Respondent EL_12 said

“In the midstream river, pluvial or inland flooding occurs when high-intensity local storm events lead to urban flooding due to insufficient drainage capacity or bottlenecks in the urban drainage system of the Xay district.”



Drainage Outlet near the Market

Drainage Outlet near the Xay Stadium

Figure 4.26: Urban drainage status

e). Riverbank erosion

Respondent EL_12 said

“The bank erosion process of the Xay district is natural since the river has a high hydraulic gradient in this reach. Such conditions combined with erodible bank material cause the river to meander. River side was undertaken to identify the season when erosion was more active; it turns out that it is towards the end of the flood season, during October-November. The reason why riverbank erosion is so severe during this time seems to be connected to soil moisture.”

At the end of the wet season, the riverbank's soil has a maximum moisture content, which increases its weight and makes the riverbank more prone to erosion and slippage, particularly when combined with rapidly receding water levels in the rivers. These processes not only threaten the flash flood embankment, but also infrastructure and residential areas. In the latter case, the result has, at times, been significant or even a complete loss of property value, while land values close to the river have fallen substantially. Many houses in the case study were already being destroyed by river erosion when the flash floods came.

Respondent II_18 said

“Residents complained that the erosion rate of the Kor River and tributaries are high. They had already lost their houses, properties, or cultivation land from the river erosion, which forced them to change their income-generating activities from farming to other jobs”.

As mentioned above, this damage from bank erosion, as shown in Figure 4.27, is a significant problem in Xay District.

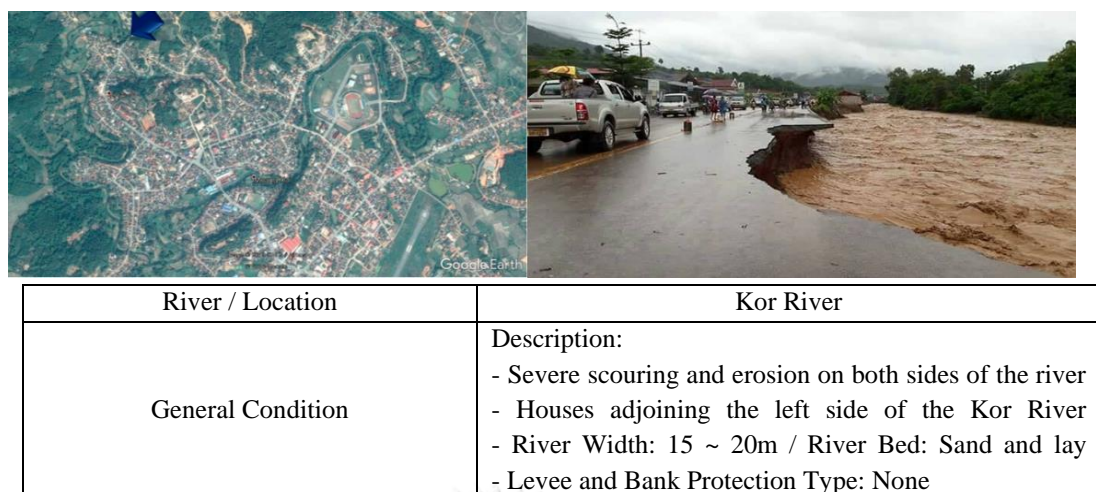


Figure 4.27: Status of bank erosion in the flooding

f). Lack of river management

Respondent II_04 said

“The local government's practices in the urban area cannot sufficiently control sedimentation and waste activities. However, they did not clean the canal; this resulted in the expected effect of blocking the extensive water drainage and exacerbating the emergency of floods in the urban area.”

The Xay district lacks sufficient plans for integrated river management that consider the geographic and urban characteristics. Therefore, integrated river planning and maintenance measures are required to improve flash flood control capabilities in the Xay district's urban area and strengthen the city's resilience with respect to floods.

4.4.2 Experienced about flood risk and impact from past till present

According to the interview results from the individual interview question no.1.2.4 (question detail in appendix A), serious damage to property and loss of life was the result of flooding in Xay District. These results were consistent in the information obtained from both interviews and focus group discussion with stakeholders, as well as primary and secondary data.

The great flash flood in 2017 occurred along National Road no.13 between Houykhon, Nasao, Namee villages, with the most of the property damage occurring along the Kor and Mao rivers. Previous to that, torrential rains throughout the district in 2008 affected the Kor River, and its tributaries and canals overflowed, causing a great flash flood in Xay District.

Respondent II_04 said

“Because at that time in 2008, no reservoir existed upstream on the Hin River. Thus, in 2010 the local government decided to construct the Hin River's reservoir, located in the southwest direction of Xay district, for stocking water and controlling water at the same time.”

Severe heavy rainfall and tropical storms frequently occur during the rainy season, lasting from May until October in Xay district, which causes repeated flash flood damage. Many great floods have occurred in Xay District, with serious damage to properties and loss of life in 1985, 2008, 2013, and 2017. Pluvial floods also frequently occur at various times in the district. The information collected is summarized in Table 4.3 below by individual flood events (Source: the district disaster prevention and control committee's report, 2020).

Table 4.3: Flood damage in the Xay district

No.	Year	Damage
1	The great flood event in 1985	<ul style="list-style-type: none"> - A flash flood event occurred after a week of heavy rain, which caused the Kor and Mao rivers to overflow in 1985. - At night time. - 52 people killed. - At the flood peak, the hospital was 1.1m underwater - The damage sustained caused the hospital to close for one week.
2	The great flood event in 2008	<ul style="list-style-type: none"> - In August, heavy rain caused the Kor River to flood in the Xay district urban areas at about 3 AM. - Increased rapidly for about 6 hours. - The flood peak damaged only the Lue Xay market, and a few villages near the Kor Riverbanks received significant damage. - Most services, such as electricity and water supply were unable to operate and experienced maximum disruption. The irrigation sector reported the most significant damage, with losses totalling 236,482,400 Kip. (Lao currency).
3	The great flood event in 2013	<ul style="list-style-type: none"> - flash flood - 19 villages in the suburbs in Xay district were affected. - 5 residential houses in the Xay district were wholly swept away. - 17 people killed (ten females). - Various infrastructure sectors were damaged with high losses.
4	The great flood event in 2017	<ul style="list-style-type: none"> - The rainfall recorded during the 4th and 5th of August, 2017 measured 132.22 mm. - A total of 441 people (258 females) from 78 households were reported to have been directly impacted. - 1 person was killed, nine houses were destroyed, and another 40 houses were severely damaged. - Various infrastructure sectors were damaged with high losses. (Details in Appendix G)

(Source: the district disaster prevention and control committee's report, 2020)

As should be clear from Table 4.3, great flood cases in the Xay district do not occur every year, and they are caused by many factors, but the heavy rainfall is clearly a frequently related factor.

4.4.3 Specific local government practice create flood risks effect local people

Relevant to research question no. 1 of this study, question no.1.2.5 was discussed during individual interviews (Question details in appendix A).

Respondent II_03 said

“The local government was indirect practice create flood risks that affect locals. Such as they had the good legislation, but for local government's management for legislation, laws, regulation, policy practice that's not strictly yet. The local government was not shown in the real action to control. Furthermore, useful things were the building code of construction, intrusion on the riverbank's right of way”.

The local government also limited the budget for flood management and awareness because, if the local government used only the laws for forcing the local people. Those laws would not be followed because it was different level conditions (rich, middle class, and poor people) and many ethnic groups living together (section 4.3.1 Demography). Furthermore, the local government combined with data of upstream, midstream, and downstream villages and insufficient understanding of local people. The local government also did not control or prohibit or penalize illegal activities regarding the riverbank area.

Respondents II_01 said:

“According to legislation, construction within 15 meters (of issued by land control authority) from the riverbank point of the Kor River was prohibited. Practically, though, this strict regulation couldn't be enforced. Restrictions on other canals were 6 meters. There was plenty of illegal squatting. From the first, the locals just needed to build a temporary house, and say that they did not have land to live on, and then they could use the land in that situation. The local or provincial government agencies made allowances for locals (agreed with the old generation). After that, the next young generation did not see the need to follow the regulation. This is why it is difficult to control the locals' action – it's due to the local government's decisions and policies.”

Some policies of the national government are mandated to local government in a top-down approach. It was good policy for flood risk management to help the locals, such as the cases where the local government prohibited people from living near the riverbank risk areas. Furthermore, the local government tried to find new suitable places for these people to live, and allocated land for them. However, it was not always supported by the locals, as the new areas they were moved to did not have the same living conditions and livelihood opportunities as did their existing locations, even if the previous location had a high risk of flood.

The local government still needs to control the clearing of land for vegetable-food planting or agricultural activities from locals. Especially, on the top sources of Kor River because the local government did not have the apparent plan to help the local people stop these activities.

The other key point relates to corruption by investors who have power and money, especially in cases where this corruption hurt efforts towards improvement or needed stricter regulation. When local technical staff from the local government inspect illegal housing, they do not have the authority to make decisions regarding relocation due to their position in the department. They need to report systematically to a person of higher authority. In these cases, first, the technical staff needs to warn the illegal squatters. Second, local government needs to be provided to raise awareness, and meeting minutes need to be recorded for future reference. This is followed by discipline; a fine is levied. The report presented to the policymaker's superior does not result in serious action being taken against the illegal settlement. In conclusion, this problem cannot be resolved by the low-ranking technical staff. In this case, the local government's indirect action allows the illegal squatter to take advantage of a gap, creating a flood-related risk situation. In conclusion, the gap in FRM is created because the decision-makers in the local government did not take any serious action to support the technical staff.

4.5 The conclusion of Chapter IV: Result 1- Xay district conditions and its flood risks

According to the research question no. 1 (from Chapter 1) leads to an assessment of the nature of the flood threat experienced in the Xay district. Xay district is surrounded by mountains, hills, valleys, and Stream Rivers channels. The Kor River flows a distance of 74.2 km from its source, including many tributaries, such as the Mao River and Hin River. Great flash floods occurred in Xay District in 1985, 2008, 2013, and 2017, with severe property damage and loss of lives (Source: the district disaster prevention and control committee's report, 2020). Three sample villages of the Xay district are included in this study. The first is upstream of Kor River (Kor noy village). It is located in the high mountains and comprises many canals. In Kor noy village, 56% of the villager's clear farmland for agricultural plantations. Since 2018, the local district government has set up four early warning system sensors, located at the upstream, midstream, and downstream villages, plus one at the Hin reservoir location. Loudspeaker equipment is located on the top of the village before the main Kor River. that the establishment of this system means that local governments and residents can receive early flood warning information in a timely fashion. The Thin (midstream) and Longkorduea (downstream) village areas are high population density areas, with people living near and along the riverbank near the district's center. Population statistics for 2004, 2012, and 2018 demonstrate the growth of the Xay district population.

Many factors, including both intentional and unintentional actions, are responsible for flood risks in Xay District. These include natural conditions (poor topography), human activities (deforestation in the upstream areas), and bad infrastructure, as well as extreme weather from a tropical monsoon climate, storms, and heavy rainfall between the rainy seasons of May to October. If the rainfall exceeds 200 mm in 2 days, this leads to flooding in the area. There is little room for water upstream and downstream because of the high population density in these villages, with houses stretched along the river in the district center. The topography is a low-lying area, flat and composite, with two tributaries -- the Mao River and Hin River -- and many canals flowing into the Kor River. Floods are characterized by two types: river floods and inland floods.

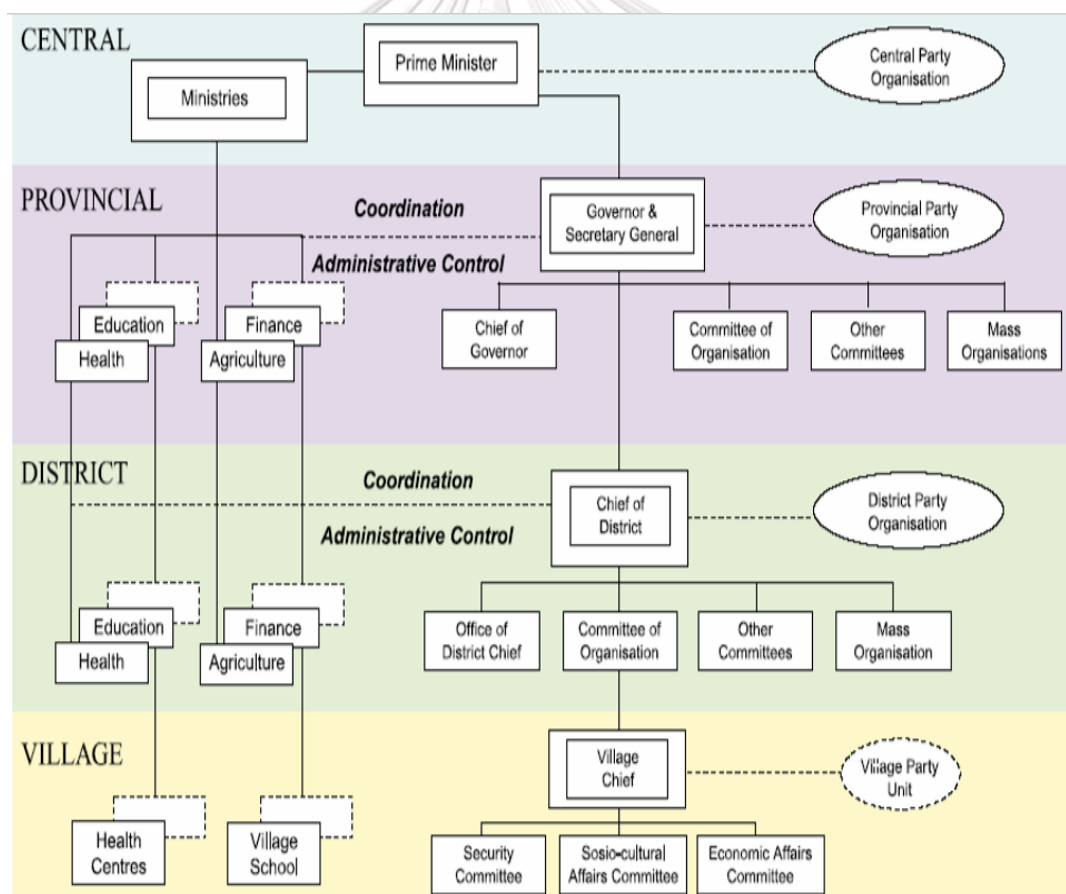
These flash floods occur frequently when heavy rain falls in upstream areas during the rainy season. In the more significant part of the mountain area, the river basin can bring a flash flood into Xay districts flat urban area just 4 to 6 hours. The area then remains flooded for 2 to 3 days as water in the urban area is slowly discharged to another district. The main cause of flood risk comprises two types of floods: pluvial flooding and river flooding. Pluvial or inland flooding occurs when high-intensity local storm events lead to flooding of urban areas with high population density due to two types of flood mechanisms: local (urban) flooding due to insufficient drainage capacity, or bottlenecks in the urban drainage system. River flooding is caused by heavy rainfall in the upstream catchment, leading to difficult river discharges and rivers' overtopping, bank erosion, and lack of river improvement. The local government's specific practices have created flood risks that indirectly affect local people. Practices such as not strictly regulating locals' intrusion on the riverbank's right of way, and lack of budget emergency events contribute to the increased flood risks faced by locals in the Xay district.

CHAPTER V

RESULT 2- THE CURRENT FLOOD RISK MANAGEMENT PRACTICES OF THE XAY DISTRICT

5.1. The Regime in Lao PDR and the Xay district

Research question no. 2 (from Chapter 1) leads to an assessment of the current flood risk management practice of the Xay district. The Lao local-level administrative system was issued as a first step in reversing the "de-centralization" trend of the 1990s. This policy guidance defined a planning and budgeting framework and sought to increase the responsibilities of provinces, districts, and villages. Provinces were to become "Strategic Planning Units," Districts "planning and budgeting units," and villages "implementation units." This system was intended to devolve planning and budgeting responsibilities to lower levels of public administration. An overview is shown in Figure 5.1:



Source: (UNDP, 2005)

Figure 5.1: Lao regime system

Although the Xay district was under a different act with regard to tasks that included flood risk management, the division of responsibilities among the different levels of government were effectively the same as those stated in the district administration organization act. Also, with the Governor and Vice Governors in total control of the Xay district, the district's public administration authority was central to coordination and supported the general work of the Governor throughout the district. Furthermore, the District Disaster Prevention and Control Committee (DDPCC) office was the main entity related to disaster tasks, including management of the flood risk (WFP, 2019).

5.2 Lao socio-economic development plan, 2016-2020

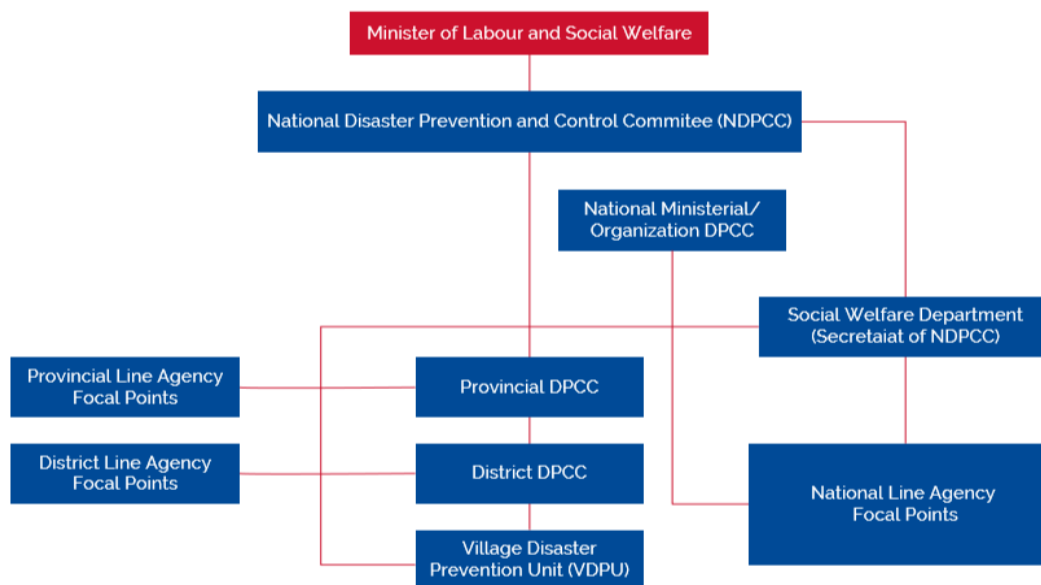
The 8th National Socio-Economic Development Plan (2016–2020), or “8th NSEDP”, meant implementing the resolutions of the 10th Lao People’s Revolutionary Party Conference, which also emphasized the areas from the previous plan implementation that still needed achievement. The plan also reflected the socio-economic development strategy until 2025 and Vision 2030. The NSEDP mentioned avoidance, mitigation, resilient management in natural disasters including flood risk management (MoPI, 2016). The Draft National Social Prevention Strategy 2018– 2030 (close to finalization) envisaged that “By 2030, Lao people would have access to social prevention. In line with these documents, the last few years have seen considerable investment in improving access to and coverage of social security” (WFP, 2019).

5.2.1 Xay district’s socio-economic development plan, 2015-2019

Xay district developed a plan related to the national government and Oudomxay provincial plans until 2020. It was a central act intended to reduce poverty as much as possible. The plan outlined the vision for the district: “Xay district vision is to be a center of trade, service, tourism, and sustainable-modern agricultural products.” As part of this vision, improvements to the communication–transportation section conditions were facilitated with the aim of providing high-quality transportation in the future, complemented by well-planned urban development. This helped the Xay district government authority to analyze and focus on socio-economic development and natural disaster-flood risk prevention at the same time (Source: The Report of Xay district’s socio-economic development plan 2015-2019).

5.3 Lao National disaster management plan, 2016-2020

In Lao PDR, from the national level, the Ministry of Labour and Social Welfare (MLSW) mandate encompasses preparedness, response, recovery, and prevention of disasters. The organizational structure led by MLSW (shown in Figure 5.2) relies on coordination among several entities:



(Source: Decree of PM in Lao PDR, no.75/pm, 2018. Detail of Roles is in Appendix)

Figure 5.2: Overview of the current institutional arrangements for disaster risk management in Lao PDR

- From the Past.

A National Strategic Plan on Disaster Management (NSPDM) was first issued by the MLSW in April 2003, with flood risk reduction as the primary focus. The overall aim of the NSPDM was to Safeguard development and reduce the harm of natural or human-made disasters to villages, districts, provinces, and also to shift the strategy from the earlier goals of relief and mitigation after disaster had damaged the society, and the country's economy to a new strategy of preparedness before disaster strikes. This entailed moving from a government-centred approach to a community-cantered approach in managing disaster by building adaptive capacity within communities.

- Until the present

Institutional mechanisms for this arrangement can follow one of three models: 1) A specialized authority, 2) Inter-ministerial coordination, and 3) A single agency. From these models, the Lao PDR national disaster management system was guided by a high-level inter-ministerial coordination mechanism, but essential responsibilities remain with the respective government agencies in a combined top-down and bottom-up interaction (UNESCAP, 2015).

The Draft of National Disaster Risk Management Plan (NDRMP) (2016-2020) supports resilient development under the 8th National Social Economic Development Plan (2016-2020; 8th NSEDP). The goals established and expected to be completed by 2020, were formulated as follows: To make society safer and minimize disaster harm on people's lives. To assist victims, helping them to mitigate impacts and quickly recover from disaster shocks. To integrate disaster prevention and management into legal and economic frameworks from the villages to the national level.

Under this disaster management plan, legislation and disaster risk management was improved and developed at national and local levels (ADPC, 2012). According to the 'Three-Builds Policy,' governance in Lao PDR was increasingly decentralized to the local level in line with an increased focus on local government and community-based disaster risk management (Aslam P et al., 2015).

5.3.1 Xay district's disaster management plan, 2015-2019

From the National Government and Oudomxay Provincial plan, the focus was for all stakeholders to participate and have a practice plan before floods occurred. All sectors needed to participate in data collection, analysis of flood impacts, policy making, and the formulation of strategies, plans, and programs for prevention and quick recovery in every period e.g., quarterly, semi-annually, and annually for the report to Xay district's governing authority. These reports were intended to help identify solutions to the problems that could be implemented before, during and after flood disaster events.

Respondent II_02 said

“The local government should disseminate the laws and regulations to villages, communities, and locals to participate and understand flash flood risk prevention -- understand the risks and danger of flood impacts that may be happening in their area. There were also campaigns for local television, radio, and newspapers about the extreme weather events, early warning system of flash floods that could affect all local people throughout the Xay district, and telling them to prepare and cope with flash flood risks.”

In the case severe flood, Xay's DDPCC office and all sectors addressed the urgent call for meetings and reports to high-level decision-makers and the Xay district's Governor in an effort to find sensible methods to solve problems associated with the floods (Source: the district disaster prevention and control committee's report, 2020).

5.4 Flood management system in Xay district

5.4.1 Organizational structure in Xay district

Xay district, established in 1961, is the capital district of Oudomxay province. Currently, Xay district consists of 9 developed village groups. In total, there are 97 villages with 22 villages making up the municipality, according to the 2014 urban plan.

Thus, the explanation of responsible roles of Xay district governmental level is detailed on the organizational chart shown in Figure 5.3: Overview of local's party-state administrative framework in Xay District (Source: Report of district Xay's revolutionary party meeting, 2020).

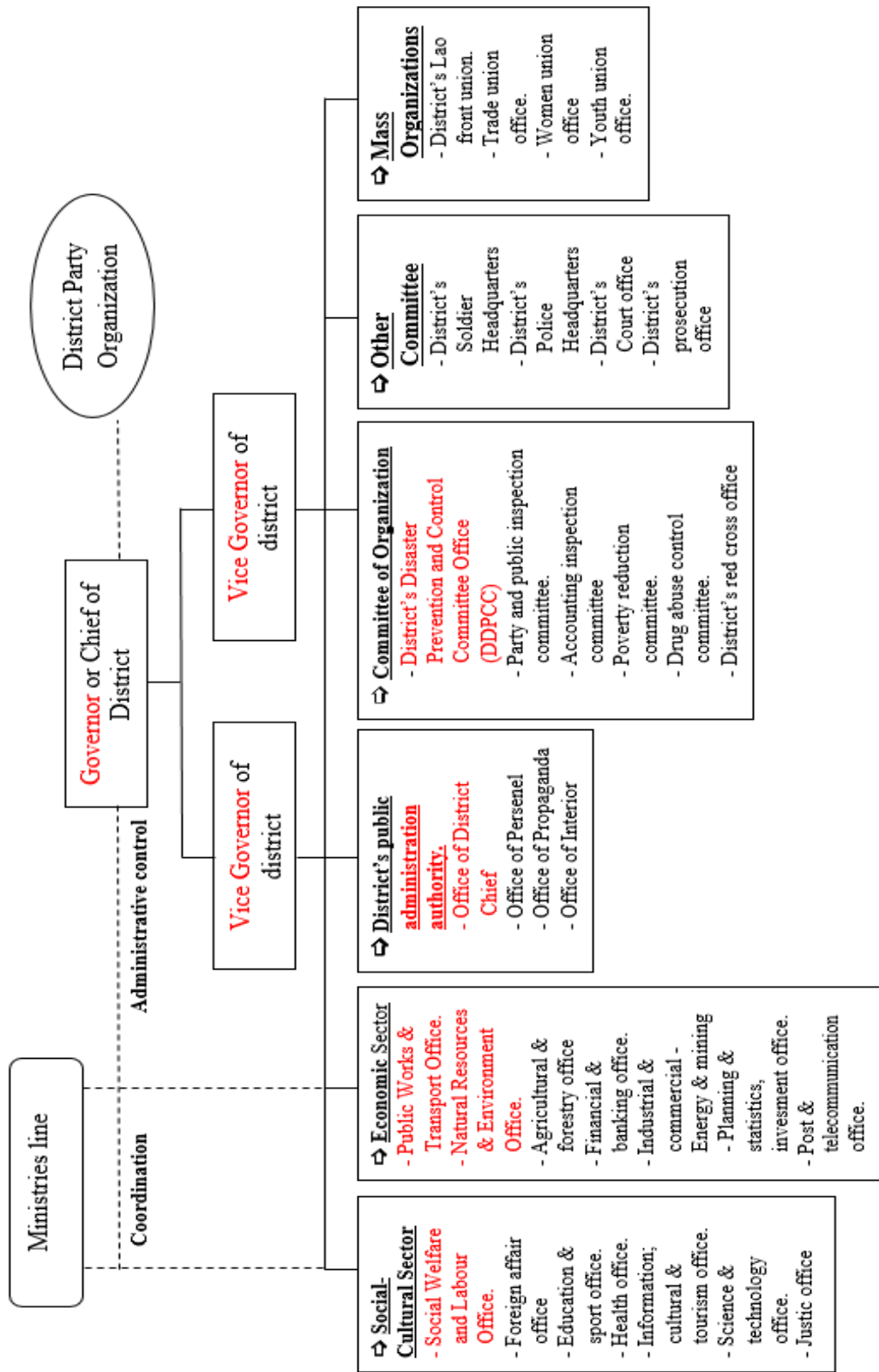


Figure 5.3: Overview of local's party-state administrative framework in Xay District

5.4.2 Responsibilities, roles, and regime in the Xay district

According to Figure 5.3, the villages, developed village groups, and districts were typical of the organization of Lao's local administration or local governmental agencies from the public side. Their responsibilities and authority were under the province and district acts (respectively) and Xay's revolutionary party administrative act.

Although the Xay district was under a different act with regard to tasks included flood risk management, division of responsibilities among the different levels of government were effectively the same as those stated in the district administration organization act. Also, with the Governor and Vice Governors to total control of the Xay district, the district's public administration authority was central to coordination, and supported the general work of the Governor throughout the district. Furthermore, the District Disaster Prevention and Control Committee (DDPCC) office was the main entity related to disaster tasks, including management of the flood risk, from both natural and man-made causes (Source: Report of district Xay's revolutionary party meeting, 2020).

5.4.3 Geography and climate conditions in Xay district

In Xay district, 85% of the total land area is covered by mountains, valleys, channels, rivers, and tributaries. Elevation ranges between the lowest of 458 meters and the highest of more than 1,800 meters above mean sea level. The average rainfall is 1,500 mm/year, and is routine during the rainy season. Some years see torrential rain storms that cause flooding in the district, whose terrain is mostly plateau surrounding flat, low lying urban areas along the Kor River (main river), and Mao and Hin rivers (tributary rivers). The urban area comprises both residential and agricultural areas, while the Kor River comprises many canals and streams flowing down to the district center, creating the risk of flash flooding in urban areas (Source: Report of district Xay's revolutionary party meeting, 2014). After 2017, one meteorological and hydrology station was established in Xay district for monitoring of weather conditions. However, reporting with this equipment is limited. Usually, any announcements are made from the central meteorological station in the country's capital of Vientiane (Source: DPWT in Oudomxay, 2014).

5.4.4 Risks of floods on Xay district

Xay District still faces many risks and is impacted by several floods each year, with the intensity of each flood depending on various factors. Flood impacts to Xay district are shown in Table 5.1:

Table 5.1: Summary of the flood impacts to Xay district from 2014-2017.

No	Year	Disaster Type	Village	Household	Population		Dead	Houses damage	Proportise damage	Areas of damage (Hectare)	Amount of damage (Lao Kip)
					Total	Female					
1	2014	Floods	2	4	16	7		13		1,8	55,580,000
2	2015		1	2	6	3		3	4	0,6	32,060,000
3	2016		2	100	589	297	2	17	12	16,1	112,136,000
4	2017		23	206	1,151	560	1	36	20	157	2,871,800,000

(Source: Department of Labor and Social Welfare in Oudomxay Province, 2019).

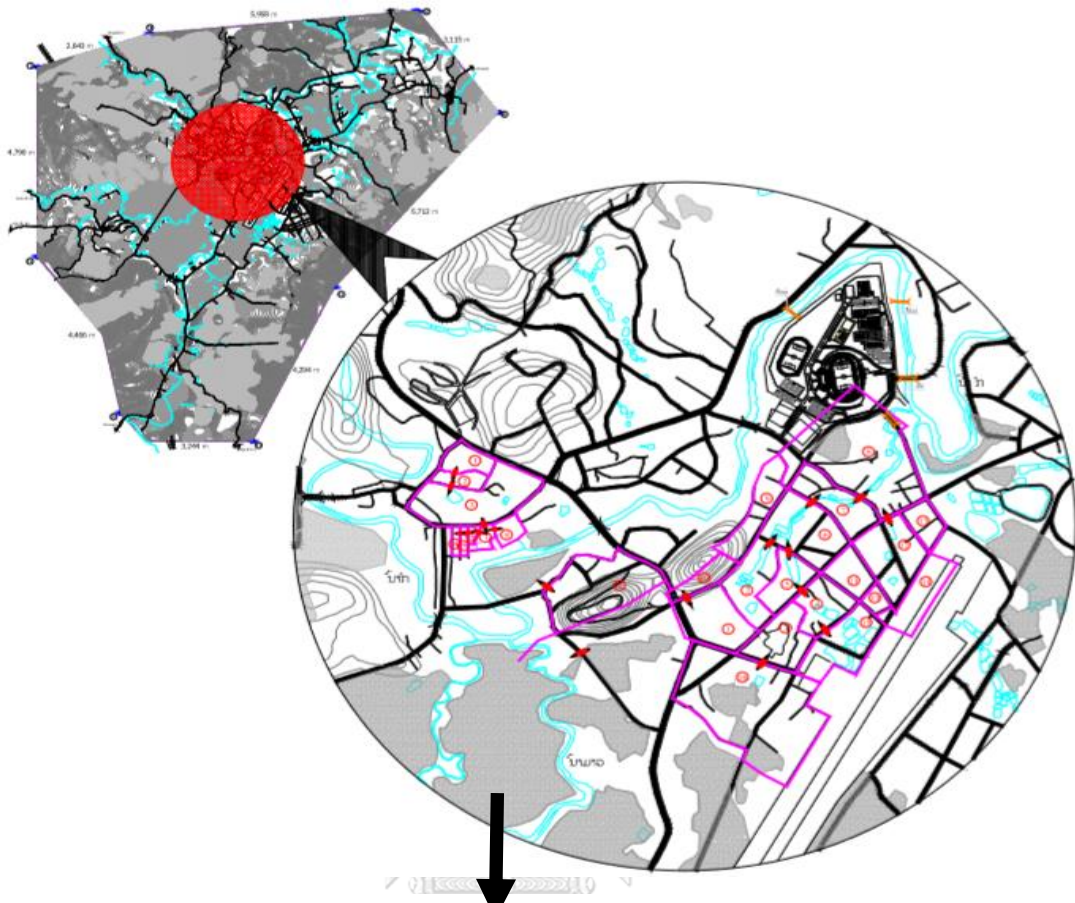
- Flood risk from changes in climate-rainfall patterns

The natural rainfall drainage management system of areas comprised the highest mountain in a North Slope, with water running down tricky terrain to the Kor River and tributaries. However, this also means that rainfall drainage systems are inadequate in urban areas for naturally receiving rainwater. As a result, some urban areas regularly face floods; places such as near the riverbank, core residential areas, and the Oudomxay Airport are subject to flooding partly as a result of fill from illegal housing that blocks the natural drainage.

Respondent II_09 said

“Furthermore, the Xay district-small town urban development’s ADB project was completed in 2009. Many natural canals and drainage paths were not cleaned and cleared of bushes regularly. This was one cause of floods when it rained heavily in this district.”

However, the district is still in need of construction of many new drainage design points, and these are shown in Figure 5.4 below:



ເຄື່ອງໝາຍ	ອະທິບາຍ	Legend	Meaning
	ອາຄານ		Building
	ເສັ້ນທາງເກົ່າ		Existing Road
	ແມ່ນ້ຳ, ຫ້ວຍ		River, Canal
	ໜອງນ້ຳ		Pool
	ເສັ້ນຂອບເຂດການວາງແຜນ		Alignment of Planning
	ເສັ້ນລະດັບ		Contour
	ເສັ້ນທາງລົດໄຟ ແລະ ສະຖານີລົດໄຟ		Railway track and stations
	ເສັ້ນປົນເຂດນ້ຳໄຫຼ		Watershed
	ທໍ່ລະບາຍໃໝ່		New drainage system
	ເຂດຕົ້ນໂຮມນ້ຳ		Totally water
	ຂົວທີ່ຈະສ້າງໃໝ່		Plan for new bridge



Figure 5.4: Existing drainage system

- Risk of flood from geography

The geography of Xay district is characterised by high mountains in the north and south, while the urban areas in the central part of the district are flat and low-lying. Most locals settled in high density villages near flash flood-prone areas beside the Kor River (Main River) and Mao and Hin rivers (tributaries).

Respondent II_17 said

“The Flood condition status in the urban area was affected by different terrain such as high mountain areas and the plateau of Donkeo village; flat areas for agricultural areas were (Nalao, Nalea) villages and rivers flowed pass to the urban center. Some years had heavy rain for many days, causing the Kor and Mao Rivers to rise with floods and flash flooding in low flood-prone areas along rivers, such as the villages (Laksi, Thin, and Longkordeua) located near the Kor riverbank.”

- River erosion

Erosion of the riverbanks was one of the impacts and risks that, after many floods, has led to many complaints from the local people. Many houses in Xay district have been destroyed by river erosion, which is common when the floods and flash flooding occur. Local data on the erosion rate indicate that it is higher in the areas of the Kor and Mao Rivers, and some households have already lost property and cultivation land.



Figure 5.5: River erosion.

- Risk of flood from deforestation

Respondent II_15 said

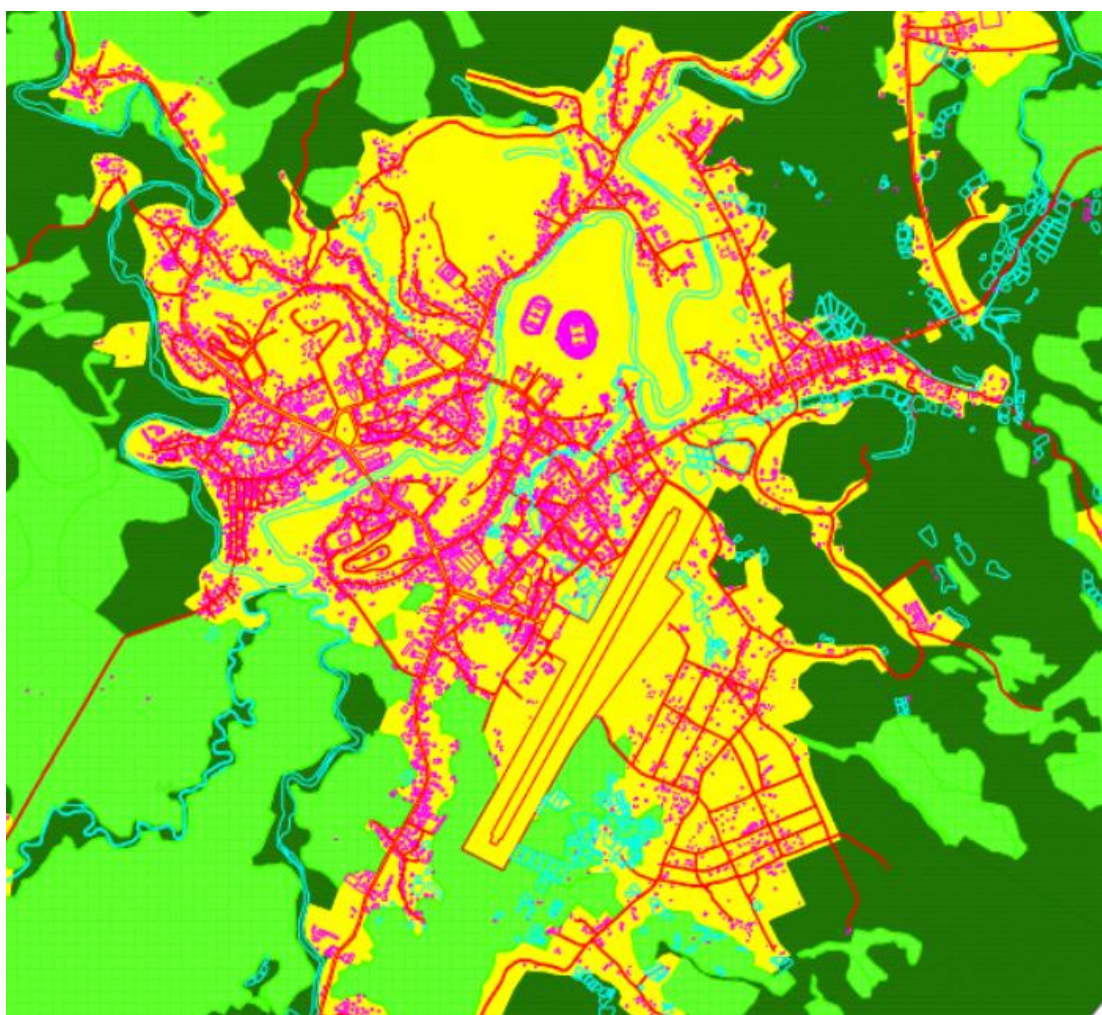
“The areas of deforestation activities were north and south of the district (mountain areas). Kor Noy’s developing village group included the Kor Noy village (Upstream village) and other villages. Most local people, 80% in the upstream villages, were directly or indirectly dependent on agriculture, especially in March-April. Locals liked to cut and burn the forest to prepare the agricultural land.”







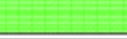

In addition, deforestation due to the expansion of agriculture still continues in this area and has complicated flash flood risk management from the top source of the Kor River when torrential rain has come in past years. Together with shallow-narrow canals, the stream of rainwater rises in the Kor River, which is one of many causes and risks of flash flooding in the upstream village, and adverse effects on midstream and downstream villages.

- Risk of flood from changes in land-use

The local population is greater in the Xay district compared with mountain areas, meaning that urban areas are getting quite dense. This effectively means that poorer residents are forced to live near higher flood risk areas (riverbanks) and low-lying areas prone to floods. Risks of flood from changes in land-use were not systematically and comprehensively taken into account during the urban development plan process. Furthermore, the land-use area in the upstream villages of the Kor River is being lost as forested land is converted into farmland or land for industrial development. The vegetation areas along the banks and inland wetlands have also been converted to other forms of land use. For example, in the midstream and downstream villages, land has been cleared for residential housing and commercial areas in many parts of the Xay district.

There was a far greater understanding of how ineffective land-use planning coupled with booming economic development can adversely affect geography and river systems, increasing vulnerability to extreme weather and several floods. However, there were still many constraints to modifying existing land-use approaches, mountain slope, and riverbank in the Xay district (Source: Provincial disaster prevention and control committee in Oudomxay, 2019).



Legend	Meaning	Area (Hectare)
	Building, housing	1,271
	Roads	2,312
	River, Canal	3,671
	Pool	
	Urban planning line	
	Area of Building	1,271
	Area of farm	2,312
	Area of forest, mountain	3,671
Total Area		7,254

(Source: DPWT in Oudomxay province, 2014)

Figure 5.6: Land-use plan for Xay district, 2014

5.4.5 Flood management practices in Xay district

- District Disaster Prevention and Control Committee office (DDPCC), (local level like Xay district).

Respectively from national (top) to provincial and local level (down) approach to concern about the disasters. The DDPCC was non-residential office of the third level in the national disaster management organization. It is chaired by a district governor,

and the committee members are drawn from the office heads at the district level and other civil society members. The committee members needed to have the two times of monthly meetings in not occur-disaster periods, including floods, and as frequently of meeting as required during emergency events.

The DDPCC was tasked with the essential functions of improving the district disaster management plan and capturing comprehensive exposure information specific areas. The district's flood management plan consisted of overall collaboration with local government agencies, NGOs, the private sector, and the general public for prevention and mitigation of flood events. Additional responsibilities included responding to different flood risks to new areas, supplying emergency resources and shelters as needed, ensuring quick recovery of medical, water, power, gas, roadways, and telecommunications infrastructure, along with development of restoration plans and carrying out destruction assessment in relation to the local victims. They also included recommending the declaration of a district state of emergency and requests for humanitarian assistance, as well as developing a master plan for the response and mobilization of resources for flood risk management with each sector (Source: the district disaster prevention and control committee's report, 2020).

- Flood management (during, after, and before)

The local government's responsibilities do not begin and end with the flood event; flood crisis management extends into the post-flood period as the government works to lead the recovery, which eventually leads to efforts to improve preparations for the next inevitable flood. All stakeholders had responsibilities. Examples of stakeholders include Xay district's DDPCC office and the social welfare-labour office relief section, whose secretary helped coordinate all sectors, the Public Works-Transport office, Natural Resource-Environment office, Information-Culture-Tourism office, Post-Telecommunications office, Mass Organization (youth, women and trade organizations), Health office (health sanitation and promotion), hospitals, the education sector, Agricultural-Forestry office, Public Security Headquarters, military headquarters, Energy-Mining office (especially electricity supply), Water Supply office, Financial office, and the Planning-Investment office, who all worked together, collaborating and coping with flood issues and trying to encourage local people to participate in the effort. These various entities and their responsibilities are summarized in Table 5.2:

Table 5.2: Main sectors of responsibility of flood management.

Sector	Flood crisis management (During)	Flood implementation (After and Before)
District Disaster Prevention and Control Committee (DDPCC) office.	- First action to prepare before floods occur, implements all policies and programs by leading all offices and supporting them to carry out their responsibilities during the flood event.	- Action to prepare and review the resilience concept prior to the occurrence of flood events, and led the development of all policies, plans, and programs post-flood by leading all offices

	- Developed the policies, strategies, plans for coping with flooding issues in every period, and proposed them to governor's decision-makers and reported to the provincial level about protection, management, and solving the flooding issues. Furthermore, wrote a proposal letter for help from national and international donors to the relief, with the aims of quicker recovery and building-back better in as short time as possible.	and supporting them to carry out their responsibilities. - Drafted and sent a proposal letter for help from national and international donors to the relief effort, in hopes of a quicker recovery.
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(Source: The District Disaster Prevention and Control Committee's report, 2020 and the Provincial Disaster Prevention and Control Committee in Oudomxay, 2019).

