2025

ICFMS - Nong District

Integrated Climate-Resilient Flood Management Strategy

Aluvium and Hydrotech Consulting

Table of Contents

Figures

Tables

Abbreviations

DAFO	District Agriculture and Forestry Office
DoNRE	District Office of Natural Resources and Environment
DWR	Department of Water Resources
DMH	Department of Meteorology and Hydrology
EbA	Ecosystem-based Adaptation
EWS	Early Warning System
GEDSI	Gender Equality, Disability, and Social Inclusion
ICFMS	Integrated Climate-Resilient Flood Management Strategy
ICM	Integrated Catchment Management
Lao PDR	Lao People's Democratic Republic
IWRM	Integrated Water Resources Management
LPC	Luang Prabang City
MoLSW	Ministry of Labour and Social Welfare
MoNRE	Ministry of Natural Resources and Environment
NDMC	National Disaster Management Committee
MTC	Ministry of Technology and Communications
MoICT	Ministry of Information, Culture and Tourism
MWPT	Ministry of Public Works and Transport
PoNRE	Provincial Office of Natural Resources and Environment
UNDP	United Nations Development Programme
XBH	Xe Bang Hieng River Basin

Definitions

Flood extent: Areas affected by flood water

Riverine Flooding: Riverine flooding, also known as fluvial flooding, happens when a river, stream, or other watercourse overflows its banks due to excessive rain. This leads to the inundation of surrounding land.

Hazard mapping: This is a map that highlights areas that are affected by or are vulnerable to a particular hazard

Representative Concentration Pathways (RCP): RCP are prescribed pathways for greenhouse gas concentrations, together with land use change, that are consistent with a set of broad climate outcomes used by the climate modelling community. Emissions in RCP 4.5 peak around 2040, then decline. In RCP 8.5 emissions continue to rise throughout the 21st century.

Other technical terms are described directly in the document.

Preface

The Integrated Climate-Resilient Flood Management Strategy (ICFMS) for Nong District, Savannakhet Province, provides a detailed Action Plan to enhance the resilience of communities to the impacts of floods and droughts and ensure effective socio-economic development that achieve the best outcome for the economy, communities and the environment. The ICFMS aligns with the direction of the Law on Water and Water Resources (revised in 2017), the Strategic Plan for the Management and Use of Water and National Water Resources until 2030, the Plan of the Natural Resources and Environment Sector, and National to district level Socio-Economic Development Plans.

The ICFMS has been developed in cooperation with related sectors such as the Department of Water Resources, the Provincial Department of Natural Resources and the Environment and the Administration of Nong District under the IWRM-EBA Project which is supported by the World Environment Fund (GEF) and the United Nations Development Organization (UNDP).

We on behalf of Nong District Administration, the Natural Resources and Environment Department of Savannakhet Province and the Water Resources Department, Ministry of Natural Resources and Environment have coordinated harmoniously in developing this Strategy with support from central and local stakeholders. We will continue this close cooperation in implementing the Action Plan including with international organizations, private sector, project developers and the community in order to achieve the goal and objectives of the Strategy.

We would like to express our gratitude to the responsible committee for their hard work, conscientiousness and authority in creating this Strategy and its implementation. We also express our gratitude to the relevant parties who have contributed information and comments on this Strategy. In particular, I would like to express my gratitude to the donors who provided financial and technical support. The document will be implemented and integrated with the Socio-Economic Development Plan of the district, and relevant plans for other sectors. It will also be reviewed and updated periodically.

At Nong District, December 20, 2024

Director of DWR | Head of the Savannakhet PoNRE | The Governor of Nong District

1 Enhancing climate resilience of communities to floods and droughts

1.1 Background

Savannakhet Province consists of 15 districts (including Nong District) and 1,022 villages with a total population of about 1 million people (Lao Census, 2016). Agriculture is particularly important for the Province, with 75% of the population living in rural areas and relying on subsistence farming for livelihoods. Approximately 15,000 km^2 of the province area is used for agriculture. Rice paddy cultivation in the province supplies ~25% of the rice consumed in Lao PDR. Most of Savannakhet Province lies within the ~19,500 km^2 Xe Bang Hieng River Basin, with the river's headwaters located in the Annamite mountains along the Lao PDR–Vietnam border, in the north-eastern region of the province.

The Integrated Climate-Resilient Flood Management Strategy (ICFMS) for Nong District aims to enhance the resilience of communities to the impacts of floods in the district, which are projected to become more intense and frequent with climate change. Flood hazard mapping for the Xe Bang Hieng River Basin shows that the lowland districts are exposed to widespread riverine flooding resulting in significant social and economic impacts. However, riverine flooding is generally not a significant issue in upland districts such as Nong district, although localised flooding is known to occur. Drought hazard mapping shows that Savannakhet Province is prone to severe droughts with a return period of 10 years. Whilst intensity of agriculture in Nong district is lower compared to lowland districts (e.g. Songkhone and Champhone districts), there is potential for significant impacts to local agriculture from drought in Nong district.

The ICFMS for Nong District outlines a strategy and set of actions over the next five years (2025-2029) to enhance the resilience of communities to the impacts of floods and droughts (including the effects of climate change) in the district. It serves as a blueprint for enhancing resilience by adopting Integrated Catchment Management (ICM), Integrated Water Resources Management (IWRM), Ecosystem-based Adaptation (EbA), and Early Warning approaches, while promoting sustainable, inclusive, and gender-responsive solutions. The ICFMS is also designed to strengthen both technical and institutional capacities, ensuring that communities can better plan for, respond to, and recover from floods and droughts.