- Laws, policies, and plans

There were many laws and national policies at the local level (e.g., national disaster risk strategic plan 2003–2020). There was no finalized national disaster response plan or associated standard operating procedures at the time.

- Early warning system and procedures

Lao PDR has a national strategy for its early warning system. When a flood is identified, the Department of Meteorology and Hydrology Department, under MoNRE, issues a written warning to the Prime Minister's office, which is then sent to the NDPCC and DDPCC (local level). The warning is broadcast through media outlets, TV, and radio systems.

- Flood risk management financing.

While disaster preparedness and response activities are supported by five funds to varying degrees, stakeholders lack sufficient contingency funds. For example, in 2008 and 2009, but only 46 percent of the funds requested were received. Thus, there is an acute need for flood risk financing in Lao PDR and at the local level.

Table 5.3: Use of disaster funds in Lao PDR

Name of Fund	Prepared-ness	Relief and response	Rehabilitation and Reconstruction	Available funding (LAK billion)
National Contingency Fund (Budget Dept, MoF)		✓	✓	100
State Reserve Fund (MoF)	✓	✓	✓	300
Disaster Management Fund (DDMCC, MoNRE)	✓	✓		0
Social Welfare Fund (MLSW)		✓		0.5
Road Maintenance Fund (MPWT)			✓	400
Provincial Emergency Fund		✓		0.2

Source: (DMRH, 2017)

5.5 The conclusion of Chapter V: Result 2 - the current flood risk management practices of the Xay district

Research question no. 2 (from Chapter 1) leads to an assessment of the current flood risk management practice of the Xay district. The Lao administrative system has been decentralizing from 1990 until the present. Responsibility for system guidance has been intended to devolve to local levels of public administration so that they could be responsible for their own planning and budgeting units. The 8th National Socio-Economic Development Plan of 2016–2020 mentioned avoidance, mitigation, and disaster risk management. As strategies to make society safer and minimize the harmful effects of natural disasters on people's lives. The Xay district's management plan 2015-2019 mentioned that all sectors needed to participate in data collection, analysis of flood impacts, policymaking, planning, and implementing programs for management and quick recovery in every period from flood shocks. In Xay district, 85% of the total land area is covered by mountains, valleys, channels, rivers, and tributaries. Elevation ranges between the lowest of 458 meters and the highest of more than 1,800 meters above mean sea level. The average rainfall is 1,500 mm/year, and is routine during the rainy season. Some years see torrential rain storms that cause flooding in the Xay district, whose terrain is mostly plateau surrounding flat, low lying urban areas along the Kor River (main river), and Mao and Hin rivers (tributary rivers). The urban area comprises both residential and agricultural areas, while the Kor River comprises many canals and streams flowing down to the district center, creating the risk of flooding in urban areas. Flood risks have increased due to changes in climate and rainfall patterns. Before 2017, the meteorological station is the limitation. However, since 2018 a number of flood risk management measures have been put into place. For example, an early warning system with sensor links and available village speakers have been installed at five risk areas throughout the Xay district. Yet river erosion continues to be a significant, as does deforestation, which primarily happens in upstream district areas.

National government decentralization has resulted in planning and implementation at the district level falling under the responsibility of the Xay district authorities. A governor is in total control throughout the district and there are office reporting lines in Xay district. The District Disaster Prevention and Control Committee (DDPCC) office is the main committee concerned with natural disaster tasks, including man made flood risk. The DDPCC is a non-resident office tasked with overall coordination, declaration of a district state of emergency, and requests for humanitarian assistance. However, its primary responsibility is flood risk management for all cycles (Before, during, and after flood events). Preparation before flooding occurs comprises all policies, plans, and programs, and responsibility for leading all organizations and supporting them in their responsibilities. The DDPCC also proposes plans to governor's decision-makers, and reports to stakeholders and authorities at the provincial level. In response to major flooding, the committee will draft a proposal letter asking for help from national and international donors to fund relief efforts during flooding. The DDPCC also has the essential functions of improving and developing the district flood management plan, and capturing comprehensive exposure information from specific areas. The plan is created in collaboration with local governments, NGOs, the private sector, and the general public in an effort to prevent and mitigate flood events. Other

actions taken by the DDPCC include coordinating the supply of emergency resources and shelters, organizing quick recovery for all infrastructure sources, formulating and implementing restoration plans, and undertaking destruction assessment with respect to the local victims.



CHAPTER VI

RESULT 3 - STRENGTHS AND WEAKNESSES OF THE XAY DISTRICT'S LOCAL GOVERNMENT FLOOD RISK MANAGEMENT PRACTICES

6.1 Current flood management of local government practice of Xay district

Research question no. 3 (from Chapter 1) leads to an assessment of the strengths and weaknesses of the current local government's flood management practices in the Xay district. Furthermore, consideration must be given to other factors, such as local community and other stakeholder participation, and how the local government has dealt with past flood risk management (before, during, and after flood events). The results are discussed below.

6.1.1. Flood risk management factors in the Xay district

Before using the 26 factors for the Xay district. The researcher reviewed this table and reference. After that, Draft the questions to interview tested with Xay district's General people, return, and revise and improve before starting in the real interview.

- Step 1: the researcher reviewed the many works of literature by incorporating and adapting Table 2.1: Flood risk requirements checklist which is a reference by (Cambridgeshire Council, 2017) from Chapter 2 of Literature Review.

- Step 2: the researcher went to visit the direct observation in the field of Xay district. The first draft was only 18 factors. To investigate the why not 20 factors or 23 factors. After investigating the Flood risk requirements checklist by comparing the real situation with the checklist. Furthermore, it can conclude to 26 factors are suitable or not for Local Resilience and Flood Risk Management (LRFRM) for the Second draft of the question.

- Step 3: the researcher goes back to discuss with the Supervision Advisor to the revision of the third draft of the question before using to interview.

- Step 4: the researcher uses the third draft of the question to discuss with the general local people in the Xay district around 10 respondents get the opinion to improve by how to revise, reduce and add more for 26 factors of LRFRM. Are the 26 factors enough or not in the Xay district?

A general local respondent comment.

“Actually, in my opinion, the 26 factors of LRFRM cover all aspects in the Xay district. If the Local government can improve all 26 factors because nowadays the local government still misses many factors. So, If the Local government can improve, I believed in the future that local government implementation can manage the flood risks in the Xay district to minimize impacts when compared with the past time”

- Step 5: The research was revised by following all comments from step 1 to step 4.

- Step 6: Afterwards, the research started to use the questions of 26 factors of LRFRM (sub-research questions) and other questions to the real interview with 25 individual respondents in the Xay district between the year 2019-2020. When the real interview, all 25 individual respondents agreed (the respondents of local government and local leaders of three villages) with 26 factors of LRFRM in the Xay district and did not add more when the real interview.

In response to the individual interview question no. 2.1.7 (question detail in appendix A, which asked about the current local government practice with strength factors, weak factors, and others on flood risk management, the comments from all 25 individual respondents comprised flood story analysis of comparison differences, phenomena, similarities, and description results, all of which were input into Excel. The results of the comments were then calculated from individual interviewees. For example, twenty-one individual respondents equalled (84%) (from the total of twenty-five) agreed with the strong factor, which means that a high percentage of these respondents use the qualitative approach to reach a conclusion. In addition, the Local Resilience and Flood Risk Management (LRFRM) factor has 26 items. The conclusion provides a narrative interpretation of the data, which was categorized in terms of comparison differences, the phenomena of existing physical problems, human activities for preparation, response, recovery practice, future prevention, and similarities of reasons manifested through informants.

Thus, the results of this study assessed the 26 total factors for LRFRM. Of the 26 factors, 18 factors (69.23%) were found to be present in the current local government practices, while the remaining 8 factors (30.77%) were found to be absent. Ideally, all 26 factors would be present if the local government had completely sustainable management in place, so the absence of 8 factors indicates that there is more work to be done. The details of the responses from the 25 individual interviewees are given in Table 6.1.

Table 6.1: Responses to questions about factor availability of Local Resilience and Flood Risk Management (LRFRM)

No	Items	Response for "Yes"	Response for "None"	Output	Result of Availability	
1	Law, legislation, policy, and regulation	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
2	Human resources development	(23 respondents/ 25 respondents) = 92%	(2 respondents/ 25 respondents) =8%	92%=Yes> 8%=None	yes	
3	Budget allocation	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
4	Equipment and technology	(5 respondents/ 25 respondents) = 20%	(20 respondents/ 25 respondents) =80%	20%=Yes < 80%=None		None

	preparedness (such as rescue resources)					
5	Rescue vehicles (such as boats, helicopters or trucks)	(4 respondents/ 25 respondents) = 16%	(21 respondents/ 25 respondents) =84%	16%=Yes < 84%=None		None
6	Meteorological and rainfall assessment	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) 0 = 0%	100%=Yes > 0%=None	yes	
7	Geographical characteristics assessment	(22 respondents/ 25 respondents) = 88%	(3 respondents/ 25 respondents) =12%	88%=Yes> 12%=None	yes	
8	Deforestation assessment	(22 respondents/ 25 respondents) 22 = 88%	(3 respondents/ 25 respondents) =12%	88%=Yes> 12%=None	yes	
9	Urban planning assessment	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
10	Local population control	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) 0 = 0%	100%=Yes > 0%=None	yes	
11	Land-use change assessment	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
12	Experience and previous risk assessment	(23 respondents/ 25 respondents) = 92%	(2 respondents/ 25 respondents) =8%	92%=Yes> 8%=None	yes	
13	Time assessment (before, during and after) and immediate flood prevention, rescue and recovery	(3 respondents/ 25 respondents) =12%	(22 respondents/ 25 respondents) = 88%	12%=Yes < 88%=None		None
14	Early warning systems and prediction equipment (such as signs, signals and networks)	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) 0 = 0%	100%=Yes > 0%=None	yes	
15	Flood awareness, education and dissemination (using television, radio, newspapers and social media)	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
16	Flood data collection and analysis	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
17	Flood map documents and map analysis	(6 respondents/ 25 respondents) = 24%	(19 respondents/ 25 respondents) =76%	24%=Yes < 76%=None		None

18	Infrastructure monitoring and maintenance (dike and bank erosion protection, and road safety)	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) = 0%	100%=Yes > 0%=None	yes	
19	Cleaning programmes for canals and drainage systems	(2 respondents/ 25 respondents) = 8%	(23 respondents/ 25 respondents) =92%	8%=Yes < 92%=None		None
20	Pumping stations and mobile pumping	(1 respondents/ 25 respondents) = 4%	(24 respondents/ 25 respondents) =96%	4%=Yes < 96%=None		None
21	Flood zones, plains and flood bypass	(1 respondents/ 25 respondents) = 4%	(24 respondents/ 25 respondents) =96%	4%=Yes < 96%=None		None
22	Evacuation procedures and surveying evacuation routes	(7 respondents/ 25 respondents) = 28%	(18 respondents/ 25 respondents) =72%	28%=Yes < 72%=None		None
23	Food and drinking water storage	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) =4%	96%=Yes> 4%=None	yes	
24	Flood shelter	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) = 0%	100%=Yes > 0%=None	yes	
25	Establishment of various teams and rescue teams	(25 respondents/ 25 respondents) = 100%	(0 respondents/ 25 respondents) = 0%	100%=Yes > 0%=None	yes	
26	Regular inspection and measurement of overall risk	(23 respondents/ 25 respondents) = 92%	(2 respondents/ 25 respondents) =8%	92%=Yes> 8%=None	yes	
			Total		18	8

Note: Total individual interview was 25 respondents.

From the finding in Table 6.1 above. Furthermore, more explanation from the first factor to twenty-sixth factor show in narrative texts below:



Figure 6.1: Results of Factor availability analysis for Local Resilience and Flood Risk Management (LRFRM) in the Xay district

The simple presence or absence of LRFRM factors isn't sufficient, however. This binary choice leaves out the qualitative issues of whether each factor is sufficiently developed or utilized. Therefore, the respondents were asked to rate each factor as a "strength" or a "weakness" in order to understand the adequacy of the LRFRM in Xay

district. The results identified 4 strength factors (15.39%) and 22 weak factors (84.61%), indicating strongly that there is much room for improvement going forward. Details of these responses are shown in Table 6.2.

Table 6.2: Result of Factors' Strength or weakness of the LRFRM

No	Items	Response for "S"	Response for "W"	Output	Factors' Strength or Weak	
1	Law, legislation, policy and regulation	(5 respondents/ 25 respondents) = 20%	(20 respondents/ 25 respondents) =80%	20%=S < 80%=W		W
2	Human resources development	(1 respondents/ 25 respondents) = 4%	(24 respondents/ 25 respondents) =96%	4%=S < 96%=W		W
3	Budget allocation	(1 respondents/ 25 respondents) = 4%	(24 respondents/ 25 respondents) =96%	4%=S < 96%=W		W
4	Equipment and technology preparedness (such as rescue resources)	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
5	Rescue vehicles (such as boats, helicopters or trucks)	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
6	Meteorological and rainfall assessment	(21 respondents/ 25 respondents) = 84%	(4 respondents/ 25 respondents) =16%	84%=S > 16%=W	S	
7	Geographical characteristics assessment	(2 respondents/ 25 respondents) = 8%	(23 respondents/ 25 respondents) =92%	8%=S < 92%=W		W
8	Deforestation assessment	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
9	Urban planning assessment	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
10	Local population control	(2 respondents/ 25 respondents) = 8%	(23 respondents/ 25 respondents) =92%	8%=S < 92%=W		W
11	Land-use change assessment	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
12	Experience and previous risk assessment	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
13	Time assessment (before, during and after) and immediate flood prevention, rescue and recovery	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
14	Early warning systems and prediction equipment	(20 respondents/ 25 respondents) = 80%	(5 respondents/ 25 respondents) =20%	80%=S > 20%=W	S	

	(such as signs, signals and networks)					
15	Flood awareness, education and dissemination (using television, radio, newspapers and social media)	(6 respondents/ 25 respondents) = 24%	(19 respondents/ 25 respondents) =76%	24%=S < 76%=W		W
16	Flood data collection and analysis	(2 respondents/ 25 respondents) = 8%	(23 respondents/ 25 respondents) =92%	8%=S < 92%=W		W
17	Flood map documents and map analysis	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
18	Infrastructure monitoring and maintenance (dike and bank erosion protection and road safety)	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
19	Cleaning programmes for canals and drainage systems	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
20	Pumping stations and mobile pumping	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
21	Flood zones, plains and flood bypass	(0 respondents/ 25 respondents) = 0%	(25 respondents/ 25 respondents) =100%	0%=S < 100%=W		W
22	Evacuation procedures and surveying evacuation routes	(1 respondents/ 25 respondents) = 4%	(24 respondents/ 25 respondents) =96%	4%=S < 96%=W		W
23	Food and drinking water storage	(3 respondents/ 25 respondents) = 12%	(22 respondents/ 25 respondents) =88%	12%=S < 88%=W		W
24	Flood shelter	(24 respondents/ 25 respondents) = 96%	(1 respondents/ 25 respondents) = 4%	96%=S > 16%=W	S	
25	Establishment of various teams and rescue teams	(21 respondents/ 25 respondents) = 84%	(4 respondents/ 25 respondents) =16%	84%=S > 16%=W	S	
26	Regular inspection and measurement of overall risk	(4 respondents/ 25 respondents) = 16%	(21 respondents/ 25 respondents) =84%	16%=S < 84%=W		W
Total					4	22

Note: S = strong, and W = weak

Total individual interview was 25 respondents.

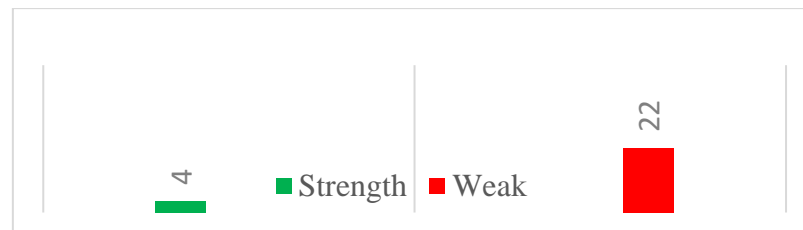


Figure 6.2: Result of Factors' level for LRFRM in the Xay district.

From the finding in Table 6.1 above. Furthermore, more explanation from the first factor to twenty-sixth factor show in narrative texts below:

1) Legislation, Law, and Policy

Currently at the national level, there are new laws related to disaster management, with a number of laws relevant to flood risks. However, a number of these laws, such as the urban planning law, national road law, land law, water resources law, etc do not specifically focus on flood risk management because the regulations emphasize strategy, vision, and overview planning, and not to specific local action.

Respondent II_01 said:

"The local government in Xay district required elaborate research and tried to promote local community participation and offered many choices for them. The Xay district had the water usage management regulation in the irrigation sector, but needed to develop the flood risk prevention in detail."

2) Human resources development

The local government in Xay district has human resource development plans and continues to work towards the improvement of its flood risk management through improved knowledge and technology.

Respondent II_04 said

"The Local governmental staff may be concerned about how to use modern technologies. For all that, they surveyed for field data collection before the rainy season to support flood risk indicators. That is a reason for hard preparedness for making response plans"

Respondent EI_14 said

"In the past, Japan and other countries' modern equipment were given to Xay district in order to help. Nevertheless, there were not enough local staff in the Xay district with degrees in meteorology and hydrology to use those types of equipment."

3) Budget allocation.

Essential factors such as the local government's attempt to allocate funds and persuade all stakeholders in the society to participate have been subject to ongoing

efforts. Since 2019, the local government has established a disaster prevention and control committee to try to gather funds and consumable and non-consumable products for flood relief. Also, they have tried to gather funds from public authorities, private companies and locals, as ordered by the Xay District Governor.

Respondent II_12 said

"The local government staff needed to give [40,000 kip/a staff/a year] for the flood fund collection and use in the next flood emergency. This fund was the responsibility of Xay district's administrative authority and the Xay district disaster prevention and control committee for expenditure and income. However, the district's inspection office was responsible for monitoring and auditing this flood fund, and reporting to the Xay district governor."

4) Equipment and technology

The local government had only the relief equipment for preparing rescue resources, resuscitation devices, first aid kits, and emergency communication devices belonging to the district's specific units. It was observed in the Xay district that the disaster rescue tools used in emergencies tended to be found with those who would use them. For example, the first aid tools and ambulance vehicles belonged to the hospital, while the fire truck belongs to the police headquarters, and so on. The district disaster prevention and control committee prepared just enough urgent tools, trucks, boats, equipment, etc., and tried to determine the best areas for them to be stored, maintained, and used.

Respondent II_09 said

"The resuscitation devices did not have a specific use during the flood situation in the Xay district, but they were available in Oudomxay's provincial hospital and did not move from the hospital to the flooded field, which meant the flood victims could be sent to the hospital if they had need of the equipment."

(A detailed list of tools can be found in Appendix F)

5) Rescue Vehicles

The local government in Xay district had use of the rescue vehicles belonging to various offices for specific use during the floods.

Respondent II_05 said

"They had only a few boats for emergency use. There was no operational rescue helicopter at the Xay district level. The local government had two types of rescue trucks: a truck for transporting flash flood victims, and a truck for transporting items to help, depending on the flash flood levels in specific areas."

(A detailed list of tools can be found in Appendix F)

6) Rainfall and meteorological pattern assessment

Assessment and calculation of rainfall data and meteorological patterns are necessary elements of flash flood prediction.

Respondent II_11 said

"In 2018, the local government set up Xay's hydrological and meteorological station located at the Donkeo village. It located in the Xay district to receive signals as part of the early warning system and broadcast alert information. Before every wet season, letters were sent to village committees about the need to prepare for flash flooding. The Office of Natural Resources and Environment (OoNRE) was responsible for early warning information at the district level; thus, they broadcast the weather situation through district radio every day. Information on upcoming storms that brought heavy rain and flash flooding was sent from the Department of Meteorology and Hydrology in the capital of Vientiane under the Ministry of Natural Resources and Environment (from the central government) to both the Department of Natural Resources and Environment in the province and OoNRE in the Xay district (to the local government). Four river water level measuring devices, and rainfall measuring equipment are located at four points on the local river system. The 1st point is at Namon village on the Mao River; the 2nd point is near the Kor River bridge upstream of Kor Noy village on the Kor River; the 3rd point is at Thin village (the mid-stream village) on the Kor river, and the 4th is at LongKorDeua village (the down-stream village) on the Kor river. Also, four sets of early warning system equipment and speakers were set at four points. The 1st speaker was set up at the Nasao village on the Mao River; the 2nd was installed at the PhouThad mountain temple at the three rivers site, with high elevation to facilitate the dissemination of information; the 3rd was located at the Thin village (the mid-stream village of study area), and the 4th point was the Provincial Health College. OoNRE sent notifications to the district, and the district sent them to the villages by fax, phone, and official letters. The village committees and schools set up information meetings when river levels rose to initiate flash flood readiness by safeguarding assets and preparing for evacuation if required. At the beginning of a flash flood event, the District Disaster Prevention and Control Committee (DDPCC) contacted villages and all the relevant agencies. Village committees then informed the Local villagers by loudspeaker systems. Often, a volunteer walked around to inform households in areas of the village too far away from the loudspeakers. Consequently, this made communication and preparation better than it had been in the past."

Some components of the early warning system are shown in Figure 6.3.

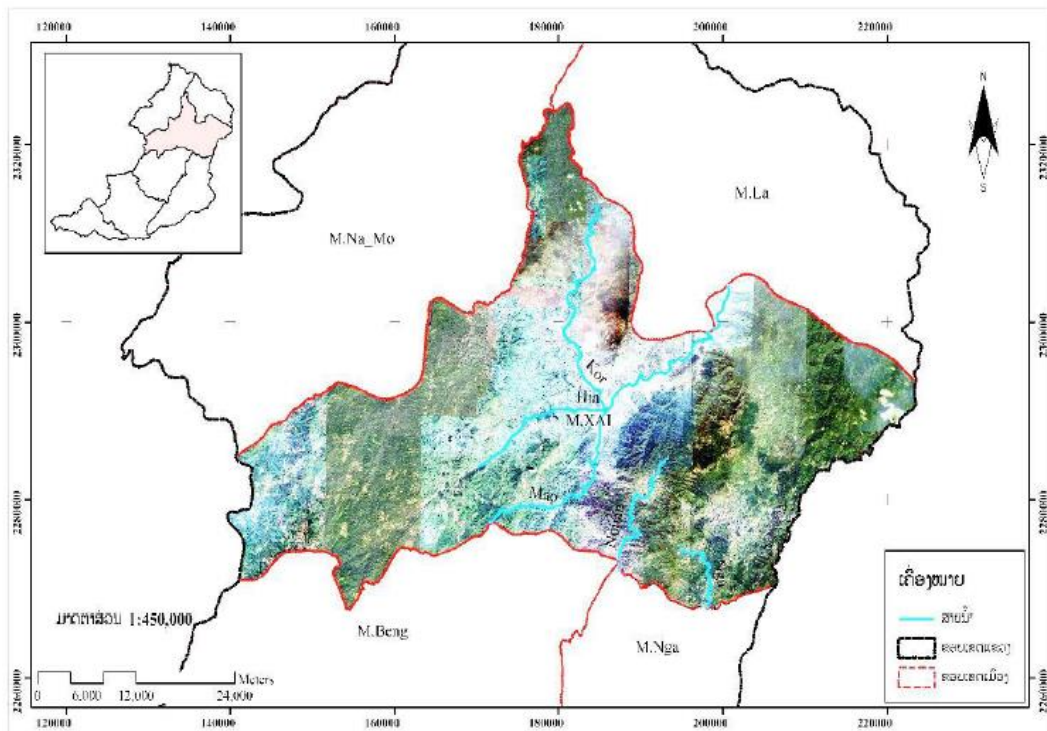


Figure 6.3: River water level measure, rainfall receive equipment, early warning system equipment and speakers in the Xay district

The meteorological and hydrological station under the Office of Natural Resources and Environment (OoNRE) in Xay regularly monitored the water level of rivers, and measured rainfall. These data were sent to computer and server equipment in the OoNRE, which can be seen in Figure 6.4.



Figure 6.4: Computer and Server at the OoNRE in the Xay district



Legend

- River
- Provincial line
- District line

Figure 6.5: Main Rivers to data monitor in the Xay district

Furthermore, the local government had access to useful information to support rainfall-meteorological assessments. Photos of the meteorological and hydrological station and surrounding area are displayed in Figure 6.6.



Figure 6.6: The location of the meteorological and hydrological station

In the Xay district, there were four water levels measuring stations at the Mao River Bridge and Kor River Bridge. Water levels at these locations were visually

measured twice daily, and automatic observation methods using flash flood gauge depth plates were ongoing. These observations provided useful data prior to the coming rainy season each year, with its accompanying need for assessment, and prediction of extreme weather. Data analysis and modeling were used to create projections for precipitation or heavy rain, and any necessary flash flood alert announcements.

However, the yearly, monthly, and daily rainfall data needed to be considered in these data analyses and flood predictions, examples of which are shown in Figures 6.7, 6.8, 6.9, and 6.10.

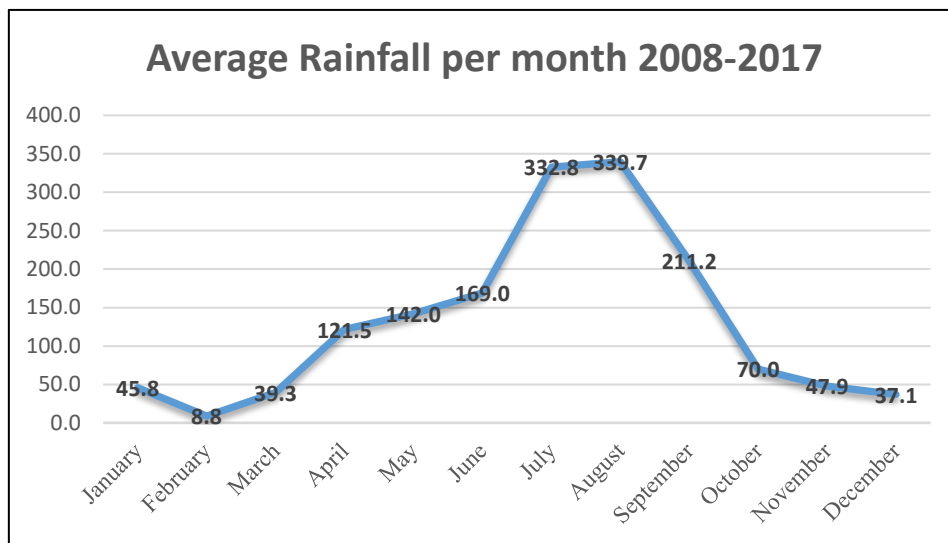


Figure 6.7: Average Rainfall per month in Xay district, 2008-2017.

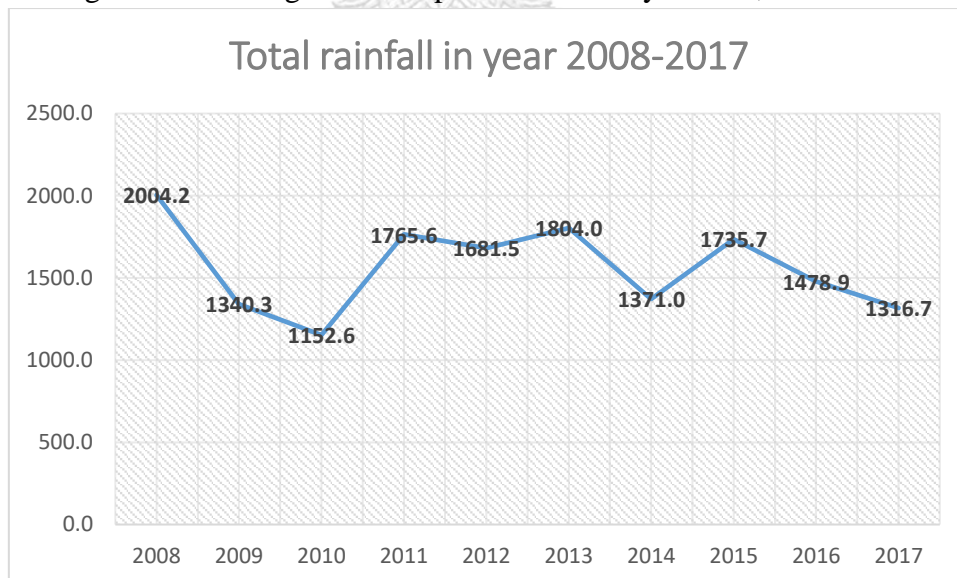


Figure 6.8: Total annual rainfall in Xay district, 2008-2017

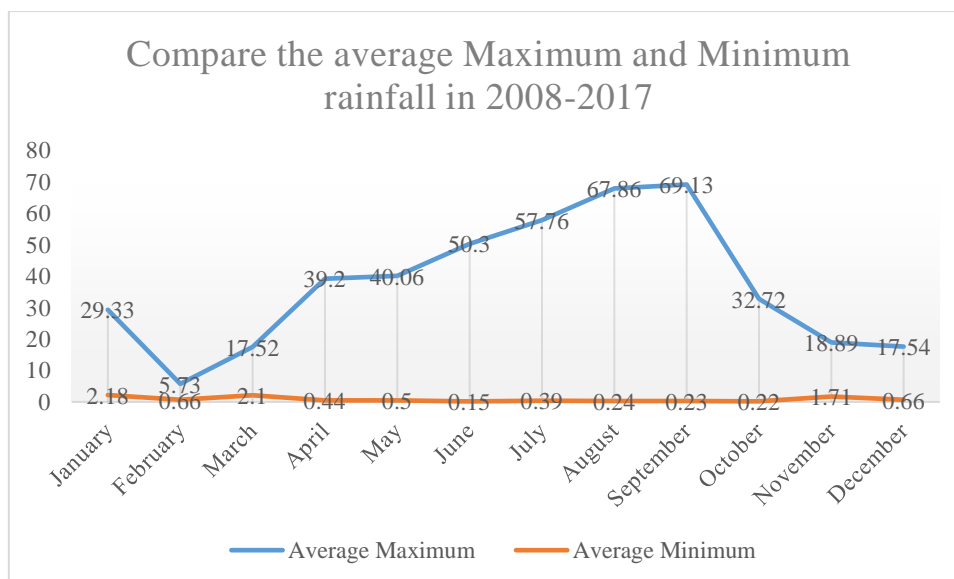
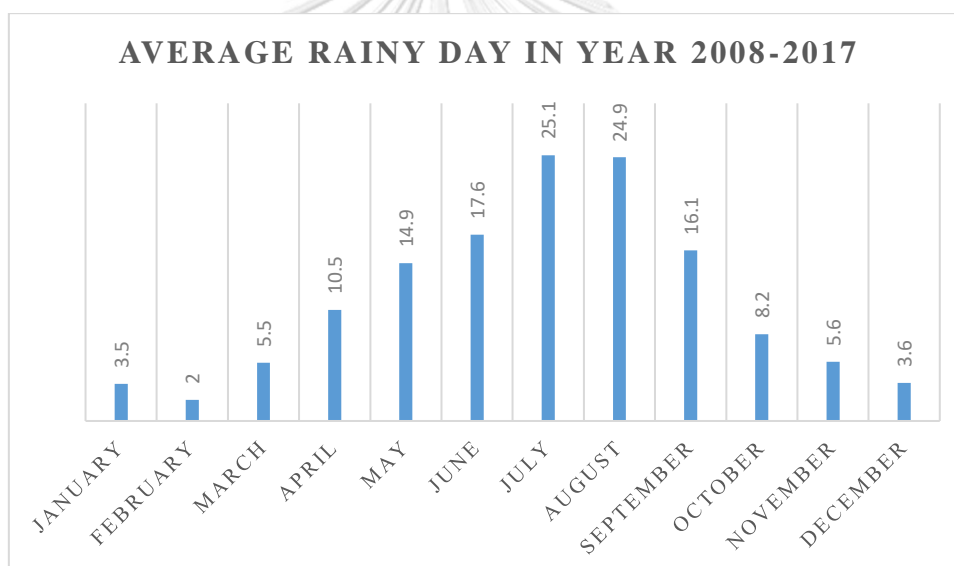


Figure 6.9: Compare the average maximum and minimum rainfall in 2008-2017.



(Source: the meteorological and hydrological station, 2020). The detail in appendix K

Figure 6.10: Average number of rainy days in the year in Xay district, 2008-2017

From the figures above, they can be seen that most rainfall occurred during the wet season months of May to October. The climatic and rainfall conditions of Xay district comprise a moderate monsoon; the rainfall in these 6 months accounts for approximately 90% of annual precipitation. With respect to average rainfall per month between 2008-2017, based on data collection and analysis, starting from June's average of 169 mm, it gradually rose to 332.8 mm in July, with the peak average rainfall at 339.7 mm in August. The average annual precipitation at the Xay station was highest in 2008, with 2,004.2 mm compared to other years, which ranged between 1,152.6 mm and 1,804 mm. Comparing the average maximum and minimum rainfall per month from 2008-2017, September (69.13 mm) was the highest, followed by August, at 67.86 mm. Furthermore, the wettest month as measured by the average number of rainy days

was July, with at least 25 days of rain. Overall, the data analysis shows that local residents and the local government need to be careful, ready, and prepared for heavy rain and a high chance of flooding between July and September, annually.

7) Assessment of geographical characteristics

In Xay district, the geographical characteristics factor was significant in flash flood management, but the details were less important than understanding the largely unchanging effects of the local terrain. The local government knew that the geography, topography, and terrain comprised high mountains surrounding low-lying urban areas at the confluence of three shallow rivers (Kor, Mao, and Hin) from a deep sedimentation valley. This is shown in Figures 6.11, 6.12, and 6.13. Not much action has been undertaken by the local government to enlarge the river's cross-section through digging, or improve the Kor River's discharge capacity. In fact, development has had the effect of blocking the water stream, exacerbating the flood events. This issue needs genuine assessment every period and requires repeated and significant follow-up action.

Respondent II_11 said

"The local government maybe did not recognize the needs as clearly as the local community because they lived there and knew their areas. Sometimes they just observed the natural characteristics, like trees and tree leaves. This point was essential; they needed to be concerned with local community participation and with their wisdom."

This point was an essential factor for local villagers and local community participation.



Figure 6.11: Landscape and terrain of Xay district



Figure 6.12: Geography of Xay district and Main, tributary rivers.

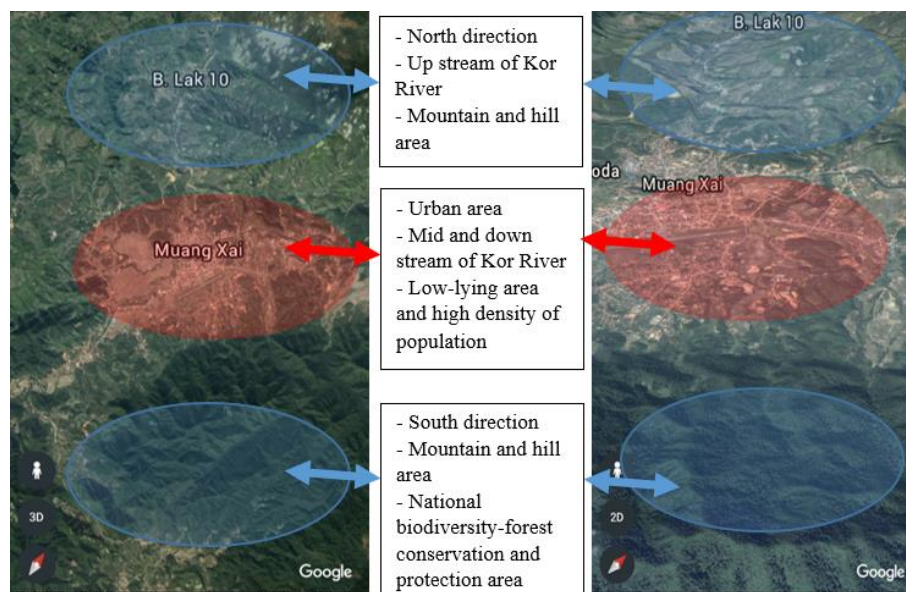


Figure 6.13: Overview of terrain in Xay district

(Source: Google Maps, 2019)

Geographic conditions of the Kor River and tributary basins are shown in the topographical maps, with elevations plotted in Figure 6.14.

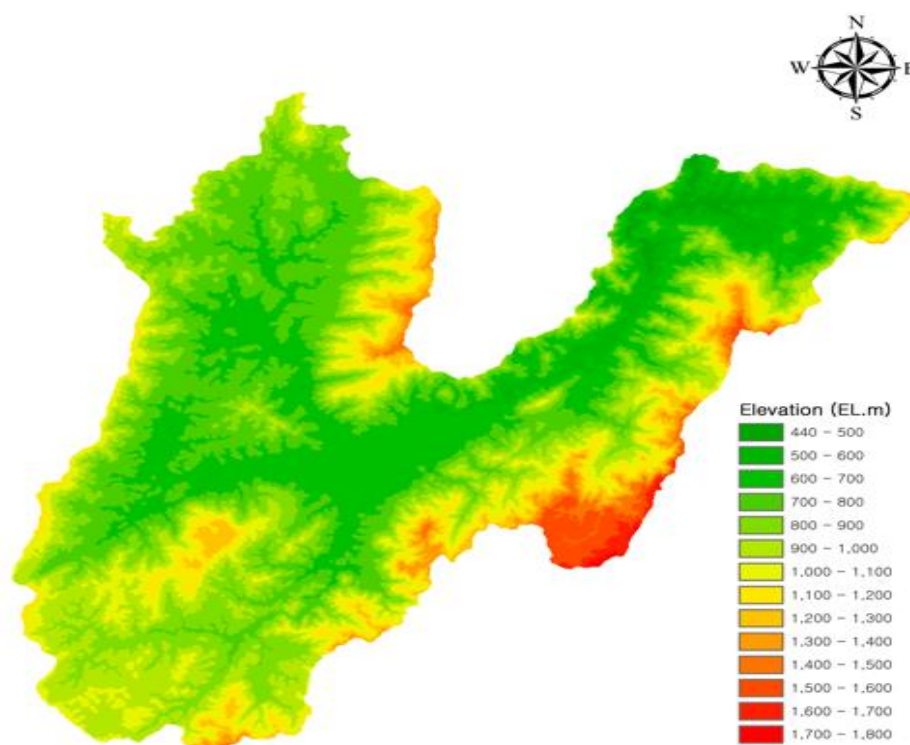


Figure 6.14: Digital elevation model for the Kor River basin
(Source: Department of Public Works and Transport in Oudomxay province, 2020)

8) Deforestation activity assessment

The village leader of the upstream village voiced concerns about deforestation, which was taking place in the north of the district in the area of the Kor Noy developed village group, which includes the Kor Noy (upstream) village and others. 80% of local residents in the upstream villages were directly or indirectly dependent on agriculture, and were typically active in farming activities in March to April of every year. Local people have traditionally cut and burned the forest as a method of clearing and preparation of the agricultural lands. This practice continues in this area and exacerbates flash flooding from the top source of the Kor River. When torrential rain falls and rushing water passes through the narrow canals in this area, the stream of water pouring into the Kor River is one of many causes of the flash flooding in the upstream village that also impacts midstream and downstream villages.

Respondent EI_09 said

“Nowadays, there are not many big trees with long roots capable of absorbing the water before it flows down to low-lying areas. The local government and village leader tried to announce a prohibition against clearing the forest, but with limited area, local farmers continued to cut the trees to facilitate the land-use change.”

Respondent II_08 said

“The local government was required to allocate alternative occupations for locals to help eliminate the practice of burning the forest. The village leader tried to allocate proper areas for each household this year, so next year they can move into the new areas to allow bushes and small trees to grow and mature as part of an ecological cycle.”

Figure 6.15 shows how burning is used to clear land for agricultural purposes in the area.



Figure 6.15: Clearing land for agriculture

9) Assessment of urban planning practices

In 2014, the central government offered help and prepared an urban plan for Xay district. Unfortunately, after that, the urban development did not go as planned.

Spatial development had rapidly taken place over the last ten years across the Xay district, especially along the main roads and rivers (Mao River and Kor River). The construction of new roads, hotels, and other infrastructure for hosting the Lao National Sport Games in 2014 and the upcoming Laos-China railway in the southwestern part of Xay district dramatically influenced its development. However, some developments needed to be improved in line with the Xay district's master plan, which delineated generalized land use for the control of urban development.

Respondent II_09 said

“Nowadays, the Xay district's urban plan practice was 60%/100% when compared with (urban plan version 2014). Moreover, the Xay district's urban plan did not review regularly and did not improve to prepare for future development. Because this work is related to national, provincial, and local governments' policies for urban development, it cannot be done unilaterally or at a local level. It needs to integrate all stakeholders in the process.”

Respondent II_04 said

“The local government did have the clear legislation for strict management, some local people liked to the intrusion of riverbank land complicate to the flood risk.”

In considering of the results of data analysis of the causes of flooding, urban planning and management by local authorities (in the upstream, midstream and downstream villages) seems to have not been very effective. Respondents indicated that the most vulnerable people (who liked to live in flood-prone areas) faced flooding risks due to the urban drainage system, and that a review the urban structure and how to improve water discharge from urban areas was needed. After that, the action plan and real action with local community participation were crucial for the long term.

However, the focus of the Xay district's development plan was to improve the road network and land-use planning. The trend of urban development focused on capital for economic, social, and tourism development, together with disaster safety (included avoiding flood risks). The concept was to achieve economic, natural, and social balance with adequate physical infrastructure. Improved urban drainage systems and implementation of new urban management regulations are needed. Residential area allocation and urban green public parks, especially green areas along the Kor riverbank, can help reduce the flood risks for local people (Source: Xay's revolutionary party meeting report, 2019).



Figure 6.16: Local government technical staff visited the field's urban planning

10) Population control

The local government tried to control the size of the local populations by managing both internal and external factors on population growth. However, with construction of a new Lao-China railway in the Xay district, many ethnic Chinese people moved to the Xay district to work in associated industries and occupations. Furthermore, these new residents attempted to build small houses along the banks of the Kor River and No. 2E national road of the Longkorduea (downstream) Village (see Figure 6.17). Most of them came from the Phongsali Province.



Figure 6.17: Local dense settlement along Kor River in the downstream village

Respondent II_03 said

“The displacement of the external population was under the control and regulation of the local government, but there were some gaps. When the Chinese people came to work and got involved in business or marriage with the Xay district residents, that meant they automatically became part of Xay district's population. Then, Chinese people stayed for a long time.”

Respondent II_10 said

“Construction of the Laos-China high-speed railway project will finish as early as the end of 2021. Because a railway station was located in Xay district, many Chinese people came to live and do business. Much of this commercial activity took place without regard for disaster prevention, especially the effect on the flood management in the Xay district.”

11) Assessment of land-use pattern changes

The urban planning law of Lao PDR needed to review for 5-10 years. Is there a change? How to do the next step, if the urban plan did not regularly assess with land-use change. The consequences of controlling urban land-use by linking with the flood prevention and floodplain zone. So, the local government needed to prepare for them.

Respondent EI_06 said

“The land-use of the population increased in Xay district compared to the mountain areas, which meant that there was not sufficient space for local population density. As a result, locals, particularly vulnerable people, settled in risky areas (riverbank), low-lying areas with flash flooding. Furthermore, forested areas near the upstream village by the Kor River were lost as forests were converted into farmland or land for industrial development. The vegetation areas along the banks and inland wetlands were converted to other forms of land-use. Meanwhile, in the midstream and downstream villages, land was cleared for residential and commercial uses in many parts of the Xay district.”

Existing approaches to land-use change were modified, despite mountain slope, riverbank, and forest protection in the Xay district. There were gaps in the policy

framework (further development of agricultural policies, technical guidelines, and implementation plans) for flood risk management related to land-use change, planning, and management. The land-use map of the Kor River Basin is shown in Figure 6.18.

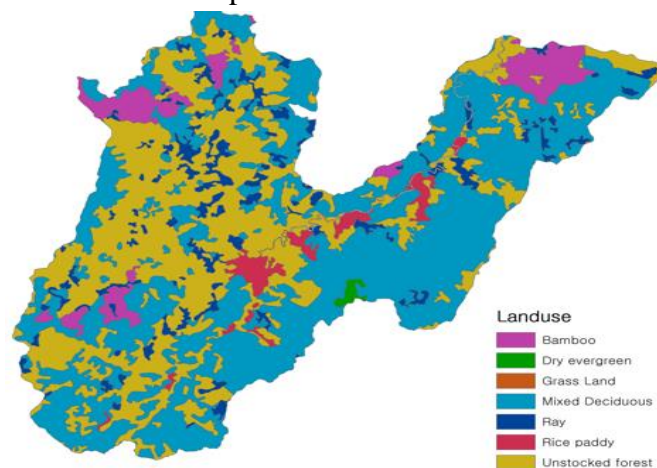


Figure 6.18: Land-use map of the Kor River basin

Table 6.3: Distribution of land-use of the Kor River basin

Land Use	Mixed Deciduous	Unstocked Forest	Ray	Bam-boo	Paddy Rice	Evergreen Dry	Grass Land	Total
Area (km ²)	452.2	331.2	9.3	52.7	22.1	2.7	0.0	920.2
%	49.1	36.0	6.4	5.7	2.4	0.3	0.0	100.0

(Source: Office of natural resources and environment in the Xay district, 2020)

12) Assessment of past experiences and learning from previous mistakes to improve future practice

Respondent II 05 said

“There were lessons learned from studying previous storms (Haima, Ketsana, and Nok ten) in 2013. After that, the authorities prepared to pass the new laws in Lao PDR to support and solve this problem. The laws focused on the overview and development of disaster management policies that included flash flood management.”

The authorities continue to develop the strategy for reducing the flood impacts with specific trends and actions, which include improving the database system and the physical infrastructure related to flood risk management.

13) Assessment (during) the flood of timely prevention, rescue, and recovery

Previous experience with flooding indicated the help for local flood victims from the local government in Xay district was often late in arriving. The DDPCC tried to learn from these past experiences, yet the budget allocations to deal with the issue were limited.

Respondent II 05 said

“During flash flooding events, the Xay district's administrative authority called for an urgent meeting to discuss the local government's response to flash flooding issues. However, before going into the flooded areas, the authorities needed to make plans and set agendas. The result was that it took a few days before they reached the flood victims. Also, they had less staff than other line offices in the Xay district, which meant that the local government needed to improve its readiness to take action in a timely fashion during emergencies.”

Respondent II 03 said

“The first responders were deployed soldiers and police officers who arrived at the flooded areas for the relief action. After that, other stakeholders visited the affected areas and made plans to assess and deploy to help in recovery and reconstruction of the damaged property using the build back better concept. Advice from the engineers and technicians were integrated into preparedness for the future.”

14) Early warning systems and prediction tools (signs, signals, and networks)

An early warning system was an essential part of the flood risk management (FRM) in Xay, and the system relied on a fairly simple system of connected sensors and speakers. When the water level rose, it triggered a sensor and a warning alert was sounded throughout Xay district via the many speakers. Then, it was reported to the district's hydrological and meteorological station (control office).

Respondent EI_03 said

“Since 2018, some research had been carried out, and the national government implemented an early warning project that developed a system and provided the equipment needed to help with the flash flood risk management in Xay district. Rainfall data was collected at the district station, and then sent to the Xay district's administrative authority, who were able to alert the village leaders and local residents of flash flood risk areas along the rivers. Moreover, other media such as TV, radio, newspaper, village speakers, Facebook programs, and etc. They were used to spread the message. Also, most locals were able to access this information on the early warning system because they were regularly checking the water levels of the main rivers (Kor, Mao, and Hin rivers).”

Local residents can easily access this early warning information, strengthening the FRM system of the local government and enhanced by the local community's involvement in its implementation. This system can reduce the flood risk to locals, and

residents can move themselves and their portable property to high safety areas prior to flooding, thanks to the advance notice provided by this system.

15) Flood awareness, education, training, information sharing, dissemination (TV, Radio, newspaper, social media, etc.)

Flood awareness was a significant factor in FRM. The local government carried out education and training on flood risk management, especially among the local households located in flood risk areas along rivers. The local government had determined the agricultural area along the riverbank and downstream of rivers to the canal scope were risk areas, and advised residents not to remove shrubs, bushes, or trees since their roots provide the erosion protection. Despite this announcement from the local authorities, some areas were still cleared because the awareness of its importance among locals was not sufficient to motivate them to comply. However, when the local government repeated the message to locals, they complied, as illustrated in Figure 6.19.



Figure 6.19: Activities on the banks of the Kor River

Respondent II 01 said

“Until now, they have not integrated official programs for flood awareness and education in the activities of all levels of school. However, the village speaker is very useful compared with other devices and suitable for local people's living style. Initially, the local government discussed with the local community what their problems were and what concerned them with respect to flood risk prevention. The authorities wanted to know how the local government could help locals. The routine dissemination of information to local villagers via the village's speaker, such as explaining the flood risks before the arrival of rainy season, was a popular idea (it was important that the voice recording of the village leader be played every day at the right time so that many people could listen to it).”

During flood events in the Xay district, communication channels included television, radio, telephone, village meetings, and village loudspeakers. For example, The Unitel Telecommunications Company had an emergency hotline that could be used in a flood event, and it worked independently from the government sector.

16) Flood data collection and data analysis

As mentioned above, the Xay district had less data about the lack of discharge capacity in Kor River, the urban drainage systems, and such things as increased rainfall due to climate change. To improve this problem, the local government tried to collaborate with all stakeholders to prepare for flood management in Xay district. Therefore, the flood's previous data analysis was reviewed and supplemental with new data for continuous improvement.

Respondent II_04 said

“The local government had undertaken some previous flash flood data analysis. They had less than perfect use the flash flood data for a future preparedness plan because the flood statistical data proposed to get the required budget and equipment for future flash flood risk management from the central government and international donation organizations for relief action.”

17) Flood map documents or flood maps for analysis

Correspondingly, the local government agencies in the Xay district did not have specific flood maps yet.

Respondent II_05 said

“For all that, the flood map-making had only general flood maps used for supporting and solving these issues. The local government also proposed to many central government offices to build capacity and technical support for this point, especially flood risk mapping to promote accurate flood data analysis and prediction of the sensitive risk areas.”

18) Infrastructure monitoring and maintenance (dikes, erosion protection, roads, bridges, electricity, water supply, hospitals, and others)

The causes of flooding and policy plans for structural methods of FRM in the Xay district were frequently considered during the study.

Respondent II_02 said

“At this time, the local government understood that there was a lack of infrastructure such as dikes, reinforced embankments, erosion protection measures, dams, reservoirs, good urban drainage systems, and others. Nevertheless, the local government always had to monitor the existing infrastructure and manage flood risks as well as possible, depending on existing conditions. Eventually, the local government proposed many plans for preparedness and construction in the future.”



Figure 6.20: Lack of infrastructure in the Xay district.

19) Routinely cleaning the canals, watercourses, and drainage systems

Due to low staffing, and lack of equipment and budget allocations from Xay district's development and administration authority, cleaning of canals was not regularly carried out.

Respondent II_09 said

"Since completion of the Asian Development Bank's 2009 project of urban development, canal cleaning and drainage system activities have not been carried out. Consequently, the canals are filled with urban waste and sedimentation; the shrubs have grown up naturally and clogged the waterways."

Measures to deal with rubbish in urban waste management and sedimentation flows down to the riverbed in the rainy season are still needed.



Figure 6.21: waste in the drainage system of the Xay district

20) Pumping stations or mobile pumps

Information about pumping stations and mobile pumps was the result of data analysis and interviews with residents living in the Xay district who had experience in this area.

Respondent EI_06 said

“The local government in the Xay district did not have a pump station or mobile pump for emergency flood situations. Nevertheless, the local government planned to set some up in the future to control the water outlet and inlet in the main rivers of the natural retention pond areas, with plans for pump stations at suitable points. Such a system required the use of the automated system; when the river water reached the danger mark”

21) Flood zones or flood plains

The local government had not allocated specific flood zones or natural retention ponds. However, they may have some planned for the future.

Respondent EI_05 said

“The district lacks flood allocation zones in suitable areas with consideration of reducing the impact on the economy, environment, and society of local people who are living there. However, maybe in the future the local government will plan to create appropriate zones.”

22) Evacuation procedures, and surveying evacuation routes

In the Xay district, there was not a specific surveyed evacuation road or procedure for emergency evacuation of flood-affected people. However, the local government and local villagers used the existing road for the primary evacuation, or used whichever roads had not been impacted by the flood. Of course, not all flood events can be predicted with accuracy.

Also, Respondent II_04 said

“The evacuation road had not been accurately prepared or surveyed before. In effect, the local government practice depended on the actual situation. Advance preparation was not the focus of the district's authorities because the local government did not know where the flood would occur. For example, Hi Phi Mountain is a high area of the Xay district (south-southeastly direction) towards which people could move away from flooding. Now, the local government has prepared a road to this point that can be used in an emergency.”

23) Food and drinking water storage

With respect to food and drinking water for flood emergencies, the local government did not have any stockpiles. When a flood emergency occurred, the local government would call upon the general public and private organisations to help.

Respondent II_25 said

“If it was a small flood impact on less than 500 households, then the local government could manage their responsibility. In the case of a great flood affecting more than 501 households, then the local government needed humanitarian aid and relief action from the general public, NGOs, the domestic central government, and from abroad.”

Supplies such as food, rice, drinking water, and dried food can be stored long-term. Furthermore, sanitation management for emergency situations needs to be prioritized by the local authorities.

24) Shelter and victim center

Respondent II_06 said

“The local government took responsibility for the flood shelters and victim centers by preparing all the public buildings available for flood victims, and taking them temporarily to higher-elevation areas and safety zones like public schools, local governmental buildings, and hospitals.”

Thus, all stakeholders collaborated in preparing the shelter point, surveying evacuation roads, stocking first aid supplies, and determining evacuation points for every zone. The shelter center needed to have toilets for the sanitation system and clean drinking water for the flood victims.



Figure 6.22: Policymakers visited the flood victim at the shelter center

25) Establishing the various teams (medical, relief, security, transport, and recovery)

Information about the use of teams and their effectiveness was developed as a result of data analysis and interviews.

Respondent II_01 said

“The local government set up many rescue teams during flooding to help the flood victims; these included health teams, transport teams, relief teams,

security teams, police teams, military teams, volunteers, and others. Each team had to follow the specific DDPCC plans and orders from the Xay district governor."

Therefore, the Xay district had many teams, such as team A (belong with health, relief, police, volunteer, and others). Team B (belong with public works, transport, planning, finance and others). The local government sent throughout the flood impact areas by going to help, monitor, and support the local government's sources with relief, response, mitigation, recovery, and reconstruction periods to a build back better concept for local flood victims. However, still encourage the local villager who had not affected participation.



Figure 6.23: Soldiers and volunteers helped to rebuild houses for flood victims

26) Regular inspection, measurement, and monitoring of overall risks

Respondent II_23 said

"The local government practice before, during, and after each year from the past until present. It can do only the short time for good action, but when the plans to do for a long time. The local government needed pay attention of many factors that mention from above of staff capacities and policy marker knowledge to understand."

Likewise, budget allocations for modern tools are also required to allow for effective, efficient, and early warning of flood risks. Starting with creation of the flood

risk map, the local authorities can work on capacity-building for local government and the local community to monitor changes in rainfall patterns linked to climate change, extreme weather, and abnormal weather situations in an effort to increase preparedness.

6.2 SWOT data analysis of the local government practices

A SWOT data analysis was performed following individual interviews in which semi-structured question no. **2.1.8, 2.1.9, 2.1.10, and 2.1.11** in **part 2** were discussed (see **Appendix A-first group**).

The results of flood risk management discussions were used to help the local government identify strengths, weaknesses, opportunities, and threats from internal and external factors related to the Local Resilience concept in the Xay district, as summarized in Table 6.4.

Table 6.4: SWOT analysis results of local government practices in the Xay district

Strengths	Weaknesses
<ul style="list-style-type: none"> - Power of legislation and regulations. - Local residents have good attitude towards participation, and are in harmony with the local government in awareness and support options during floods. - Good access to health services. - Younger members of the community are skilled in the use of smartphone technology. - Many people in flood-prone areas have built two-story houses so that they can move people and assets above the water level if required. - It is the policy of the local banks to support flood victims for livelihood recovery. - Four strength points of LRFRM were identified by the study: (Meteorological and Rainfall pattern assessment, Early warning systems and prediction types of equipment (sign, signal, network), Flood shelter and victim center, establish the various teams (medical, relief, security, transport, and recovery by building back better concept)). 	<ul style="list-style-type: none"> - Low levels of technical knowledge among local government staff. - Lack of funds to repair public and private infrastructure damaged in big flood events. - Some works stilled overlap at the local and provincial government levels. - Most works are carried out only during the flooding with relief action. - No frequent flood awareness, training, and no routine exercise of real simulations. - Twenty-two weak points of LRFRM were identified by the study: (Equipment, rescue vehicles, no strict management of the urban plan, land-use change, less previous data, less flood map data, and others).
Opportunities	Threats
<ul style="list-style-type: none"> - Peace and stability of local politics. - The Laos-China Railway project will finish soon, providing new economic support. - The district can implement non-structural practices to encourage tourism and flood risk management at the same time. - External organizations such as the World Food Program, Care international, Plan international, and others offer potential sources of help. - The wisdom and familiarity with geographical characteristics of locals and local government staff can be used in FRM. 	<ul style="list-style-type: none"> - Some critical village infrastructure is currently located in flood-prone areas. - Various ethnic groups live together, and incoming external population from other provinces and abroad means that there are fewer areas for safe residence in the district. - Extreme and unpredictable weather from climate change.

<ul style="list-style-type: none"> - Promote reforestation for the locals by use of tree credits and assurances. - Support the flood map creation and analysis in the future. - Promote land and area conservation and development of flood victims shelters for emergency cases, and promote tourism and a fair environment for relaxing places. 	
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- Strengths of the local government practices in Xay district according to the results of individual interviews for semi-structured question no. 2.1.8 in part 2 (Appendix A-first group)

Respondent II_01 said

“When it comes to the strength factors of local government practices, the important points are the power and influence of legislation, and regulation as an instrument of control over the local residents' practices. It is important for better understanding and high levels of participation. Of particular importance is budget support for education, distribution of information, and other needs throughout the Xay district. However, the local government wanted collaboration between the authorities and the local community for good implementation with strict regulation for high levels of compliance.”

Political strength was based in the decentralized system that reallocated responsibilities from the national policies to local government, widening action, peace, and stability at the district level.

Economic strength was based in protection of residents' livelihoods; that is, helping the local flood victims by pushing the policy of banks toward support of rebuilding efforts, collecting funds from donations and support from NGOs, and accessing the local market. However, the local government promoted the agricultural and livestock activities and tourism as the focal points in the neighbouring districts, while promoting both internal and external investors with concerns about flood risk management at the same time.

Social strength was based in the collaboration of all the stakeholders throughout the Xay district.

Respondent II_09 said

“In pre-flood preparations and post-flood recovery, it was important to prioritize physical infrastructure functions based on build back better concept such as river improvement structures (dikes, reinforced embankments, erosion protection, reservoirs, flood gates, and wires, as well as road networks that can

be accessed year-round, public buildings, schools, hospitals, communication devices, water supply, and electricity to support flood management.”

- Weaknesses of the local government practices in Xay district according to the results of individual interviews for semi-structured question no. 2.1.9 in part 2 (Appendix A-first group)

Respondent II_04 said

“The local government's weak factors were insufficient technical knowledge of human resources that showed in many local governmental staff that had graduated with a degree in political studies or an agricultural subject that's not relevant to flood prevention engineering, water resources management, hydrology, or meteorology. Consequently, there were few professional hydrological and meteorological staff in this sector. Other weaknesses included lack of sufficient budget and updated modern tools for predicting floods well in advance.”

The local government did help during the flooding events by providing relief action. Nevertheless, it did not have intervention plans for all flood cycles (before and after). That meant there was no preparedness, and, after flooding, the build back better concept was not practiced due to many factors.

Political weakness was manifest in lack of strictness and lack of preparedness and elaborate plans for flood response based in sustainable action.

Economic weakness after flooding was driven by the lack of response by the local government, in which they could not meet the requirements set out by banks. For locals, consumer goods were controlled by middlemen who sometimes engaged in profiteering by increasing the price of goods. This also led to fewer and smaller investment projects in Xay District due to concerns with environmental issues.

Regarding environment, land-use management was still weak, and the locals continued to cut and burn the forest. Moreover, the local government still allows the private sector to excavate sand, gravel, and minerals along the Kor River, which adversely impacts the ecology, aquatic animals, and changes the course of the river channel.



Figure 6.24: Excavate the sand, gravel, and minerals along the Kor River.

- Opportunities related to the local government practices in Xay district according to the results from individual interviews for semi-structured question no. 2.1.10 in part 2 (Appendix A-first group)

Respondent II_01 said

“In the Xay district, the local government led the socioeconomic development, public security and national defense to peace and stability through one party leading without protest from a long time ago until now. Consequently, the national, provincial, local government, and Chinese partners have been working together on the Laos-China High-Speed Railway project since 2018, hoping it will finish as soon as the end of 2021 if everything goes to plan. The railway passes through the Xay district, making it potentially a future center of trade and commerce plus the many tourists who may come to this district in the future.”

The local government knew that the railway project would increase the number of domestic and foreign tourists coming into Xay district. The policymakers also decided to construct two parks along the Kor River and encourage tourism at the same time as they tried to enhance flood prevention with non-structured methods.

Another choice for local government was to gather funds for use in the emergency cases from central and provincial budgets, and from external international donation organizations located in Xay district such as the World Food Program, Care International, and Plan International.

Respondent II_01 said

“Nevertheless, there were opportunities for promoting the area, and locals planted many trees in the upstream area and other areas to enhance their credibility against a future time when a flood would cause damage to local residents’ property. Furthermore, local government staff made use of local wisdom about geographical characteristics to understand their areas and make

genuine enhancements to flood risk management. The flood map was essential for prediction of the next event. It was an excellent opportunity to support the creation of a flood map and use of related analysis in the future. Another opportunity area was for the local government to stock for food and drinking water in every period.”

- Threats to the local government practices in Xay district according to the result from individual interviews for semi-structured question no. 2.1.11 in part 2 (Appendix A-first group) of the case study.

Local government organizations and local residents confirm that it is challenging to predict extreme weather and climate change early enough to affect the impact of a flood. No one can be 100% sure when the rainy monsoon season will come with storms and typhoons to create a great flood that will affect the locals, and it is difficult to be sure that the local government will manage the situation well. The only thing local residents can control is the decision to adapt and move to a higher elevation area early for safety.

Many local ethnic groups live together, and the population of immigrants from other provinces and abroad has been steadily increasing. These people have tried to build a small household located along the riverbanks. These people often group together based on a common specific ethnic language. Faced with an increasing population and language barriers, the local government has found it increasingly difficult to allocate safe elevated evacuation areas effectively.

Respondent II_13 said

“One threat related to local government practices is that people in high positions may be tempted to corruption by some business owners when they are subject to regular inspections, and monitored for strict regulation of building codes and invasion of river bank conservation areas.”

6.3. Local community, village, people practice for participation in flood risk management

According to the results from question no. 2.1.4 in part 2 (Appendix A-first group), all local people were obliged to take part in preventing floods and reducing their adverse effects by monitoring, reporting flood risks, getting involved in preparedness, reducing losses, providing relief support, and helping with recovery after shocks.



Figure 6.25: Local government and local villagers participated in flood awareness plans.

In the past, the local government announced a flood alert to local villagers and the local community via the village leader, who took responsibility for coordination and participation only for that time or short period. Moreover, even when the government authorities were far away from them, they could not act independently, so it was not sustainable for local villagers to join with the local government's practices.

Respondent II_15 said

“The local government and local community collaborated to help build the new houses for flood victims with the resilient build back better concept. Furthermore, some houses were repaired when they had a little damage through participation of the responsible line offices and youth volunteers, who provided the labour while the local government provided the materials.”

The local government required the local community, village leaders, and villagers to clean and cut overgrown grass, mostly the grass near their houses, which also meant clearing the natural blockages in the urban drainage system. However, this had not been carried out in a long time.

When the local government provided the money to help flood victim during the flood, the local people were willing to help.

Respondent EI_02 said

“Also, the local government focused on promoting participation by the local community. One essential point was preserving nature; the goal was to find the best natural materials (bamboo, sand, timber, grass, and shrub plantation) for erosion protection and flash flood prevention with less investment. Those were great ideas that supported sustainable action. Another emphasis was for local people to preserve the natural retention ponds. In the end, through cooperation between the local government and the local community, they were able to get more advantages from their actions, and improve sustainability.”

- The conflict between the local government and local people

In response to question no. **2.1.5** in **part 2 (Appendix A-first group)**, Respondent II_04 said

“Conflict between the locals and the local government about flash flood risk management was common. For example, the locals were intruding into river conservation areas that were controlled by the urban planning law, land law, and water resource law. However, locals were always acting illegally to this point; they would fill the land in that area even though it was prohibited by the local government.”



(Source: Author, 2021)

Figure 6.26: Fill the land in the right of way of Kor river

Respondent II_02 said

“The local people still produce waste and allow it to block the main river and watercourses; this changes the natural water flow, which has an effect on other properties. Therefore, the local government penalized them under Xay district’s urban plan regulation.”

Respondent II_08 said

“There was another conflict; some local people paid less attention to strict regulation of the forest, and still cut and burned trees to clear land for agricultural activities.”

Clearly, the local people and the local government still have some gaps that require solutions in the future, if the local government wants to adopt Local Resilience and Flood Risk Management (LRFRM) effectively.

6.4 Other stakeholders (Academy, NGOs, Businesses, volunteers, others) practice for participation in flood risk management

There were research results related to the interests and involvement of other stakeholders in response to semi-structured question no. **2.1.6** in **part 2 (Appendix A-first group)**.

Different actions were taken by all stakeholders, such as education institute, non-government organizations, and volunteers, when the local government required them to participate and help during past floods.

Respondent II_02 said

“When the local government made the feasibility study plans for constructing the flood protection structure of the dikes, weirs, floodgates, riverbank protection, and others, they were also coming to participate, sharing their opinions, and discussing how to create a sustainable plan and achieve the targets with real action in the next step.”



Figure 6.27: Participation of stakeholders

Stakeholders participated in getting help and relief to flood victims. Most efforts of the local government were aimed at trying to provide relief action first, and mitigation during flood events. The results of government stakeholder cooperation have been mixed.

Respondent II_05 said

“Stakeholders helped only to build some new houses and repair some parts of damaged houses. Furthermore, support was provided in the form of food and drinking water (both consumable and non-consumable goods) in the emergency. But following the short-term recovery, and after those floods, victims needed to depend on themselves to survive going forward.”

The national government and the local government promoted foreign relations, along with regional and local cooperation related to flood risk management through sharing lessons learned and information gathered. The local/regional cooperation was especially apparent in training for flood emergency response.

Respondent II_10 said

“There were lessons to be learned from the previous actions of other organizations. One example was the road-bridge management in Oudomxay province, which was helped with construction of riverbank protection in some areas where there had been damage to national roads no.13 N, 2 W, and 2 E.

Those roads are located near the rivers, and are meant help protect the riverbanks and National Roads at the same time.”

Additionally, Non-Government Organizations supported flood emergency relief efforts by providing equipment. For example, the World Food Program (WFP) supported the establishment of temporary mobile warehouses for use in flood emergencies, and helped strengthen the preparations to store and sort food supplies and relief items in Xay district.



(Source: Vientiane-times newspaper, 2020)

Figure 6.28: Temporary mobile warehouse support by WFP

6.5 Local government practices to deal before floods occur in Xay district

According to the result of discussing and interviewed for semi-structured question no. 2.1.1 in **part 2 (Appendix A-first group)**, since 2018, the local government in Xay District had used the early warning system to inform locals who lived-in high-risk areas to evacuate and move valuables and livestock to safer areas before flooding occurred. Xay district also had some general types of equipment and sources. The impact of previous experiences had taught the local residents and authorities to adapt and prepare, and readiness before the arrival the rainy season each year.

Respondent EI_10 said

“Before the flood occurred ten years ago, the situation was not good; there was not enough equipment of all types for all local government levels. As an example, there were not as many mobile phones in use generally. Nowadays, the local government has many mobile phones for communication throughout the Xay district. This is a great tool for the early warning system and offers good flood management applications for local people via the local government's practices, and allows alerts to be given to locals who live along the riverbanks of the Kor, Mao, and Hin rivers for flash flood awareness, readiness, and safety.”

Respondent II_03 said

“The local government tried to suggest guidelines and various flood risk management methods for the local people's awareness, and they paid the mobile phone bill for local governmental staff who work on flash flood issues using mobile phones to contact specific authorities. Since 2018, the local government

has had the hydrological and meteorological station for the early warning system. The station has equipment and gauges to measure rainfall and water levels in order to issue early alerts throughout the Xay district; these are good practices compared to the old times.”

The local government provided sources of training for the local people, but did not follow up with routine actions to mitigate flooding. Some villages had more knowledge, but its effectiveness depended on whether or not the village resources and assistance to carry out projects.

The local government was aware that most floods were caused by rainfall and other related factors; they also made preparations for the rainy season in order to have an impact on the flood issues throughout the Xay district, with three levels of alert, from low to high. An effort was made to utilize monitoring to provide early alerts to villages when flooding seemed likely. During the June-October rainy season every year, there was a need to prepare safe zones at higher elevations and to increase general preparedness for flood risks.

Table 6.5: Flood risk level of each month in the Xay district

Risk	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flood							x	xxx	xx	x		

Notes: The "x" means great flood risk level
 The "xx" means two times great flood risk level
 The "xxx" mean three times great flood risk level

Respondent II_01 said

“Coordination mechanisms and communication in the Xay district were undertaken by the DDPCC and the secretary staffs, who were the focal points of flood prevention and relief efforts under each office. They carried out different duties, and had responsibilities for flood preparedness and response plan implementation when risky situations occurred. The weather forecast and climate change were monitored, with warnings about storms, cyclones, torrential rain, and other dissemination situations broadcast via the speaker. The alert announcement would be given to the local people throughout the Xay district, and villages in high-risk areas would prepare for flood events and avoidance at the time.”

The duties to be carried out were the strategy development, research, policy planning, flood response, and preparedness plan in every period (before, during, and after), and a bottom-up approach was expected to be used at every level. Flood prevention, control and problem solving all took place. Requirements were put in place via laws and regulations for emergency help to relieve the suffering of flood victims in the future. Furthermore, this local government needed to find sources for everything

needed for relief, such as donations from the central government and international organizations. During flooding and recovery after the flood. The flood relief fund can help to quickly returned a normal situation with a local resilience concept in place to build back better for the long-term.

However, the secretary staffs still had a number of duties, as follows:

Data collection, analysis of flood damage, and development of a response plan for coping with the flood in every period was the responsibility of the DDPCC, which had to find suitable solutions at the time of each flood event. Expanded legislation had to be explained to the local villagers in order that they would recognize and understand flood risk areas and the need for appropriate actions. Announcement via radio, television, newspaper, and speaker systems about extreme weather situations, especially about heavy rain, storms, and cyclones were disseminated as part of the early warning system. Alerts from the Department of Hydrology and Meteorology (MONRE) were monitored at the central level. During great floods, the DDPCC needed to hold urgent meetings to plan emergency response activities and report to the top policymakers like the Xay district's Governor. The local government tasked each line office with their responsibility for preparedness.

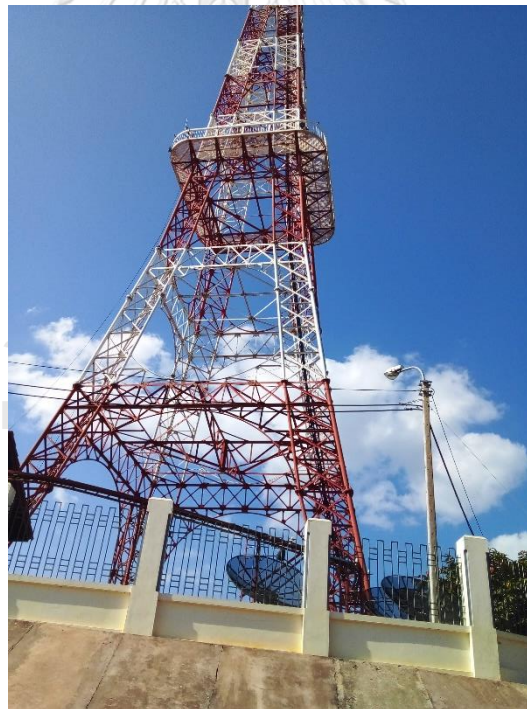


Figure 6.29: The radio station at the Xay district used to broadcast announcements about extreme weather situations.

Some highlights tasks of each office are summarized in Table 6.6.

Table 6.6: Responsibilities before the flood occurs of each office

Line Offices	Responsibilities before the flood occur
Office of District Public Administration	<ul style="list-style-type: none"> - The Focal point for receiving requests and reports from all sectors or offices for monitoring. Readiness to cope with floods. - Announcements, invitations to all stakeholders came to the meeting, discussion and make plans (or report if necessary)
Office of Labour and Social Welfare	<ul style="list-style-type: none"> - The focal point office to coordinate with all sectors. - Plan summary, projects, and strategy plans about flood preparedness and response. - Organize the meetings for preparing the plans - Summarise equipment plans, vehicles, and budgets.
Office of Natural Resources and Environment	<ul style="list-style-type: none"> - Monitor the weather situation regularly for timely early warning. - Distribute information and announcements about the weather situation for early warning alerts to society. - Monitor gauge measurements at the river level and warn local people as needed in risk-sensitive areas.
Office of Health	<ul style="list-style-type: none"> - Manage the data about clean water drinking and usage in each village. - Manage every equipment, vehicles, and budgets. - Prepare the water for use in emergencies.
Office of Agriculture and Forestry	<ul style="list-style-type: none"> - Set the plans for agricultural products; set the sub-funds for seeds, livestock, and technical equipment. - Manage and control the food stocks such as rice, dry food, and others.
The district Army headquarters.	<ul style="list-style-type: none"> - Steer, organize, monitor reports of the true situation throughout 24 hours. - Weather data monitored from the Donre and reported to small army units and district army headquarters in regular practice. - The fighting section focused on arranging the provincial and local district soldiers for mitigation, preparedness, and assistance to flood victims.
The district police headquarters	<ul style="list-style-type: none"> - Collaborate with police forces in each sector and each level. Deployment of police officers, vehicles, and equipment.
Office of Public Works and Transport	<ul style="list-style-type: none"> - Prepare for bidding, cost appraisal for the emergency unit, and bidding for acting contractors in each flood risk area. - Monitor inspection, repair of bridges and roads affected by flooding and landslide issues. - Prepare the human resources, equipment, vehicles, and budgets needed to cope with flooding during the rainy season and normal situations.
Office of Finance	<ul style="list-style-type: none"> - Set the budget for flood emergency cases. - Appoint a specific financial committee with responsibility for coordination of all stakeholders. - Persuade all stakeholders to provide needed support.




More detail about the tasks and responsibilities of each office can be found in Appendix G.

Table 6.6 summarises the tasks and responsibilities of each office, but many factors affect the response actions required in actual flooding events.




Since 2017, the local government and national government have collaborated with NGOs like *Save the Children International*, *CARE*, and the *French Red Cross*. They also prepared the Manual of Minimum Standards for Community-Based Disaster Risk Management (CBDRM), which primarily focuses on the flood risks because it is the most natural disaster in Lao PDR. The manual proposes implementing various flood risk reduction measures, and a wide range of technical guidelines for local community


awareness and participation with local government agencies. They are encompassed by a number of key elements, as follows:

Table 6.7: The Manual of Minimum Standards for Community-Based Disaster Risk Management (CBDRM).

No.	Processes	Key indicators
1	<p>- Minimum Standard on Site/Community, Village, and District Selection.</p> 	<ul style="list-style-type: none"> - The Site/Community, Village, and District selection for CBDRM activities are participatory, consultative, and based on known vulnerabilities (including gender and age) and capacities, or lack of the communities targeted for most hazard-prone villages. - Key Risk, vulnerabilities, and hazard related analysis and index documents are available at their level, and used to define the criteria for selection of the site/village. - The selection criteria have been discussed among key stakeholders, including crucial VDPCC members, in a participatory manner and shared with the community for their feedback. - The list of criteria has been reviewed, and the list of vulnerable villages updated yearly in consultation with crucial PDPCC, DDPCC, and selected VDPCC members. Basic village profiles are established and updated.
2	<p>- Minimum Standard in Flood risk assessment</p>  	<ul style="list-style-type: none"> - Detailed Risk, Vulnerability, and Capacity Assessments are carried out at the village level for selected sites/villages in a participatory manner where people of different age groups and gender participate equally in the process. - A standard procedure is established within local governance structures, especially DDPCC and VDPCC, to manage the risk assessment process. - Budgets are available to support local action. - Hazard Vulnerability and Capacity Assessment is conducted with the community's participation from different age groups and genders to gather key information on floods. - The results of risk, capacity, and vulnerability analysis are published (or displayed) at the village level by VDPCC. - A baseline for flood risk management capacities and vulnerabilities is updated for each location/site/Village.
3	<p>- Minimum Standard on Flood Risk Reduction and Mitigation measures.</p>	<ul style="list-style-type: none"> - The risk reduction and mitigation measures have been effectively implemented at the village level utilizing local knowledge and resources to their best for the selected site/village where people of different age groups, ethnic groups, and genders have participated equally. - The risk reduction and mitigation measures identified in plans are implemented effectively using local knowledge, skills, and resources

	 <p>The top illustration shows a group of people in a meeting room, with one person standing and pointing at a document on a table. The bottom illustration shows a woman sitting at a desk, with thought bubbles above her head depicting a person being rescued from a boat, a lightning bolt striking a house, and a flooded area with houses.</p>	<p>under the leadership of VDPCC and with support from DDPCC, PDPCC, and other identified stakeholders.</p> <ul style="list-style-type: none"> - Risk reduction measures are implemented in a participatory manner to reduce village-level vulnerabilities and increase the capacity to cope with floods. - Risk reduction measures are incorporated as long-term sustainable solutions.
4	<p>- Minimum Standard on Emergency Preparedness Measures</p>  <p>The top illustration shows a group of seven people wearing orange safety vests and hard hats, standing together. One person is in a wheelchair. The bottom illustration shows a community meeting with a man standing and presenting to a group of people seated around a table.</p>	<ul style="list-style-type: none"> - The emergency preparedness measures are set out at the village level, and include clearly defined standard operating procedures and roles and responsibilities of critical personnel for managing the risks. - The most likely flood scenarios are defined in consultation with the community at the village. - The standard operating procedures for activation of the emergency response plan, needs assessment, security, financial management, procurement, and decision making/ coordination exist at all level. - Evacuation routes and safe places or shelters have been identified and communicated to all the communities through acceptable media. - The village-level early warning system and procedures are in place and have been transparently communicated to all the communities, including the publicly available display of illustrations at various locations for easy access and understanding. - Emergency contact lists of the DDPCC, and the VDPCC are available. - The emergency preparedness plan has been updated regularly (at least once a year) before the critical time of flood by the community in a participatory manner.
5	<p>- Minimum Standard on Emergency Response and Recovery.</p>	<ul style="list-style-type: none"> - The response in villages is carried out as per the procedures set out in emergency preparedness plans; if a flood occurs, the sectoral responses must adhere to national and international standards and are based on the affected population's needs. - The decision to respond to an emergency is made based on the agreed criteria and procedure set out in the emergency preparedness plan.

		<ul style="list-style-type: none"> - A joint needs assessment has been carried out, and the response program design is based on the affected population's needs. - The sectoral response activities adhere to national and international standards. - The response is timely, efficient, and useful. - The response is well coordinated, transparent, integrated, inclusive, and well monitored. - The emergency response plan includes early recovery options. - The emergency response plan is reviewed regularly, and further assessed for the longer-term recovery needs of affected communities. <p>The recovery plan encompasses the affected population's social, economic, and environmental needs, addressing longer-term recovery, and is linked to socio-economic development plans.</p>
6	<p>- Minimum Standard on Flood risk management planning process</p>  	<ul style="list-style-type: none"> - A participatory planning process for flood risk management has been carried out at the village level for selected sites where people have equally participated in order to lay out the strategy and action plan to reduce, mitigate, prepare and manage the identified risks, and integrate these with the socio-economic development plans. - The CBDRM planning process is part of local government responsibilities, and are linked with the province and national level governance structures and procedures. The VDPCC led-Village Planning processes are undertaken with support from the DDPCC, PDPCC, and other stakeholders. - The CBDRM plan is based on identified risks and linked with development plans and budgeting mechanisms, and firmly integrates age, disability, gender, and environmental issues in a comprehensive manner. - The CBDRM plan has provisions that further link to Socio-economic development plans. - The CBDRM plan is endorsed, and budget provision has been made for identified risk reduction, mitigation, and preparedness activities.
7	<p>- Minimum Standard on Monitoring, Evaluation, and Learning.</p>	<ul style="list-style-type: none"> - The CBDRM identifies indicators to measure the process, output, and outcome of CBDRM processes at the village level, which were defined in consultation with the community in a participatory and transparent manner and continuously monitored and reported. Activities are improved based on learning throughout implementation.

	<ul style="list-style-type: none"> - A monitoring and evaluation framework was prepared under the leadership of the VDPCC and local communities, with support from DDPCC and PDPCC. - Monitoring, Evaluation, and Learning capture qualitative and quantitative information. - The lessons learned from preparation and implementation of CBDRM processes are captured regularly, and CBDRM plans are improved. Community feedback is captured and acted upon.
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(Source: The Save the Children International, 2017)

6.6 Local government practices to deal during flooding

There were results related to local government practices during flooding in Xay district from semi-structured question no. **2.1.2** in **part 2 (Appendix A-first group)**.

Respondent II_01 said

“During the flood, the local government set up a specific flood relief and mitigation committee, and many teams to help the flood victims. The committee and teams include many stakeholders, social welfare officers, soldiers, police, health officers, and volunteers (youth, women, other), who went to help save lives and move property and affected local people from risk areas to safer areas. First responders like the soldiers and police are always the first to arrive and help the save the lives of flood victims.”

Moreover, the sub-rescue teams, such as the health team, relief team, transport team, security team, and others, went to help the flood victims in high-risk areas. The local government set up a team to convince donors to provide the required relief money, and made specific flood relief announcements throughout the Xay district. Each team was also responsible for collecting field data regarding all flood victims. Teams also helped locals to relocate household items and to clean affected houses. After that, they reported to the governor of Xay district and other top-level authorities for decisions on monitoring and control of suitable actions for flood impact reduction.



Figure 6.30: Leaders of the Xay district gave the consumable and non-consumable stuff for flood victims

Respondent EI_14 said

“At the time of the flash flood, alerts were more critical, and they tried to build the network. However, the local government needed to be concerned about distinguishing between fake news and real news to disseminate believable reports to the local people.”

Respondent II_09 said

“The flash flood came in the night time when local people are busy sleeping. When flash flooding hit, the locals couldn’t move to survive. They needed to climb to the top of trees and stay overnight until the next morning when the rescue teams went to help them back to the safety zone. Nevertheless, it was a natural flood disaster, and the effect was challenging to forecast for all relevant sectors. The public works and transport sectors and police collaborated to focus on road accessibility to help the flood victims and maintaining the good road conditions for every team to have access to provide help. Moreover, they tried to persuade construction companies to help the flood victims.”

- Procedures and processes during the flooding

The local government implemented response procedures and plans for flood emergencies that were to be carried out at the time of flood by every stakeholder, as shown in Table 6.8.

Table 6.8: Period of the procedural process the during flooding

Period	Procedure process	Result of response
01- 24 hours	<ul style="list-style-type: none"> + <u>Share the flood information</u> - DDPCC, and the rescue team sound the early warning system and assess the flood impact to all stakeholders, including the public and private organizations, and local residents. - Arrange a meeting to share the flood data between all stakeholders and to find the best solutions to flood issues. Respond and determine the next steps to arrange a suitable priority for necessary solutions. - Prepare the primary data for livelihood protection and foods, and water drinking as well as providing shelter for flood victims. - Clear and improve roads in order to access flood areas. - Other information about the flood impacts. + <u>Analysis by secretary team of DDPCC.</u> - Specific team to research, plan, and assess flood issues. - Determine the capabilities of the district level authorities. 	<ul style="list-style-type: none"> - Shared and exchanged data about early warning. - Analysis, data assessment and reports to top-level policymakers. The necessary data about the flood impact areas is prepared for all stakeholders.
24- 72 hours	<ul style="list-style-type: none"> + <u>If the flood event causes considerable damage and cannot be controlled at the district level.</u> 	

	<ul style="list-style-type: none"> - The provincial level authorities need to help or intervene. - Encourage the human resources throughout the district to help. - Determine and define the initial flood impact, and communicate with the coordinator of flood response and preparedness action. + <u>If the flood event causes moderate damage.</u> - The rescue teams continue to closely monitor and maintain awareness. - The rescue teams guarantee all stakeholders are aware of all information about the flood issues. - Manage and disseminate reports about the flood issues to all the stakeholders. - Present decisions of the DDPCC. - Organizes meetings and generates advance reports. - Supplies the necessary help by following the plans. - Identifies the problems and decides urgent priorities. - Encourages all the human resources in the district to help. - The rescue teams produce the first draft report of necessary information to policymakers. 	<ul style="list-style-type: none"> - Agreement on the strategic response plans. - The DDPCC determines the time frame for implementation and urgent tasks for immediate active response.
72 hours to 7 days	<ul style="list-style-type: none"> - Emergency response implementation. - Urgent general assessment, implementation, and advance report for action to DDPCC. - Report summary for damage from all sectors after the flood occurred via the policymaker's vertical reporting line. 	<ul style="list-style-type: none"> - Emergency response. - Urgent general assessment. - Report summary for damage from all sectors after the flood occurred via the policymaker's vertical reporting line.

However, each office of the local government still has responsibility for preparedness, and even those offices without many local governmental staff have to carry out their responsibilities. Some highlights tasks of each office are summarised in Table 6.9.

Table 6.9: Responsibilities during the flooding time of each office

Line Offices	Responsibilities during the flooding time
Office of District Public Administration	<ul style="list-style-type: none"> - Focal point for coordinating urgent meetings and arranging action plans; delegate all the duties to all sectors. - Coordinate the deployment of soldiers and police forces, public agencies, and private sector to help the flood victim, and issue timely alerts of risk. - Coordinate all stakeholders for data collection, and reports and budget assessment from all sectors, and allocate relief resources, and solve problems for flood victims.
Office of Labour and Social Welfare	<ul style="list-style-type: none"> - Coordinate with the resident and acting office and all stakeholders for help and relief of the flood victims. - Enter the field for data collection, urgent damage assessment, and report to top-level authorities in horizontal and vertical reporting lines in every period.