The ICFMS covers the following key areas within its scope:

- Geographical Coverage: The strategy applies to the Nong District within the Xe Bang Hieng River Basin, with a focus on the target rural communities in the villages of Nongvilai, Saveu, and TangAlai Neua.
- Sectors: The strategy involves cross-sectoral collaboration, focusing on water resource management, land-use planning, ecosystem management, infrastructure implementation, early warning and preparedness to ensure a holistic approach to flood and drought resilience.
- Stakeholders: The project engages national and local government bodies, community organizations, civil society, and development partners to co-develop and implement the strategy. Attention is also given to involving vulnerable groups, such as ethnic minorities and women, in the planning and decision-making process.
- Timeframe: The proposed action plan spans five years, from 2025-2029, and includes short-term actions to build immediate resilience, as well as longer-term structural and non-structural actions, including infrastructure investments and ecosystem restoration initiatives.

1.2 Alignment with existing policies, plans and strategies

The ICFMS has been developed aligning with the existing policies, plans, strategies and initiatives as summarised below.

Socio-Economic Development

District

This ICFMS contributes to the goals and focus directions of the Social Economic Development Plan of Nong District, in particular with regards to:

- Goal 1: To make the economy of the district grow with quality. Focus work plan 1: Macroeconomy is strong and stable. Focus work plan 2: Develop agriculture-forestry in a modern and sustainable direction.
- Goal 3: To improve and upgrade the material and mental living conditions of the people, especially in rural areas, to be able to do stable production, and gradually increase family income so that people's lives are improved. Focus work plan 4: To promote the role and participation of women, youth, disadvantaged, disabled and senior citizens in socio-economic development.

Province

The ICFMS contributes to the 5-year Socio-Economic Development Plan (2021-2025) of Savannakhet province by supporting the target economic growth rate, protection of nature and the environment, and use of natural resources effectively to benefit society.

National

The ICFMS contributes to the National Strategy on Socio-Economic Development (2016-2025) by supporting continuous economic growth in the direction of quality, balance, and sustainability. The ICFMS also aligns with the protection of nature and the environment and use of natural resources effectively in a sustainable, effective and green direction. Finally, it contributes to Goal 8 of the National Sustainable Development Goals (SDGs) to promote continuous, inclusive and sustainable economic growth.

Watershed Management

This ICFMS contributes to the Xe Bang Hieng Watershed Management Plan (2021-2025) six programs: (1) Create a management mechanism and participate in the management of the catchment area (2) Manage the use of water and water resources (3) Manage information on water and water resources (4) Protect and restore water and Water resources (5) reduce the effects of floods, droughts and climate change and (6) manage land, forests, environmental protection and pollution control.

Disaster Management

This ICFMS contributes to the "Disaster Risk Reduction Strategy in Savannakhet Province until 2035" in particular with regards to capacity building for disaster prevention and risk reduction, and disaster control.

Climate Change

The ICFMS contributes to the Actions Plans in the National Strategy for Climate Change By 2030 in particular: 1) Develop, manage information systems, report conditions, events and effects of climate change; 2) Strengthen the resilience and the ability to adapt to climate change for basic infrastructure, production systems, businesses, services, ecosystems and communities as well as all sectors that are vulnerable and affected; 3) Promote education, awareness and public participation on climate change; 4) Connect and create a favourable environment to manage the impacts of climate change; 5) Strengthen organisations and human resources to manage climate change. The ICFMS also contributes to Sustainable Development Goal 13 to take urgent measures to combat climate change and its impacts.

Anticipatory Actions

The Lao Government is currently collaborating with the Food and Agriculture Organisation (FAO) to develop Anticipatory Action Protocols for agricultural drought. It is an Early Warning System consisting of trigger points (risk level) informed by an Effective Drought Index (EDI) using rainfall observations and forecast data. Anticipatory Action is an approach that combines early warning information with actions to mitigate the impacts of droughts on the most vulnerable people. The goal is to act before the drought impacts materialise to support vulnerable households through such interventions as distributing drought-tolerant crop varieties and providing animal feed and health support. The FAO is also working the Department of Meteorology and Hydrology (DMH) on flood trigger points and Anticipatory Actions for livestock evacuation. The trigger points are informed by rainfall observations and forecast which are in turn used to forecast river water levels. The system is being tested with the intent that it will be deployed to DMH.

Early Warning

Early Warnings For All (EW4ALL) 2024-27 is a special initiative of the United Nations (UN) Secretary General, which aims to spearhead action to ensure every person on Earth is protected by early warning systems by 2027.

Under the umbrella of EW4ALL, Lao People's Democratic Republic (Lao PDR) aims to scale up prior efforts and strengthen national early warning systems

According to the EW4ALL Road Map for Lao PDR (United Nations, 2024), the DMH has undergone major upgrades in terms of their observation network and forecasting systems. However, there is now an increased demand for localized and actionable early warning information among agencies and end-users from different sectors, including agriculture and disaster risk management. This is important to help build trust in warning services amount communities. The report also outlines that communities lack of knowledge about risks and appropriate responses. Furthermore, the 9th National Socio-Economic Development Plan (NSEDP) emphasizes the need to strengthen the capacity of disaster management committees in central, provincial and district level in disaster risk reduction and preparedness. It also aims to improve the quality of reporting and effectiveness of news alerts related to temperature, weather, earthquakes, and water levels. Gaps and proposed activities in the Road Map that are relevant to addressing challenges at the district and village community levels for this project are outlined in Section 5.

Conservation Strategy

This ICFMS contributes to Goal 4 and focus directions of the Social Economic Development Plan of Nong District – Focus on development within the province to be green and friendly to the environment. Work plan 1: to protect the environment and prepare to deal with and respond to risks from natural disasters. Work plan 2: To manage and use natural resources sustainably. The ICFMS will contribute to the Sustainable Development Goal 15 – To protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

1.3 Process for developing strategy

The ICFMS for Nong District forms part of a larger project titled "Integrated Water Resource Management and Ecosystem-based Adaptation in the Xe Bang Hieng River Basin and Luang Prabang city" (referred to as the IWRM & EBA Project).

The IWRM & EBA Project is funded by the Global Environment Facility (GEF) and delivered by the United Nations Development Programme in the Lao People's Democratic Republic (Lao PDR). This project aims to support the government of Lao PDR to promote the integrated management of land and water resources for targeted rural and urban communities in the Xe Bang Hieng River Basin (XBH) and Luang Prabang City (LPC).

The IWRM & EBA Project has three Outcomes:

- Outcome 1: Enhanced national and provincial capacities for integrated catchment management and integrated water resource management in target rural and urban communities.
- Outcome 2: Reduced flood risk through headwater conservation, restoration and protective infrastructure, supported by climate-resilient and alternative livelihoods.
- Outcome 3: Effective knowledge management and Monitoring and Evaluation (M&E) through awareness/advocacy and monitoring of climate change impacts and adaptation opportunities in target rural and urban communities.

Outcome 1 consists of two Outputs:

- Output 1.1: An assessment of EbA and protective infrastructure options for XBH and LPC, flood- and drought-risk maps of XBH, and an economic evaluation of urban ecosystem services for LPC.
- Output 1.2: ICFMS developed for LPC and the XBH Basin, supported by an updated hydrometeorological monitoring network, early-warning systems (EWS) and revised emergency procedures for the XBH Basin.

This ICFMS is part of Outcome 1.2 and builds on the data gathered from previous risk mapping and hydrological models (from Output 1.1). These strategies will align with broader IWRM and ICM goals, ensuring that interventions are sustainable and support long-term climate resilience.

The development of the Nong district ICFMS has been highly consultative, with multiple stakeholder consultations to seek inputs and review from village, district, provincial and central level stakeholders (Figure 1). The process was also guided by the key approaches outlined below – ICM, IWRM, EbA and Early Warning Systems.

Figure 1. *Process and timeline adopted in developing ICFMS*

Integrated Catchment Management

ICM is a process that recognises "catchment" as the organising unit for understanding and managing ecosystem processes in a context that includes social, economic and political considerations, and guides communities towards an agreed vision of sustainable natural resource management in their catchment.

Integrated Water Resource Management

IWRM is a process that promotes the coordinated development and management of water, land and related resources to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. The basis of IWRM is that the many different uses of finite water resources are interdependent, and that unregulated use of scarce water resources (surface and groundwater) is wasteful and inherently unsustainable.

Ecosystem based Adaptation

EbA), also referred to as Nature-based Solutions(NbS), harnesses biodiversity and ecosystem services to enhance the resilience and reduce the vulnerability of people and the environment to climate change (Figure 2). EbA involves the conservation, sustainable management and restoration of ecosystems (such as forests, floodplains, rivers and wetlands).

Figure 2. *Ecosystem-based Adaptation conceptualised in the Driving Forces-Pressures-State-Impacts-Responses framework (Source: UNEP-UNDP-IUCN (2010)*

Early Warning Systems

The Early Warning System (EWS) analysis presented in this strategy draws on the UNDP framework for Early Warning Systems (UNDP, 2018) (Figure 3). The framework provides expected elements of successful EWS across the following themes: i) risk knowledge; ii) monitoring and warning system service; iii) dissemination and communication; and iv) the response capability of agencies and communities.

Figure 3. *UNDP framework for early warning systems (Source: UNDP, 2018)*

2 Situation Assessment

2.1 Geography

Savannakhet Province, situated in the central region of Lao PDR, is the country's largest and most populous province (over 1 million people). The majority, more than 75%, reside in rural areas, relying on subsistence agriculture in small villages. The province's significance lies in its connection to the Xe Bang Hieng river basin, particularly the lowland region which is crucial for agriculture. These areas contribute approximately 25% of the rice consumed in Lao PDR, playing a pivotal role in the nation's food security.

Nong District is located in the upland of the Xe Bang Hieng River Basin (Figure 4). The district population of 34,109 is spread across 69 villages with 7 main ethnic groups living together: Lao, PhouThai, Makong, Katang, Tri, Pako and Taoiy. The Lao people account for 40%, the Thai people account for 20%; The Makong tribe accounts for 15%; the Katang tribe accounts for 10%, the Tri people account for 8% the Pako people account for 5% and the Taoiy people account for 2% (Nong City Planning Office, 2018).

The district population is generally concentrated in the centre of the district (particularly around Nongvilai village), the north of the district along the network of rural roads, and to the south in proximity of the Xe Lanong River. The most populous village by far is Nongvilai with a population of around 2385, with all other villages have population less than 1,000 (the median village population is about 376). The Xe Lanong River flows from the south, through the middle of the district before flowing out at the eastern end of the district where a large hydropower reservoir has been constructed (Figure 4). The two target villages of Nongvilai and TangAlai Neua are located on the Xe Lanong River, with the target village of Saveu located in proximity of one of its tributaries. The proportion of the village population considered poor (poverty headcount) is higher in the western and eastern part of the district, with poverty headcount estimated at 70-80% in the target village of Saveu for instance compared to 10-20% in Nongvilai (Figure 5).

The gross domestic product (GDP) of the district in 2019 reached 244 billion kip, an increase of 26 billion kip compared to 2014, in which:

- Agricultural sector account for 78.9 % of GDP.
- The industrial sector account for 7.4 % of GDP
- The service sector account for 14.7 % of GDP.

The average GDP per capita in the district is 7.37 million kip or equivalent to 877 US dollars.

2.2 Ecosystems

A considerable area of Savannakhet Province and Xe Bang Hieng River Basin, particularly the central and eastern region (which include the upland catchments), is highly forested. The ecosystem services provided by forested land in regulating the catchment hydrology and in protecting river water quality benefit communities across the basin. Forested land promotes infiltration of rainfall and reduces surface runoff, regulating baseflow in the dry season and floods in the wet season. Forested land also uses less water than agricultural land, protecting yield in surface water systems including springs, local watercourses and main river stems.