	<ul style="list-style-type: none"> - Develop and maintain timely emergency plans. - Liaise with the district Red Cross to prepare help in the emergency, and equipment for protecting or restoring the buildings and livelihoods of the flood victim as needed.
Office of Natural Resources and Environment	<ul style="list-style-type: none"> - Cooperate with all stakeholders in flood damage assessment and report to the rescue team for the summary.
Office of Culture, Information and Tourism	<ul style="list-style-type: none"> - Sound early warning alert and go into the field to gather flood data news. - Cooperate with all stakeholders to monitor the situation and help the flood victims. - Use equipment and vehicles for relief and help. - Collect data for impact on tourism places and flood victims.
Office of Health	<ul style="list-style-type: none"> - Investigate the clean water sources had an impact in some places. - Identify clean water sources for emergency use and repair at every point; if unavailable, need to find from other sources. Moreover, manage distribution to each flood impacted village. - Persuade the drinking water processing facility to help the flood victims. - Share knowledge about disease prevention and protection from the floodwater and sewage water. - Distribute the mosquito prevention nets to the flood victims.
Office of Agriculture and Forestry	<ul style="list-style-type: none"> - Use the fund for emergency distribution for food, labour, vegetables, and livestock. - Damage data surveyed for renewing compensation plans. - Organize labour for emergency rescues. - Provide relief to the agriculture and forestry sectors.
The district army headquarters.	<ul style="list-style-type: none"> - The district army forces are needed quickly to provide warning alerts and report on the flood disaster situation. - Establish a headquarter to coordinate information and report to the top level. - The decision-maker for each level needs to find, collect, and help the flood victims, and solve problems for the flood victims. Furthermore, prepare equipment for readiness and deployment. - In the emergency, need to use mobile military forces to arrive at the flood areas on time and report to the top level.
The district police headquarters	<ul style="list-style-type: none"> - Use police vehicles for deployment to flood event points, and to transport supplies of drinking water to flood victims in a timely manner. - Control traffic and security at the flood areas.
Office of Public Works and Transport	<ul style="list-style-type: none"> - Implement solutions to traffic and safety problems. - At the time, identify emergency solutions implement plans and allocate areas for constructing shelters.
Office of Finance	<ul style="list-style-type: none"> - Prepare and follow expenditure plans. - Persuaded all the stakeholders to provide needed support. - Control the income-expenditure series. - Collaborate with all the stakeholders to provide support.

More detail about the tasks assigned to every office can be found in Appendix H.

6.7 Local government practices to deal after the flood occurred

Local government practices for dealing with post-flood situations were described and discussed in response to semi-structured question no. 2.1.3 in part 2 (Appendix A-first group).

Respondent II_02 said

“After the flood occurred, most of the local government’s practices focused on drainage improvement recovery in the urban areas, road, electricity, water supply for the temporary period, and trying to acquire more funding from the central government and external donation organizations to assist recovery and new construction with the build back better approach. However, some local people were trying to recover by relying on their own understanding and their own resources and only basic riverbank protection. Standard riverbank protection required the workers to deep dig and pour deep pile of rip-rap mountain rock or concrete. Some local people did well in some areas, too. For example, near the Kor River Bridge, no.1 was the housing and land erosion down to Kor River when the intense water flow had cause havoc with protection work done by individual local people and inspected by a technical engineer from the local government authority. The local government was now making construction of riverbank protection structures a priority of the dry season.”

The Xay district Office of Public Works and Transport tried to upgrade the building code regulations under the primary legislation to control flood risk by signature from the Xay district governor and agreement with the Oudomxay province Governor.

Respondent II_04 said

“The local government had to prepare the recovery plans to cope with future flash flood risks. They tried to allocate new safety areas for local flood victims. However, the Xay district’s Development and Administrative Authority needed to be wholly concerned about this after the flash flood occurred. The priority should have been to routinely clean the canal and urban drainage system. Therefore, the local government maintained the responsibility for preparedness in each line office, even those offices had insufficient local governmental staff to take care of the responsibility.”

Some highlights tasks of each office are summarized in Table 6.10.

Table 6.10: Responsibilities after the flood occurred of each office

Line Offices	Responsibilities after the flood occurred.
Office of District Public Administration	<ul style="list-style-type: none"> - Review all present works and past actions, and coordinate reports from all the sectors together with the Office of Labour and Social Welfare and report to the Xay district’s Governor to try to get control the recovery actions for all work and all sectors. - Prepare the summary and conclusion report about the flood issues. - Persuade internal and external entities to provide help, relief, and recovery resources to enable a return to the normal situation in the shortest possible time.
Office of Labour and Social Welfare	<ul style="list-style-type: none"> - All stakeholders review the past impact data and hold a general meeting for the flood response and preparedness plan implementation before the next emergency. - Data conclusion; report the damage data and impacts from all sectors throughout the Xay district. - Report to top-level in horizontal and vertical reporting lines in every period. Moreover, proposed to every sector in the society come to help or to persuade flood victims, then come back to a normal situation in the shortest time.

Office of Natural Resources and Environment	<ul style="list-style-type: none"> - Perform field surveys and prepare summary for making proposals to policymakers about the risk areas, and allocate new safety areas for flood victims. - Prepare budget plan for allocating the new safety areas and land-use.
Office of Culture, and Tourism	<ul style="list-style-type: none"> - News collection for persuading society to assist flood victims with things such as shelter, food, water and medicine.
Office of Health	<ul style="list-style-type: none"> - Obtain required funds for construction and repair of the clean water source system and ensure available usage. - Disseminate information to the local people and community about disease prevention. - Monitor the water quality.
Office of Agriculture and Forestry	<ul style="list-style-type: none"> - Help the farming and productivity areas to recover quickly. - Set the plans for buying the seeds in the emergency case. - Help the flood victims with products, seeds of rice and vegetables, equipment, and assistance with technical methods. - Use emergency funds to compensate producers.
The district army headquarters and district police headquarters	<ul style="list-style-type: none"> - The army forces need to build new houses using the resilience concept and recover farming areas to return to the normal situation. - Collaborate with the local village's DDPCC for dissemination of information about the flood management plan to the local people.
Office of Public Works and Transport	<ul style="list-style-type: none"> - Data summary, reconstruction, and improvement of the roads as soon as possible, using the resilience concept of build back better for all infrastructure activities.
Office of Finance	<ul style="list-style-type: none"> - Conclude, summarise, and report to policymakers and all stakeholders

More detail about the tasks assigned to every office can be found in Appendix I.

Respondent II_09 said

“There were lessons learned from the great flash flood of 2017, such as that of the NaPa village located in the southwest of the Xay district. After that flood, the local government resettled the local people to new village areas and helped develop a new master plan and comprehensive urban plan, provided technical assistance, allocated budget, and made many other efforts to help, including field surveys and plans for riverbank protection. In addition, the local government, through the Governor of the Xay district, ordered local peoples’ participation and cooperation in moving from prone-risk areas to new areas of high terrain for safety. Moreover, the local government agencies and stakeholders helped build the new elevated houses by following the resilience concept to build back better, and to enhance preparedness and readiness to cope with the next flood event.”

Figure 6.31 shows the construction of elevated houses after flooding subsided.



Figure 6.31: new elevated houses

Respondent II_08 said

“Mostly, the Office of Agriculture and Forestry in the Xay district supported the quick recovery of locals’ livelihoods in the farming and production areas, and sent breeding livestock to the area quickly; the office also provided agricultural seeds, and service in the technical methods for local victims.”

Figure 6.32 shows some of the efforts coordinated by local government agencies after floods had subsided.



Figure 6.32: The local government agencies give the breeds of livestock and the agricultural seeds to the local victims.

6.8 The conclusion of Chapter VI: Result 3 - the strengths and weaknesses of local government of the Xay district’s flood risk management practices

Assessment of the strengths and weaknesses of the current local government’s practices of local risk management in the Xay district is based on answers to research question no. 3 from chapter 1 of this study.

Clearly, the local government has many factors that require improvement. This study assessed 26 total factors for LRFRM. It was found that the local government practices had eighteen of these factors, but that eight factors were absent. In assessing the strengths and weaknesses of the 26 factors present in the local government’s practices, it was found that four of them (15.39%) comprised the strength factors, while the remaining twenty-two factors (84.61%) were absent or comprised weaknesses.

This led to a SWOT data analysis of local government practices in Xay district. Strength factors were found to be related to the power of legislation and regulations, and the fact that the local residents had a high level of participation and worked in harmony with the local government. In 2018, the local government set up Xay’s hydrological and meteorological station. It was the responsibility of the Xay district to manage the unit, which manages the early warning system. Before every wet season, official letters were sent to district and village committees about preparing for flooding. The village committees set up information meetings when river levels rose, in an effort to promote flood readiness by safeguarding assets and preparing for evacuation if required. At the beginning of a flood event, the DDPCC called villages and relevant agencies, then informed the village communities about the situation by local loudspeaker systems. Often, volunteers walked around to inform households in the village areas too far away from the loudspeakers to hear the announcements. Consequently, this sector can perform better than it has in the past.

The weak factor was found to be the lack of technical knowledge of local government staff, and lack of funds to repair public and private infrastructure damaged in flood events. Some overlaps exist between the local and provincial government levels, and most infrastructure work is done only during the flooding as part of the relief action.

The local government in the Xay district acted before floods occurred to use the early warning system for alerting locals living in flood risk areas to move to high safe areas. Local residents were encouraged by the local government to adopt, adapt, and prepare, and the local government sources relied on locals' knowledge prior to the arrival of the annual rainy season of June-October every year.

During the flash flooding period, the local government visited flood victims at the shelters and set up a flood relief committee and other various teams. However, the local government still needed to ensure that fake news was not shared with the public. Flood action procedures are divided into three periods: the first period (01-24 hours), the second period (24-72 hours), and third period (72 hours to 7 days) for flood response action. Division of responsibilities for all offices belongs to the district authorities and DDPCC.

Local government practices to deal with the post-flood situation in the Xay district are focused on drainage improvement in urban areas and infrastructure enhancement. They tried to obtain more funding from the central government and external organizations to promote and fund new construction with a build back better approach. However, the local authorities only have enough funding to carry out cleaning of canals and drainage systems, which is still not carried out routinely for other works. The local government resettled the local people to new village areas. It supported the local government's master plan and comprehensive urban plan, provided technical assistance, and allocated funds in the budget, as well as making plans for constructing flood protection structures such as dikes, weirs, floodgates, riverbank protection, and others. The local governments and stakeholders helped build new elevated houses using the local resilience concept to build back better for enhanced preparedness to cope with flood events in the future. Moreover, field surveys were carried out and plans were developed for riverbank protection. The Governor of the Xay district ordered locals' participation and cooperation in moving from prone-risk areas to new higher elevation areas.

CHAPTER VII

RESULT 4 - OPPORTUNITIES FOR IMPROVING XAY DISTRICT'S LOCAL GOVERNMENT FLOOD RISK MANAGEMENT PRACTICES

7.1 Discussion about strengthening the local resilience and flood risk management (LRFRM) of local government practices in the Xay district

Research question no. 4 (from Chapter 1) of this study relates to how local government practices can be enhanced and strengthened by adopting the policy of local resilience and flood risk management (LRFRM), which affects this district's sustainable development. Responses from both individual and expert interviews to semi-structured question no. 3.1.1 and no. 3.1.2 in **part 3** (See Appendix A for the first group, individual interviews, and Appendix B for the second group, expert interviews) and other sources support the data analysis.

Respondent II_01 said

“The Lao government policies are prepared based on LRFRM. The central and local governments recognize the importance of flood risk management. The local government encourages individuals and organizations to contribute financial and technical assistance, equipment, and vehicles, and to make efforts, and offer advice, and other incentives related to LRFRM. The local government also focuses on developing human resources, constructing infrastructure, researching, transferring scientific knowledge, applying modern technologies and environmentally friendly approaches, and applying local wisdom in support of LRFRM. The local government needs to strengthen LRFRM in the future.”

Respondent II_04 said

“The local government may set the strictest legislation for flood management; after that, they need to plan for implementation and follow-up, along with regular management and prevention. There is also an ongoing need to clarify and justify the work. The local government has the opportunity to improve some past weaknesses and solve them at present while they prepare for the future. This includes the use of structural methods and non-structural methods to accompany the human resources development considerations to help the local community achieve the district's sufficiency budget. A key is understanding flood risk and hazards.”

It is important that local government leaders are assigned to undertake their roles, so they can arrange the priority of the LRFRM and prioritize which essential factors (out of the 26 factors) should be undertaken first (Detail shown in Table 7.1). Generally speaking, human resources development should be seen as the most important. Moreover, the budget should aim to provide efficiency. Through allocations for equipment, and current information about the level of rainfall, the weather forecast, speed of distribution needs to be reliable. Moreover, the local government's practice of investment in infrastructure construction for the short-, middle-, and long-term with an eye towards prevention and response is also important.

Results from discussions and interviews with both groups for semi-structured question no. 3.1.6 in part 3 (individual interview of the first group) and combined with

(second group) for expert interview question no. 4.6.1 in part 4 (second group) (see details in Appendices A and B) as shown in Table 7.1.

Table 7.1: Summary of factors for strengthening local resilience and flood risk management (LRFMR)

No	Factors	Discussion to strengthening the factors for LRFMR	Evidence for every discussion. There are seventh steps to proof for each discussion of the LRFMR concept, such as:
1	Law, legislation, policy, and regulation.	<ul style="list-style-type: none"> - Prepare specific flood policies and laws. - Strengthen by enforcing the laws and regulations to the illegal person. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
2	Human resources development	<ul style="list-style-type: none"> - Human capacity development of local government staff in meteorology and hydrology. Add in modern technologies. - Secure the right person in the right job; do not need to move to other places. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
3	Budget allocation	<ul style="list-style-type: none"> - The local government establishes the flood fund. - Fund the budget from many sources. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit);</p>

		<ul style="list-style-type: none"> - Build alternative money sources. - Engage a third-party to audit income and expenditure. 	<p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
4	<p>Equipment and technology preparedness.</p> <ul style="list-style-type: none"> - Rescue resources - Resuscitation devices - First aid kits - Emergency communication devices 	<ul style="list-style-type: none"> - Supply sufficient tools before the flood emergency events. - Year-round stock in the warehouse, ready for use. - Promote use of smart, resilient technology systems. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
5	<p>Rescue Vehicles such as:</p> <ul style="list-style-type: none"> - Boats - Helicopters - Trucks - etc. 	<ul style="list-style-type: none"> - Supply enough rescue vehicles. - Routine exercises to simulate local government practices. - It would be ideal for the Xay district to have a helicopter that can access areas of the land for emergency and rescue efforts. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
6	Meteorological and Rainfall	<ul style="list-style-type: none"> - This factor is most important in mountain 	<p>First, desk study, literature study and field visit to the case study area;</p>

	pattern assessment	<p>areas like the Xay district.</p> <ul style="list-style-type: none"> - Regular monitoring of rainfall data, water level. - Maintain accurate early warning and alert systems. - Combine with the locals' wisdom in some suitable areas. 	<p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
7	Assessment of geographical characteristics	<ul style="list-style-type: none"> - Improve the knowledge of Geographic Information Systems (GIS), especially in mountainous areas where flash floods are common. - Routine exercise and use of place-based data. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
8	Deforestation activity	<ul style="list-style-type: none"> - Reforestation of upstream river areas. - Guarantee financial credits to tree owners. - Allocate new high safety areas, such as natural flood ponds, from among the risk areas. - Prohibit the deforestation, except as permitted by the local governmental offices. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p>

			Seventh, final discussion come from the research outcome.
9	Urban plan practice assessment	<ul style="list-style-type: none"> - Restrict the urban plan regulations and building codes. - Develop the political, economic, social, environmental, and flood risk management at the same time. - Resilient concept for building back better after flood damage with non-structural and structural methods. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
10	Control the population level	<ul style="list-style-type: none"> - Allocate and distribute residences & businesses to appropriate areas of the Xay district. - High tax for inhabitants of the risk areas. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
11	Land-use change pattern assessment	<ul style="list-style-type: none"> - Zoning risk assessment that integrates flood management policy and spatial land-use planning efforts over the long run. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p>

			Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.
12	Assessment based on experience, identifiable risks, and impacts from the past.	<ul style="list-style-type: none"> - Previous flood database is necessary to plan for future-readiness. - Empirical calculation and analysis. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
13	Time assessment (before, during, after flooding) for flood prevention, rescue, and recovery.	<ul style="list-style-type: none"> - Assess the earliest time for a rescue team to help in emergency situations. - Suitable plans and real acts of recovery and reconstruction in short-, medium-, and extended-term operations. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
14	Early warning systems and prediction equipment (signs, signals, networks)	<ul style="list-style-type: none"> - Use smartphones to track flood warnings in real time. - Extreme weather forecasting and monitoring provided 24 hours a day and 365 days per year. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p>

			<p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
15	Flood awareness, education, training, information sharing, dissemination (TV, Radio, newspaper, social media, etc.)	<ul style="list-style-type: none"> - Flood Awareness and education integrated into schools, public places, and local communities at all levels. - Regular exercises and simulations by local government staff with local community participation. - Disseminate to all media via many sources. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
16	Flood data collection and analysis	<ul style="list-style-type: none"> - Flood data collection and analysis are critical to future preparedness. - Post-flood needs assessment carried out to support to help the victims. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
17	Flood map documents or flood map for analysis	<ul style="list-style-type: none"> - Analysis of the flood hazard maps; analysis includes history as well as potential future flood events. - Develop awareness among all citizens. 	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different</p>

			<p>aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
18	<p>Infrastructure monitoring and maintenance (dike, erosion protection, roads, bridges, electricity, water supply, etc.)</p>	<p>- Engineering infrastructure is significant; requires careful budget and cost planning.</p> <p>- Manage budget limitations by combining with natural source methods in the local materials.</p>	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
19	<p>Routinely clean the canals, watercourses, and drainage system.</p>	<p>- An essential factor for the improvement of drainage capability in urban areas.</p> <p>- Encourage local peoples' participation.</p>	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p> <p>Third, go back to visit the field of the case study area (2nd visit);</p> <p>Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels;</p> <p>Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p> <p>Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district.</p> <p>Seventh, final discussion come from the research outcome.</p>
20	<p>Pumping stations or mobile pumping</p>	<p>- Need to consider in the urban areas; flexible and easy to place.</p>	<p>First, desk study, literature study and field visit to the case study area;</p> <p>Second, interviews with 25 individual respondents throughout the Xay district;</p>

		<p>- Suitable types of pumping stations or mobile pumping.</p>	<p>Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
21	<p>Flood zones or flood plains. Flood bypass.</p>	<p>- Need to update the local governments' policies for these flood zones, flood plains, and flood bypasses because of the link with many factors in the decision. - Identify essential areas for land allocation.</p>	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
22	<p>Evacuation procedures, surveying evacuation routes</p>	<p>- Survey the evacuation routes before the flooding occurs and determine the elevated safety areas. - Regular exercise of evacuation procedures. Train the local residents.</p>	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>

23	Storing food and water	<ul style="list-style-type: none"> - Use the flood fund for food, drinking water, and non-consumable items to be stored in the public's many warehouses. - At least three days' worth or more of stored food and drinking water for the flood victims and rescue teams. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
24	Flood shelters and victim center	<ul style="list-style-type: none"> - Survey and allocate suitable buildings for use as shelters in elevated safety areas. - Check and supply the sanitation systems in the shelters. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.</p>
25	Establish the various teams (medical, relief, security, transport, and recovery with a resilient build back better concept)	<ul style="list-style-type: none"> - The various teams that the local government might set up are necessary for controlling the flood impact at the local level. In addition, the specialist teams can identify team members with skills and other assets that are likely to be useful. - Under some conditions, the local government can integrate all teams into one team with various specific skills. 	<p>First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district;</p>

		- Various rescue teams must train regularly in local and national professional action centers.	Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.
26	Regular inspection, measurement, and monitoring of overall risks.	- The local government practices should be founded on sustainable action using the bottom-up approach or the top-down approach as appropriate. - Try to combine all 26 factors for local resilience and flood risk management (LRFMR) in the initial and final action plans for the long-term with the prior inspection.	First, desk study, literature study and field visit to the case study area; Second, interviews with 25 individual respondents throughout the Xay district; Third, go back to visit the field of the case study area (2nd visit); Fourth, interviews with 14 expert respondents for understanding different aspects of flood prevention, management and recover at the local and the national levels; Fifth, three separate focus group discussions to confirm and deepen understanding of local government practices at the Xay district; Sixth, maintain contact via the WhatsApp group chat, until present, with interested respondents who live in the Xay district. Seventh, final discussion come from the research outcome.

From the key discussion in Table 7.1 above. Furthermore, additional explanation in the narrative texts below:

1). Law, legislation, policies, and regulations

In the case study of Xay district, policies have not been promulgated in the form of specific flood control laws. An overview of disaster laws can offer limited guidance on actions to be taken in the event of flooding emergencies.

Respondent II_11 said

“Strengthening the legislation, policies, and regulations needs to be part of the action plan, and serious practice should be the priority for precautionary flood prevention.”

Respondent II_02 said

“It should be a priority to strengthen the specific flood law and integrate the responsible organization with other sectors such as agricultural policy, public works-transportation, urban plan development, emergency management, and natural conservation. The attention of village leaders and leaders at all local government levels is needed. The village speaker system should be used as a tool for the early warning and protection of local residents. The policy of using the military and police together for intensive implementation is an excellent activity.”

However, economic development is as important as environmental and social equality, especially in the natural retention areas.

2). Human resources development

Development of human resources is one of the key elements to enhance the strengthening of the local government's use of LRFRM.

Respondent II_14 said

“The local government should upgrade the education regarding flood risk management and water management technology. Additionally, they need to have people with the skills to analyze problems, planning, decision-making, risk analysis, and sector conflict management. The local government should attend to strengthening the capacity of enhanced managing resources to their stakeholders because the capacities' components comprise the need to develop knowledge, skill, understanding, experience, awareness, motivation, and work ethics. The local staff should be developed to enable them to manage an effective control system to deal with not flood impacts and more. However, the human development policy currently encourages local staff to study meteorological and hydrological subjects and to become expert in this field to the extent possible at educational institutions, with financial support from the local government budget.”

Furthermore, it is important that those who study in these areas (meteorological and hydrological subjects) return to work in the local area. Learning more about flood vulnerability prioritization, and then enhancing flood precautionary preparedness from the training, sharing the education, social mobilization, participation, monitoring, and evaluation performance are all components of good human resources development programs. The local government is enabling its local staff development to handle the LRFRM, which helps move it toward sustainable urban development and flood risk avoidance.

3). Budget allocation

Financial management and effective budgeting are critical components of flood risk management. A method is needed to manage the finances of the flood relief fund, covering the district government's primary finance-related responsibilities in recovery and reconstruction, and identifying and mobilizing financial resources.

Respondent II_12 said

“Since 2019, the local government has established the flood fund for the future, comprising [40,000 kips/a staff/a year] from the government side, and it has encouraged the local community to participate more actively.”

Respondent EI_02 said

“Another point is trying to establish a flood fund for dealing with emergencies at the village level. However, the effort often results in collecting bananas, coconuts, or other agricultural products and livestock to sell in the market; after that, the sale proceeds go into the flood fund where they are used for promoting

the local economy and productivity. This idea might have been created by the local government to show off to the locals, who understand this concept. Afterward, the program is established, management can be transferred to the local community for sustainable action. Motivate them to pay attention and build the local community because they know their conditions better than anyone. The local government's budgetary practices in the Xay district have been implementation since 2019.”

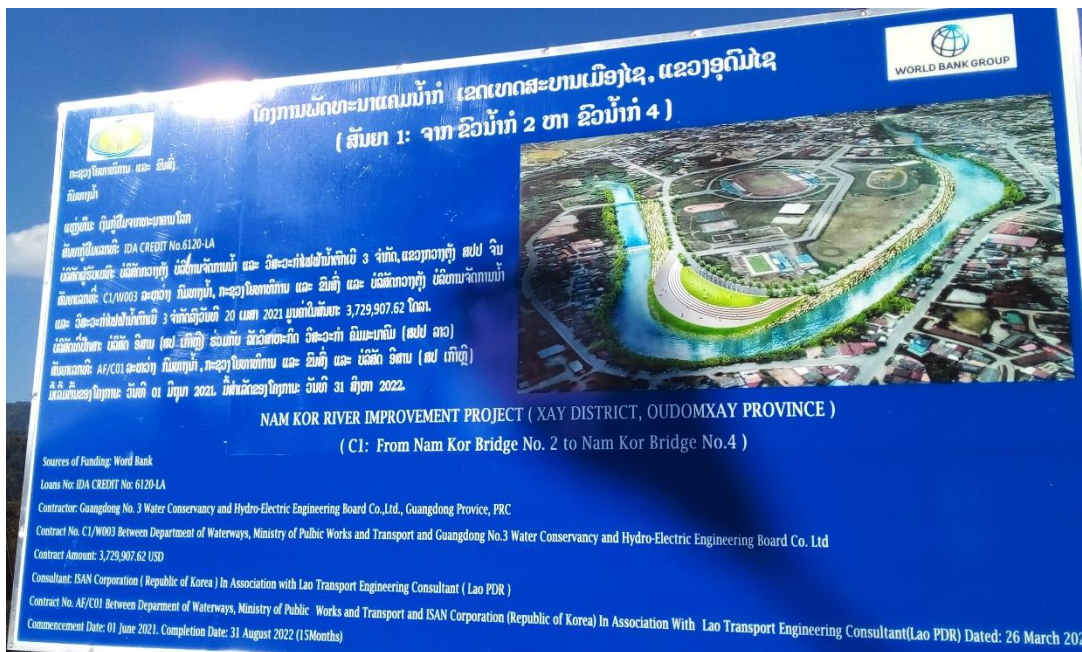
Respondent EI_01 said

“The national and international sides concept can still be used to promote international assistance for the flood guarantee fund from the ASEAN countries. Each member country has an obligation to deposit 5 million US dollars per year into the fund. When your country is a flood occurs in the future, the relevant government can access 30-50 Million US dollars, depending on the scale of the flood. It is like a financial safeguard for society. Moreover, the rescue team continually drills, and can be sent to help any country when they are needed; these rescue efforts are supported by this budget.”

Furthermore, Respondent II_01 said

“The local government in the Xay district has gotten budget allocations from the Lao National government and World Bank to support the Nam Kor river improvement project (Xay district, Oudomxay Province) starting from 01 June 2021 and expected to finish on 30 August 2022. This budget is around [3,729,907 USD]. The first phase extends from Nam Kor River Bridge no.2 to Nam Kor River Bridge no.4 and involves enhancing Kor river discharge capacity during the flood, width of river improvement, and erosion protection in this area. In addition, in the next step, if the local government can get additional budget allocations, then the Xay district government will continue to improved protection from flood issues and urban development at the same time, but access to the finance resources is crucial to pay for the required infrastructure.”

The construction work discussed above is shown in Figure 7.1 below.



(Source: Author, 2021)

Figure 7.1: The sign and construction activity for the Nam Kor River improvement project (Xay district, Oudomxay Province).

4. Equipment and technological preparedness

The technology and equipment are necessary to flood risk mitigation, with smart technology being an important element to integrate into LRFRM. The local government needs to develop and disseminate knowledge to help facilitate flood resilience across the district, and having equipment standards for both personal protective equipment and team equipment is essential. Additionally, many declared assets involve specialist capabilities, and rescue workers need to deploy with effective tools such as band radios, flares, ropes, rescue animals, and helmets.

Respondent II_04 said

“Communication should be designed to apply the smartphone technologies, with handheld communications devices supplied to all team members, with spare batteries and charger (all waterproofed) with the team commander and team manager. Buoyancy aid tools and a knife as buoyancy aid ancillary equipment and attached to buoyancy aid for immediate use should be standard for

everyone. Moreover, every member of rescue teams must carry a whistle. Helmets designate all rescue team members; helmet lights and light sticks must have the appropriate color (yellow or red), with a sturdy light (with full batteries) attached to the helmet for use during low-light and night operations. Also, all rescuers who work with boats and helicopters must carry eye protection to meet the relevant safety standards. Torches sufficient for three nights of deployment should be attached to each rescuer during hours of low light and darkness. Thermal protection skullcaps or a neoprene hood should be available, and gloves should provide thermal protection for all. Suitable footwear, such as walking boots or boots with reinforcement and good grip, are required and should have reinforced toecaps. Responders operating in the flood environment or operating in an area with the potential to accidentally enter the water should wear a personal flotation device fitted with crotch straps, reflective tape, an oral inflation tube, and a whistle. Additionally, at least each module should have a 15 or 20-meter throw line, with a well-designed method of attachment that can be used for throwing line bags to the flood victims and rescue team members.”

5). Rescue Vehicles

The local government should prepare rescue vehicles as part of its routine practices and flood risk management planning based on LRFRM in Xay district. The availability of rescue vehicles provides the basis for a set of planning assumptions.

Respondent II_06 said

“The vehicle should be suitable to carry personnel and equipment, and offer the ability to provide basic welfare needs during two deployment types: vehicles for transporting flood victims, and the transport of consumable and non-consumable goods. This requires logistical and maintenance by the facility for the financing team for up to 3 days of deployment. Cash might be considered for broader area flood incidents, along with an initial supply of fuel for vehicles and boats sufficient for 8 hours of constant activity after deployment. The local government also needs to supply food and snacks for all team members for the initial 8 hours of deployment, and 4 liters of drinking water per person.”

These assets include teams from the fire department, rescue service ambulances, lowland rescue trucks, mountain rescue, the police service, and excavators for evident landslides. The local government should expect to maintain their respective teams following the best quality standards, paying particular attention to the training, equipment, and first aid.

- Boat operations

Respondent II_02 said

“The type and quantities of boats required will vary according to team type; for example, a team might define its equipment requirement as a boat capable of being driven upstream while carrying six persons. Operating a small rescue team in a flood environment is challenging for most crews and any operation

due to the open water, the risks of impact with shallow ground or debris, and the risk of collision with small boats.”

Good communications with the boats and crew need to be established. Rescue personnel or flood victims who are using automatic inflating life jackets may need to have the life jacket put into a manual inflation mode shortly before being transferred. If this is not possible, the automatic mode must be disabled once onboard the aircraft, with the crew alerted when this action is complete.

- Helicopter operations

Respondent II_01 said

“It would be ideal for the Xay district to have a helicopter that can access areas of the land for emergency and rescue efforts. Helicopters offer an essential search and rescue capability during wide-area flood events. They may be required to rescue stranded people in difficult access locations, transfer the injured, and conduct search operations over otherwise inaccessible areas to help the flood victims. Some air assets can support logistics, such as deploying the rescue teams to isolated communities as part of the overall strategy.”



Source: (BBC, 2020)

Figure 7.2: Helicopter operations to help the flood victims.

6). Rainfall and meteorological pattern assessment

Respondent II_11 said

“Meteorology, hydrology, rainfall, and previous flood data collection are crucial for analysis and prediction of future floods. To improve the current flow monitoring data set in the Xay district location, new water level stations have been installed on the Kor River. These stations have been located to help provide potential flow boundary condition data for flood modelling. This can help a lot because the early warning system checks and shares important early alert information. More data can be collected and the modern equipment that

can be combined with local wisdom for more accurate and cost-effective flood risk assessment.”

7). Geography characteristic assessment

Respondent EI_12 said

“The Geographic Information Systems (GIS) database should be widely diffused and offer information on how to solve flood issues that come along with high mountains, plateaus and low-lying areas, with a meandering river. The challenges may meet and overcome with a shortcut solution, with discharge being good for downstream residents. Identifying the right solutions will require in-depth study, and possibly bypassing for support in the rainy season. It is easier to solve issues upstream, but for mid- and downstream areas with different fast discharge conditions, more erosion control programs are needed.”

Respondent II_04 said

“In the northern part, like the Xay district, flash floods are caused by runoff from the surrounding high mountains and are difficult to control. What is required is adaptation and preparedness, with an early warning system well-maintained and frequently tested. The local government and local residents might have the experience and knowledge needed for successful action with respect to geographical information. After all, the local villagers have adapted to the natural ways. Yet, those who live in the high-risk areas still have a lot, and look at the river with the steep, high mountains and deep riverbanks that can create the flash flood any time or immediately in the rainy season.”



(Source: Author, 2021)

Figure 7.3: Kor River’s water level in the normal situation.

8). Deforestation activity assessment.

Reforestation activity in the Xay district may be able to make use of relevant lessons from abroad.

Respondent II_08 said

“Japan prepares annually for forest planting, and that forest can guarantee financial credits of valuable forest in their land. This impenetrable forest can absorb a great deal of water that would otherwise be released to flow downstream, and that can delay, minimize or prevent floods from occurring midstream and downstream. On the other hand, without the forest, waste timbers, waste fencing, and waste from urbanization activities collect in the river bed in the rainy periods and create temporary structure blockage in the river; after that, when the blockage breaks apart, it creates sudden flooding.”

9). Urban plan practice assessment

Respondent II_02 said

“The urban planning control assessment, and development of flood risk management reflect broader social concerns in combination with the inevitability of many factors such as extreme weather, economic development, and population growth. This perspective seeks to complement traditional hard approaches focused on flood defense through non-engineering design to facilitate a more flood-adapted urban area. In this sense, urban design initiatives focus on promoting a resilient ‘build back better from flood’ concept in the Xay district. The local government has reflected this concept in its efforts to promote greater cooperation of all stakeholders, including engineers, urban designers, emergence planners and landscape architects, policymakers, the local community, and others in the Xay district.”

Respondent II_09 said

“The hard structural solutions (dikes, reservoirs, shortcuts, bypasses, and erosion protection) are generally inflexible, and once their capacity to prevent flash flooding is exceeded, that can be very expensive. Nevertheless, non-structural investments like acceptable urban and land-use planning practices before starting the developments, and preventing risky investments with good risk analysis are just as essential. The greater the level of structural flood protection, the more need there is for complementary non-structural measures. Monitoring the building development in these areas and publishing the results compared to the former situation may realize regularly.”



Figure 7.4: High elevates the house's slab from the Kor River

Respondents EI_09 said

“The green infrastructure approach is a method and application that interconnects the network of natural areas and other open spaces to conserve natural ecosystem values and functions. Displayed among these benefits is the retention of water so that drainage into watercourses is protracted, and the peak inflow associated with flood events is avoided.”

Furthermore, the pathways by which floodwater reaches these receptors, such as river channels and drainage systems, enable water retention in the built environment through ecologically sensitive development patterns.

10). Controlling the population

Another element of flood prevention planning involves population control in the Xay district.

Respondent II_03 said

“The highest population density areas are attractive for urban and infrastructure development. It is not possible to guarantee 100% flood prevention in densely populated flood-prone areas. There is a growing tendency to adopt a more proactive approach to flood risk management, based on the many lessons learned from losses due to destructive floods. Regulation decisions in LRFMR need to be systematic, and based upon flood hazard mapping, flood risk assessments, and the extent to which various possible interventions, including structural and non-structural measures, can reduce flood risks associated with high-density population.”

Respondent EI_05 said

“The idea of relocation should be part of a review of the great flood from the previous data collection, and relocation of affected people outside of their areas of origin should see as a last resort. Such relocation can delay the community's development. Relocation may move people away from their livelihoods and their relationship networks and social support systems. Relocation is not just about shelter, or even shelter and services, but all of the elements that make it possible for a local community to live and function at a particular new location. Importantly, the local government and all stakeholders needs to support relocated local residents until they can make a livelihood by themselves.”

11). Land-use change pattern assessment.

Land-use change is part of the long-term strategy to achieving the solution. Previous data support pattern assessment for land-use and urban planners. Land-use planning and actual land-use practice comprise the platform for bringing this information together in a single series of maps or a single plan, providing decision-makers with an essential rational tool to use in setting all levels of flood management policies.

Respondent II_04 said

“It's important that land-use control, water management policy, and spatial land-use planning efforts, in the long run, must concentrate towards attaining an equilibrium stage between economic development and urbanization on the one hand, and the need to allocate more space to water for flood flow retardation and water retention on the other hand. This is space that must be earmarked. The exigencies of flood prevention must become one of the guiding principles in spatial land-use planning.”

Respondent EI_10 said

“Land-use risk assessment means to improved knowledge concerning the extent and evolution of floods, simulating different high-water incidences, study, comparison of zoning scenarios, integrating this risk assessment via identification, and mapping of hazards and risk areas into land-use policies. The analysis requires a functional network of resources, data, and relevant information that should be systematically developed, maintained and analyzed under the long-term perspective of a single entity with the professional outreach and qualifications required for the task.”

12). Assessment experience risk and impact of the past.

This assessment describes the data collection, analysis methods, flood locations, and the initial resilient post-flood recovery framework used to guide the implementation. It makes connections between the Xay district and flood data collect from flood victims together with local community-based evidence. The local government may review the previous flood damage assessments and engage in relevant data analysis in order to learn from mistakes in the previous experiences and prepare for satisfactory readiness in the future.

Respondent II_04 said

“They may start with empirical contributions; the previous data provides a basis for an assessment of the long-term flood recovery efforts after the last extraordinary flood incident in Xay district in 2017, which links the evidence. The data review is conducted with interest in establishing the connections between households, organizations, and society. Its role is to promote flood disaster recovery and reconstruction with the ‘build back better’ concept through the resilience in the next step of Xay district.”

13). Time assessment (before, during, after) in flood prevention, rescue, and recovery

The local government should have the capacity to respond to flood events with complete coordination of information systems and existing forms of assistance, following the appropriate contingency plan.

Respondent II_02 said

“Time assessment involves assessing the earliest time for a rescue team to help in emergency situation. Factors in the assessment include the availability of flood rescue teams that can mobilize to a local flood field early and used in a supporting role, operating in remote areas that may be isolated by the flooding. Proper mobilization of rescue teams is reliant on appropriate advice, orders, and, following the completion of rescue efforts, a more timely review to be exercised,

developed, and improved. It facilitates 24-hour support, based on 12-hour working shifts and the flexibility to establish early credentialing.”

Respondent II_06 said

“Comprehensive local contingency plans to respond to flood events should be prepared appropriately in due time and maintained in operational status everywhere flooding might occur due to direct flooding, or dam or dyke-break. These plans should cover the crisis management before, during, and after the flood event, along with organizational schemes with a transparent allocation of responsibilities on each level, a flood defense section at the local level, and provision of information for the management of large-scale and local floods. There also need to be good sources of access to real-time information on the situation.”

14). Early warning systems and prediction equipment (signs, signals, and networks)

Traditional measuring instruments such as rain gauges should play a fundamental role as far as possible. Information might become more accessible. The traditional and the new technologies should coexist efficiently. A reliable flood warning and forecasting system, depending upon consistent hydro-meteorological basins rather than on sectors, is one of the basics for improving the protection against floods of extreme weather conditions. Because of the short reaction time in the event of flash floods in mountainous areas, the warning of floods should be based on real-time information from an automatic precipitation gauge network combined with quantitative radar precipitation data and rainfall forecasts. The flood warning services system should be decentralized and capable of providing timely local warnings.

Respondent EI_10 said

“There are effective early warning and weather forecast systems available. Now, all people have smartphones that are great for accessing specific flash flood information via real time monitoring applications on the mobile phone, so local people can track the flood information and extreme weather. Furthermore, typical dissemination about other issues, like the COVID 19 virus outbreak, allow for dissemination of guidelines and proactive solutions along with real-time tracking.”

Respondent EI_12 said

“Teams of forecasters should be, where possible, composed of meteorologists and hydrologists, who work to simulate run-off and flash flooding in large river basins because of extreme rainfall. This requires a distributed rainfall run-off model that considers the influences of topography, precipitation amounts and intensities, antecedent soil moisture, land-use type, and soil type. Exercises on

flood prevention and mitigation should be utilized by managers capable of providing 24-hour a day, 365-day a year monitoring and forecasting.”

Respondent II_04 said

“An automatic information system, providing and exchanging data about the operation of relevant hydraulic structures should be set up and operated together with the flash flood warning services and in cooperation with other participants involved in the flash flood prevention, mainly administrators of watercourses and operators of hydraulic structures. A practical and reliable flash flood forecasting and warning dissemination system should be set up to keep the community informed, and, at an individual level, keep flood authorities and citizens in risk areas updated with the latest developments. The media, such as official warning services, state and private broadcasting services, satellite-based communication systems, alarm calls on the radio (switching on radios by remote control), mobile telephones, the Internet, Teletext, and others provide critical infrastructure. They should be tested and updated according to technological progress. Alarms and action plans must be adapted to local conditions in all rivers throughout the Xay district.”

7.5: New meteorological instruments at the Hin River Reservoir are shown in Figure



(Source: Department of Natural Resources and Environment in the Oudomxay Province, 2020)

Figure 7.5: prepare the new meteorological instrument at the Hin River Reservoir.

15). Flood awareness, education, training, information sharing and dissemination (TV, Radio, newspaper, social media, etc.)

It may be a strategy for local government to include flood education in teaching, learning materials, and equipment at all school levels from primary to university. Teachers can also play a role in communicating the importance of flood risk management that includes information about specific flood risks in the school's area. They may build their capacity based on LRFRM to teach children to adults about preparedness. Dissemination of information is a highly diversified activity that requires significant experience under local government conditions and needs to be carried out in conformity with the local government using efficient information technologies.

Respondent II_14 said

“The Xay district, due to efforts by the education office, most of the schools are already making plans to support educational services in flood-affected villages, and have already identified key activities whose action is needed to meet short, medium, and long-term after flood needs. The education recovery strategy may strengthen the education system at the district level, making schools and communities more resilient to floods and the effects of climate change. Regular joint exercises should be systematically arranged, and the training of flood crisis management teams should be ongoing.”

Respondent EI_01 said

“Flood awareness from local governments can be adopted as a tool that makes us of national and international connections. However, announcements may be made via TV, Radio, and other media, e.g., ASEAN countries coordinate an ASEAN disaster day around the 2nd week of October every year to enhance educational awareness of flood mitigation and prevention among all citizens. Public awareness campaigns can promote the message that flood prevention is the personal responsibility of anyone who lives and works on the river, and, more broadly, in potential flood areas. All measurements linked to public information and awareness-raising are most effective when they involve participation at all levels. Public participation in decision-making is a cornerstone of the successful integrated action aimed at improving the quality and application of the decisions, and allowing the public to express its concerns while enabling authorities to take due account. Public participation can be encouraged; the local government should ensure that the information concerning flood prevention plans is transparent and easily accessible to the public. Usability of flood map information can be optimized by necessarily preparing to focus the flood point to reduce the damage. Information based on Geographic Information Systems (GIS) should be widely diffused and explained. Information and education must keep flood

awareness alive. Flood marks should also be placed in the communities and landscape to remind the public of the danger and help those not accustomed to the use of maps.”



(Source: National Disaster Prevention and Control Committee, 2020)

Figure 7.6: Flood relief stuffs from ASEAN countries.

Respondent II_02 said

“The district's short-term actions after the flood must include immediately resuming the delivery of flood data, while the reconstruction and rehabilitation of permanent structures is carried out using the ‘build back better’ approach. That involves providing improved and well-equipped learning facilities for locals. A multi- LRFM should be provided and integrated into the database. Medium-term plans (about 2 to 3 years) may focus on strengthening LRFM and recovery strategies in schools and local communities, providing training and capacity building, and conducting “training of trainers” (ToT) sessions on psychosocial support for teachers and volunteers. All stakeholders and education development committee members of district should be trained with a comprehensive safe local area program. Moreover, it is important to provide training in data collection and data analysis to improve the data quality in the management information system. Long term plans (about 3 to 5 years) should focus on strengthening LRFM to safeguard local communities. Implementation that ensures local communities can assess flood risk information, and which provides plans for evacuation, prepares for the response, copes with and makes provisions for recovery from flood events when affected by a flood disaster is critical as well. The result should be enhanced knowledge, attitudes, and skills related to LRFM among local residents and the general public to develop a safety culture.”

16). Flood data collection and analysis.

- Data collection

As far as local government is concerned, collected data and statistics provide detailed reports about flood damage on infrastructure, including damaged property, description of locations, water height, and extent.

Respondent II_11 said

“The meteorology and hydrology station of Xay district provided data, documents, and verbal descriptions of past events in the form of maps demarcating flood zones and districts that had been hit in the past. The station needs to also provide a database of emergency situations concerning in future events, reporting locations, time, and event type. Furthermore, they need to provide that all year, and the archive needs to be easily accessible at all times. Any website can prove to be an excellent guide to locating information sources. Pictures and videos obtained from channels, newspapers, and residents are exceptionally revealing of flooding conditions.”

- Data analysis

Upon collection and high-quality information is selected from raw data and stored in a database, categorizing different types of evidence like water stages, extent, speed, severity and type of damage, time, and duration of flooding. This step is followed by the compilation of a comprehensive list of past floods and accompanying data, such as damage to structures and other information that has been plotted in a GIS environment, together with evidence from pictures and videos to form an accurate reconstruction of flood events.

Respondent II_03 said

“Information technology provides powerful tools to support data collection and analysis in various applications. The selected team manages information collected from a range of possible applications. This information can be composed by virtually anyone with a smartphone or tablet. Using open-source software and potential flood management applications improves community flood preparedness. The selected team needs to work in partnership with all the levels of governments”

17). Flood map documents or flood maps for analysis.