Table 1. Nong District land cover

Land cover classification	Area (ha)	%
Regenerating Vegetation	90,886	53.46
Mixed Deciduous Forest	37,877	22.28
Evergreen Forest	23,645	13.91
Other Agriculture	5,870	3.45
Upland Crop	5,264	3.10
Forest Plantation	3,944	2.32
Water	1,163	0.68
Urban	567	0.33

Grassland	514	0.30
Other Land	137	0.08
Dry Dipterocarp Forest	109	0.06
Agriculture Plantation	28	0.02
Rice Paddy	17	0.01

The land cover in Nong District comprise largely of regenerating vegetation (53.5%), mixed deciduous forests (22.2%) and evergreen forest (13.9%), with agricultural/crop land cover adding up to only about 6.6 % but spread widely across the district area (see Table 1 and Figure 6). A large area of forest is under National Protection to the east and south of the district (Figure 4).

2.3 Climate and hydrology

The Nong District is situated in a tropical area, which also extends into a monsoonal zone. It experiences two primary seasons – a dry season from November to early May and a wet season from May to October. The monthly average temperature in the district is relative stable throughout the year with a peak of around 42 °C in April (based on M. Nong station weather data 1995-2018). The district receives an average annual rainfall of about 1,592 mm (based on M. Nong station weather data 1995-2022) with most of the rainfall occurring during the wet season. About 95.2% of the flow in the Xe Lanong River is therefore during the wet season with flow increasingly significantly from June until September (based on Xe Lanong River station flow data 1995-2004).

While country specific data on climate change is limited, the average daily temperatures in Southeast Asia have already risen by 0.5 to 1.5°C between 1951 and 2000 (Mastrorillo, 2016). Additionally, a Lao PDR Government report of climate vulnerability assessment in Lao PDR illustrated that the average maximum temperature in Savannakhet Province is expected to rise (2021-2050) by 1.10°C for Representative Concentration Pathways (RCP) 4.5 and 1.36°C for RCP8.5 (MoNRE, 2020). MoNRE (2020) also indicated that from 2021-2050, the average maximum rainfall in Savannakhet province was expected to rise 12.32mm and 49.6mm for RCP 4.5 and RCP8.5 respectively. Southeast Asia is also expected to see significant increases in average annual economic losses between 2005 and 2050 due to flooding with impacts on freshwater availability, food security, human health and industrial outputs (IPCC Sixth Assessment Report, 2023). This is a significant issue for Lao PDR which depends heavily on natural resources..

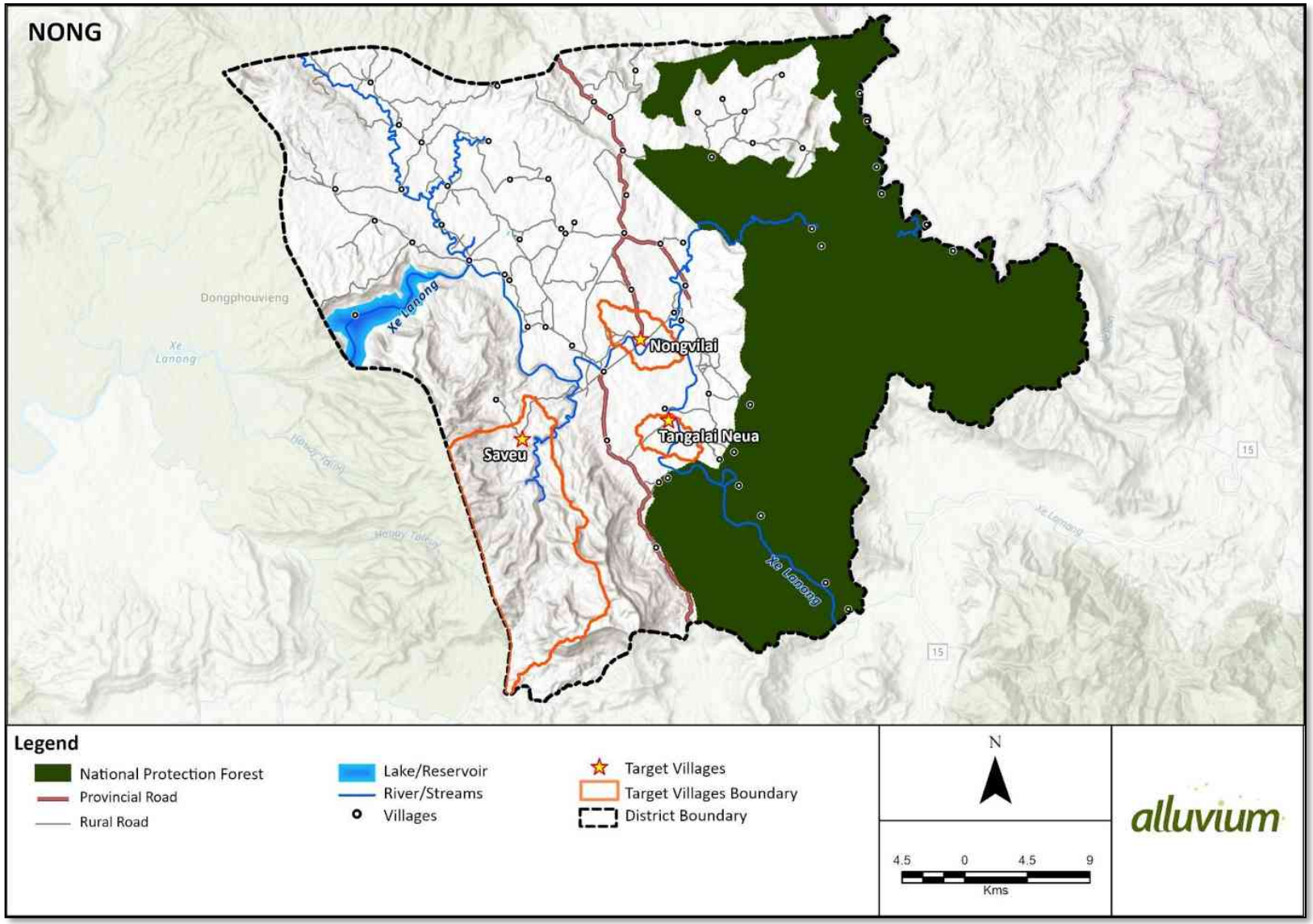

Figure 4. *Nong District – Geographic features*

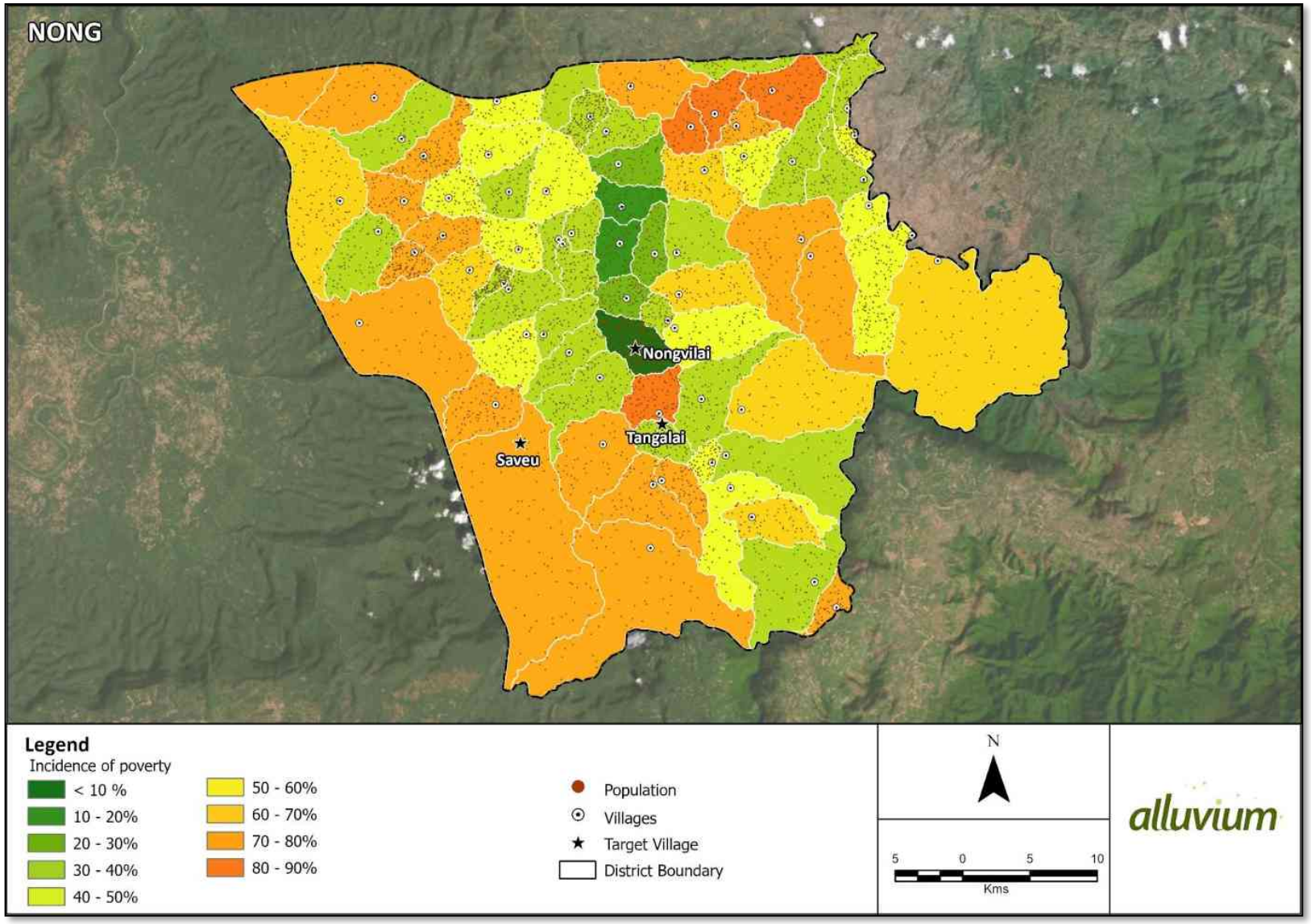

Figure 5. *Incidence poverty in Nong District (Source: https://apps.k4d.la/analyst/)*