The flood hazard maps include historical as well as potential future flood events of different probabilities, illustrating the intensity and magnitude of hazards on a selected scale, and they provide the basis of considerations and determinations about land-use control, flood-proofing of constructions, flood awareness, and preparedness.

Respondent II_11 said

“Flood hazard maps point out areas at risk and are necessary for planning. Maps must be easily readable and show different hazard levels. They are a planning tool and help ensure that all actors have the same information on a particular hazard's spatial extent. Flash flood maps should reduce damage potential by integrating its outputs into spatial planning and emergency planning. It provides

guidance on various other flash flood mappings to consider, ranging from how to handle other boundaries (floodplain, jurisdiction, etc.) that are coincident with the seclusion boundary. The map will include many areas and flash flood-prone communities, and the use of the map assists in maintaining floodplain relationships.”

18). Infrastructure monitoring and maintenance (Dikes, erosion protection, roads, bridges, electricity, water supply, and others)

The local government is responsible for the maintenance and the defenses that comprise flood emergency operations. It should be structured task-wise at each local level. Construction work in flood-prone areas and other designated areas should be subject to review before work is commenced. Moreover, activities may be incorporated with the new construction to support the retention, storage, and drainage of water in the floodplain.

Currently, the local government from the Xay district has an erosion and flood protection project underway in the urban area for water discharge, especially in the rainy season, to avoid flood risk in the future. The project is underway near the Kor River as shown in the Figure 7.7.



Figure 7.7: Clearance works for erosion and flood protection construction.

Respondent II_04 said

“In many cases, construction and new measures can contribute more to damage reduction than all the natural water retention measures and technical flood protection together. The planning and approval stages of further construction work should consider new and relative construction methods that incorporate the need to maintain space for water, thus, selecting the appropriate materials for the contingency construction for the flood prevention.”

Risk reduction incorporates a number of flood prevention measures, among which information and awareness play an essential role in LRFRM.

Respondent II_10 said

“Quality of infrastructure monitoring, maintenance and appropriate design, and adequate budget allocation for maintenance are required for the local government to prepare a recovery strategy for infrastructure in the short term. This includes emergency repairs and maintenance of dikes, embankments, erosion protection, wire, roads, and bridges, with priority on critical sections of flood discharge capacity, which can be restored to stock conditions, and emergency support that can reach affected people. Medium-term recovery needs (six months to two years) include periodic maintenance of all infrastructure. Moreover, extreme climate resilience principles should integrate into maintenance treatment and improvement methods for long-term recovery needs (beyond two years). The local government's climate-resilient improvements should be integrated into selected sections of the infrastructure. Improvements could include additional riverbank slope protection, raised embankments, improved drainage, and improved structures of these long-term measures.”

19). Routinely clean the canals, watercourses, and drainage system

Respondent EI_09 said

“A significant task that improves drainage capability in the urban areas is the cleaning out of drainage paths. There are two types of flooding in the Xay district. One type happens when the river has driven flooding and pluvial flooding (overflow at the urban drain). However, the local government could use the appropriate design and routine actions to maintain urban drainage lines, street inlets, maintenance holes, etc. In addition, the local government in the Xay district expects propose urban development and drainage improvement projects to be implemented in the district soon. The local government has to clean the canal, and dredging the main rivers like the Kor, Mao, and Hin Rivers, improving rainfall drainage. It also needs to improve the big canal around the PaSak village to handle water that flows down from PhuoKeing Mountain and releases into the Kor River.”

20). Pumping stations or mobile pumps

In the Xay district, the local government should provide a full range of pump solutions.

Respondent II_04 said

“Although the solutions are flexible and it is easy to place in a wide range of installations, selecting the right solution requires accurate understanding of the conditions. Pump solutions can be optimized according to their exact demands and specific installation when the correct data is available. The depth of the structure has to be considered; the depth of the pumping station is vital. It is also important to consider the benefits of high flow to ensure self-cleaning. Knowledge of water velocity is also important for preventing sedimentation and the need for regular cleaning. If the operation varies much with the seasons, then

dimensioning the pumping station serves as a reliable guard against flooding and minimizes the consequences when it happens. Furthermore, there may be good reasons for employing automatic frequency control can be related to its functionality and energy saving.”

21). Flood zones or flood plains.

Respondent II_02 said

“Local government policies must integrate many factors. Urban plan development to the urban regulation management integrates the land-use changes with the population management. The local government may also consider the suitable use of flash flood zoning as an integral part of effectively managing safety at a flood incident to control the inner and outer cordon. The zoning requires the appropriate use of response resources that operate in the correct locations as follows: the hot zone is the area covered with water, and is the high-risk area; operations in the hot zone should be restricted to living and local water management activities that are appropriate for the environment, economy, and society. The warm zone is the area adjacent to the water and remains a risk area. This zone may be larger or smaller, depending on the terrain. When operating near slopes, embankments in the warm zone should be restricted to locals who are appropriately following regulations. Finally, the cold zone is considered the safe area located outside the risk zones.”

A key element of flood zone planning is allocation of natural ponds or retention areas that will not affect villagers’ livelihoods in the wet season or dry season. Furthermore, if the local government can maintain the routine, that is also crucial for the sustainable plan. In addition, this work concerns the policy makers in all aspects.

22). Evacuation procedures, surveying evacuate routes.

The local government evacuation plans should be based on information from the confinement plan, and should support effective measures in saving lives, movables, livestock, and removal of hazardous materials to save lives, and protect society from flood risk and damage sites.

Respondent II_09 said

“Plans need to build up the knowledge of evacuation actions, practice, and regular training for real evacuation. Those in authority, with responsibility for flood control in the Xay district, need to work with local people before flood stock, and encourage participation from all stakeholders. The relief camp needs to have consumable and non-consumable stocks for surviving at least three days, to enable flood victims to wait for the other relief items and rescue teams from the outside.”

23). Storing food and drinking water.

The local government should provide at least three days or more of stored food and drinking water for the flood victims and rescue teams in Xay district. The local government needs to prepare the food. Staff at each health center and hospital will need to be trained in emergency management and disease prevention control.

Recovery plans are needed for food, agriculture, and livestock. The agricultural sector may immediately support the demand for the dry season crop production; medium and long-term systematic approaches must address technical knowledge of farming households in the Xay district.

Respondent II_03 said

“In the short-term plans, the priority of the local government should be preventing deterioration of the lands and food security of the flood-affected areas, with particular attention paid to the poorest and most vulnerable people who have lost assets or crops from the floods, and who may suffer from the loss of labor opportunities and income from the destruction. Cash transfers as food assistance to the most vulnerable households are crucial. The linkages to the medium- and long-term include dry season cultivation inputs and support that should be provided to the affected farming households until the next harvest. Efforts might also include support for vegetable gardening inputs to enhance food production and access to diverse foods. The livestock sub-sector should also be supported. Similarly, the fisheries and aquaculture sub-sector should be concerned with replacing fingerlings and feeding to restock fishponds in selected locations where repairing these structures could be considered through a safe public work scheme. More flood-resistant construction designs could support the “build back better” concept in the fisheries sub-sector. Medium-term plans (2 Years) need to provide for the agricultural production system, which may need further support to recover fully. Additional crop inputs for the last part of the wet season and support the next year of the dry season need to be considered for the most affected areas because of differences in cultivation practices and varieties. Improved agricultural system resilience approaches should be identified during this time in this sector. Long-term plans (2 to 5 Years) should focus on applying policy and system strengthening approaches, the building back better approach, and supporting the agricultural system and sector to become extreme weather resilience and flood disaster resilience. Reviews and data analysis under the medium-term activities suggest implementation and upscaling.”

24). Flood shelters and victim centres.

Respondent II_05 said

“Implementation of the flood shelter concept in any flood alleviation scheme has four basic aims: to reduce flooding, to reduce damage, to save lives, and to save property. A particular scheme may cover all four elements through such measures as building embankments to protect shelter areas. On the other hand, small areas of the flood shelters may help in saving lives and properties. These shelters can be used to manage relief and rehabilitation activities in an organized

way. The shelters can also be used as schools, public-private buildings, and local community centers when there is no flood. The shelter provides elevated safe areas, in which structural measures can offer protection due to practical planning and construction solutions.”

The shelters can be used to store emergency medicine and relief materials as well as providing shelter. While the menace of the flood can be reduced to some extent by building embankments, it cannot be eliminated from all the areas. For the areas of frequent flooding, evasive measures to reduce the sufferings of the people seem to be effective. Flood shelters comprise a form of evasive action. These shelters may provide the victims of the flood with a place to survive during floods and to be rehabilitated afterward. The shelters can be used as the centre of relief and rehabilitation activities in a broader perspective.

25). Establish the various teams (medical, relief, security, transport, and recovery with a resilient ‘build back better’ concept)

The various teams that might be established by the local government are necessary for control at the local level. In addition, the specialist teams can identify team members with skills and other assets that are likely to be useful, though this does not require the asset to have the necessary equipment and specific knowledge.

Respondent II_01 said

“The advanced medical professional such as a doctors and paramedic teams comprise members who are health care professionals, and who have additional medical skills and equipment. Like everyone in the health sector concerned with first aids, recovery and transfer to the nearby hospital, the relief teams can monitor the flood shelters and the fields. Moreover, the security teams like the armed forces might make all participation safe and enable implementation tasks. The transport teams can provide sufficient vehicles for logistics in every condition and in a timely manner. After the flood has receded and it is time for reconstruction, the recovery team is critical, repairing through the build back better concept for saving life and valuable property in subsequent events.”

Respondent II_02 said

“The local government can integrate all teams into one team with various specific skills for a flood rescue team that can be unique. This team has members with specialist skills in clearing debris and negotiating collapsed structures. No additional equipment would be required; for example, the ladder operations team would have members with specialist skills in working from ladders and helmets that comply. Furthermore, the helicopter ground operations team has helicopter training and equipment, including eye protection, handheld smoke flares, and ground-to-air radio communications. The boat operations team has experienced in operations from boats, also with eye protection and communication devices.”

Respondent II_05 said

“However, the country also has to rely on the United Nations (UN) rescue team, the ASEAN rescue team. They need to upgrade their knowledge and practices, with routine training, e.g., when a flood occurs in Lao PDR, Thailand can send this team to provide help at all levels, including the local level.”

26). Regular inspection, measurement, and monitoring of overall risks.

Respondent II_01 said

“The local government needs to make a regular inspection as part of the flood management effort. A clear action plan should follow in order to improve maintenance and preparedness against all risks, and to insure the effectiveness of the measurement and monitoring processes. The flood prevention practices and specific organization mitigation responsibilities for the operation should be regularly reviewed and updated at the local level. Every improvement, development, and rehabilitation work along all sections of the flood defense and measurement plans needs to be documented and integrated into new routines.”

Respondent II_04 said

“In addition to public and individual measures, insurance can be an essential factor in increasing the awareness and reducing the financial risk for individuals, public authorities, and local level organizations where flood risks exist. The goal is to reduce the vulnerability of assets located in flood-exposed areas through application of adequate measures.”

Early risk inspections and post-event appraisals to ‘build back better’ contribute to good arrangements so that future events will be less harmful. Finally, contributions are also made through publications, seminars, and lectures aimed at education and creating awareness among the public, the decision-makers, locals, and the technical experts. Adequate systems and technology are those that enable emergency supervision of local resilience and flood risk management (LRFRM) performance. Of particular importance to effective flood management are earthen embankments, which should be developed and utilized in a timely manner to help reduce risks from flooding.

7.2 Plans for local government practice.

7.2.1 Plans for the local government with respect to structural methods of flood risk reduction and prevention.

Discussions and interviews for semi-structured question no. 3.1.3 in part 3 of the first group, combined with expert interview question no. 4.3 in part 4 of the second group focused on structural methods of flood risk reduction and prevention.

In previous floods, experiences mentioned in Chapters 4 and 5 showed that each measure of the flood risk analysis and plan contributes to reduction of flooding damage compared to the case study of the Xay district.

1) A concept for solving the discharge capacity and river management issues of the Kor River.

The local government's river improvement plan in Xay district focuses on increasing the Kor River's flash flood discharge capacity through dredging, excavation, and improvement of embankments, along with lowland and bank protection.

Heavy rainfall in the upstream basin leads to high discharges into rivers. Currently, there are no facilities such as embankments, dikes, or water gates to prevent flash flooding due to the high-water level in the Kor River and tributaries.

- A concept for solving the drainage capacity of urban areas.

Respondent II_09 said

“Usually, river profile improvement contributes to the capacity of flash flood conveyance, with high volumes of water flowing downstream in order to lower the local water level. The river's morphology comprises severe bottlenecks and sedimentation in the river cross-section because of poor management. Thus, width enlargement and dredging of the river channel needs to be carried out. With respect to the drainage capacity of urban areas in the Xay district, and widespread flooding due to internal and external water downtown, at this point, the local governments, local residents, and other stakeholders need to work collectively and cooperatively to take action and solve problems in the short, mid and long-term. Because of the need to clean the drainage system regularly, pluvial flooding occurs when high-intensity local storm events cause urban flooding due to insufficient drainage capacity or bottlenecks in the urban drainage system of the Xay district.”



Ordinary

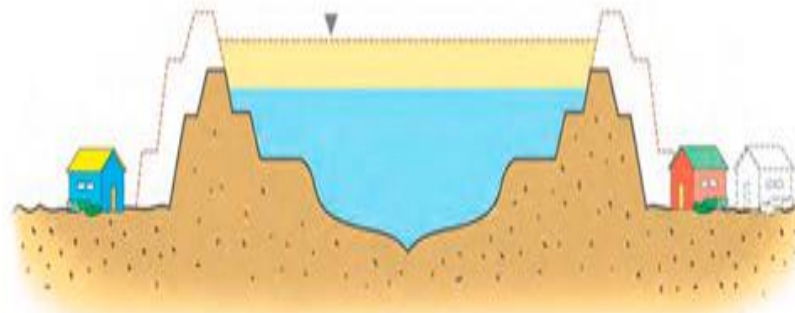
Flooding due to backwater

Flooding due to overflow

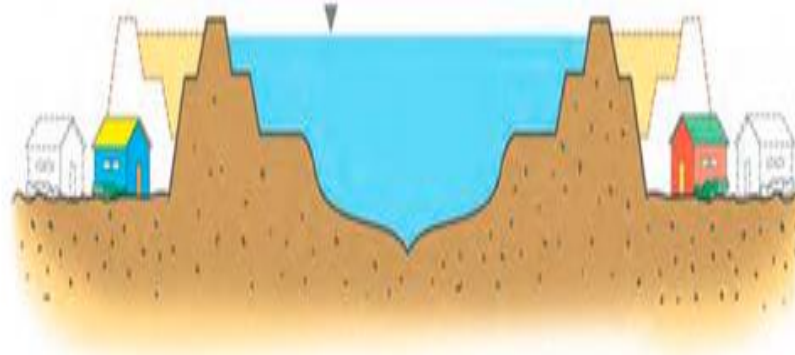
Figure 7.8: Conceptual diagram for inundation.

- Management of the Kor River.

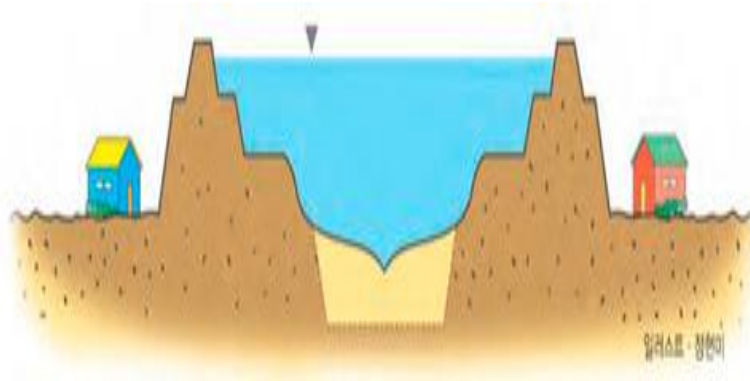
The concept for river improvement is to improve its discharge capacity, and it is based on three suitable structural methods (or hard engineering) to solve the issues.



(a) "Levee" to reduce flooding by raising the embankment



(b) "Levee" to reduce flooding by widening the river



(c) “Dredging” to lower flood levels by removing sediment from river bed
(Source: Department of Public Works and transport in Oudomxay province, 2020)

Figure 7.9: Concepts for improvement of the river discharge capacity.

Respondent EI_12 said

“The Xay district local government has carried out flood control efforts, including the downtown urban area. However, it lacks a plan for integrating river management that considers the geographic and urban characteristics. Therefore, integrating the river plan and maintenance measures is required for improvement of the flash flood control capabilities in the Xay district downtown area, and to strengthen the city's resilience in flash flood disasters.”

The river improvement plan proposed by the local government focuses on increasing the flood discharge capacity of the Kor River by widening the channel through dredging and excavation, an embankment along with lowland, or bank-protection, as shown in Figure 7.10.

After field observation and review of the secondary data comprising the plans of the local government with respect to the Kor River, and considering the present condition and social features along the river, it seems that various typical cross-sections are being installed section by section, after considering hydraulic factors (water level, velocity, tractive force, etc.), slope, material, and function. The significant considerations to decide on the channel training are as follows:

- Conditions of the existing riverbank in the Xay district.
- Efficient protection from flood hazards and severe erosion.
- Stability of riverbank and appurtenant structures.
- Connection with future development plans in the Xay district.

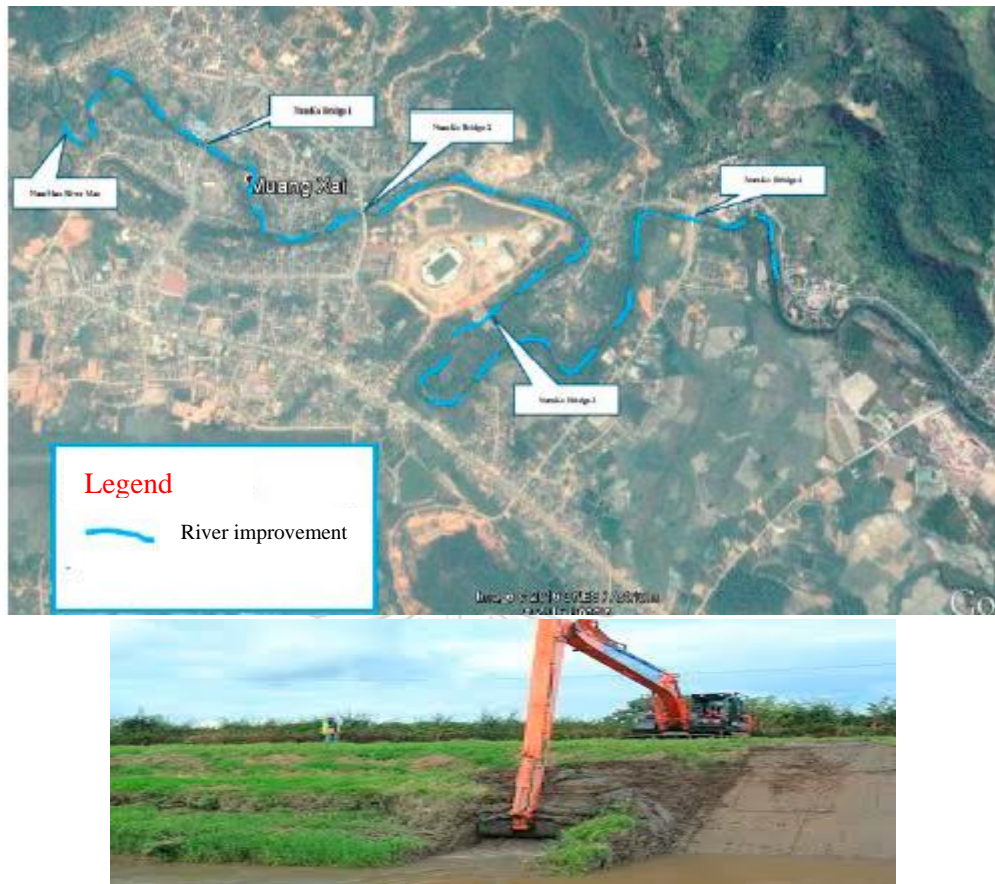


Figure 7.10: Alignment of river improvement and location of the dike, bank-protection.

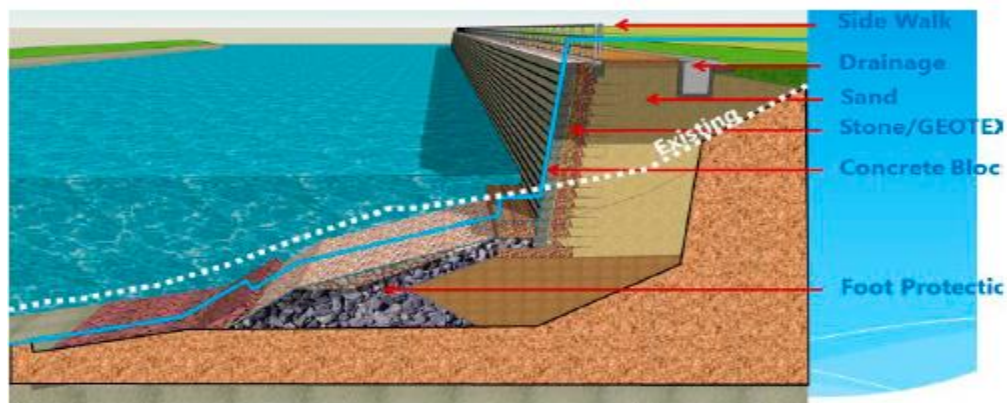
2) The concept for dike and riverbank protection.

Respondent EI_11 said

“The erosion of the Kor riverbank and tributaries in the midstream area (Thin village) of Xay district is an entirely natural process since the river has a high hydraulic gradient in this reach. Conditions, combined with erodible bank material, cause the river to meander. One of the main reasons why riverbank erosion is so severe seems to be connected to soil moisture. At the end of the wet season, the riverbank's soil has a maximum moisture content, increasing its weight and making the riverbank more prone to erosion and slippage, particularly when combined with rapidly receding water levels.”

River / Location	Kor river / Near the Gasoline Station
General Condition	<p>Description:</p> <ul style="list-style-type: none"> - Severe scouring and erosion on both sides of the river - Houses adjoining the left side of the Nam Kor River <p>River Width: 15 ~ 20m / River Bed: Sand and lay</p> <p>Levee and Bank Protection Type: None</p>

Figure 7.11: Status of bank erosion



Source: (Department of Public Works and Transport in Oudomxay province, 2020).

Figure 7.12: Concept of river improvement and erosion protection.

Respondent EI_12 said

“Having researched the concept of dike works, this could be a practical option. Dike construction along the rivers to protect the urban area could prevent the river's high-water level from overflowing the embankments in the urban area of the Xay district along the Kor River. Preferentially, channel capacity for flood conveyance would be secured in the river channel. Therefore, after the confluence of three rivers, the Kor River's channel capacity will be sufficient to handle the flow the flood waters downstream. The concept is to undertake dike construction along the river.”

Increased channel capacity for flood water conveyance would be ideal for the Kor River channel. In the section upstream from the three rivers' confluence, construction of an east side dike for protecting the urban area from the flood is recommended for Xay district.

3) Concept for shortcutting a meander in the Kor River.

A Kor River shortcut plan exists for the downstream village (Longkorduea village) area in an effort to improve discharge capacity. The location of the shortcut downstream is designed to minimize the removal of houses and infrastructure.

Respondent EI_02 said

“The shortcut is designed to increase from 20 m in the upstream part up to 40 m in the downstream connection with the Kor River. The shortcut will contribute to rapid flood discharge from the urban area of the Xay district, with some reduction in flood damage (6% reduction in flood damage in 20 years). However, the original shortcut line is better for draining floodwaters from upstream areas to downstream areas directly. It can contribute to rapid flood discharge from the urban area.”

(Department of Public Works and Transport in Oudoxay province, 2020) and (ISAN consultant, 2020) for Oudomxay’s urban development program.

The proposed shortcut is illustrated in Figure 7.13.



Figure 7.13: A map and photos of the proposed shortcut alignment.

4) The concept for building reservoirs.

- Concept for managing increasing heavy rainfalls attributed to climate change.

Respondent II_04 said

“There are plans to build reservoirs in the upstream area (Kornoy village) of the Kor River and Mao River in order to manage heavy water stock before discharging it downstream. This is necessary because climate change is causing abnormal weather conditions, with large amounts of rainfall all at once in the river basin.”

The Kor River’s current condition as it passes through Xay District is that it needs a sufficient discharge capacity to protect from heavy rain caused by climate change.

Therefore, a comprehensive approach is needed to reduce flood damage. It is also necessary to find optimal measures by dividing the portion of potential flood waters to be contained by basins and the portion to flow into the Kor River and tributary channels.

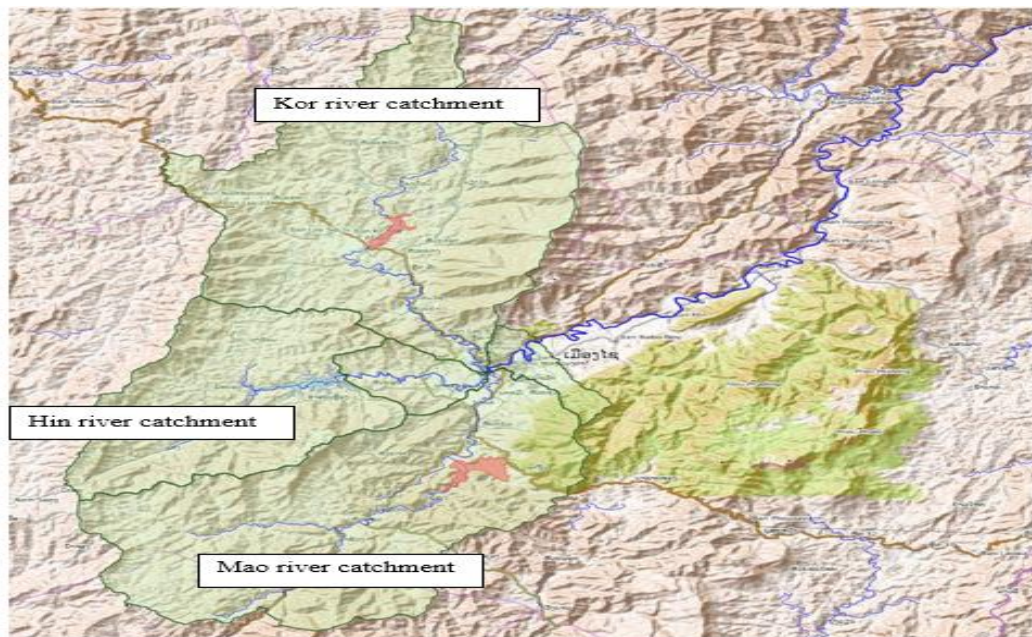


Figure 7.14: Concept for flood allocation in River Basin

(Department of Public Works and Transport in Oudoxay province, 2020) and (ISAN consultant, 2020) for Oudomxay's urban development program.

As can be seen in Figure 7.14, which compares the existing area (left side) and a new concept for a retention pond (right side) with an inlet and outlet system for stocking a large amount of water in suitable areas with less effect on local people during the flooding.

The reservoir infrastructure represents use of structural methods. Starting from a river basin perspective, the Xay district's rivers are subdivided into three sections: upstream of the district, in the district center (midstream), and downstream of the district. The reservoir infrastructure measures have been re-designed and add to the intervention in a stepwise approach. As shown in Figure 7.15.



(Source: Department of Public Works and Transport in Oudoxay province, 2020)

Figure 7.15: Hypothetical locations of potential new reservoirs in the Kor River and Mao River catchments. The reservoir in the Hin River catchment is an existing reservoir.

Respondent II_09 said

“There are plans to build the two reservoirs – one each upstream of the Kor River and Mao River catchments for flood retention and peak flood shaving by reference from the previous experience. This intervention was inspired by the Hin catchment, where a reservoir of about 3.2 km² already exists. It is planned those two new reservoirs will be constructed in the Kor and Mao River catchments, with similar dimensions and design as the existing reservoir in the Hin River catchment. These two reservoirs should help to reduce the peak flood discharges in both hydrographs of the Kor and Mao Rivers.”

Respondent EI_02 said

“Based on analysis of the data for two reservoirs, they will result in a 79.4% reduction in damage annually, compared with the reference case. Furthermore, in the 2-year and 5-year return periods, an average of 95% damage reduction is expected. Normally, reservoirs are the best option for storing excess water and delaying flood concentrations. However, these points need careful consideration by the local government. The reservoir construction will require enormous expenditure for construction, compensation, and harm an environment and human society, as well as creating the potential for massive downstream damage in the case of a dam collapse.”

(Department of Public Works and Transport in Oudomxay province, 2020) and (ISAN consultant, 2020) for Oudomxay's urban development program.

5) Riverside parks and flap gates.

Plans exist for installation and construction of riverside parks, which represent structural methods of flood risk management, but after they are done, these riverside parks will adopt non-structural methods of operation and management.

According to secondary data analysis, the proposed seven flap gates will have a positive impact on the flood damage reduction strategy in Xay district, and will support the improvement of tourism development in Xay district, connecting with the Laos-China high-speed railway project in the future.

6) Adapting Existing Bridges and Weirs

From the field visit, eight major existing bridges and one weir were identified at the Kor, Mao, and Hin Rivers in the Xay district (as shown in Figure 7.16). The span of each bridge provides enough capacity to discharge the flood downstream, and the slab of each bridge is very high, except the upstream Mao River Bridge, which looks different. The upstream Mao River Bridge was impacted by debris flow during the flood in 2017, and there are plans to reconstruct it.

The Kor River Bridges (Nos. 1 and 5), Mao River, and Hin River Bridge, based on visual inspection in the field, may need also to be reconstructed to ensure bridge integrity and safety for the people. Those bridges will require a precise safety inspection in the future.

The Mao River weir was installed for irrigation water supply, and it is in good condition. However, this weir has an adverse effect when a flood occurs; that is why it will be reconstructed soon.



Figure 7.16: A sample of Kor River Bridge No.1

The Kor River Bridge No.1, with a high elevation slab and two spans, is quite old and located at a bottleneck in the Kor river. It needs to be reconstructed because of the bottleneck.

The Mao River Bridge downstream comprises a high elevation slab and three spans and provides enough slab elevation and span for water flowing down to the Thin village's Kor river channel.

The existing Mao River's weir adversely affects Xay district when the flood comes because of increased water levels caused by the fixed height weir made of concrete. So, it is essential that the fixed concrete weir be replaced with a movable weir as soon as possible, as shown in figure 7.17:



The existing Mao River weir

Movable weir

(Department of Public Works and Transport in Oudoxay province, 2020) and (ISAN consultant, 2020) for Oudomxay’s urban development program.

Figure 7.17: Concept for suitable weir for the Xay district

7.2.2 Plans for the local government regarding non-structural methods for flood risk prevention.

Plans for non-structural methods of flood risk control were part of the discussions and interviews in response to semi-structured question no. 3.1.4 in part three (first group), and was combined with the expert interview question no. 4.4 in part four (second group).

1) Non-structural measures.

Respondent EI_11 said

“Many factors such as urban planning, flood zoning, laws-regulation enforcement, and early warning systems might be taken into consider action from the previous flood experiences and be integrated into preparation for the future. Reduction of flood damage may result from these routine activities”.

(Department of Public Works and Transport in Oudoxay province, 2020) and (ISAN consultant, 2020) for Oudomxay’s urban development program.

2) Flood control plan in the Xay district

Establishing policies and plans represents significant implementation actions of the local government agencies. These agencies must pay attention, and need to require participation from all stakeholders in order to improve the discharge capacity of the Kor River.

Respondent II_02 said

“The river flows through the downtown of the Xay district; it is necessary to establish a plan for flash flood prevention measures in the Xay district by preparing various measures such as channel widening, river improvement, levee and bank protection, embankments, and water gates”

3) Drainage improvement plan in Xay district

Considering geographical characteristics, it is necessary to establish a plan for the Xay district’s drainage system, in order prevent damage caused by inland flooding that results from heavy rain.

4) Flow allocation plan for flood reduction in the river basin

Xay district, which is located at the confluence of the three rivers (the Kor, Mao, and Hin rivers), has a relatively narrow width of the river channel and a residential area. To minimize the scale of flooding in the Xay district downtown, the plan should consider prevention measures at the upper part of the river basin to reduce flood waters flowing down into the Xay district urban area.

Respondent EI_10 said

“Therefore, it is necessary to establish a plan for flood allocation within the river basin by reviewing the facilities (retention pond, dam, and reservoir) for reducing flash flood discharge at the upper area of the river basin.”

- The Kor River retention option

Respondent EI_12 said

“A retention pond would be installed in the lateral zone beside the rivers to stock flood volume and decrease peak flood; this concept is called "off-line storage" or "monkey cheek." When a flash flood occurs, the retention pond has sufficient influence on stock flood volume to decrease the peak flood. The concept on the monkey cheek and the zone designated for monkey cheek is that it may be used as farmland outside the rainy season.”

The off-line storage (or ‘monkey cheek’) areas would act as a good flood plain only when a flood occurs. At all other times, it would be utilized for farming.

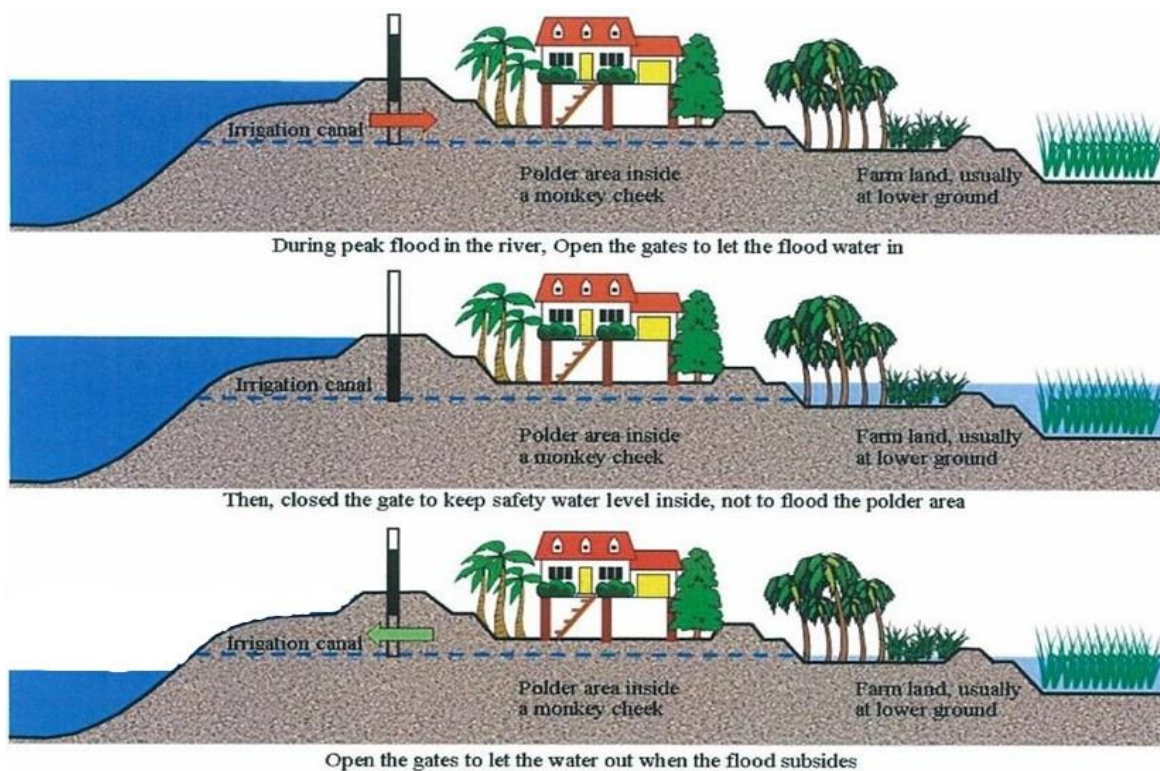


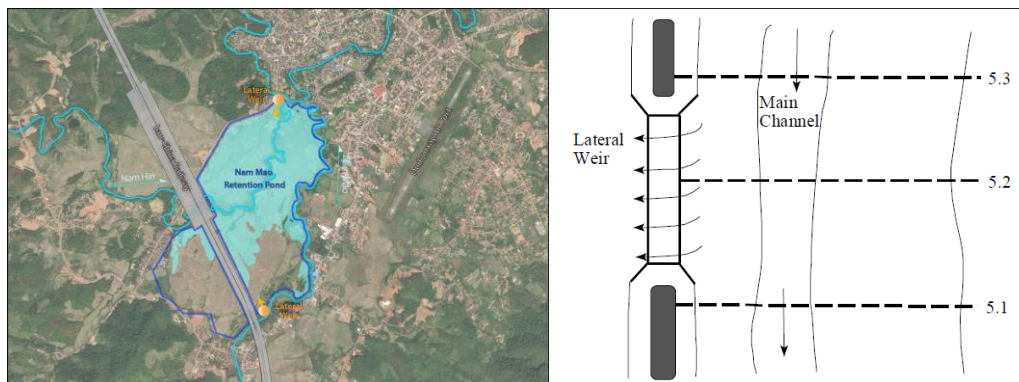
Figure 7.18: Concept of a retention pond and monkey cheek.

- Location of the lateral weir.

Respondent EI_10 said

“The effect on the peak flood will be determined by the lateral weir's location to overflow into the retention pond. The lateral weir's location to overflow into the Mao River retention option is adjacent to the upstream area of the Xay district to be protected from the flash flood. The most effective method of flash flood reduction by retention pond is to share flood volume from each river. The Hin River's flood volume is insignificant because the river is smaller than Kor and Mao Rivers. Therefore, lateral weirs have to be construct at two points upstream of the Kor and Mao Rivers. This storage volume will be utilized to store flood waters, and the rest of the flood water will flow into the Kor River near Xay district. The harmonization with the storage volume of the Mao River retention pond and the amount of flood flowing into the Kor River channel is essential for the establishment of effective flood mitigation measures.”

However, as an observation based on inspection of the site, the lateral weir should be located before confluence of the three rivers, as shown in Figure 7.19.



(Department of Public Works and Transport in Oudoxay province, 2020) and (ISAN consultant, 2020) for Oudomxay’s urban development program.

Figure 7.19: Location of the Mao River Retention Pond

5) Green Infrastructure and Riverside Park plan

Respondent II_04 said

“In line with tourism promotion and flood risk management, two riverside parks have been proposed for the Xay district: one located in a Kor River area with 3 hectares (Park No.1) and the other along the Kor River with 14 hectares (Park No.2). Establishment of these parks represents the integration of non-structural methods, and the consideration will clearly define the technical and the socio-economic validity of the proposed parks”

The river in the Xay district flows dynamically through the city, not through many straight lines, but following its natural course. The proposed parks (as seen in Figure 7.20) will take advantage of the river’s natural meandering course.



Figure 7.20: Top view of park no.1 and park no.2.

7.3 The Xay district's local government process for local resilience and flood risk management (LRFRM) in all cycles of flood life.

The local government process for LRFRM was discussed in both groups of individual interviews in answer to semi-structured question no. 3.1.5 in part no.3 (first group) and combined with expert interview question no. 4.5 in part no.4 (second group).

7.3.1 Process for the local resilient flood management before the flood occur.

For adequate preparedness before flooding occurs, the process of flood risk management and prevention comprises the outlining of plans and measures for preventing and reducing flood risks, which shall include the actions described in Figure 7.21.

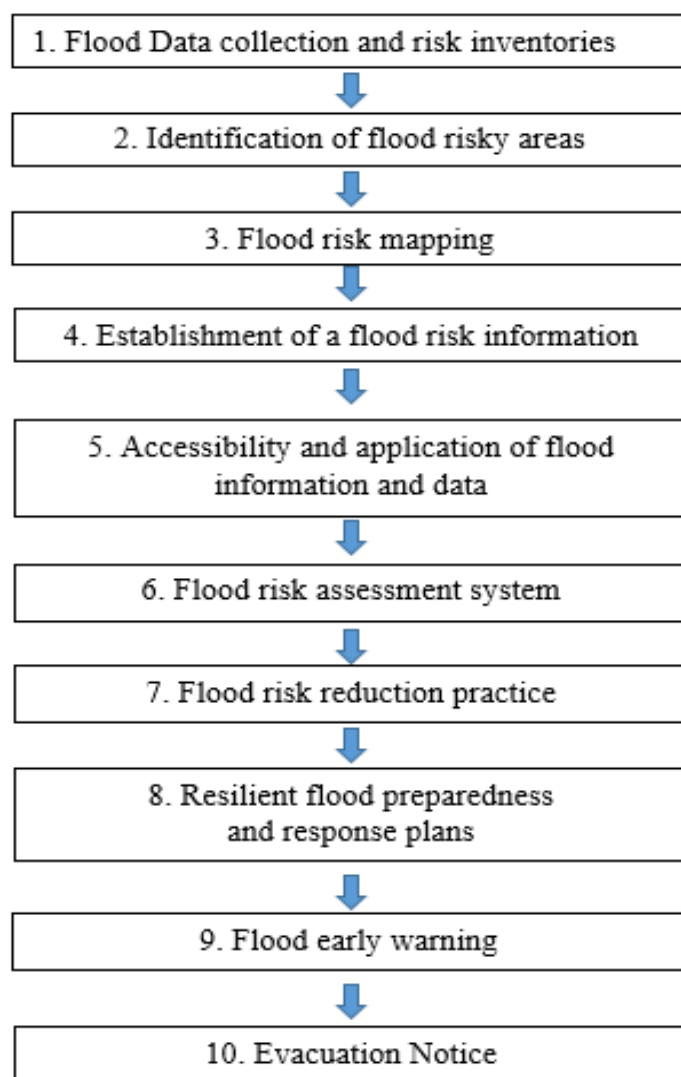


Figure 7.21: The Process of Local Resilience and Flood Risk Management (LRFRM) activities before they occur.

1) Flood data collection and risk inventory involve data gathering, assessment, analysis of flood risk areas, modeling, prediction, and resources inventory, including

information sharing mechanisms, and assessing damage from several floods, and investment in LRFRM. Each relevant sector conducts flood data collection and risk inventory within their areas of responsibility and submits reports to the relevant DDPCC and the Governor of district.

2) Identification of flood risk area is the responsibility of each specific flood management organization (the DDPCC) at each level. It shall deliberate and consider the natural characteristics of the landscape and level of flood severity for identifying potential risk areas. The LRFRM Plan, includes urban planning, land-use planning, provision of settlements and livelihoods, construction of infrastructure and development projects to assure safety and resilience from various floods.

3) Flood risk mapping at each level requires collaboration between the relevant sectors, organizations, and local authorities. It includes assessment and production of a flood risk map for the local people living in the areas of risk surveillance, and helps residents and others to avoid the risk of damage from floods to villages and houses, and also help protect those engaging in agricultural production and other activities.

4) The establishment of a flood risk information system builds the necessary tools needed for local resilient and flood risk management in a smooth, timely, quick, accurate, effective, and efficient manner. It includes central, provincial, and local specific flood management organizations. They collaborate with the relevant line offices and local authorities to establish, improve, manage and apply the resilient flood risk management through an information system by linking it to the district statistical information database, including providing and sharing flood risk information at each locality.

5) Accessibility and application of information and data means that individuals, legal entities, and local governments may access and use information from the flood risk information system or database. Those using surveys and research information may be charged fees and services according to regulations. Those wishing to use raw data/information from the sectors concerned will need to define clear objectives for its application and information analysis.

6) Flood risk assessment evaluates the level of risk, danger, historical flood occurrence, and prediction of potential risk, as well as damage to life, assets, the economy, and the environment. The local government outlines regulations on resilient flood and risk management assessment in collaboration with line offices, organizations, and local authorities.

7) Flood risk reduction includes measures and mobilization to prevent possible events, whether natural and human-made that may result in adverse impacts on lives and assets. Such risk reduction is based on the strategies and on maps of identified flood risks, and include the application of engineering techniques for infrastructure construction that is resilient, as well as public awareness campaigns.

8) Resilient flood preparedness and response plans are created using a process of preparing, planning, and setting up measures for preventing or responding to a flood event to reduce damage. Relevant actions taken may include danger warnings, commanding operations, search and rescue, and establishment of warehousing systems for storage of supporting equipment, or providing emergency relief, temporary shelters,

medical services, using the military forces, police and civilian, equipment, transportation vehicles, communications and facilities, and cooperating with and requesting assistance from all stakeholders.

9) The local government gives quick, accurate and timely early warning of expected flooding through a notification and declaration of a surveillance area through media broadcasting and other means to allow the local people, communities, and all parties to have enough time to prepare in advance to respond to potential floods.

10) A flood evacuation notice is a notification for local people residing in the flood risk areas to quick move out of the area. When a flood evacuation notice is issued, the people should prepare themselves, and then travel with their valuables and assets in the safe areas provided, or identify a specific area. The entity that issues the flood evacuation notice is the same as the one issuing the early warning.”

7.3.2 Process for the local resilient flood control during the flood emergency.

Issues related to LRFRM during flood emergencies were discussed and both individual interviews in response to semi-structured question no. 3.1.5 in part 3 (first group) and combined with expert interview question no. 4.5 in part 4 (second group).

During flooding, the flood control process and activities may restrict the impact of several floods that occur to avoid loss of life, and significant damage to public assets, residents' assets, and other parts of the local community through systematic implementation of seven processes:

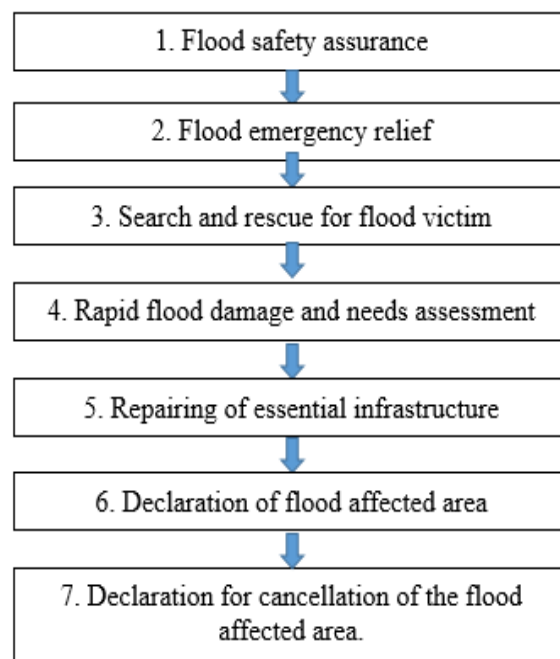


Figure 7.22: The Process of management activities during the flood emergency.

1) Safety assurance by the specific flood management organization at each level involves collaboration with the line offices of local government to exercise measures on safety assurance on health, lives, and assets of the local people affected by floods, and the rescue teams that come to help.

2) In effort to deliver flood emergency relief where the flood occurs, the local government belonging to the area may be proactive in providing emergency relief immediately and on time, with the relevant specific flood management organization providing emergency aid, temporary shelter, food and drinking water, water supply, emergency medical services, clothes, and other relief items for the people affected by flood disaster.

3) Teams search for and rescue flood victims at the time of a flood. At the appropriate level, the specific flood management organization shall collaborate with the local government to search for, rescue, and evacuate affected people to safer areas.

4) Rapid flood damage and needs assessment is a necessity in the area where the flood occurs, and with all sectors and stakeholders working together to conduct rapid flood damage and needs assessment for planning emergency support to the flood victims.

5) The local government has to take responsibility for repairing essential infrastructure. The relevant sectors might take on the urgent repair of the essential infrastructure needed to ensure that the initial emergency response can be undertaken effectively, based on the reality on the ground and the relevant specific flood management organization's consent.

6) Declaration of an emergency by the local government of a flood-affected area impacted by a great flood, leading to significant damage to life, property, the environment, or infrastructure is standard. In case of a flood that covers the area of more than one village, the relevant District Governor may issue the declaration for those areas affected by flood disaster based on a proposal made by the District Disaster Prevention and Control Committee. In case of a disaster, occurring that covers the area of more than one district, the Provincial Governor may issue the declaration based on a proposal made by the Provincial Disaster Prevention and Control Committee.

7) Declaration of the cancellation of the state of emergency in flood-affected areas also has to happen at some point. The local government shall announce the end to the state of emergency in a flood-affected area within its areas of responsibility after the flood has ended, based on a relevant specific flood management organization's proposal.

7.3.3 Process for the local resilience post flood recovery activities.

The process for post-flood recovery activities was discussed in the individual interviews in response to semi-structured question no. 3.1.5 in part 3 (first group) and combined expert interview question no. 4.5 in part 4 (second group).

This post-flood period is significant for rehabilitation and offers an opportunity to prepare for future flood incidents. Post-flood recovery activities may restore the livelihoods of people affected by flood disaster. Repairing and reconstructing after the flood upgrades infrastructure affected by flood issues with the 'build back better'

concept of local resilient action. The local government and residents should cooperate to carry out the following actions:

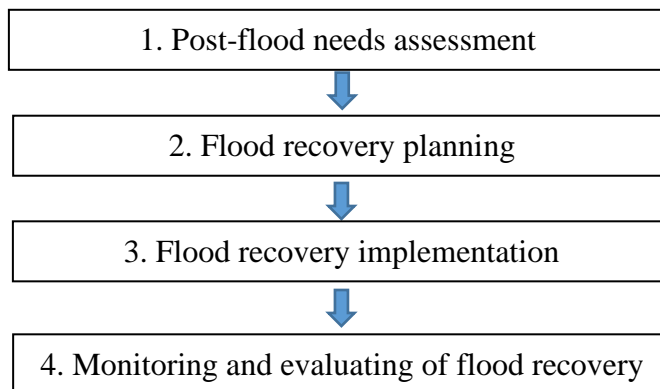


Figure 7.23: the process of post-flood recovery activities

1) The local government practice of post-flood needs assessment evaluates the level of damage, the needs for restoration of livelihoods, and repair and reconstruction of infrastructure affected by the flood. At the appropriate level, the specific flood management organization may collaborate with the local organizations in the affected area, involving all sectors and parties in carrying out a timely post-flood needs assessment that provides the basis for rehabilitation and support efforts.

2) Flood recovery planning may be based on the results of this post-flood needs assessment. All relevant stakeholders work to create a recovery plan and submit a proposed flood recovery plan to the local government and make a proposal through each government level for consideration and approval.

3) Flood recovery implementation by the local government where the flood occurred may proactively lead to implementing the approved flood recovery plan in collaboration with all stakeholders and parties concerned. Individuals, legal entities and organizations engaged in production, business, services, or any activities that led to the flood incident might take responsibility for remediation and rehabilitation of the affected infrastructure under the supervision of the relevant specific the District Disaster Prevention and Control Committee with “build back better” concept of LRFRM.

4) Monitoring and evaluating flood recovery shall be proactively undertaken by the local government where the flood occurred. All sectors and parties concerned shall make a report to all government levels and policymakers respectively.

7.4 The solution of A Conceptual framework of this study.

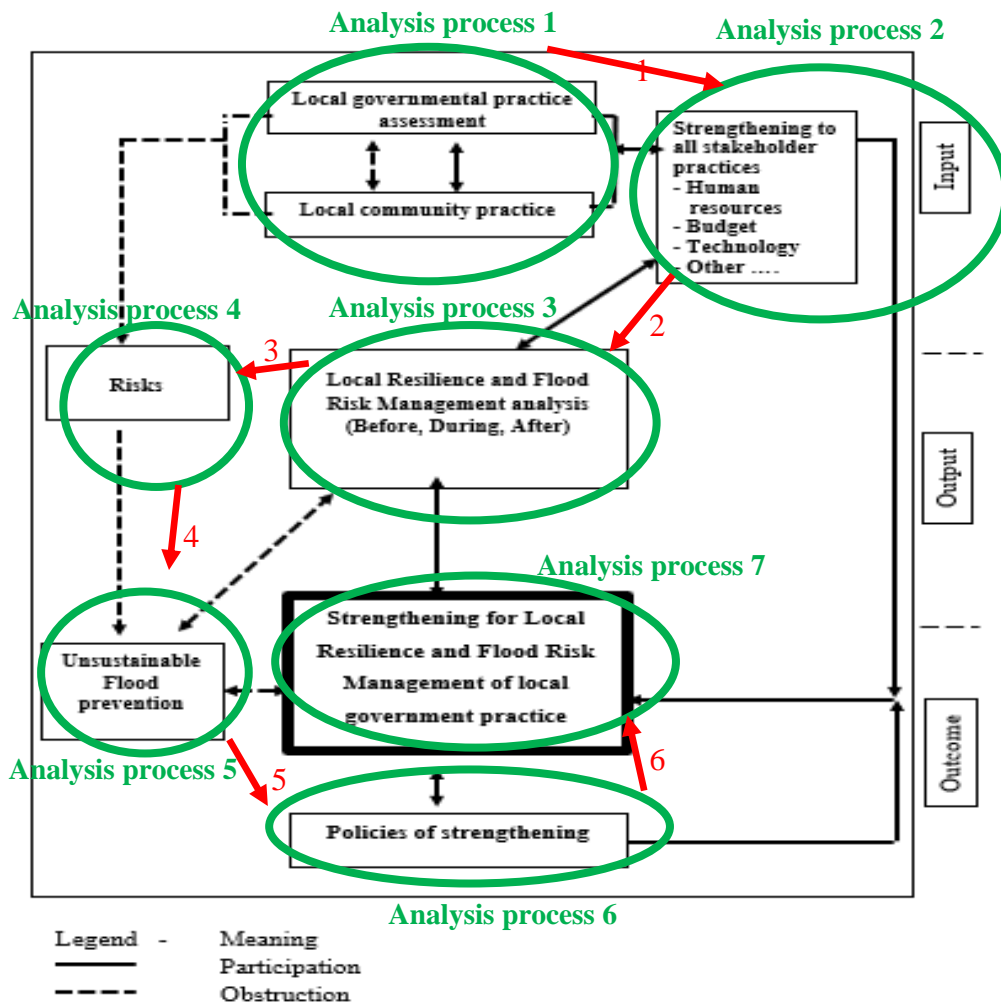


Figure 7.24: Analysis process of the conceptual framework of this study

The figure above illustrates the deeper understanding that results from case studies that are linked to conceptual framework that is based on a 7-step analytical process described below.

7.4.1. The conceptual framework inputs of this study

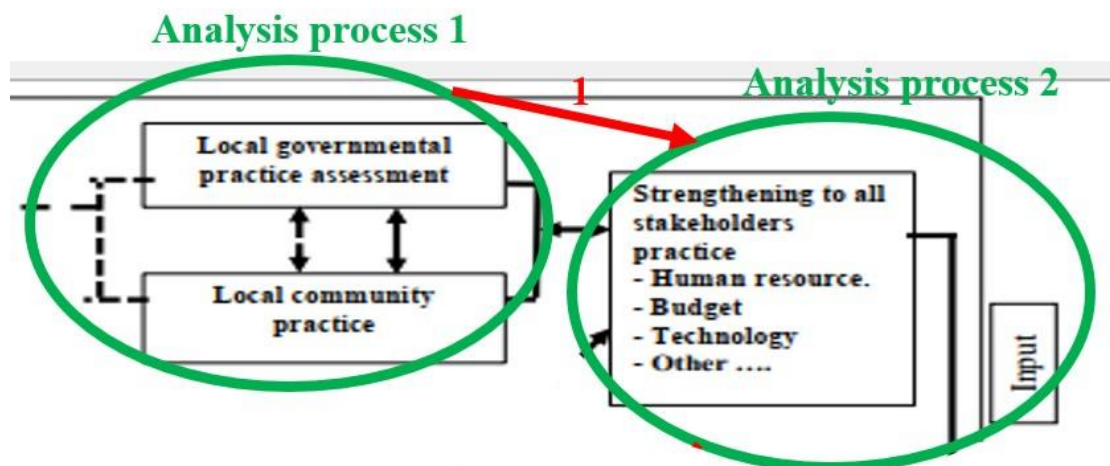


Figure 7.25: Analysis process steps 1 and 2 of conceptual framework.

- Analysis process 1: local government practice and local community participation.

Evidence to prove for analysis process 1: local government practice and local community participation. It comes from the review, data analysis, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample village studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district (From all questions of Appendix A, but especially, focus the question number 1.2.2. Please share your opinion of the natural flood characteristic of flood in the Xay district?; question number 1.2.3 What do you think are the main causes of flood risk in this district? (e.g., Policy or local government practices, human resources, climate patterns, rainfall patterns, urban planning practices, land-use changes, geography, deforestation, increasing population, budget, types of equipment, or others.); And 2.1.4 How does the local community, village, people practice for participation in flood risk management? (They do in individual action or participation with the local government deal?), third, go back to visit the field of the case study (again). Thus, the detail as follows:

This case study of Xay district follows a conceptual framework that is built around two types of interaction regarding local government practices. These practices are defined by 26 factors that together comprise the concept of local resilience and flood risk management (LRFMR). Figure 7.25 illustrates two processes, with Process 1 focused on the local practices of three case study villages (upstream, midstream and downstream), with participation represented by the solid line and obstructive action represented by the dashed line.

The local government's implementation in Xay district was often not impressive, and may not have earned the confidence of local residents. However, it's also true that the local residents did not participate fully in flood risk management

efforts. They are often more focused on their own livelihoods and personal benefit, with less concern towards flood management, and always waiting for local government support. Although national government decentralization has affected flood risk management by empowering the local government level, lack of funds and modern tools hamper flood risk management in Xay district. Of the 26 key factors that comprise LRFRM, the local government in Xay has only 4 strength factors as opposed to 22 weak factors. Clearly, action needs to be taken to improve the area's LRFRM. Currently, many poor residents in the district are settled in the flood-prone areas where they face ongoing risks from floods that occur with regularity within the affected risk areas.

If the local government tries to act alone, it will not succeed. The local people are also vital to the efforts of returning conditions back to the normal situation and restoring livelihoods damaged by flooding. Participation of all stakeholders with the local government is essential to the success of the LRFRM initiatives such as setting up response teams in the villages, flood education, raising awareness of local people what to do before, during, and after floods based on the early warning systems that need to focus local villages' readiness. However, analysis of Xay district local villages suggest that there is still a need for more participative action, such as forest preservation that local people can undertake without concern about the economic aspect, and others among the 26 factors of LRFRM.

- Analysis process 2: Strengthening the practice of 26 factors among all stakeholders.

Evidence to prove for analysis process 2: Strengthening the practice of 26 factors among all stakeholders. It comes from the review, data analysis and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample villages studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district (From all questions of Appendix A, but especially, focus the question number 2.1.7 What do you think about the current local government practice factors of flood risk management of this district?), third, go back to visit the field of the case study (again). Thus, the detail as follows:

From reviewing the practices of local government and the local community, it can be concluded (from Chapter 6, Section 6.1.1- Current factors for local resilience and flood risk management in the Xay district) that, from 26 factors that comprise LRFRM, Xay District has strength in 4 of the factors, but exhibits weakness in the remaining 22 of the factors, a situation that needs to be improve in the future, if the local government wants to enhance its local resilience and flood risk management (LRFRM) in the Xay district. Moreover, the local government should understand the reasons for improving the 26 fundamental factors.

The factors related to extreme weather events demand the most attention: especially the early warning system, forecasting, alert, monitoring, and others.

Encouraging all stakeholders to participate in flood risk management links with the urban, economic, social, and environmental development for sustainability.

- Input from the analysis processes no.1 and no.2

The data collection and analysis comprised four methods: 1). the documents of desk study (secondary data), 2). Direct observation in the field with participatory and non-participatory approaches (primary data), 3). Two sets of interviews, i.e., individual interviews in the first group, and a second group of expert interviews (primary data) as well as some secondary data, and 4). Focus group discussion (primary data). All of the methods integrate and link the input to the analysis processes no. 1 and no. 2. They indicate the local government practices in Xay district still need to be improved, with weakness found in 22 factors of 26 total factors comprising LRFRM (detail from the Chapter 6, Section 6.1.1- Current factors for local resilience and flood risk management in the Xay district). One issue is that the participation between the local government and local villagers typically does not last beyond the short-time effect when the most local people act and follow the local government orders. However, sustainable long-term action is necessary for strengthening; actions need to continue beyond the immediate recovery and even through the dry season, with as much emphasis on preparation and prevention of future flood disasters as there is on recovery from the latest one. While it is easy for residents to feel that actions outside the rainy season do not have any affect on flooding issues when the water level is low, the opposite is true. Actions taken in the dry season and the rainy season are different; the readiness of the pre-flood period, mitigation during the flood, and use of the ‘build back better’ concept in the post-flood period work together synergistically to constantly reduce the flood risks. The point of sustainable action using the local resilience and flood risk management is to create long-term stability and reduction of flood risk in the Xay district.

7.4.2. The output of the conceptual framework of this study

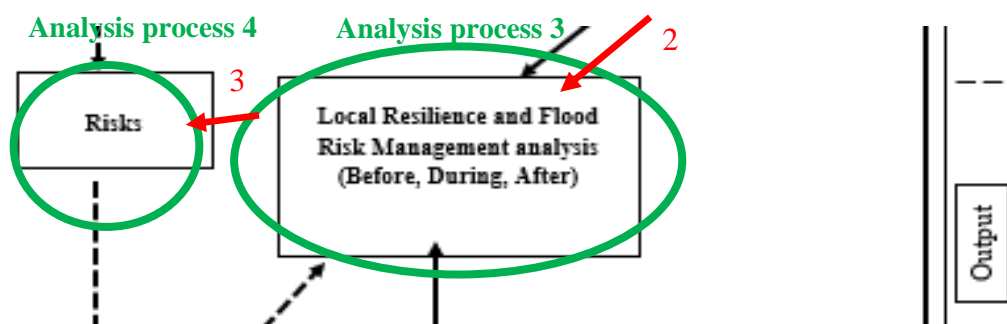


Figure 7.26: Analysis of processes 3 and 4 of the conceptual framework

- Analysis process 3: Local resilience and flood risk management (LRFRM) analysis (before, during, and after)

Evidence to prove for analysis process 3: Local resilience and flood risk management (LRFRM) analysis (before, during, and after). It comes from the review, data analysis, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample villages studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district (From all questions of Appendix A, but especially, focus the question number 2.1.1 How does the local government practice deal with risks before floods occur in the Xay district?(e.g., Preparation, Warning, information, organization, resource planning, deployment planning, Insurance, Prevention, land use planning, technical measure, biological measure, etc.); the question number 2.1.2 How does the local government practice deal with flood risk management during flooding in this district?(e.g., Intervention, Alert, rescue, damage mitigation, information or instruction, etc.); the question number 2.1.3 How does the local government practice deal with flood risk management after the flood has occurred in this district?(e.g., Recondition, provisional repair, supply and disposal, transport systems, communications, financing, emergency legislation, Reconstruction, build back better repair, strengthening of resilience, financing)), third, go back to visit the field of the case study (again). Thus, the detail as follows:

Once the analysis of processes nos.1 and no.2 have been completed, then it is possible to focus on the result from the conceptual framework's input, and insert data support for this study.

The key to improvement in analysis process no. 3 is that the local government and local residents work together to assess and improve the 26 factors comprising the LRFRM concept in all of the flood cycle periods.

Before flooding: Both the local government and local residents must participate in impact data collection and analysis of past flood events, create plans and survey safe elevated areas and evacuation routes, and store food and drinking water. Preparation of rescue resources, resuscitation devices, first aid kits, and emergency communication devices must be carried out, followed by establishment of shelter centers for flood victims. This should all be managed under the flood risk management plan, as the area works to formulate and implement the flood prevention plan, which involves readiness, response and evacuation, as well as preventing flooding risks at the operation centers and in the field.

During flooding: The main action taken during flooding is mitigation work. However, the local government also provides relief for people affected by the flood. The local government should practice emergency procedures and have various teams conduct search and rescue operations. The early alert information is essential to help

the locals and to prepare the necessary items for flood relief, such as food, water and first aid.

After flooding: The budget is a primary concern for the local government in the post-flood period. The local authorities can take care of data collection, but further action may be constrained by lack of funds. It is important that this limitation be overcome, as the long-term recovery and reconstruction under the LRFRM concept in the Xay district requires the wherewithal to implement the ‘build back better’ concept.

It's clear from the case study that, to date, Xay district has not been successful in its approach to post-flood periods. The local government has failed to effectively develop the needed capacity with respect to the 26 factors that comprise LRFRM. This is not sustainable; the local authorities need to start immediately to prepare for the future.

- Analysis process 4: Risks

Evidence to prove for analysis process 4: Risks in the case study. It comes from the review, data analysis, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample villages studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district, third (From all questions of Appendix A, but especially, focus the question number question number 1.2.4. Could you describe your experience with flood risk and its impact on this district from the past until the present? In which year did the great flood effect local people in the Xay district?), go back to visit the field of the case study (again). Thus, the detail as follows:

From the analysis of processes nos. 1, 2, and 3, there is a consequent link between accurate data analysis and the analytical process no.4 of the local government practices with respect to flood risk management in the Xay district. Many potential risks of floods, such as extreme weather and climate change, cannot be completely eliminated. However, steps that can and should be taken to mitigate risks. The district has an urban area located near the confluence of three rivers that makes insufficient use of protective dykes, reforestation, high embankment, erosion protection and reservoirs along with management of the risk points in rivers. The situation is exacerbated by poorly functioning water control gates, and narrow and shallow natural channels to drain floodwater. Moreover, increasing local population is driving rapid urbanization in the area. This population increase has been largely driven by the people have come to the area to serve and prepare for the completion of the Laos-China high-speed railway project, which will finish soon (scheduled completion at the end of 2021). Due to land scarcity and poor enforcement of local laws, many of these newcomers have settled informally along the banks of the main rivers, increasing potential flood risks.

- The output from the analysis processes no.3 and no.4.

The result of the first 4 processes of the conceptual framework makes it clear that while there are some areas of strength with regard to flood prevention in Xay district, overall, there are too many weak areas that need to be improved. The current situation is not sustainable implementation.

Furthermore, Xay District is still faced with substantial flood risk. The local government in Xay district needs to implement immediate assessment and planning (as discussed in Chapter 7, sections 7.2.1 and 7.2.2 – Plans for local government practices that rely on structural and non-structural methods for LRFRM), as well as implementing a structured process of LRFRM development for all cycles of the flood life (as discussed in Section 7.3 – Local government process for LRFRM).

To mitigate or avoid the risks of flooding, the local government needs to prepare itself for future flood response and damage mitigation by implementing LRFRM and the ‘build back better’ concept.

7.4.3. The outcome of the conceptual framework of this study.

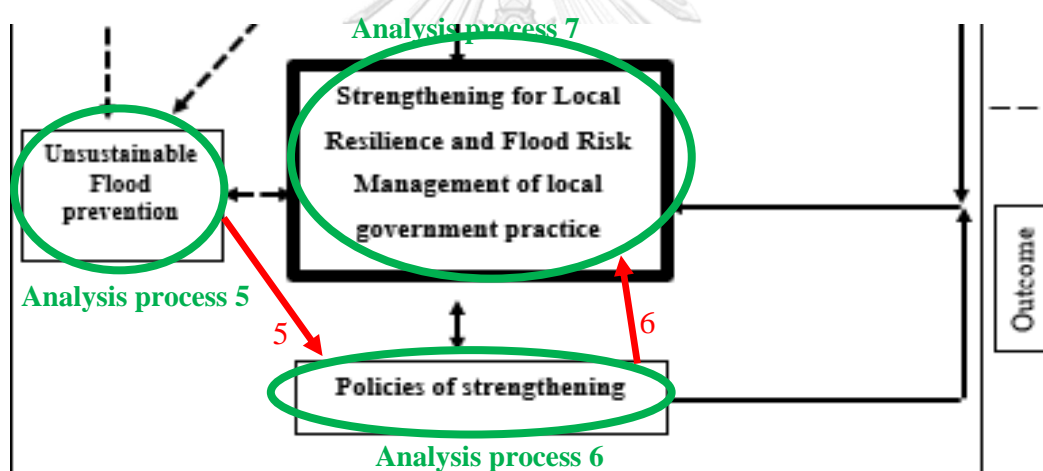


Figure 7.27: Analysis process 5, 6, and 7 of the conceptual framework.

- Analysis process 5: Unsustainable flood prevention

Evidence to prove for analysis process 5: Unsustainable flood prevention. It comes from the review, data analysis, results of finding and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample villages studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district, third, go back to visit the field of the case study (again). Thus, the detail as follows:

This process is linked to the results of analysis processes no. 1, no. 2, no. 3, and no. 4. It can display the case study still the unsustainable flood prevention and risk management from many factors and conditions because the Xay district still manages

some risks that depend on the Xay district conditions. Moreover, it tends to focus on them during flooding, with the relief activities as the primary focus of action.

Both local government agencies and villagers have weak flood risk management, combined with an absence of flood management factors. The consequence of this situation is unsustainable for Xay district, and assessment and initial preparedness for many risks are immediate needs. However, opportunities for improvement and development exist now and, in the future, and the local government will be able to develop plans that involve external partners and multiple sources of funding.

- Analysis process 6: Policies for strengthening the local resilience against flood risks.

Evidence to prove for analysis process 6: Policies for strengthening the local resilience against flood risks. It comes from the review, data analysis, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample villages studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district (From all questions of Appendix A, but especially, focus the question number question number 3.1.1 Does the local government have policies, plans for flood risk management for new development and strengthening the local government practice? and the question number question number 3.1.2 How effective has the enforcement of these policies, plans been as it relates to regular updates, and prioritization?), third, go back to visit the field of the case study (again). Fourth, interview with 14 expert respondents for different aspects of the local to the national level. Fifth, three times' meetings of focus group discussions to confirmation at the Xay district, and sixth, confirm by the WhatsApp group chat until present with interesting respondents who live in the Xay district (It is like the third party to confirm again and again). Thus, the detail as follows:

When the national government has an overview of disaster law, that means a policy to support this issue is developed at the central level. After that, the local government at the Xay district level needs to details for the unique local conditions so that it can find suitable solutions, based on LRFRM. These solutions should ensure that the specific flood organization knows about the flood risks from the analysis processes nos.1 to 5. Furthermore, analysis process no. 6 focuses on development of policies in order to improve and strengthen the local government practices.

Initially, the priorities for this work need to be arranged. Show off in the action by expanding the central policy of the national government to specific policies aimed at strengthening the local government practices. This can happen through either a top-down approach or interactive bottom-up approach, as appropriate to the local government in the Xay district. The overall goal is the optimization of the 26 LRFRM factors. However, while the local government may take the lead in this effort, it can encourage the local community organizations and local villagers to participate, and to

diligently follow and enforce regulations designed to control this work and promote participation.

- Analysis process 7: Strengthening the local resilience and flood risk management (LRFRM) for sustainable practices by local government.

Evidence to prove for analysis process 7: Strengthening the local resilience and flood risk management (LRFRM) for sustainable practices by local government. It comes from the review, data analysis, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district (From all questions of Appendix A, but especially, focus the question number 3.1.3 Does the local government have any structural or hard engineering method for flood risk prevention to help local people?; 3.1.4 Does the local government have any non-structural or soft engineering methods for flood risk prevention to help local people?; 3.1.5 How does the local government cope with flood risk management for the resilient concept of the Xay district? and 3.1.6 How does the local government develop all necessary factors to strengthening flood risk management for the resilient concept in the future?), third, go back to visit the field of the case study (again). Fourth, interview with 14 expert respondents for different aspects of the local to the national level. Fifth, three times' meetings of focus group discussions to confirmation at the Xay district, and sixth, confirm by the WhatsApp group chat until present with interesting respondents who live in the Xay district (It is like the third party to confirm again and again). Thus, the detail as follows:

In seeking to analyze the ability to strengthen the LRFRM of local government practice, this analysis process combines many results. If the local government in Xay district can solve the problems and improve support for those items found lacking in the analysis processes nos.1 to 6, then, those factors will be extremely useful for the local government to use in its efforts to strengthen the LRFRM of the Xay district. Nowadays, the Xay district stills manages; the authorities plan but do not have sufficient budget, modern technological tools, or other important resources. Local governmental staff have no had sufficient knowledge, throughout the Xay district, for efficient management up to this point.

The conceptual solution builds on the analysis process no. 6 of strengthening policies, and tries to encourage process no. 7, which is strengthening of local resilience and flood risk management (LRFRM) of local government practice by promoting some ideas for further preparation and study for the perfect solution in the Xay district.

Results from all analysis processes can point to actions that should be undertaken before, during, and after floods. If the local government and local villagers perform various functions that comprise the 26 factors of LRFRM, that will strengthen local government action and assure a better future. Such actions include: assessing the needs and capability of the local government and local villagers, enhancing

preparedness for flood emergencies, raising flood awareness through education at primary schools to university, managing flood map information for future reference, routine training and practice for capacity-building, networking, monitoring and reporting with helpful local governmental staff, obtaining modern tools and sufficient numbers of rescue vehicles, allocating budgets, and planning with all levels of government to provide support with multi-resource mobilization.

- The outcomes of conceptual framework for this study.

The outcome analysis emphasizes the analysis processes no. 5, no 6, and no. 7. However, demand analysis is still linked with the analysis processes nos.1 to 4. Overall, the goal of this study is to identify methods that are right and suitable for local resilience and flood risk management (LRFRM) in the Xay district. The local government practice needs to apply today's preparedness to manage present and future risks.

The outcome of strengthening local government practice to enhance LRFRM is that authorities and residents understand risks at the site, including the role of flood risk management policy in managing the risk. The risk assessment shall begin with the database collection, and provide reports that set out the findings, conclusions, and recommendations using every resource that the local government has. The policies on 26 factors shall be considered within the priority. The flood risk assessment plan shall enable further steps in the design, plans, construction, and installation to be undertaken.

The outcome of this study points to the vital point that LRFRM is needed in the Xay district as it will lead to continuity of plans and policies, and support flood risk management through readiness, preparation, response and prevention rather than the past practices, which have been focused primarily on mitigation and recovery. The emphasis on the 'build back better' philosophy will enhance the resilience concept, enhancing the sustainable long-term action taken before future flood events occur.

7.5 The conclusion of Chapter VII: Result 4 - Opportunities for improving the Xay district local government's flood risk management practices

What would a successful outcome of this analysis look like? The Xay district embraces local resilience and flood risk management (LRFRM). The local government encourages individuals and organizations to contribute financial and technical assistance, equipment, vehicles, advice, and other incentives to LRFRM. It also focuses on developing human resources and applying modern technologies. The local government may also set the strictest legislation for flood management. After that, they need to plan for following and action together. Then, routine action because the local government could improve from some current weak points by solving them and developing flood risk management for the future. Land in the Xay district to be used for the flood retention ponds can be allocated in order to store floodwater before it is discharged at the proper time. The local government might also prepare a manual for use at the local level to help residents understand the importance of making plans, monitoring, and evaluating results in the short, medium, and long term. Such a manual would also encourage participation by the local residents, and try to point out the

structural and non-structural methods used to achieve the goals within the district's sufficiency budget. The authorities may also prioritize the factors of LRFRM, based on which factors might be most essential. Moreover, fill the gaps between the local government practices and participate with local residents and other stakeholders for flood risk management in all three periods (e.g., before, during, and after flooding). A detailed summary of the 26 factors comprising LRFRM is provided in Table 7.1- Summary of strengthening the factors for local resilience and flood risk management (LRFRM) in the Xay district).

Furthermore, there are plans for the local government to utilize structural methods for flood risk prevention. The issues related to discharge capacity and the river management of the Kor River will be solved through dredging, excavation, and improving embankments, along with lowland and bank protection from erosion and slope issues during the flood. The solution to the drainage capacity of urban areas relies on flood water conveyance, with water flowing efficiently downstream to lower water levels in the urban areas of Xay district. The Kor River shortcut plan in the downstream village of Longkorduea will help optimize discharge capacity. The riverside park and flap gates offer more structural methods for flood risk management, as is true of the plan for adapting seven existing bridges and one weir to better support discharge conditions.

There are also plans for implementing non-structural methods. For measurement of flood severity, many urban planning factors, flood zoning, laws-regulation enforcement, and early warning systems might be considered in preparing for the future. Four scenarios are available for reduction of flood damage, and it is up to the local authorities in Xay district to adopt the appropriate flood control. After that, they need to require participation from all stakeholders, which is necessary for establishing a plan for the Xay district drainage system that will receive broad support and effective implementation. The Xay district, which is located at the confluence of three rivers (the Kor, Mao, and Hin rivers), has a relatively narrow of the river channel. The Kor River retention option would generally be installed in the lateral zone beside the rivers to stock flood volume and decrease peak flood, using methods such as "off-line storage" and "monkey cheek." The lateral weir effect on the reduction of peak flood will be determined by the lateral weir's location, with overflow going into the retention pond. More green infrastructure is planned with two riverside parks that will have an effect on the urban planning dimension of the LRFRM.

The Local government in the Xay district's Process for the local resilience and flood risk management (LRFRM) in flood life cycles

For preparedness before the flood occurs, LRFRM might outline plans and measures for preventing and reducing flood risks, which should include the following:

- 1) Flood data collection and risk inventory.
- 2) Identification of risk areas. The specific flood management organization such as DDPCC at each level shall consider the natural characteristics of risk areas.
- 3) Flood risk mapping at each level involves collaboration with the relevant sectors.
- 4) The establishment of a flood-risk information system builds the necessary tools.
- 5) Accessibility and application of information and data.

- 6) Flood risk assessment evaluates the level of risk.
- 7) Flood risk reduction includes measures and mobilization to prevent possible events.
- 8) Resilient flood preparedness and response plans rely on a process of preparing, planning, and setting up measures.
- 9) The local government gives an accurate and timely early flood warning through a notification and declaration of a surveillance area through media broadcasting and other means to allow the local residents sufficient time to prepare for the coming flood.
- 10) A flood evacuation notice means to issue a notification to the residents and businesses in the local areas.

The process for the resilient flood control during the emergency may limit the impact of several floods:

- 1) Safety assurance of the specific flood management organization at each level.
- 2) Immediate and timely flood emergency relief where the flood occurs.
- 3) Team search and rescue for flood victims at the time of a flood occurring.
- 4) Rapid flood damage and needs assessment in the areas where the flood occurs.
- 5) The local government may repair essential infrastructure.
- 6) Declaration of a state of emergency by the local government of a flood-affected area.
- 7) Cancellation of the state of emergency in flood-affected areas. The local government shall announce cancellation of a state of emergency in a flood-affected area within their areas of responsibility after the flood has ended, based on a relevant specific flood management organization's proposal.

The process for the resilient post-flood recovery activities is focused on rapid rebuilding and restoring the livelihoods of people affected by the flood disaster:

- 1) The local government practice of post-flood needs assessment evaluates the level of damage and need for reconstructing infrastructure affected by a flood.
- 2) Flood recovery planning may be based on the results of a post-flood needs assessment for livelihood restoration and rehabilitation with participation of the local governments.
- 3) Flood recovery action by the local government where the flood occurred may proactively lead to implementing the approved flood recovery plan in collaboration with all stakeholders.
- 4) Monitoring and evaluating flood recovery shall be done proactively in collaboration with the local government, and reports shall be made to all levels of government levels and all relevant policymakers.

There is a conceptual framework to reach the solutions proposed in this study. The analysis relies on 7 processes.

- The input of conceptual frameworks

Analysis process no.1 has its foundation in the joint practices of the local government and local community. Analysis process no.1 can be summarized by regarding the two ways of interaction of the local government practice with the 26 factors of LRFRM in conjunction with the practices of the local communities (upstream, midstream, and downstream villages) (representative samples). Results indicate that the current interaction between the local authorities and the local communities is less than perfect, and that obstruction is actually practiced on both sides. The local government's implementation in Xay district was often not impressive, and may not have earned the confidence of local residents. However, it's also true that the local residents did not participate fully in flood risk management efforts.

Analysis process no.2 focuses on strengthening all stakeholders' practices. From reviewing the practices of local government and the local community, it can be concluded (from Chapter 6, Section 6.1.1- Current factors for local resilience and flood risk management in the Xay district section) that, from 26 factors that comprise LRFRM, Xay District has strength in 4 of the factors, but exhibits weakness in the remaining 22 of the factors, a situation that needs to be improve in the future if the local government wants to enhance its local resilience and flood risk management (LRFRM) in the Xay district. Moreover, the local government should understand the reasons for developing the 26 fundamental factors (details from Chapter 6, Section 6.1.1- Current factors for local resilience flood management in the Xay district). One issue is that the participation between the local government and local villagers typically does not last beyond the short-time effect when the most local people act and follow the local government orders. However, sustainable long-term action is necessary for strengthening; actions need to continue beyond the immediate recovery and even through the dry season, with as much emphasis on preparation and prevention of future flood disasters as there is on recovery from the latest one.

- The output of the conceptual framework

Analysis process no.3: LRFRM analysis (before, during, and after). It can result from the conceptual framework's Input and insert data support for this study. The key to improvement in analysis process no. 3 is that the local government and residents work together to assess and improve the 26 factors comprising the LRFRM concept in all of the flood cycle periods. During the flooding, the local government should practice emergency procedures and have various teams conduct search and rescue operations. The early alert information is essential to help the locals and to prepare the necessary items for flood relief. Before the flood occurs, both the local government and local residents must participate in impact data collection and analysis of past flood events, create plans and survey safe elevated areas and evacuation routes, and store food and drinking water. After the flood, the local authorities can take care of data collection, but further action may be constrained by lack of funds. It is important that this limitation be overcome, as the long-term recovery and reconstruction under the LRFRM concept in the Xay district requires the wherewithal to implement the 'build back better'

concept. The local government has failed to effectively develop the needed capacity with respect to the 26 factors that comprise LRFRM. This is not sustainable; the local authorities need to start immediately to prepare for the future.

Analysis process no. 4. Many potential risks of floods, such as extreme weather and climate change, cannot be completely eliminated. However, steps that can and should be taken to mitigate risks. The district has an urban area located near the confluence of three rivers that makes insufficient use of protective dykes, reforestation, and reservoirs along with management of the risk points in rivers. The situation is exacerbated by poorly functioning water control gates, and narrow and shallow natural channels to drain floodwater.

- The outcome of the conceptual framework of this study

Analysis process 5: The Xay district still the unsustainable flood management from many factors and conditions. Moreover, it tends to focus on them during flooding, with relief activities as the primary focus of action. Both local government agencies and villagers have weak flood risk management, combined with an absence of flood management factors. The consequences of this situation are unsustainable for Xay district, and assessment and initial preparedness for many risks are immediate needs.

Analysis process 6 covers the policies of strengthening. When the national government has an overview of disaster law, that means a policy to support this issue is developed at the central level. After that, the local government at the Xay district level needs to details for the unique local conditions, so that it can find suitable solutions, based on LRFRM. These solutions should ensure that the specific flood organization knows about the flood risks from the analysis processes nos.1 to 5. Furthermore, analysis process no. 6 focuses on development of policies in order to improve and strengthen the local government practices.

Initially, the priorities for this work need to be arranged. Show off in the action by expanding the central policy of the national government to specific policies aimed at strengthening the local government practices. This can happen through either a top-down approach or interactive bottom-up approach, as appropriate to the local government in the Xay district. The overall goal is the optimization of the 26 LRFRM factors.

Analysis process 7. The local government in Xay district needs to finish plans and move onto the process of implementation as soon as possible (this is discussed in Chapter 7, sections 7.2.1 and 7.2.2 - Plans for local government practices with structural and non-structural methods for local resilience and flood risk management (LRFRM) in the Xay district, and Section 7.3 - local government's process for the LRFRM in all cycles of flood life). Improved understanding is required for mitigating and responding to risks. Moreover, the local resilient concept that relies on a 'build back better' philosophy for mitigating future flood risks is critical to success in the next step.

It shows that, in seeking to analyze the ability to strengthen the LRFRM of local government practice, this analysis process combines many results. If the local government in Xay district can solve the problems and improve support for those items found lacking in the analysis processes nos.1 to 6. Then, those factors will be extremely useful for the local government to use in its efforts to strengthen the LRFRM of the Xay district. Nowadays, the authorities plan but do not have sufficient budget, modern technological tools, or other important resources. Local governmental staff have no had sufficient knowledge, throughout the Xay district, for efficient management up to this point. Results from all analysis processes can point to actions that should be undertaken before, during, and after floods. If the local government and local villagers perform various functions that comprise the 26 factors of LRFRM, that will strengthen local government action and assure a better future. Such actions should result in strengthening local government to ensure preparedness, readiness for flood emergencies and flood awareness at all levels, including support with multi resource mobilization. Overall, the goal of this study is to identify methods that are right and suitable for local resilience and flood risk management (LRFRM) in the Xay district. The local government practice needs to apply today's preparedness to manage present and future risks. The outcome of strengthening local government practice to enhance LRFRM is that authorities and residents understand risks at the site, including the role of flood risk management policy in managing the risk. The policies on 26 factors shall considered relevant within the best priority.

The outcome of this study points to the vital point that LRFRM is needed in the Xay district as it will lead to continuity of plans and policies, and support flood risk management through readiness, preparation, response and prevention rather than the past practices, which have been focused primarily on mitigation and recovery. The emphasis on the 'build back better' philosophy will enhance the local resilience concept, enhancing the sustainable long-term action taken before future flood events occur.

CHAPTER VIII

CONCLUSION AND RECOMMENDATIONS

This research has been carried out to study the flood risks affecting local government practices of Xay district in the Lao PDR in order to review the risks faced in the past and learn from them, assess the local government practice to solve the risks, and develop a conceptual framework model of strength for the local government practices based on creating local resilience and flood risk management. The study conclusions and recommendations are offered in this chapter.

8.1. The flood risk management in Xay district

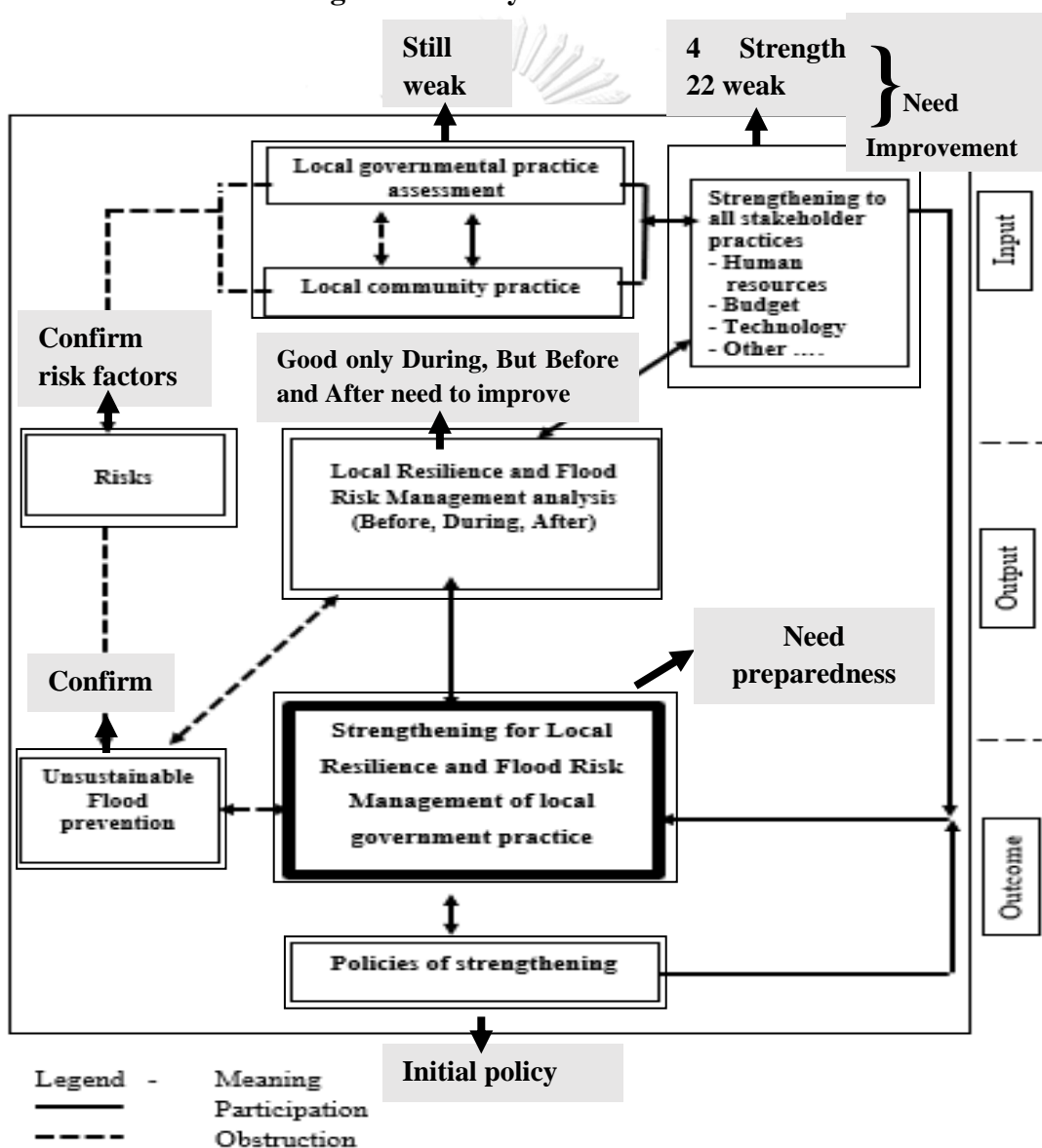


Figure 8.1: The conclusions derived from the conceptual framework of this study.