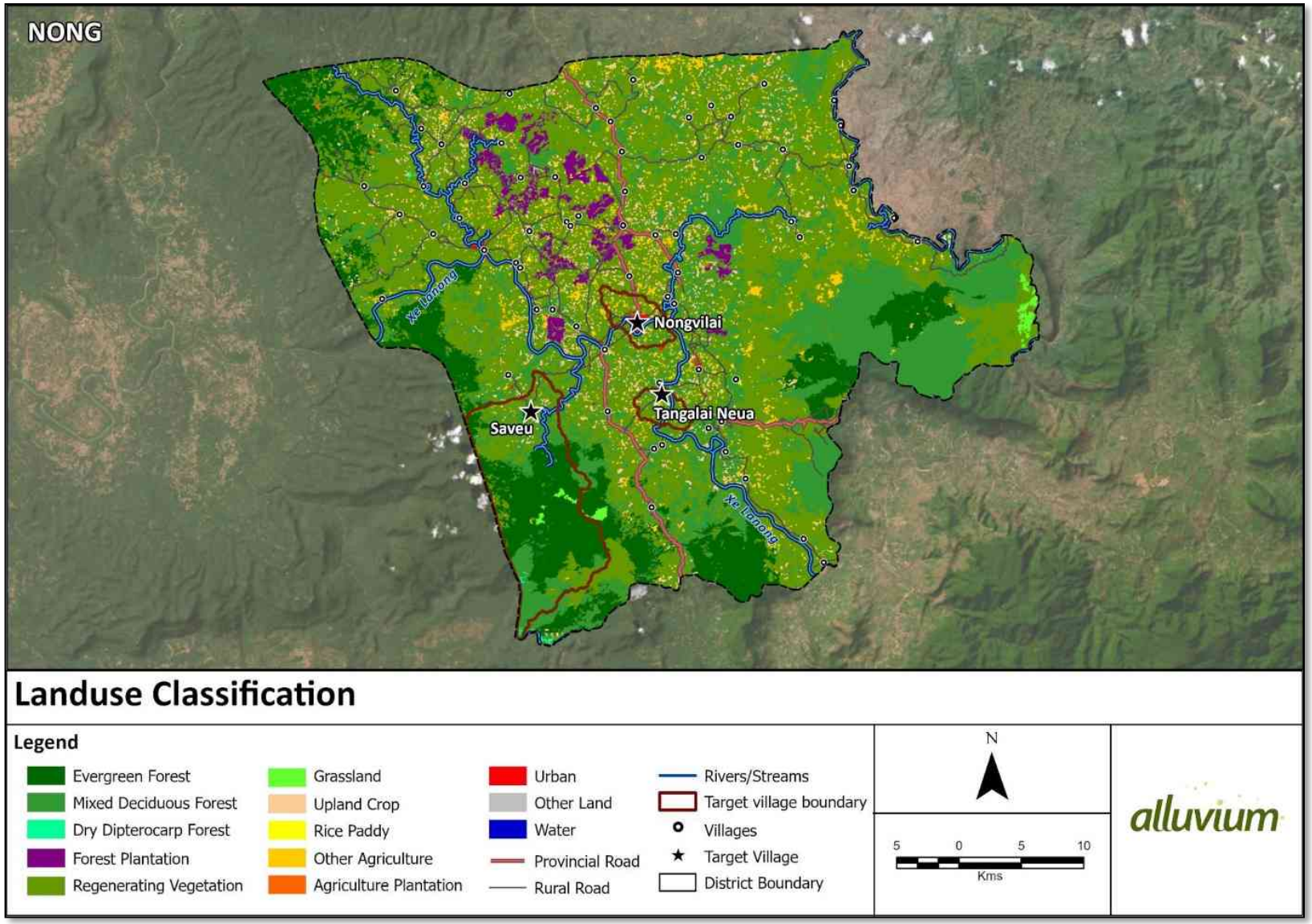

Figure 6. *Land cover in Nong District (Source: https://apps.k4d.la/analyst/)*

2.4 Water resources

According to the report on agriculture production planning for dry season (2024) from District office of Agriculture and Forest, there are 10 main reservoirs; 19 pumping stations; and 9 natural ponds in Nong District.

There are aquifers over the Nong District including Basement, Volcanic, Schists), Sedimentary Paleozoic, Karstic, Sedimentary, Mesozoic, and Alluvial. The groundwater storage depth in Savannakhet as well as Nong District is approximately 90-450 cm, and the groundwater potential is approximately 0.1-0.5 L/s (Viossanges, 2017). Groundwater extraction via community wells or household tube wells is the important source of water supply for domestic use in villages.

Nongvilai village

Nongvilai village is located along the Xe Lanong River. It is the with most populous village in the district with a population of around 2385. The village has piped water supply. The villagers rely on bottled water for drinking from nearby private sources. Before pipe water was installed, villages would rely on river water for drinking and washing. About 30 households have groundwater tubes. There are five community groundwater wells, however four are not functional. During floods or droughts, villagers rely on a mix of pipe water, groundwater, river water and pond water. There are two large storages that the villages rely on for irrigation of rice paddy fields, as well as fishing and livestock water supply. These two storages were implemented by DAFO. Riverbank erosion along the Xe Lanong River was identified as an issue by the village stakeholders. However, on inspection, the riverbanks were found to be reasonably well vegetated and stable. A recommendation is to consider land use controls to manage development and uses along the riverbanks in order to reduce the impacts of riverbank erosion.

Saveu village

Saveu village is along a tributary of the Xe Lanong River – the Sanor River. The village is home to 657 people. The villagers rely on a combination of spring water and groundwater (after boiling) for drinking. There is an existing spring in the middle of the village which is surrounded by private land but nevertheless accessible to all villagers for drinking water. There are four groundwater community wells for drinking, washing, cooking, gardening, and livestock water supply; however, two wells were not functional. There is another groundwater spring in private land close to the village, however supply has reduced significantly in recent years. Land clearing around the spring has also resulted in sediment-laden runoff filling up the spring. Land clearing and plantation of cassava was observed during the site visit around the village and further away (see site photo E). It is understood that individual households are clearing land for cassava production, which is placing pressure on forest land and water resources. The area of rice paddy fields managed by the village is 58 ha, swidden land is 80 ha, banana cultivation and cassava 30ha and 10 ha respectively. Ten households rely on land adjacent to a small creek (Sanor creek) for rice cultivation over 25 ha (about 3 km away).