According to Figure 8.1, many results of the study prove the LRFRM concept in the case Xay district.

The first proof comes from desk study and literature study (ADPC, 2010), which shows that more than 200 mm of rain falls in the Xay district in two days, floods occur. This was confirmed by the field visit for the case study. Currently, poor river improvement management still exists in the Xay district. A clear need is to focus on increasing the Kor River's flood discharge capacity, at the confluence of three rivers, at locations upstream from the business district. The Xay district's urban area geography comprises a low-lying area, flat and composite, with two tributaries -- the Mao River and Hin River -- and many canals flowing down to the Kor River. Thus, it is proven that it is necessary to "confirm risk factors and unsustainable flood prevention".

The second proof comes from interviews with 25 individual respondents throughout the Xay district and representatives of three sample villages. It seems the local government practice and 3 samples of local community participation confirm "still weak participation" based on the finding that they act only in the short time during a flash flood, but that, after that, when the time comes for post-flood action and before another flood occurs, the local government and local people still fail to be proactive about flood risk management. For example, locals were found to be intruding into river conservation areas that are controlled by the urban planning law, land law, and water resource law. However, locals have always acted illegally with respect to this point; they would fill the land in these areas even though it was prohibited by the local government. The local people still produce waste and allow it to block the main river and watercourses; this changes the natural water flow.

Clearly, the local people and the local government still have some gaps that require solutions in the future. Nonetheless, the 25 individual interviews confirmed the presence of four strength factors of the LRFRM concept in the Xay district and twenty-two weak factors that "need improvement" in future preparedness. In particular, bolstering the weak points is essential to improvement. For instance, only during the flash flood did the local government set up a specific flood relief committee and many teams to help the flood victims. Teams also helped locals to relocate household items and to clean affected houses. So, the finding confirms the local government "pays attention during the flash flood more than during the post-flood action and before the flood in the long-term". Moreover, the local government is concerned about the time processes of the emergency action taken to respond with early help or late practice during the flooding in order to implement response procedures and plans for flood emergencies.

The third proof involved going back to visit the field of the case study (again) in order to prove the data analysis.

The fourth proof comprised interview with 14 expert respondents, which helped to confirm analysis of data collected from three different levels -- the national level, provincial level, the local level.

For the fifth proof, three separate focus group discussions were held at the Xay district. These focus groups suggested the policies of strengthening the "initial policy" for flood management in the Xay district, which, in turn, suggests a discussion on how to strengthen local resilience and flood risk management of local government practice "need for preparedness."

The sixth proof comes in the form of a WhatsApp group chat that is ongoing until the present time with interested respondents who live in the Xay district, allowing them to reconfirm the studies finding.

After the great flash flood in 2017, the local government and local people in Xay district attempted unsuccessfully to rely on previous rainy season experiences for managing flash flood risks. They need a new approach that prioritizes preparedness based on local resilience and flood risk management (LRFRM), combined with high awareness and early flood information.

This study concludes that the local government's practices with respect to LRFRM in the case study. e.g., the local government of Xay district and three sample villages located upstream, midstream, and downstream. The results show many weaknesses exist among the 26 factors that comprise LRFRM in the context of the abnormal weather situations that affect implementation of management strategies. The study also finds that the leading natural causes of flash flooding relate primarily to insufficient discharge capacity of the Kor River and tributaries. The urban area in particular suffers from lack of drainage capacity, and, during the heavy rainfall patterns of extreme events, the result is bank erosion of rivers, unmitigated due to the lack of river improvement.

The study also found that, in assessing the 26 total factors that comprise LRFRM. The Xay district had eighteen factors in place, while eight factors were missing altogether. However, despite the presence of these twenty-six factors, they are not uniformly well developed and implemented; there are four strength factors and twenty-two weak factors out of the 26 total factors (detailed in Chapter 6, section 6.1.1.) The use of LRFRM is adversely affected by the local government's lack of strict regulation and frequent poor interaction with local villagers in some risk areas; clearly, there is some level of inability of the local government to handle such problems. Eventually, effective adoption and implementation of LRFRM will depend on improvement in these areas and effectively encouraging local community participation in the Xay district's flood risk management efforts.

The local government was found to have insufficient investment in human resource development, and did not have enough specific technical capacity to apply the appropriate technology. They had only a few staff working on this issue. Generally, the focus is on short-term implementation of relief action, which occur immediately flood response plans are developed. Nevertheless, once the immediate recovery has taken place, the authorities are not doing enough to prepare for the long term. This lack of long-term proactive vision is a problem. A change in focus to include proactive planning and adoption of a 'build back better' approach would ensure the sustainable development aspects of policymakers' decisions, and the resultant actions would give local people reason to believe in the leadership and vision of the local authorities. If the local government wants to adopt the LRFRM concept in the future, with its need to improve and support all 26 factors and integrate them into the policies, plans for structure and non-structure methods, then a total commitment to this new direction is required.

Flash flooding is usually an annual event along the Kor River and its tributaries due to monsoon rains during the wet season and the inadequate river channel capacity, which lead to enormous flood risks in Xay district. In addition to this, debris flow and sediments add to the flood damage due to lack of infrastructure for flood control and

river channel capacity. Therefore, there needs to be consistent implementation of structural and non-structural measures. Infrastructure for LRFMR in urban areas, such as dikes, bank-protection, floodgates, and on-line & off-line retention ponds for flood control, have not installed along the Kor River and its basin. Also, inadequate and old street inlets, side ditches on the roads, and drainage frequently generate a pluvial flood in the urban area. Some areas without flap gates for the drainage outlets can also be affected by backwater from the river when it floods.

Urban planning management is needed to implement LRFMR in the near future. Local governments need to exercise control, and manage land-use and urban development, which depends on establishing an effective urban plan. However, the Xay district has historically operated with a low budget for management, operation, and maintenance that is insufficient to its needs. This can be solved by allocating more money for maintenance and management from both the local government and national government levels.

The flood mitigating measures and the updated flood risk assessment show that, with a combination of downstream, midstream, and upstream measures, flood risk can be substantially reduced in the urban area of the Xay district. The immediate solution for reducing the flood risk is increasing the Kor River's discharge capacity downstream of the confluence of the three rivers. This discharge capacity is currently limited, as the flow has to squeeze through the narrow river profile at the Xay district center. At extreme flow conditions of the Kor, Hin, and Mao rivers, the combined inflow exceeds this capacity; hence, flooding occurs.

8.2. Assessment of current local government practices.

From the results, the local government needs to improve all 26 factors (especially for eight missing factors and the twenty-two weak factors) and set stricter enforcement of laws and regulations for the LRFMR. Then, it is important to make plans to implement routine structural and non-structural methods and practices. Moreover, the local government needs to allocate a sufficient budget, acquire modern technological tools, and implement training for the local government staff that will lead to capacity building in concern with local residents' participation.

The local government needs to implement effective management of the flood zones, dams, reservoirs, and retention ponds to stock a large amount of floodwater before it is discharged to natural rivers at appropriate times. The critical point is to negotiate with the local residents in order to arrange appropriate use of land for long-term conservation and flood retention ponds. This may require that some local households be resettled from high-risk areas, which would then be converted to public land.

The local government must integrate the many urban development programs in the future. One step in this process would be to make a LRFMR and prevention manual for local government and local people to use; it could provide guidance for making plans, and monitoring and assessing outcomes; this needs to happen with short-, medium-, and long-term objectives in mind, and needs to account for actions being taken before, during, and after floods occur. Duties should be assigned to all

stakeholders such as the local government, local residents, youth volunteers, police-military deployments, and all villages in high-risk areas within the district. These stakeholders can fill the gaps of SWOT analysis that mention in (chapter 6- section: 6.2 SWOT data analysis of the local government practices) between the local government's practices and full implementation of LRFRM as it relates to urban drainage improvement, waste management, strict urban planning management, land conflict resolution. The result should be sustainable management of this district with less flooding. If all stakeholders participate, that means in the final outcome of LRFRM will be sustainable action. In the long term, the local people will continue the LRFRM plans.

As part of this coordinated plan, the upstream village might allocate villagers' land for sustainable uses, and take other actions such as regulating the use of the forest. However, it may also be necessary to invest in more infrastructure. The plan may require a reservoir or a dam to be built. These are expensive and complicated actions; there may be possible points of concern regarding economic cost, or social and environmental impact. At midstream, the village is protecting the district area by absorbing peak floodwaters and increasing the amount of water in irrigated flood plains, and by regulating urban development and land-use. The downstream village has to protect essential zones, and manage flood ways around the area. The other component is the development of a database, prediction tools, and early warning systems. Furthermore, it is essential to establish a specific flood management organization and promote public awareness, participation, and support of the local government.

8.3. Strengthening local governmental agencies through the application of LRFRM

The local government practices for resilient action make use of both the bottom-up and top-down approaches (that means all stakeholder participation). Furthermore, it also means a commitment to enhancing and integrating all 26 factors of LRFRM, and the early warning and alert system for the long-term. Certain measures, such as building concrete canals for improved discharge must be undertaken. Also, non-structural strategies such as increased participation, awareness, and education are essential parts of the effort, and must be followed by serious action, starting with early evaluation, leading to implementation.

The strengthening of the local government practices to achieve LRFRM means that the local government has to invest more in human resource development and apply the appropriate technology in Xay district. Generally, the local authorities have focused mostly on a short-term implementation in LRFRM. However, to make real progress, they need to be more proactive and consider the need for sustainable practices with respect to nature conservation and management plans. Furthermore, their policy decision-makers and routine actions of local government practice need to demonstrate increased attention to the functional features of capacity that should go hand in hand with strengthening, which is more technical in focus if capacity gains are deep-rooted

and based in sustainable action. The study indicates that the focus on early warning technical capacity remains strong in capacity improvement for LRFRM activities.

Xay district shows that strengthening and enabling the environmental plan for effective LRFRM can emerge in many forms beyond creating LRFRM structures and skills. Activities can be aimed at strengthening advocacy mechanisms, encouraging at all local government levels, generating support for good practice, reducing cultural barriers, and demonstrating alternatives for local livelihood.

The concept of implementing the river profile improvement plans contributes to improving discharge capacity downstream, through dredging and river channel enlargement of bottlenecks, together with dealing with sedimentation in the river bed. Moreover, the erosion process can be prevented in all seasons. If possible, using the shortcut at the meandering point will improve discharge capacity and be suitable for the Xay district.

With respect to LRFRM, a key point of flood risk reduction is mitigation of risks of damage to local villagers, built infrastructure, and agricultural lands, as well as any other urban or rural assets that directly or indirectly contribute to local society, economy, environment, and livelihoods in Xay district. Flood risk reduction policies also need to comprise a harmonization of structural and non-structural measures with short, medium, and long-term measures carried out in each time scale (before, during and after flooding). The proposed flood-risk reduction programs for the Xay district have a number of elements, as follows:

- Reduction of the risk and the local likelihood of flash floods.
- Promotion of local resilience and flood risk management (LRFRM) in the Xay district.
- Consideration of opportunities to work with natural processes and, where possible, design dual-purpose facilities delivering multiple benefits from LRFRM.
- Routine flash flood risk communication, awareness-raising, and emergency response.

8.4 Discussion

In the discussion for this study, four methods were used for data collection: the first method was desk review, the second involved direct observations in the field, and the third & fourth methods comprised semi-structured interviews with two groups, with the fourth, in particular, including three separate sets of focus group discussion.

Data analysis was followed by a qualitative narrative analysis which involved listening to and recording the flood stories of the respondents. The data display was categorized in terms of comparison of differences, phenomena, and similarities, with supporting reasons revealed by informants, according to the conceptual framework of this study, culminating in a narrative description of the results.

The literature of the Department of Natural Resources and Environment in the Oudomxay Province (2020) mentioned that early warning systems and prediction

equipment (signs, signals, and networks) are important components of flash flood risk assessment because flash floods occur at the confluence of three rivers: the Kor, Hin, and Mao Rivers located upstream from the district. Because its geography features high surrounding mountains combined with a low-lying urban area, which is relatively flat and frequently experiences heavy rain during the rainy season, the river basin in the more significant part of the mountain area experiences flash flooding in the Xay district urban area. This flash flooding occurs rapidly in 4-6 hours, yet drainage takes between 2-3 days, adversely affecting the urban area as water is slowly discharged to another district (Lar district downstream of Kor River). So, the discussion suggests professional action for early warning by regular monitoring of rainfall data, and water levels, maintaining accurate early warning and alert systems, and sometimes combining those resources with the local residents' wisdom in some suitable areas. In addition, it may consider the previous data collection and analysis for how the local governments can warn about the flood risk and respond to flash flood events through coordination, planning, and provision of emergency rescue teams to help the flash flood victims. Moreover, the literature supports the resilience concept (UNISDR, 2017) and having or developing the ability to cope with the great floods.

The first finding of the study is that the concept of 'build back better' for Local Resilience and Flood Risk Management (LRFRM) for the Xay district has been effective in the past. After the great flood in 2017, the local government in the Xay district set up an early warning system sensor and equipment upstream of where the main Kor River flows down to the village. Since 2018, the village leader has been provided with the early flash flood warning information and distributes it to the local villagers. The local villagers are then able to prepare to move their families, and people can carry critical things from the low area to high safety areas. The local residents have adapted by using their previous experiences when coming into the rainy season. They know they need to prepare for flash flood mitigation and prevention. Furthermore, the early warning sensors system and equipment are still in place at 4 points throughout the Xay district. Thus, the next step in flood preparation suggests setting up many more places and using smartphones to track flash flood warnings in real-time. Extreme weather forecasting and monitoring are provided 24 hours a day and 365 days per year to encourage application of the Sendai framework, the annual UNISDR report of 2017 (UNISDR, 2017), and the 'build back better' concept for analyzing ways to adapt them for the Xay district condition. Particular attention needs to be paid to the time of the south tropical monsoon, from May to October (rainy season). During the monsoon, widespread storms and typhoons from the South China Sea cover the land and affect the Lao PDR and Xay district, resulting in widespread heavy rains. If there is more than 200 mm of rainfall accumulation in 2 days, it leads to flooding in risk areas (DMRH, 2017). Meteorology, hydrology, rainfall monitoring, and previous flood data collection seem crucial for the analysis and prediction of future floods. To improve the current flow monitoring data set in the Xay district area, new water level stations might be

installed on the Kor River, Mao River, and Hin River. These stations may help provide potential flow boundary condition data for flash flood modelling. This can be very helpful because the early warning system checks and shares important early alert information. More data can collect and cost-effective flood risk assessment carried out. Furthermore, according to the report on deforestation and forestry management in Xay district (Xay district's Agricultural and Forestry Office, 2019); (Forests & D, 2013), deforestation from locals' activities over the past few years Have led to agricultural lands being replaced by urbanization and land-use changes to agricultural fields. The geography of the upstream villages comprises mountainous areas with many canals. 56% of the local villagers practice farming, clearing the land for food plantations along the Kor River and surrounding lands. According to the village report, only around 40% of the forest remains. The Kor River's upstream section is relatively narrow, and there are no facilities for flash flood control within the basin. The embankment of the Kor River shows some signs of erosion, and sediment resulting from erosion has been deposited in the Xay district's downtown area, where the flow velocity is reduced. This could be attributed to insufficient cross-sectional flow in the downtown area. The discussion may need to assess geographical characteristics, improve the knowledge of Geographic Information Systems (GIS) for local government staff, and share in training and demonstrations from experts with the local people, and involve them in with routine exercises, especially in mountainous areas where flash floods are common. Recommended actions include reforestation of upstream river areas and the guarantee of financial credits to tree owners. It is also important to allocate new high-safety areas, and make plans for natural flood ponds from among the risk areas. The local government may prohibit deforestation, except as permitted by the local governmental offices. Furthermore, the land-use change pattern might do the zoning risk assessment that integrates flood management policy for the long run.

The literature of the Lao PDR national disaster management system is guided by a high-level inter-ministerial coordination mechanism, but essential responsibilities remain with the respective government agencies in a combined top-down and bottom-up interaction (UNESCAP, 2015). However, the Lao regime system (UNDP, 2005) mentions an assessment of the current flood risk management of the Xay district. So, the Lao local-level administrative system is decentralized. According to the 'Three-Builds Policy,' governance of flood management in Lao PDR is increasingly decentralized to the local government level (Aslam P et al., 2015).

With respect to the second finding of the study, this policy guidance defines a planning and budgeting framework, and seeks to increase the responsibilities of districts, and villages. The Xay district has become a planning and budgeting unit and the villages have become implementation units. This system may intend to devolve planning and budgeting responsibilities to district levels of public administration. It is suggested that a specialized local organization be set up at the Xay district level for the specific flood control. This entails moving from local government practice to inviting

participation of the local people in managing floods by building adaptive capacity within their areas in order to make society safer and minimize flood harm to local people's lives. There are many aspects involved in this. It is, of course, necessary to assist victims, helping them to mitigate impacts and quickly recover from flash flood shocks. It is also critical to integrate flood prevention and management into legal and economic frameworks from the villages to the district level as well as to update data collection and analysis on managing the flash flood risk plan, and making the resilience plan. There should be urgent meetings to address flood relief and report to high-level leaders who are decision-makers to find sensible solutions and to make policies. Many resources, such as finance, tools, vehicles, and programs for flood prevention need tangible support in every period.

Another literature report was reviewed about strengthening the capacity of ASEAN to implement risk-informed and shock-responsive social protection systems for resilience: Lao PDR case study. The District Disaster Prevention and Control Committee (DDPCC) office representative related that the office was responsible for overall coordination, including the declaration of a district of the emergency plan for flood response (WFP, 2019). It suggested a sufficient budget with modern flood risk management (Postek et al., 2019). Although the Xay district was under a different act with regard to tasks that included flood management, the DDPCC is a non-residential office of the third level in the national disaster management organization. The responsibilities among the different levels of government are effectively the same as those stated in the district administration organization act, with the Governor and Vice Governors in total control of the Xay district. Furthermore, the DDPCC committee is the main entity related to flood risk management and needs to meet twice monthly in non-flood periods, and as frequently as required during emergency events. The DDPCC is tasked with the essential functions of improving the district flood management plan and capturing specific risk areas. Additional responsibilities include responding to different flood risks in new areas, supplying emergency resources and shelters as needed, ensuring quick recovery of the medical, water, power, gas, roadways, telecommunications, and infrastructures, along with developing restoration plans and carrying out destruction assessment in relation to the local victims. The local government's responsibilities lead to recovery, which eventually leads to efforts to improve preparations for the next inevitable flood. The first action of the DDPCC office is to prepare before floods occur and implement all policies, strategies, plans, and programs for coping with flooding issues in every period. Furthermore, another responsibility is to write a proposal letter for help from national and international donors to the relief, with the aims of quicker recovery and building back better in an as short time as possible.

The local government may consider improving the Local Resilience and Flood Risk Management (LRFRM) policy and preparing specific flood regulations. The local government authorities should strengthen them by enforcing the regulations against the

illegal persons living in settlements along the Kor riverbank and serious practice should be the priority for precautionary flash flood prevention. In addition, the local government needs to integrate the responsible organization with other areas of government responsibility such as agricultural policy, public works-transportation, urban plan development, emergency management, and natural conservation. The attention of village leaders and leaders at all local government levels is needed. The village speaker system should be used as a tool for the early warning and protection of local residents. The policy of using the military and police together for intensive implementation is an excellent flood control activity. However, it is also a good idea to develop the human resources capacity of local government staff in meteorology, and hydrology. Likewise, the local government should secure the right person in the right job. Moreover, the local government has been preparing for budget sufficiency by establishing a specific flood fund in 2019; the local government has established the flood fund for the future, comprising 40,000 kips/a local governmental staff/a year from the government side. It has also encouraged the local community to participate more actively; however, the effort often results in the collection of bananas, coconuts, or other agricultural products and livestock to sell in the market; after that, the sale proceeds go into the flood fund. This idea might have been created by the local government to show off to the locals, who understand this concept. Once a program is established, management can be transferred to the local community for sustainable action. The money for the flood fund needs to come from many primary sources and alternative sources such as international organizations in order to pay for needed equipment and technology preparedness. The technologies and equipment (buoyancy aid tools, rescue resources, resuscitation devices, first aid kits, emergency communication devices, knives, whistles, helmet lights, light sticks, eye protection, torches, thermal protection, gloves, walking boots, crotch straps, reflective tape, throw lines) are necessary to flash flood risk mitigation, with smart technology being an important element to integrate into the LRFRM concept. The local government needs to disseminate knowledge to help facilitate flash flood resilience across the Xay district. It also needs to supply sufficient tools before the flood emergency events and year-round stock in the warehouse (especially, before the rainy season every year). and prepare rescue vehicles as part of its routine practices on LRFRM in the Xay district. The type and quantities of boats required are determined by the need to be driven upstream while carrying many persons. Good communications with the boats and crew also need to be established, and rescue personnel or flood victims who are using automatic inflating life jackets may need to have the life jacket put into manual inflation mode shortly before being transferred. The trucks and other vehicles must be suitable for carrying flood victims, personnel, and equipment. It would be ideal for the Xay district to have a helicopter for emergency use in order to access areas that are inaccessible to land vehicles and boats. The local government might supply enough rescue vehicles and routine exercises to simulate local government practices. Another

important activity that needs to be carried out before flooding occurs is that the local governmental must routinely coordinate cleaning of the canals, an essential factor for the improvement of drainage capability in urban areas, and the local authorities must encourage local peoples' participation. The local government has to clean the canal and dredge the main rivers like the Kor, Mao, and Hin Rivers, improving rainfall drainage. It also needs to improve the big canal around the PaSak village to handle the water that flows down from PhuoKeing Mountain and releases into the Kor River. The local government's focus is for all stakeholders to participate and have a practice plan before floods occur. All sectors need to participate in data analysis of flood impacts, and programs for prevention and quick recovery in every period. This should include quarterly, semi-annual, and annual reports to Xay district's governing authority. These reports can help identify solutions to problems that can be implemented before, during, and after flash flood events.

Assessment of flood risk management factors, and completion of a requirements checklist can be applied at the district level in order to assesses the local government's capacity for disaster risk reduction modelling as a tool to support natural hazard risk management, as was done in the Seoul Metropolitan area (Bae & Chang, 2019). It guided the integration of many components such as communication coordination, early warning systems, information sharing, risk-vulnerability assessment, training, and stakeholders. Moreover, the role of local government's engagement in flood management was analyzed through consideration of many factors. Resilience in flood-risk areas was seen as a critical component of flood management. Strengthening community resilience can balance structural measures for flood prevention (Torrens Resilience Institute, 2015). (Ishiwatari, 2012) mentioned desk studies, data collection, and analysis as prerequisites for the well-functioning local government act. It assessed the daily climate record, including maximum, and minimum rainfall statistics from 2008-2017 (Xay's Meteorological Station, 2019), abnormal weather, heavy rainfall, and statistical analysis for 10 years.

The third finding of this study leads to an assessment of the strengths and weaknesses of the current local government's flood management in the Xay district. Furthermore, consideration must be given to other factors, such as participation by local residents and other stakeholders, and how the local government has previously dealt with flood risk management (before, during, and after flood events). Thus, the third finding assessed the 26 total factors of the LRFRM concept. Of the 26 factors, 18 factors (69.23%) were found to be present in the current local government practices, while the remaining 8 factors (30.77%) were found to be absent. Nevertheless, this binary choice leaves out the qualitative issues of whether each factor is sufficiently developed or utilized. Therefore, the respondents were asked to rate each factor as a "strength" or a "weakness" in order to understand the adequacy of the LRFRM in the Xay district. The results identified four strength factors (15.39%) and 22 weak factors (84.61%), indicating strongly that there was much room for improvement going forward. The

simple presence or absence of LRFRM factors isn't sufficient. However, factor data analysis of response to floods and other challenges. Moreover, The Xay district area has a tropical monsoon climate that requires analysis of the effects of the rainy season and analysis of mountain conditions surrounding the Kor River Basin. Ideally, all 26 factors would be present if the local government planned to have completely sustainable management in the Xay district. Assessment of current local government action should improve all 26 factors (especially for the eight missing factors and the twenty-two weak factors) and set stricter enforcement of laws and regulations for the LRFRM concept. Again, the local government should allocate a sufficient budget, acquire modern technological tools, and implement training for the local government staff that will lead to capacity building in concert with local residents' participation.

The data used in Strength, Weakness, Opportunity, and Threat (SWOT) analysis) can act as a focus for resolving the gaps between the local government's practices and full implementation. It is essential to try to solve the weak points, such as low levels of technical knowledge among local government staff in the Xay district and lack of funds to repair public and private infrastructure damaged in big flood events, and to try to improve the twenty-two weak points of LRFRM identified by this study. Furthermore, the local government may prepare to prevent the threats. Some critical village infrastructure is currently located in flood-prone areas. Various ethnic groups live together, and the incoming external population from other provinces and abroad means that there are fewer areas for safe local residence in the Xay district, considering the unpredictable weather from climate change. Thus, the local government in the Xay district encourages opportunities to implement structural methods and non-structural practices to flood risk management. Some areas of wisdom and familiarity with the geographical characteristics of locals can be used in the LRFRM concept. The local government could promote reforestation for the locals by use of tree credits and other assurances. Again, the local government should support the strength factors such as political strength from the decentralized system that reallocates responsibilities from the national policies to local government, widening action, peace, and stability at the district level.

Another important point involves the power of regulations as an instrument of control over the local residents' practices. This suggests supporting flood map creation and analysis in the future, and it is essential for better understanding and high position levels of participation. Of particular importance is budget support for education, and distribution of information throughout the Xay district.

In pre-flood preparations and post-flood recovery, it is important to prioritize physical infrastructure functions based on building back better concept. Many people in flood-prone areas may build two-story houses so that they can move people and assets above the flood water level, if required.

Inside the LRFRM factors, four strength points of LRFRM were identified by the study: Meteorological and rainfall pattern assessment, early warning systems and

prediction types of equipment (sign, signal, network), flood shelter and victim center, establishing the various teams (medical, relief, security, transport), and recovery by following the 'build back better' concept.

The literature of (Mooney, 2015) discusses assessment of risk and impact information from past-related urban management. The urban area's terrain in the Xay district comprises low-lying areas which are high risk for flood hazards. Critical elements of risk management include the land-use plan (DPWT in Oudomxay province, Lao PDR, 2019) and assessment of the local residents' use of the land for flood management. Most local residents and villagers have settled in high density near the flood-prone areas beside the Kor, Mao, and Hin Rivers. The study found that the local government in the Xay district acted before floods occurred to use the early warning system to alert locals living in flood-risk areas to move to high safe areas, aware that the Xay district's terrain comprises both high mountain areas and low-lying areas. Local residents were encouraged by the local government to adopt, adapt, and prepare.

The local government sources rely on locals' knowledge for flood management prior to the arrival of the rainy season of June-October every year. The local government should pay attention to flood data collection. The data analysis can be critical to future preparedness. While the meteorological station of Xay district might provide data on past events in the form of maps demarcating flood zones and districts that had been hit in the past, the station needs to also provide a database of emergency situations concerning future events, reporting locations, times, and event types. Furthermore, they need to provide that all year, and the archive needs to be easily accessible at all times. Any website can prove to be an excellent guide to locating information sources that can include pictures and videos obtained from broadcast channels, newspapers, and residents, all of which are exceptionally revealing of flooding conditions. Data analysis indicates selection from raw data and storing in a database, categorizing different types of evidence like water stages, extent, speed, severity and type of damage, time, and duration of flash flooding. The information has been plotted in a GIS environment. Information technology provides powerful tools to support data analysis in various applications, and this information can be composed by virtually anyone with a smartphone. Using open-source software and potential flood management applications improves local community preparedness. The local government may use the flood fund for food, drinking water, and non-consumable items to be stored in the public warehouses. At least three days' worth of stored food and drinking water for the flood victims and rescue teams should be on hand. Elevated safety areas must be identified; evacuation procedures need to be in place, and the evacuation routes surveyed before the flash flooding occurs. Moreover, regular exercises of evacuation procedures should be carried out to train the local residents. Plans need to build up the knowledge of evacuation actions, and regular training for real evacuation. During the flood, the effectiveness of this preparation can be assessed

through measurement of emergency response time of local government action, emergency rescue, and time to help affected people.

During the flooding period, the local government visits flood victims at the shelters and sets up a flood relief committee and other various teams. Moreover, flood action procedures are divided into three periods: the first period (01-24 hours), the second period (24-72 hours), and the third period (72 hours to 7 days) for flood response action. The local government may review the actions taken during the previous flood and engage in relevant data analysis in order to learn from past mistakes and prepare for satisfactory readiness in the future. The role of local government should be to promote flood disaster recovery and reconstruction with the 'build back better' concept through resilience. This requires timely assessment during flash flood, rescue, and recovery. The local government should have the capacity to respond to flood events with complete coordination of information systems and existing forms of assistance, following the appropriate contingency plan. Time assessment involves assessing the earliest time for a rescue team to help in an emergency situation. Factors in the assessment include the availability of flood rescue teams that can mobilize to a local flood field early to be used in a supporting role, operating in remote areas that may be isolated by the flooding. It facilitates 24-hour support, based on 12-hour working shifts. The local government needs to set up a specific flood relief and mitigation committee, and many teams to help the flood victims. Moreover, the sub-rescue teams, such as the health team, relief team, transport team, security team, and others, must be deployed to help the flood victims in flooding areas. The local government might also set up a team to convince donors to provide the required relief money and make specific flood relief announcements throughout the Xay district. What's more, in the Xay district, the local government should provide a full range of pump solutions. Such solutions need to be flexible and they should be easy to place in a wide range of installations. Of critical importance, flood shelters and victim centers can help to reduce flooding impacts, save lives, and save property. These shelters can be used to manage relief and quick rehabilitation activities. Sometimes, the shelters can also be used as schools, public-private buildings, and local community centers when there is no flood. Xay district's disaster management plan from 2015-2019 (The Xay's DDPCC office, 2019) discusses data collection and analysis for managing the flood risk plan and making the resilience plan. The third finding of this study also focuses on local government practices to deal with the post-flood in the district, in particular, drainage improvement in urban areas and infrastructure enhancement of the Kor River and its tributaries. However, the local authorities only have limited funding to carry out the cleaning of canals and drainage systems, which is still not done routinely. Moreover, there were lessons learned from the great flood of 2017, such as that of the Napa village for flood risk area located in the southwest of the Xay district. The local government resettled the local people to new village areas. Furthermore, it supported the new village areas' master plan and comprehensive urban plan, provided technical assistance, and allocated funds to

support them. The local governments and stakeholders helped build newly elevated houses using the local resilience concept to build back better for enhanced preparedness to cope with flood in the future. After a flood occurs, the local government's practices suggest quick recovery of all infrastructure for flash flood prevention. The local government should try to obtain more funding from the central government and external organizations to promote and fund new construction with a 'build back better' approach. However, some wealthy local people live near the riverbank in the Xay district. The local government might encourage them to undertake best construction practices, with high embankments and flash flood protection, using their own funds and local government support the technical assistance. Additionally, the local government may upgrade and take strict action regarding the building code regulations to control flash flood risk in the Xay district. Comprehensive contingency plans to respond to flood events should be prepared appropriately and in a timely manner. These plans should integrate the LRFRM concept before, during, and after flood events and provide for good sources of access to real-time information on the flood situation and awareness of the local people as well.

One report mentioned some programs to support surveys, data collection, and analysis for the HEC-RAS program. Data analysis was used to simulate results after installation of a shortcut in the Xay district; it showed how to reduce water levels in the flooded area in the Kor River meander and contribute to rapid flood discharge from the urban area. Furthermore, a report of flood protection measure types (Frisco Project, 2019) divided actions into non-structural and structural prevention measures to be adapted for implementation. Another paper (Postek et al., 2019) provides guidelines for allocating a sufficient budget with modern flood management. The Sendai framework promotes applying the 'build back better' concept (UNISDR, 2017) and analyzing the role of local government's engagement in flood management from many factors (UNISDR, 2010), (Torrens Resilience Institute, 2015). In a report on nature-based solutions to address global societal challenges (Cohen-Shacham et al., 2016) it was found that green infrastructure can help filter, absorb, and reduce the speed of stormwater runoff, which reduces urban flooding in conjunction with Eco-River restoration patterns, overlapping site analysis for supporting Eco-green infrastructure elements, and trying to provide a clear basis for the important factors for land-use planning, and economy (Department of Public Works and Transport in Oudomxay province, 2020).

With respect to the fourth finding of this study, the local government in the Xay district plans a concept for solving the discharge capacity and river management of the Kor River. It is focused on increasing the Kor River's flood discharge capacity through dredging, excavation, and improvement of embankments, along with lowland and bank protection. Again, the heavy rainfall in the upstream basin leads to high discharges into rivers. Currently, the local government from the Xay district has an erosion protection project underway in some urban area for water discharge in the Kor River, especially

in the rainy season, to avoid flood risk in the future. The river's morphology comprises severe bottlenecks and sedimentation in the river cross-section because of poor management. Thus, widening and dredging of the river channel needs to be carried out. Therefore, integrating the river plan is required for the improvement of the flood control capabilities in the Xay district downtown area, and to strengthen the city's resilience in flash flood disasters.

The plans of the local government with respect to the Kor River, and considering the present condition, propose that various typical cross-sections be installed section by section, after considering hydraulic factors (water level, velocity, tractive force), slope, material, and function. The significant considerations in deciding on the channel training are as follows: conditions of the existing riverbanks, efficient protection from flood hazards, stability of the riverbanks, and connection with future development plans in the Xay district.

The concept of dike works could be a practical option. Dike construction along the rivers to protect the urban area could prevent the river's high-water level from overflowing the embankments in the urban area along the Kor River.

Preferably, channel capacity for flood conveyance would be secured in the river channel. Therefore, below the confluence of the three rivers, the Kor River's channel capacity would be sufficient to handle the flow of the flood waters downstream. So, the Kor River shortcut plan exists for the downstream (Longkorduea village) area in an effort to improve discharge capacity. The shortcut may contribute to rapid flood discharge from the urban area of the Xay district, with some reduction in flood damage.

The concept of building reservoirs to manage increasingly heavy rainfalls attributed to climate change may be an element of flood risk management in the area. There are plans to build reservoirs in the upstream area (Kornoy village) of the Kor River and Mao River in order to manage heavy water stock before discharging it downstream area. This is necessary because climate change is causing abnormal weather conditions, with large amounts of rainfall all at once in the river basin. The Kor River's current condition as it passes through Xay District is that it needs a sufficient discharge capacity to protect from heavy rain caused by climate change. Based on analysis, the construction of two reservoirs would result in reduction in damage annually. The local government suggests paying attention to the engineering infrastructure for significance; which requires both a sufficient budget and cost planning at the Xay district level. Construction work in flood-prone areas should be subject to review before work is commenced. Moreover, activities may be incorporated with the new construction to support the retention, storage, and drainage of water in the floodplain. New measures can contribute more to damage reduction than all the natural water retention measures and technical flood protection combined. The planning stages of further construction work should consider new construction methods that incorporate the need to maintain space for water. Thus, selecting the appropriate materials for the contingency construction for flood prevention is important. Risk reduction incorporates

a number of flood prevention measures, among which information and awareness play an essential role in LRFRM. Quality of infrastructure monitoring, maintenance, appropriate design, and adequate budget allocation for maintenance may require the local government to prepare a recovery strategy for infrastructure in the short term. This includes emergency maintenance of dikes, embankments, and erosion protection, with priority on critical sections of flood discharge capacity, which can be restored to stock conditions.

While flood mitigation or prevention measures and emergency response to flash flooding are important, of equal importance are medium-term recovery and improvement methods for long-term recovery needs (beyond two years), which require planning to implement routine structural and non-structural methods. The local government needs to implement effective management of the flood zones, reservoirs, and retention ponds to stock a large amount of floodwater before it is discharged to natural rivers at appropriate times. The critical point is to negotiate with the local residents along the Kor River in order to arrange the appropriate use of land for long-term conservation and flood retention ponds. This may require that some local households be resettled from high-risk areas, which would then be converted to public land. The local government must integrate many urban development programs in the future. One step in this process would be to make an LRFRM and prevention manual for local government and local people to use; it could provide guidance for making plans, monitoring and assessing outcomes. This needs to happen with short-, medium-, and long-term objectives in mind, and needs to account for actions being taken before, during, and after floods occur.

The implementation of LRFRM as it relates to urban drainage improvement, strict urban planning management, and land conflict resolution should result in sustainable management of this district with less flooding. If all stakeholders participate, that means the final outcome of LRFRM will be sustainable action. In the long term, the local people will continue the LRFRM plans. While urban plan practice assessment may restrict the urban plan regulations and building codes, it could also be used to prepare for the resilient concept of building back better after flood damage. The development of flood risk management seems to reflect broader social concerns in combination with the inevitability of many factors such as extreme weather, economic development, and population growth. In this sense, urban design initiatives focus on promoting a resilient build back better concept from flood in the Xay district.

Of course, the hard structural solutions (dikes, reservoirs, shortcuts, bypasses, and erosion protection) are generally inflexible, and once their capacity to prevent flooding is exceeded, that can be very expensive. Nevertheless, non-structural investments like acceptable urban and land-use planning practices before starting the developments, and preventing risky investments with good risk analysis are just as essential. The green infrastructure approach may offer a method and application that interconnects the network of natural areas and other functions. Furthermore, the local

government may update the policies for flood plains, and flood bypasses because of the link with many factors in the decision and identifies essential areas for land allocation. Furthermore, if the local government can maintain the routine, that is also crucial for the sustainable plan.

As per the fourth finding of this study, the specific flood control organization from the local government should be seen as the most important. The establishment of a community flood management committee played an essential role in flood risk management. A paper of systematizing community-based disaster risk management (CBDRM): case of an urban flood-prone community in a Thailand upstream area (Tanwattana, 2018) supported the notion that the discontinuity of local government actions in Thailand and Lao PDR were the similar. In both cases, the local governments practice emergency response after flooding occurs more so than establishing readiness before floods occur. A paper on resilience in flood risk management: a new communication tool (Govindarajulu, 2020) concerns the resilient infrastructure and built environments relate the strengthened capacity of institutions and actors in flood management.

Moreover, the budget should aim to provide efficiency; through allocations for equipment, and current information about the level of rainfall, the weather forecast, speed of distribution needs to be reliable. Awareness is a significant factor in flood risk management. The local government carried out education and training, especially among the local households located in flood risk areas along rivers, and when the local government repeated the message to locals, they complied.

In the Xay district, regulations did not act effectively in the form of specific flood control regulations. The local government required elaborate research and tried to promote local community participation together with the local government act and offered many choices for them. The Xay district had the water usage management regulation in the irrigation sector, but needed to develop the flood risk prevention in detail. The local governmental staff was concerned about how to use modern technologies, and they surveyed for field data collection before the rainy season to support flood risk indicators. However, the Xay district did not integrate official programs for flood awareness and education in the activities of all levels of the school system, although the village speaker system was found to be very useful compared with other devices, and is suited to local people's lifestyle.

The local government regulations are prepared based on LRFRM, and the local government also focuses on developing human resources, constructing infrastructure, researching, transferring scientific knowledge, and applying modern technologies in the future. It is important that local government leaders are assigned to undertake their roles, so they can arrange the priority of the LRFRM and prioritize the most essential factors (out of the 26 factors).

The local government may set the strictest legislation for flood management. After that, they need to plan for implementation and follow-up, along with regular

management and prevention. This includes the use of both structural methods and non-structural methods to accompany the human resources development considerations to help the local community. The local government suggests that flood awareness and education be integrated into schools, public places, and local communities at all levels from primary to university. They might implement regular exercises and simulations by local government staff with local community participation and disseminate relevant information to all media via many sources. The local government may the strengthening the policies and regulations that need to be part of the action plan, and serious practice should be the priority for precautionary flood prevention. The village speaker system should be used as a tool for the early warning and protection of local residents. Additionally, they need to have local governmental staff and local people with the skills to analyze problems, planning, and decision-making.

An action plan for disaster risk management mechanisms is expected to be developed at all governmental levels, including villages, and capacity enhancement can lead to sufficient flood readiness (Few et al., 2016). This research mentioned that, along with long-term strategies, policies, and planning continuing through greater collaboration with sustainable development goal (SDG), Goal 11 by make cities and human settlements inclusive, safe, resilient and sustainable (UNDP, 2015).

In accordance with the fourth finding of this study, preparedness before flooding occurs, flood data collection, identification of flood risk area are all responsibilities that lie at the local level. Flood risk assessment evaluates the historical flood occurrence and prediction of potential risk. The local government gives quick, accurate and timely early warning of expected flooding through notification and declaration of a surveillance area through media broadcasting in order to allow the local people to have enough time to prepare in advance to respond to potential floods.

During flooding, teams search for and rescue flood victims. At the appropriate level, the specific flood management organization shall collaborate with the local government to search for, rescue, and evacuate affected people to safer areas. Rapid flood damage and needs assessment is a necessity in the areas where the flood occurs. The local government has to take responsibility for repairing essential infrastructure needed to ensure that the initial emergency response can be undertaken effectively, based on the reality on the ground.

As result of discussion from synthesis and data analysis, it was found that the process for the local resilience post flood recovery activities relies on significant flood recovery planning based on the results of post-flood needs assessment. Flood recovery implementation by the local government where the flood occurred may proactively lead to implementing the approved flood recovery plan in collaboration with all stakeholders concerned with the 'build back better' concept of LRFRM.

After that, regular inspection, measurement, and monitoring of overall risks is essential. The local government practices should be founded on sustainable action using the bottom-up approach as appropriate. An effort should be made to combine all 26

factors of the LRFRM concept into the final action plans for the long-term with the prior inspection. The local government needs to make regular inspections as part of the flood management effort, and a clear action plan should follow in order to improve maintenance and preparedness against all risks, and to insure the effectiveness of the measurement and monitoring processes. The flood prevention practices and mitigation responsibilities for the operation should be regularly updated at the local level.

Every improvement, and development work along all sections of the flood defense, needs to be documented and integrated into new routines. In addition, flood risk mapping at each level requires collaboration between the relevant sectors and local authorities. This includes assessment and production of a flood risk map for the local people living in the areas of risk surveillance. Early risk inspections and post-event appraisals to 'build back better' contribute to good arrangements so that future events will be less harmful. Finally, contributions are also made through publications aimed at educating and creating awareness among the general public, the decision-makers, and local residents. The study put forward recommendation for all three cycles of flood life. Such as six actions to be taken before the flood: precautionary readiness, undertaking data collection and risk inventory analysis, implementing and maintaining the early warning system, developing and implementing policy and legislative improvement, enhancing the role of the local government and the village leader in resilience action, and defining the roles of all stakeholders – all of which are relevant to the period before the flash flood occurs.

Eight actions during the flood are critical: implementing emergency response measures; optimizing time management; setting up pumping stations and mobile pump management; managing evacuation, food, drinking water and medicine; establishing flood shelters; deploying various rescue teams; and making the emergency budget available. Six actions are critical after the flood for enhancement of resilience: adoption of 'build back better' capacity for the long-term; urban development planning, and land-use planning linked with local and external population increases; Land-use change restrictions and building codes considered by the local government; strengthening physical infrastructure; obtaining sufficient financing; and the sustainable action of local government practice for LRFRM. More detail on recommendations can be seen in section 8.5 (Recommendations) of the next section.

If the local government and local villagers perform various functions that comprise the 26 factors of LRFRM, that may strengthen local government action and assure a better future. This can happen through an interactive bottom-up approach, as appropriate to the local government in the Xay district. The outcome of strengthening local government practice to enhance LRFRM might be that authorities and local residents understand risks at the site. The flood risk assessment plan shall enable further steps in the design, planning, construction, and installation to be undertaken. This study points to the vital point that LRFRM is needed in the Xay district as it will lead to continuity of plans and policies, and support flood risk management through readiness,

preparation, response and prevention rather than the past practices, which have been focused primarily on post flood damage mitigation. The emphasis on the ‘build back better’ philosophy may enhance the resilience concept, enhancing the sustainable long-term action taken before future flood events occur.

8.5 Recommendations

8.5.1 Recommendations for action before the flood.

For the case of Xay district. It is recommended that the primary short-term action of the local government be to strengthen the 26 factors of LRFRM. The local authorities should consistently develop and update the long-term action plan for local government practices and sustainable participation of local residents and community organizations. Local resilience is a crucial concept related to many supporting factors.

- Recommendation for action before the flood No 1: the precautionary readiness, data collection and risk inventory analysis.

The local government may consider the flood data collection and risk inventory from historical and current data to prepare for the future, and identify flood risk areas and implement risk mapping. The establishment of a flood risk information database that is accessible is a necessary application of technological systems. This needs to be combined with a system of continuous flood risk assessment and flood risk reduction practices, and resilient flood preparedness and response plans. The local government needs to maintain a flood early warning system capable of flood warnings, flood evacuation notices, and notification and declaration of a surveillance area or state of emergency through media sources and local village-wide broadcasting systems.

- Recommendation for action before the flood No 2: the early warning system.

An important factor is the early warning system’s link with meteorological and rainfall assessment, which helps local governments and local villagers respond better with the flood risk management activities that save lives and protect property.

- Recommendation for action before the flood No 3: Policy and legislative improvement.

The local government also needs to provide clear guidelines for LRFRM, warning-alert systems, and response procedures. The local government should also give more priority to fast drainage systems and pumping stations. There are a wide range of structural and non-structural instruments that can be employed to mitigate the risk of flood. All preparedness measures need to be supported by specific and appropriate legislation in the form of national flood control laws, regulations, and decentralization that empowers local government and locals in the Xay district.

The policies for sufficiency financing and allocation should be stable and adequate during all stages of flood life cycles, not just in response to specific flood emergencies.

The policies of human resources development, and strengthening flood education, awareness, training, and practice include the technical works that support

local governmental dealers, local people, and all stakeholders. These factors strengthen the understanding and readiness directly tied to LRFRM.

The policies should prepare adequate equipment, technology, and rescue vehicles, and perform the geographical characteristic assessment and reforestation activities.

- Recommendation for action before the flood No 4: Role of the local government of resilience action.

Decentralization is a good system to give more power to take action from the National government to the provincial government and to the district government level, but they should give sufficient budget, human resources, technical knowledge, tools, and vehicles to the district level and village level (local level) as well. It suggests setting up a specialized local organization at the Xay district level for the specific flood control organization. To make society safer and minimize flood harm to local people's lives. The local authorities need to promote LRFRM through self-responsibility and awareness to local residents and organizations. It is essential to disseminate information on how the local government-based preparedness activities contribute to an increase in the local readiness level. These actions will make a difference in coping with flood risks by developing connections with other local communities in the Xay district to share their experiences. Additionally, local area risk mapping conducted by local villagers, with local government participation, will help increase local villagers' awareness levels in case a flash flood happens.

Promoting the local community resilience in the Xay district involves establishment of village-level disaster prevention and control committees (VDPCC's) across the Xay district, as well as prioritizing action in villages most prone to flooding, such as Thin Village (mid-stream), LongKorDeua Village (down-stream), and other villages. It is also important to implement an effective community-level feedback mechanism for the district area through the VDPCCs. The local committees should also be involved in detailed mapping exercises in flood-prone areas of the Xay district.

The local government will also implement flood management awareness-raising programs within local communities and schools to help residents understand the flood risks. The plan also includes trial mobile applications for early warning and LRFRM data collection at the local level.

- Recommendation for action before the flood No 5: Role of village leader of resilience action.

It is vital to maintain close coordination between the local government and villagers. A village leader is a person who is highly respected in the village and who is in charge of supervising all activities in the village. The village leader is also responsible for making announcements to everyone in the village to help build preparedness and resilience for flood risk management.

- Recommendation for action before the flood No 6: Roles of all stakeholders.

Organizations like the military, police, academies, private sector companies, and NGOs are important stakeholders in LRFRM. Other important groups comprise

organizations like the district women's union, district youth union, district trade union, and veteran's union, all of whom play key roles in working with local people and community, and educating the local community about flood risk awareness.

They need experts from the central government and international organizations who had experience in flood risk management like deep flood issues or always frequent happen in their areas to come and share their good experiences and train the local government authorities and local people in the Xay district to well understand and get more knowledge, and train how to prepare, implementation and share the manual of flood risk management of different case studies to their consideration. After that, it tries to suggest them and find alternative ways for sources. So, the local government and local people may be proactive and pay attention more than this time of nowadays. Furthermore, it also concerns for long term action as well.

8.5.2 Recommendations for during the flood.

In the time of flood emergency, the local government should pay attention to flood safety assurance, and flood emergency relief. Moreover, the various search and rescue teams looking for flood victims at the time of a flood should be early at the flood fields, performing rapid flood damage and needs assessments. After that, the local government should start immediate repair of essential infrastructure. Other duties include official declaration of flood-affected areas in the Xay district.

- Recommendation for during the flood No 1: Emergency response measures

During the flood, communication and public information management, search and rescue coordination, shelter management, food stock and distribution of food and supplies, financial management, volunteer coordination, and donations management are all critical activities. Furthermore, to prepare the Xay district to cope with flood risks, it has necessary to plan what may done, if an extreme weather event occurs. Local villagers in flood risk areas should trained how to face risks, use response techniques, and use suitable equipment. Local governmental staff should be trained to use and prepare appropriate equipment, as well. It is also necessary to evaluate the possible resources that can be mobilized for emergency response action.

- Recommendation for during the flood No 2: Time management.

The time taken to rescue flood victims is very important in the flood emergency case. Typically, relief should arrive to support the flood victims within 24 hours. In addition, the suitable plans should be in place for short, medium, and long operations. Contingency plans should also be in place to respond of flood events in a timely fashion and maintain operational status everywhere that flooding is occurring.

- Recommendation for during the flood No 3: Pumping stations and mobile pump management.

During the flood, the pumping stations and mobile pumps can be deployed to help improve floodwater discharge in flood zones. That means increasing flexibility of pumping operations in urban areas with easy-to-install mobile equipment in the Xay

district, which requires that suitable types of pumping stations or mobile pumping equipment be selected and stored in advance.

- Recommendation for during the flood No 4: Evacuation management.

Evacuation procedures and surveying evacuation routes to the high-elevation safety areas is another critical part of planning. There should be routine evacuation drills, with training for the local residents and general public to help them understand what to do during a flood emergency. Proactive plans need to build up the local population's knowledge of evacuation routes.

- Recommendation for during the flood No 5: Food, drinking water and medicine management.

The local government should store at least three days' worth of food and drinking water in the emergency shelters and non-consumable items in the public warehouses for the flood victims and rescue teams. Health centers and hospitals need to store appropriate medicine, and staff should be trained in management and disease prevention. The storage plans for food, other agricultural products and livestock may also be used to support the demand during the dry season crop production; systematic medium and long-term approaches must be used to address the technical knowledge of farming households in the Xay district.

- Recommendation for during the flood No 6: Flood shelter.

Flood shelters for victims must be surveyed in advance and suitable buildings allocated as shelters in high-elevation safety areas an appropriate sanitation system in the shelter. The shelters can used as schools, public-private buildings, or local community centers outside of flood emergencies.

- Recommendation for during the flood No 7: Various rescue teams.

Establishment of various rescue teams and support teams (medical, relief, security, transport, and recovery with a resilient concept for build back better) is necessary for getting aid and relief to the flood victims in the Xay district.

- Recommendation for during the flood No 8: Emergency budget.

Sufficient financing is a key consideration and very important resource in the all periods of the flood events (example., before, during and after).

8.5.3 Recommendations for after the flood.

Following the 26 factors of LRFRM concept, employing the 'build back better' philosophy, should be use in the hard engineering and soft engineering approaches. The local government practices may be concerned with evaluation of needs, flood recovery planning, and implementation by the local government.

The plan is actually a series of interconnected sub-plans, including response planning, training, raising public awareness, flood forecasting, warning, alert, and setting development policy, setting alternative plans, and local social structure strengthening.

- Recommendation for after the flood No 1: Enhancement of resilient ‘build back better’ capacity for the long-term

The research identifies specific factors that require strengthening in the local government by considering the Xay district and the three case study villages. The specific strengthening needs include provision of better local government, access to financial security, good local villages, best infrastructure quality, and support from institutions and good health conditions. Examples of improved local village infrastructure include sound drainage systems linked to land-use and urban management, the best housing quality (high level technical advice for design and construction), strengthening livelihood options, and helping to cope with flood risks. Significantly, encouraging social networks among local residents will help improve this strengthening effort and enhance the local community’s ability to cope with increasing floods. The preparedness capacity and resilience of the local government must be used to help poor people because they have no access to needed finance and construction materials to improve the quality or location of their houses and LRFRM in the Xay district.

- Recommendation for after the flood No 2: Urban development planning, and land-use planning linked with local and external population increases.

Local government professionals' actions reduce flood risks. Flood control systems provide space for floodwater. Therefore, it is suggested that Xay district should review all urban planning to adjust and reduce these flood risks in a number of different time frames: short-term (two years), medium term (five years), and long-term (ten years). It is crucial to improve physical infrastructure and urban planning management.

- Recommendation for after the flood No 3: Land-use change restrictions and building codes considered by the local government

There are a number of strong reasons for river improvement and urban development plans to be implemented the Xay district. New development areas and flood-prone risk areas demand that the authorities pay attention to land-use changes and restrictions on land use in flood-prone areas under LRFRM, mitigation, and readiness.

Another important activity to be undertaken post-flood is studying the flood map in hopes of identifying of future flood risks or potential events of different probabilities, with intensity and magnitude of hazards illustrated on a selected scale. Flood hazard maps link with land-use restriction point out areas at risk and are necessary for planning flood proofing of constructions, increasing flood awareness, and enhancing preparedness.

- Recommendation for after the flood No 4: Strengthening physical infrastructure

Physical infrastructure needs to be maintained, and it needs to function well to enable local communities to respond effectively and recover quickly with a resilient ‘build back better’ concept. Therefore, LRFRM measures to existing infrastructure and

plans for long-term development of infrastructure should be prepared, monitored, and maintained. Plans should include infrastructure work such as solving the discharge capacity and the river management issues of the Kor, Mao and Hin Rivers, and the drainage capacity of urban areas. It should also address things like raising the embankment, widening the river, efficient protection from flood hazards and severe erosion, dike and riverbank protection, and addressing the shortcut of the meander in the Kor, Mao and Hin Rivers in the suitable place.

Another key element of infrastructure planning and implementation is building reservoirs. It is suggested that a number of concepts be adopted to deal with increased heavy rainfall caused by climate change. Riverside parks and flap gates, adapting existing bridges and the existing weir, together with flow allocation plan for flood reduction in the river basin are essential. A retention pond and flood zone should be installed in the lateral zone beside the river to stock flood volume and decrease peak flood waters; the zone designated for the 'monkey cheek' may use as farmland in the regular season.

- Recommendation for after the flood No 5: Sufficient financing

Financial funding of these activities needs to be stable, adequate, and publicly acceptable, with straightforward funding mechanisms for drainage investment, operations, and routine actions. The funds need to be available for local financing: various means of borrowing, current revenues, special revenues, grants of funds from the provincial and national governments, the contribution of landowners, and finally, special user charges. The possible ways to strengthen the Xay district finances to achieve LRFRM include flood insurance and recovery support for a resilient 'build back better' concept.

- Recommendation for after the flood No 6: the sustainable action of local government practice for local resilience and flood risk management (LRFRM).

The sustainable action of local government practice suggests the use of both the bottom-up approach and the top-down approach in trying to provide all 26 factors of LRFRM in Xay district. Action plans need to be developed for the mid-term, long-term with the involvement of all stakeholders.

Following the developed action plan should improve the level of preparedness, leading to mitigation of all risks. Moreover, measurement and monitoring of the process of flood prevention, and identifying specific organizations to be responsible for the operation should be undertaken regularly at the local level. Early risk inspections and post-event appraisals aimed at implementing the 'build back better' philosophy should contribute to better future outcomes. Other contributions can be made through publications, seminars, and lectures aimed at education and creating awareness among the public, the decision-makers, and the technical experts. An adequate system and use of technology for supervision of LRFRM performance, especially construction of earthen embankments during floods, should be developed and utilized in a timely manner to help authorities identify any flood risks that may bring about positive consequences with respect to the area's flood management.

Guidelines for an integrated urban LRFRM plan should call for implementing structural and non-structural measures in the Xay district to prevent losses of life or

assets in the district. Therefore, a set of guidelines has been developed to assist with the creation of an integrated urban flood risk plan for the district. In addition, it can guide the development of a strategic integrated urban design and LRFRM plan for the Xay district. This improvement brought about by this strategy is essential for management of water and floods as spatial planning increases flood risk awareness and improves practical strategies to cope with LRFRM in the Xay district.

Actions to support LRFRM in the Xay district start with identifying green measures and activities to promote local community flood resilience in the Xay district. It is essential that the local government identify the required cost, and then source funding for locally appropriate retrofitted flood mitigation and drainage control measures to existing waterways around the Xay district. The authorities need to support villages to take ownership of riparian areas and establish dual-purpose green zones (flood mitigation, visual amenity, and production of raw materials) by incorporating low-cost, effective vegetative solutions.

8.6 Contribution of the research

This study can update the academic contribution with many theories due to the flood risk management link with many factors and theories as well. But these findings focus on the Practical Resilience or "un-resilience" in the case study of Xay district, Lao PDR. It can confirm to continuing "un-resilience" due to lack of implementation of the principles of local resilience and flood risk management (LRFRM concept) currently. However, the local government in the Xay district plans to implement both structural and non-structural measures and process to integrate LRFRM into all cycles of flood life. Nonetheless, the local government suggests improving many weak factors from the result of this study.

Four contributions have been identified:

1. Theoretical contribution - updating and growing the literature in the field of study.
2. Policy contribution - updating policies related to the case study,
3. The LRFRM model for sustainable practices by local government in Xay District offers a novel contribution.
4. Contribution of the case study practice.

Again, the four contributions are shown below:

8.6.1. Theoretical contribution

This study's significance by discussing how it updates existing theory, provides comparative considerations, and introduces practices that are key to strengthening the local resilience and flood risk management (LRFRM concept) of local government practices and the practices of local villages in the Xay district, Lao PDR. Currently, it is a new update from many works of literature that focus on the least developed

countries like the Xay district and Lao PDR. This study develops the existing knowledge by adopting, adapting, and strengthening the concept of LRFRM in the Xay district. The case study supports to update the idea that the complexity of local government practice must be understood. Comprehensive regulation for improving resilience to minimize the flood risk must be developed and enforced even though they still have twenty-two weak factors to challenges in the Xay district. Moreover, it is essential to improve social, economic, institutional, and physical indicators of the local areas through preparedness and awareness measures. The flood insurance schemes should be boosted to build back better, with quick recovery. It is an updated new idea to sell agricultural products and livestock to the market and stock for flood funds. However, local rich people who live near the main riverbank can promote their own money for high embankment construction for flood prevention. It is an alternative way to request from the international organization. Therefore, the local government needs to educate the locals through all available media and local workshops to strengthen measures, and the authorities must not permit the construction of houses in flood-prone areas; instead, buildings need to be relocated to high-elevation safety areas.

Furthermore, LRFRM is updated to support the base on effective early warning systems that will also save local lives and property (Qasim et al., 2016). While, the action of the early warning system has been quite good since 2018 until nowadays, but they still need to prepare and install immediately the early warning tools throughout the Xay district's risk areas. There is a need for knowledge, resources, priorities, and motivation to perform that influence flood risk management preparedness (Norén et al., 2016). This should all be managed through the emergency operation center and quick rehabilitation at the same time, provided for in the national law and local flood management regulations. This will be beneficial and lead to the implementation of structural and non-structural measures for LRFRM in the Xay district for specific local conditions. Improvements using a strategic LRFRM framework need to emphasize participatory collaboration among local government agencies and all stakeholders. Moreover, the local government's capacity to reduce risk in a decentralized system is greatly influenced by access to financial and operative resources for specific flood control organization. There is still a significant knowledge gap regarding how local governments' political resources can best be used for effective implementation (Ruiz-Rivera & Melgarejo-Rodríguez, 2017). If the Xay district still can peace and stability that still support flood risk management as well. Certain patterns are fundamental to society's capacity and relationships between internal and external factors that contribute to mitigating urban flood risk (Becker, 2018). Urbanization has challenged land-use patterns, which strongly influences the LRFRM plan for the Xay district. Flood management maps may update using the spatial analysis tools of the Geographic Information System (GIS), which will be useful in the effort to reduce the dangers and enhance the LRFRM of the risk areas (Waghwala & Agnihotri, 2019). Preparedness of local communities is a key to mitigating more immediate flood impacts while

improving social resilience for longer-term recovery (Nakanishi & Black, 2018). Despite the theory that sufficient information about flood risks should influence public and locals' behavioural changes to support for LRFRM (Abunyewah, 2020). This study may update bridge the gap between policymakers, practitioners, local community leaders, and local villagers with respect to LRFRM (Dash & Punia, 2019). Importantly, this study's findings confirm the concept that "build back better" actions in the long term can be improved and planned at different local levels and scales in the Xay district (UNISDR, 2017). Nevertheless, they are still Un-resilience practices for the LRFRM concept in the Xay district at moment.

Findings also confirm that villagers, local leaders, and local governments can engage to improve and strengthen actions in the Xay district for subsequent steps in the process. Furthermore, this research's empirical findings strongly reinforce the importance of a close interconnection between local government support of local activities, community resilience, and institutional structure. There are requirements, such as an excellent local government mechanism, staff capacity, development of physical infrastructure, strict urban planning management and land-use change control, in combination with routine action, mobilization of participating in policies, plans, programs, and projects.

This study contributes to the literature on the risks of flooding, at least with respect to least developed countries and local areas like Xay district, Lao PDR. There is a need to further explore the idea that extreme weather risk prediction and management needs to be developed more fully; more specifically, better coordination and technological tools are needed to incorporate local community participation in designing response plans and reducing the vulnerabilities of the local communities at risk. These activities will enhance the local government's resilience in Xay district in the future.

Finally, this research's findings also add to a growing body of literature on strengthening flood management. Taken together, the findings of this research contribute to identifying critical issues for strengthening local government to enhance the LRFRM of Xay district. The proposed measures will enhance the local resilience to cope with future flood risks.

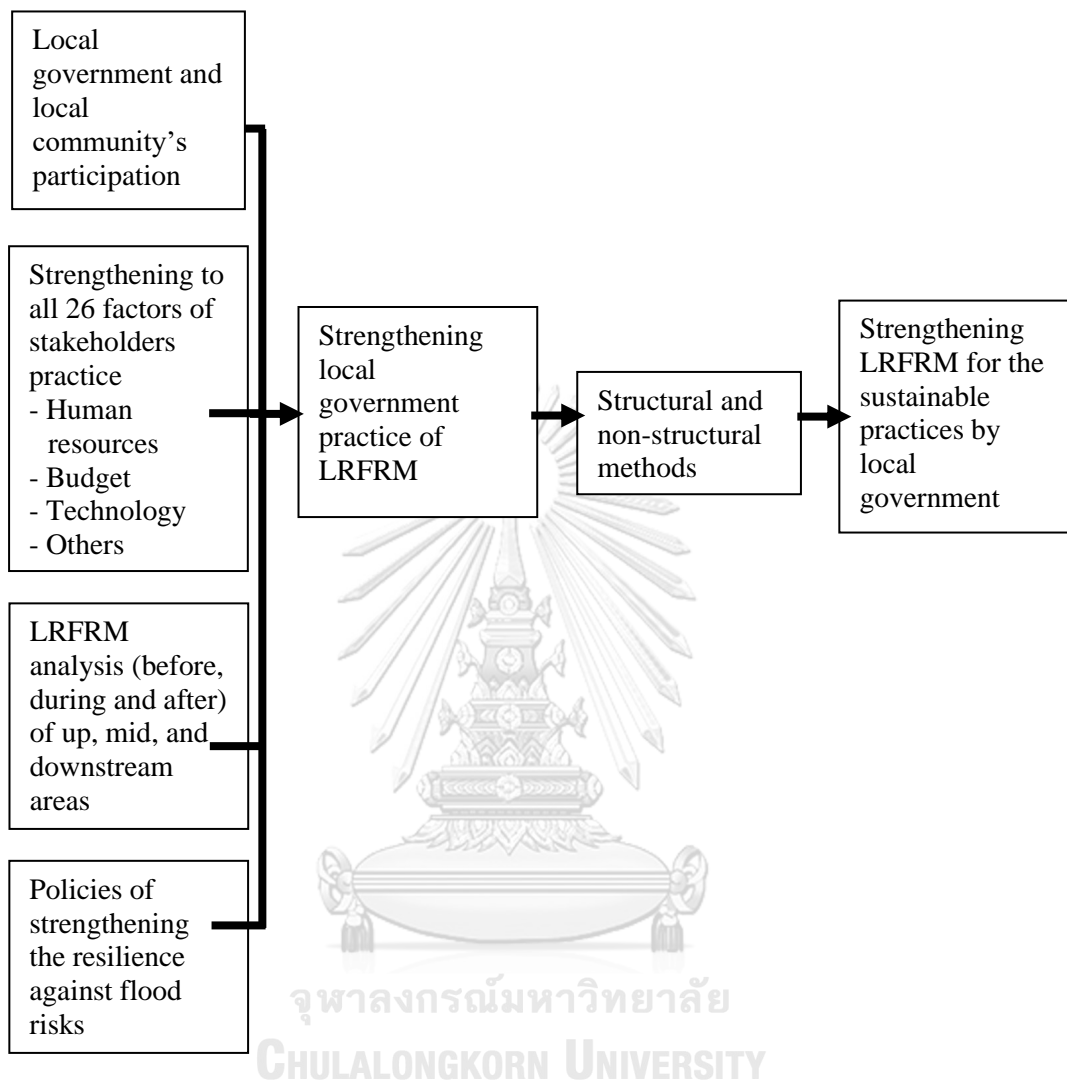
8.6.2. Policy contribution

This research tries to create and strengthen the local government policy to enhance LRFRM at Xay district. The local government at the Xay district level may establish the specific flood control organization to elaborate researching for the unique local conditions in the Xay district. So, it can find appropriate solutions that based on LRFRM concept. It supports incorporating the local government, all stakeholders, and the local community to strengthen the policy of preparedness. It had developed plans to be implemented in the Xay district. The research also provides additional evidence

of the value of institutional support from local governments and the participation of local residents. In other words, they can both directly improve the lives of poor local villagers living in flood-prone risk areas, and support regulation in the urban area of Xay district. It is clear that the local government in the Xay district needs to pay attention to regulation control, and flood preparedness accounting at the local level for rescue and relief operations. If the previous action trends to inclusive doing for relief act during flash flood, but in the next step, the local government's policy suggest to pay more to readiness for flood prevention. Furthermore, proactive to any factors of LRFRM that local government can do as moment and prepare for the future. A policy framework must be adopted, adapted, and strengthened based on the guidelines of the Lao National Disaster law and of "The Sendai framework for disaster risk reduction 2015–2030" proposed by the United Nations (UNISDR, 2017) for the Xay district.

Analyzing the governance perspective by addressing policy, guidelines, and mitigation plans. This study highlighted the gaps in policies that can be reshaped to reinforce resilience in the case study. Therefore, update implementing a standard land-use policy by defining land utilization zones along the riverbank in a flood-prone area and unique policy for upgrade green infrastructure zone that incorporates local level plans is a critical element. Furthermore, the decentralization of power at horizontal and vertical levels among multiple institutions is part of the process of preparing policies, regulations, plans, and standard updating of specific flood control policies. Strengthening includes a shift to the bottom-up approach; encouragement of transparency and accountability, decentralization of the allocation of both technical and financial resources to improve training, particularly at the district level, and investigation of the insurance schemes for the guarantee of the “build back better” concept after a flash flood disaster are all important steps that need to be taken. Strengthening efficient capacity plays an essential role in creativity in the local line offices. Improving LRFRM policies, and creating mechanisms for improving regulation, flood management policies, programs, and action plans could better achieve the stated goals. Urban planning assessment might call for restrictions on urban planning along with new regulations. Addition, Land-use change pattern assessment is part of a zoning risk assessment that integrates the flood management policy in the long run. The local government may diligently follow and enforce regulations designed to control the local resilience against flood risks and promote the participation of locals. If active public engagement and local participation are prioritized as critical components of flood information sharing and communication. It is of profound significance to national and local efforts aimed at flood risk management and sustainable urban development.

8.6.3 Local resilience and flood risk management (LRFRM)'s model for the sustainable practices by local government in Xay District.



Note: Local resilience and flood risk management (LRFRM)

Figure 8.2: LRFRM's Model for the sustainable practices by local government in Xay District adapted from this study's conceptual framework.

Evidence to prove for Local resilience and flood risk management (LRFRM)'s model for the sustainable practices by local government in Xay District. It comes from the review, data analysis and combine with new outcome for this study, and field surveying comparison with differences, phenomena, and similarities, with supporting reasons revealed by the Xay district and 3 sample studies. First, desk study, literature study, and visit the field of the case study, second, interview with 25 individual respondents throughout the Xay district, third, go back to visit the field of the case study (again). Fourth, interview with 14 expert respondents for different aspects of the local to the national level. Fifth, three times' meetings of focus group discussions to confirmation at the Xay district, and sixth, confirm by the WhatsApp group chat until

present with interesting respondents who live in the Xay district (It is like the third party to confirm again and again), and confirm by Seventh, Outcome from this study. Thus, the detail as follows:

- Local government and local peoples' participation

The proactive action of local government planning procedures has become increasingly needed; that includes critical stakeholders with areas of concern along with local villagers with strong opinions. There are many opportunities for practices, preparedness, readiness, and build back better concepts with LRFRM. Such as it includes a local government leader's leadership attitude, promoting the participation of local residents, planning, monitoring, implementation, and coordination. Locals' participation in flood risk management and acceptance of self-responsibility is an essential component that is deserving of attention from local government officials. Efforts to make new flood hazard maps and collect information through locals' participation can have a strong positive impact on Xay district's urban development preparedness. When locals take part in preparing a flood hazard as a part of flood-risk reduction measures, they better understand the nature of flood risks in each area. It is also useful to develop locals' self-responsibility through these readiness activities. So that they display that a progressive approach to strengthening is in several ways being supported by local governments. A strong community organization is essential for resilient communities capable of reacting to the risks that floods present to local residents, the local economy, infrastructure, and the environment.

- The Xay district and all 26 factors of LRFRM.

The local government should improve, revise, and update information as much as possible: regulation, and policy need to be prepared with respect to the specific flood policy and strengthening by strictly enforcing regulations. Human resource capacity development is a specific subject for local governmental staff; meteorology and hydrology, in particular, along with artificial intelligence technologies are important to the ability to control risks in the future. Sufficient budget allocation and insurance from many sources also comprise important components of LRFRM. Rescue equipment and other appropriate tools must be acquired before the flood emergency events along with rescue vehicles. Routine exercises and simulations need to be carried out to test and improve emergency response and evacuation plans. Meteorological and rainfall pattern assessments ensure accurate early warning, alert systems and regular monitoring of the rainfall data and water level. The geographical characteristics assessment may intend to improve the knowledge of geographic information systems. Significantly, flash flooding is more common in mountainous areas. Reforestation assessment might also require reforestation up-stream of rivers. Urban planning assessment might call for restrictions on urban planning along with new regulations, building codes, and

implementation of a 'build back better' concept after flood damage, with reliance on both non-structural and structural methods. Controlling the population also includes distributing the essential services to other areas of the district. Land-use change pattern assessment is part of a zoning risk assessment that integrates the flood management policy in the long run. Assessment of experiences and risks of the previous floods are necessary both for populating the relevant databases, and for future-readiness preparation. Time assessment that happens before flooding helps in planning timely prevention, rescue, and recovery and preparation of suitable plans and real action for recovery and reconstruction. Early warning systems and prediction equipment (signs, signals, and networks) can use smartphones to track the flood and issue early warnings based on severe weather forecasting and monitoring, routine acts, and working with teams 24 hours a day and 365 days per year. Flood awareness, training, and information sharing (TV, Radio, newspaper, social media, others) comprise a regular exercise in real places with local government staff and local participation. Flood database analysis is the critical factor in a systematic review for future preparedness. Flood map analysis might include both historical and potential future flood risks. Infrastructure monitoring and maintenance (dikes, erosion protection, roads, bridges, water conveyance shortcuts) are adequately prepared using hard engineering infrastructure. Routinely cleaning canals and drainage systems is an essential factor for improving drainage capability in the urban areas. Pumping stations or mobile pumps need to be considered for use in urban areas -- ones that are easy to use and relocate. People living or operating businesses in flood zones need to be fully aware of the local governments' policies. Other important pre-flood activities include surveying evacuation routes and determining the high-elevation safety areas. Food and drinking water for emergency use in the many public warehouses and at least three days of supplies for the flood victims and rescue teams must be stored appropriately. The local government also needs to establish the various teams (medical, relief, security, transport, and recovery with 'build back better' concept) necessary at the local level. Overall risk inspection needs to be integrated into the local government's routine practices, based on either the bottom-up or top-down approach, as appropriate. Overall, the local government needs to aim to combine all 26 factors of LRFRM into a coordinated and integrated long-term action plan.

- LRFRM before, during, and after flooding of upstream, midstream and downstream areas.

Preparing for the next event in all three periods (before, during, and post) of flood risk management relies on accurate assessment, preparing for the flood, and establishing the specific flood organizations to control and operate the early warning system. Paying attention to the risk-prone areas along the main rivers throughout Xay district areas is also important. Every resource must be utilized, sufficient numbers of

rescue vehicles and adequate equipment needs to be stocked in the local governmental organization's warehouse.

Moreover, it is important to take steps in non-structural areas to improve flood knowledge and awareness throughout the district to all levels. During a flood event, the local government might assign a specific rescue team to work in concern with many stakeholders to go to the flood damaged fields and help the local flood victims survive and return to their normal livelihoods. For all that, a flood alert is a crucial tool to effectively share information with local people who live downstream where flood waters can peak rapidly in an emergency. Nevertheless, after the flood occurs, the local government must quickly recover with a 'build back better' concept for improvements to infrastructure, such as the housing of flood victims, roads, the electricity network, water supply, and other infrastructure that is necessary to support the livelihoods of local residents. In some high-risk, flood-prone areas, it may be that the local government needs to move the locals to new safety areas with safer conditions. This sort of major restructuring requires substantial budget support, but it is part of the essential and impactful long-term action.

- Policies for strengthening resilience against flood risks.

Local resilience and flood risk management (LRFRM) affects the sustainable development of Xay district. The central and local governments recognize the importance of flood risk set by the National Disaster Prevention law to extend and relate to flood risk unique policies to all people, all society participation with attention in every sector of Xay district.

With strengthening principles, key improvements related to LRFRM will follow: consistent policy, law, strategy and the local social-economic development plan, local defense, public security, and agreements with all stakeholders. Other benefits include recognizing flood risk prevention, control and recovery as vital activities. Moreover, steps will be taken to ensure there is equality, fairness, transparency, openness, and accountability, and also to ensure that information on meteorology, weather, rainfall, hydrology, environmental risks, and other information related to LRFRM issues is provided accurately, continuously, quickly, and on time, and that the engagement of all stakeholders in society and collaboration among local line offices, organizations, and local people is ensured.

- Strengthening local government practice of LRFRM.

The local government may set the strictest legislation for flood management and plan for following with real action on risk management and prevention such as establishing flood zones or retention ponds in suitable places. Another action the local government can take is to develop and distribute a flood risk management manual for local residents based on the resilient concept.

According to the results of the Xay District case study based on LRFRM and the ‘build back better’ concept, this can be a way to better prepare for the future. However, it takes advantage of the opportunity to change something better from the past. The rationale for local peoples' involvement is that the activities of local residents are deeply rooted in the society and culture of a local area. They enable people to take on more responsibly through local community participation and contribute through strengthening coordination, facilitating individual efforts and solidarity, enhancing the effectiveness of cooperation within the local community, providing a platform for consensus-building, supplementing local government efforts, and harmonizing LRFRM efforts with other development activities. Resilience in flood risk management is the ability to withstand the pressure of many issues while also maintaining the capacity for building back better, resistance, learning, and transformation.

- Plans for local government practices are based in both structural and non-structural methods.

Both structural and non-structural methods are combined at the same time to achieve LRFRM, and the specific type of method used depends only on the resources available to support the concepts put forward for solving the discharge capacity and the river improvement. Solutions such as enlarging the rivers and using the shortcuts in some meander areas, along with dikes, weirs, flood gates and riverbank protection for quick release the massive amount of water when the heavy rain falls represent effective structural approaches. Improvement of the urban area's drainage capacity reduces the flood and minimizes damage from the flood. In addition, river improvement planning requires high levels of expertise, so decisions and opinions of local people and local government should be seriously considered, and it is necessary to match the local peoples' ideas and opinions based in local wisdom with the particular knowledge and experience of experts.

Specific recommended optimization structural measures for damage reduction are as follows:

- Upstream: Reservoirs for retention and storage.
- Midstream: Dike works (elevation of levee banks).
- Downstream: River improvements, including bank-protection and shortcuts.

Non-structure plans focus on many factors of LRFRM. Policies and plans are crucial elements of local government action of urban planning, flood zoning, law-regulation enforcement, reforestation, geography measurement with GIS tools, and early warning systems to improve response times. However, river improvement may connect with local areas and all stakeholders related to readiness, flood control, the economy, environment, and social livelihoods. The expansion of a well-balanced strategy for LRFRM considers diverse types of measures conditioned on the flood type. Adopting a good combination of structural and non-structural measures helps locals reduce flooding. Flash flood forecasting and an effective early warning system are the current measures to reduce the negative impacts of flooding. Nevertheless, some features influence such systems' effectiveness of data sources, decision support, coordination, and responses. Hydro-meteorological data (notably rainfall and evaporation) are essential to flood forecasting and early warning systems. Key

observations on river discharge and river water levels are consequently vital for the effectiveness of non-structural measures. Urban drainage structures are resilient measures that usually aim to absorb, store, delay, and drain water to diminish peak run-off. Specific sustainable urban drainage structure measures include retention ponds, and storage tanks. Applicability of these measures depends fundamentally on the local topography, socio-economic development, and climate conditions. Aiming to progress LRFRM in Xay district, this sector will further explore non-structural subjects such as education, communication channels, data collection, local community resilience, and local government agencies for flash flood adaptation and mitigation.

- Strengthening LRFRM for the sustainable practices by local government in the Xay district.

Emphasizing resilience is a key concept related to many factors to support as follows:

Analysis of the local resilience concept: flood education, awareness, capacity, training, and practice can be enhanced through the addition of technical support. These factors form capacity, and this understanding directly improves flood risk data analysis.

Local government resilience: It is important to disseminate information on how the local government-based preparedness activities contribute to an increase in locals' readiness level in coping with flash flood risks by developing connections with all local communities in the Xay district to share their experiences. Additionally, local area risk mapping conducted by local villagers, and with local government participation, will help increase local villagers' awareness levels in case a flash flood happens. The local government policymakers are deeply concerned with the economic, environmental, and social points of view, and hope that flood-aware knowledge may build a safer community that protects life and property for future generations. The local governments need share information and flood risk maps on TV, radio, newspapers, the internet, and other social media at the Xay district levels throughout the year.

Integration of urban areas into LRFRM plans: To support the meteorological-hydrological modernization and LRFRM systems, intended to develop the delivery of weather, climate, and hydrological services and early warning systems with physical investments including capacity building to strengthen flood resilience in Xay district, structural investments include river improvement, riverbank protection, dikes, embankments, and others (mentioned in Chapter 7, section 7.2.1 and 7.2.2). Infrastructure investments could be supplemented with non-structural measures, including strengthening land-zoning, institutional capacity-building, integrated urban and LRFRM. The flood risk reduction is the mitigation of damage to local people, and policies that reflect a comprise that includes a well-balanced mix of both infrastructural and non-structural measures in short, medium, and long-term time scales.

8.6.4. Contribution to practice

This research has contributed to local government practice activities by exploring the context of appropriate methods for LRFRM in urban areas of Xay district. In the northern part of Lao PDR and also include the Xay district area. The natural characteristic of the Xay district is like a flash flood, at the confluence of three rivers. Its geography features high surrounding mountains combined with a low-lying urban area. The local government and three villages are required to deal with flash flood risks, and the research considered what gaps need to be filled in flash flood prevention and management. The local government in the Xay district should establish a specific flood control organization in real practice as soon as possible. It is important that local government leaders are assigned to the priority of the LRFRM concept and prioritize which essential factors (out of the 26 factors) should be ready for before, during, and after periods. The human resources development should be seen as the most necessity. Moreover, the budget should aim to provide efficiency. Through allocations for equipment and current information about the level of rainfall, the extreme weather forecast needs to be reliable. Moreover, the local government's practice of investment in infrastructure construction for the short-, middle-, and long-term with a vision towards the LRFRM concept is also a crucial priority. Nonetheless, it may combine with non-infrastructure in some appropriate areas.

The proposed practice indicates what steps need to be taken to reduce risks and enhance the strengthening the local government practices along with flash flood risk management in villages. The results also provide a better understanding of the relationships between unpredictable weather information related to resilience readiness and local governmental actors in the Xay district, which, in this case, acts as a representative for many districts of Lao PDR and to other similar areas from countries that have the capacity to adopt and adapt to their similar conditions.

By attempting to bring the local government and the local community together, this study identifies proposals to reduce risks, while enhancing readiness, and flash flood prevention, along with promoting the “build back better” philosophy during recovery from flash flood impacts. Integration of urban areas development into LRFRM plans. However, the local government capacity, finance, technological tools, and cooperation may be significant challenges for local government management in Xay district. The local government should also take practical steps in multi-institutional coordination for risk identification and assessments, land use-planning, implementation of mitigation strategies, monitoring, and evaluation of mitigation performance. Its focus on the development and preparation of a strong rehabilitation accounting for reconstruction damaged buildings through developing land banks at a safer place, intended to prevent new constructions in hazardous areas in the first place, and relocation of existing structures before and after a flood, adopting suitable practice and good governance of LRFRM in the Xay district conditions are all important elements of improved local government practices. The sustainable action of local government practice suggests the use of the bottom-up approach implementation.

Additional contribution to practice come in the form of bridging the gap in study that reviews flash flood risks in Xay district and how to reduce these risks by recognizing the role of LRFRM factors in simulating preparedness and proactive measures being implemented by the local government and local communities. The

study contributes to practice by providing assessment, suggestion, and useful tools for use in Xay district for all stakeholders, mainly to ensure the success of reducing the flash flood risks. The new frame design adds some new components that had been previously missing from other frameworks. The above contributions reflect the novelty of this research, which argues that flooding poses a serious risk to lives and property in Xay district under current conditions. Therefore, the study recommends immediate actions to mitigate the flash flood risk at Xay district, such as installing an adequate rainfall-runoff monitoring station system that covers the risk areas. The local government must encourage widespread public communication through social groups and many teams. Because the locals share a common interest in LRFRM and desire explicit knowledge about how to manage flash flood risks, an important step in the process involves producing and distributing guidelines and information kits by local government to support efforts towards community education and awareness. In practice, the provision of training and equipment often dominates capacity development for LRFRM interventions. The capacity improvement strongly suggests that it is confined to technical aspects of the provision of resources such as improving coordination, decision-making processes and fostering an enabling environment, which tends to be successful in the long run. Thus, if flash flood preparedness is to be realized, flash flood management programs must ensure sufficient and participatory information dissemination as a measure to influence intentions to prepare for flash flood risks among the public. Therefore, flash flood management policymakers must ensure that the local community participation is a core element of risk communication. Only when adequate and complete information is given to the public engagingly and interactively can positive behavioural changes in terms of flash flood preparedness be assured. The study proposes alternatives for considering plans' effectiveness, efficiency, practicability, and indirect effects for plan implementation within the available budget. All alternatives have been estimated in combination with authorities in the different sections of the Xay district.

8.7 Limitations of research

One of this study's limitations was that the researcher went to the field to collect data on relevant topics for observation of flood risk management from January 2019 to September 2020, with only two rainy seasons and no great flood event in Xay District. There was no opportunity to study a great flood and to observe the best solutions for emergency response and local government procedures. However, the focus of the study was on the social science perspective from local government on how they deal with issues relating to flood risk management.

Although, all of the objectives were achieved, there were some time and scheduling constraints to contend with in dealing with senior local governmental authorities in Xay district to collect the required data. The researcher needed to contact them many times, and policy decision-makers are always busy.

Finally, the effect of the COVID 19 situation in the Lao PDR during data collection from January 2020 to August 2022 created unique limitations and challenges.

8.8. Possibility for further research

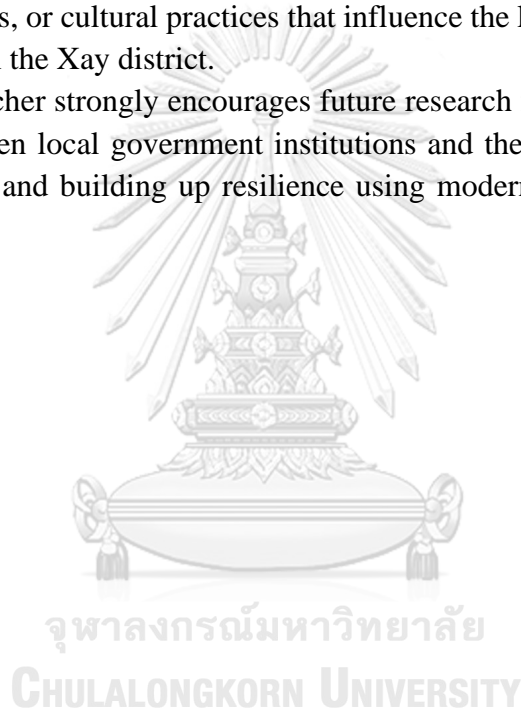
It is suggested that further research should include conducting many case studies in different regions of the Lao PDR to compare and use the best-case practices to share with other similar districts for the purpose of strengthening LRFRM.

Consideration of amendments to the existing decrees and laws regarding specific flood risk management should also be considered.

This study investigates broad issues in the Xay district; further research into other districts will also narrow down the specific flood risk factors.

Other research opportunities may be concerned with the knowledge of risks, extreme weather prediction, rainfall condition-related behaviours, local peoples' perceptions of risks, or cultural practices that influence the local government's practice of strengthening in the Xay district.

The researcher strongly encourages future research focusing on identifying the interactions between local government institutions and the local community in flood risk management, and building up resilience using modern technology like artificial intelligence (AI).



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