TangAlai Neua village

TangAlai Neua village is located along the Xe Lanong River in the upland region. The village is home to 455 people living. The villagers rely on a combination of spring water and groundwater (after boiling) for drinking. There are two springs for drinking water which are about 300 metres from the village. These are “watering holes” likely located along creek lines within rice paddy fields. Water is collected from these watering holes and is accessible to all villages despite one of the watering holes being on private land. There are no buffers around the watering holes which are also accessible to livestock. There are four groundwater wells in the village supplying water for cooking, washing, livestock and garden irrigation. The area of rice paddy fields managed by the village is 20 ha, swidden land is 60 ha, and cassava 65 ha. It is noted that the rice paddy fields have been developed within creek lines likely because of the wet condition suitable for rice cultivation. 30 households in TangAlai Neua village own and manage about 20 ha of rice fields next to the Houay Tabon River.

2.5 Flood and drought risks

Floods

Floods and droughts impact on communities in the Xe Bang Hieng River Basin. Riverine flooding is caused by high rainfall throughout the basin including in the upper areas, and overflow of rivers leading widespread inundation of the surrounding areas. Flood hazard mapping show that riverine flooding occurs primarily in the western area of the basin in the lowland regions, particularly within Champhone, Songkhone and Xonbuly districts (Antea, 2024). These districts are affected by flooding primarily due to their geographical and hydrological characteristics. They are traversed by several rivers, including the Xe Bang Hieng and Xe Champhone Rivers, which are prone to overflow during the wet season. The topography of this region is predominantly low-lying, making it more susceptible to water accumulation and flooding.

Whilst widespread riverine flooding is not an issue in the upland region (including Nong district) compared to the lowland region, there are still impacts from localised riverine flooding and riverbank erosion. In both Nongvilai and TangAlai Neua villages for instance, about 20 households in each village close to the Xe Lanong River were affected by rising river water level in 2009. In TangAlai Neua, these houses have since moved to higher grounds. In Nongvilai, river water level rose did not reach house floor level – nevertheless the families sought shelter at the school as a precaution. At the district level, there are gaps in the understanding of flood and riverbank erosion risks at the institutional and community level, and a lack of integration of these risks into land use planning. There are also gaps in flood early warning services, including poor mobile phone coverage network in remote areas of the district which impacts on dissemination of warnings.

Droughts

The rainfall pattern in the east of the Xe Bang Hieng River Basin (upland region) is different to the west (lowland region), with higher rainfall and shorter duration of consecutive dry days (i.e. periods without any rainfall) in the east for the 5-, 10, 50- and 100-year return periods (Figure 7) (Antea, 2024). This suggests that the security of water supply from rainfall driven systems such as ponds, local watercourses, and shallow springs is less vulnerable in the upland region (including Nong District) with lower likelihood of such systems drying up or ceasing to flow.

The Standardized Precipitation Index (SPI) is an index which quantifies precipitation deficits relative to the normal local climate. It is calculated using accumulation periods of 3-months, 6-months and 1-year to reflect relevance for agricultural practices. For a 3-month moving average under current climate, the SPI indicates that Nong District is likely to experience 'moderately dry' condition with a 5-year return period. For a 6-month moving average under current climate, Nong District is likely to experience 'severely dry' condition with a 5-year return period up to 50-year return period. For a 6-month moving average under current climate, Nong District is likely to experience 'extremely dry' condition with a 100-year return period.

Efforts to mitigate the impacts of drought is required across Savannakhet Province. Impact of droughts in terms of damage cost to agriculture is found to be higher in the lowland region given the higher intensity of agriculture compared to the upland region. In Nong District, damage to agriculture is estimated at about $ 65,600 USD, $59,600 USD and $29,800 USD for target villages of Nongvilai, Saveu, and TangAlai Neua respectively for a 6-month drought period with a 100-year return period (Antea, 2024).

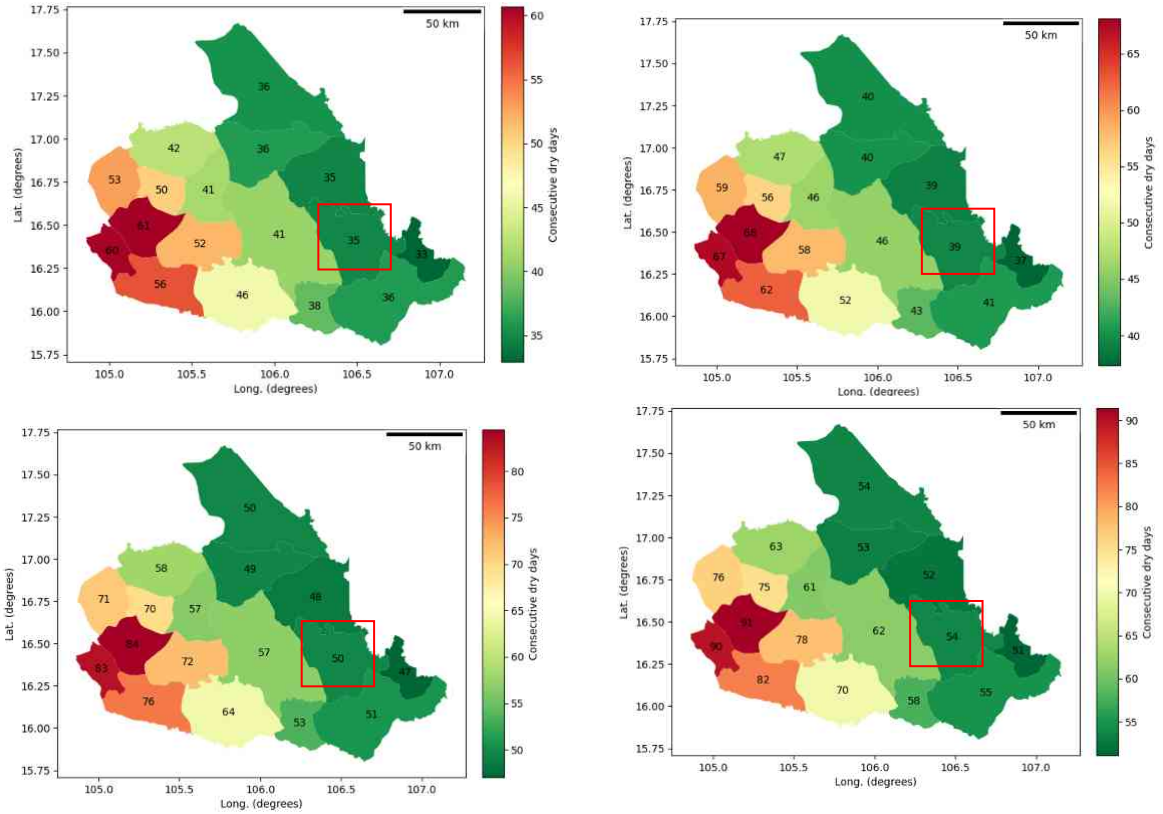

Figure 7. *Consecutive dry days (yearly mean per district) for a 5-year (left top), 10-year (right top), 50-year (left bottom), and 100-year (right bottom) return period (Source: Antea, 2024). Red Box indicates Nong District*

Early Warning System (EWS)

The system for forecasting and warning for flood and drought in Savannakhet Province is presented in Figure 8. Under this system, the DMH of MoNRE is mandated to collect, evaluate, and disseminate information on hydrometeorological parameters including rainfall, evaporation, river water level, and flow. Monitoring and observation systems run by DMH consist of observation stations, data transmission and telecommunication networks, data processing and storage systems, and data management systems.

At provincial level, the "Water Resources" and "Meteorology and Hydrology" sectors of the Provincial Natural Resources and Environment (PoNRE) have direct responsibility for hydrometeorological data collection on daily weather data and daily water level change in each river, and provision of this data to DMH in Vientiane. At the district level, the DoNRE is responsible for compiling and collecting daily water level and rainfall data from stations installed in the district. This data is reported twice per day, except in emergency times, when they are reported more frequently depending on the level of emergency. It should be noted that the collection of hydrometeorological data is still mainly the responsibility of central agencies.

The "Meteorology and Hydrology" sector of PoNRE also has responsibility for receiving and disseminating weather forecasting from DMH to relevant agencies in the province and districts such as the Provincial Flood and Drought Steering Committee, and other line agencies including the district Office of Natural Resources and Environment (DoNRE). DoNRE in turn sends the information to District Governor and District line agencies. Information is then sent to village communities by phone. Warnings are issued to villagers through megaphones or other facilities that villages have. On a normal day, weather forecasting information from DMH is sent directly to Provincial Meteorology and Hydrology at 11 am. In the case of an emergency, DMH sends information twice per day depending on weather situation and water level, with average synoptic every 6-12 hours. It takes on average 24 hours for weather forecasting information from DMH to reach villages, but longer for remote communities that have limited communication and telecommunication services.

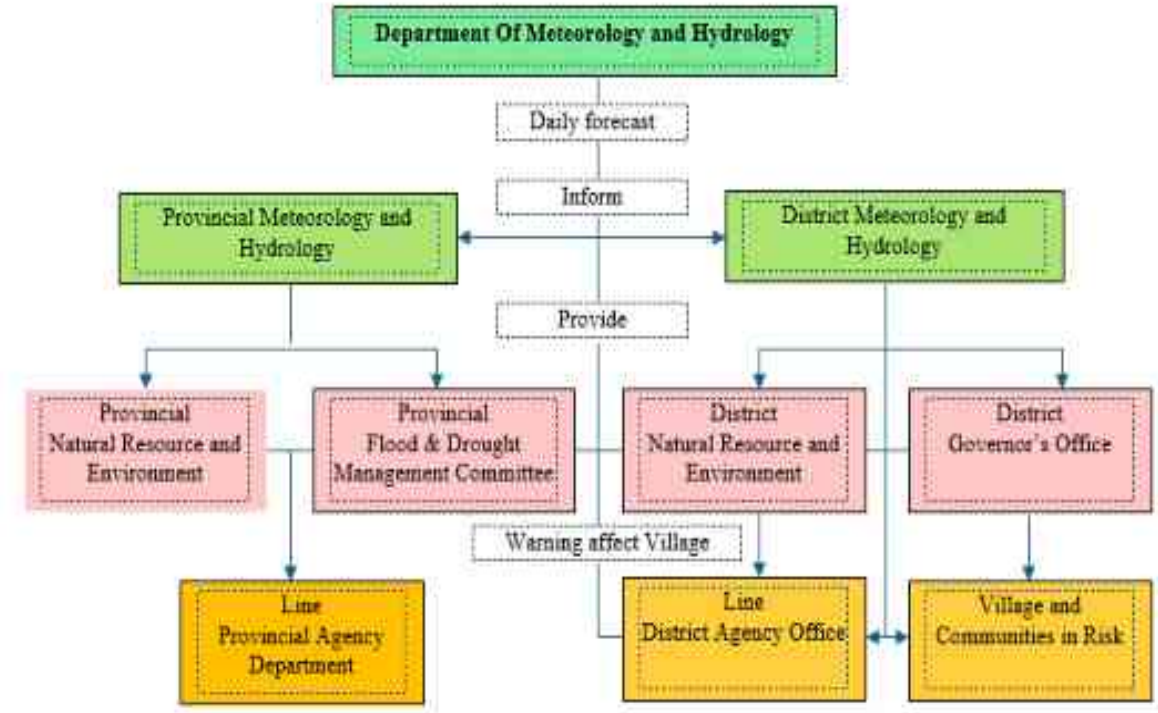

Figure 8. *The system of forecasting and warning for flood and drought in Savannakhet Province.*

Hydrometeorological infrastructure

Hydrometeorological data collection is needed for flood and drought forecasting. To improve collection of hydrometeorological data in Xe Bang Hieng River basin, the Department of Meteorology and Hydrology DMH under MONRE has recently collaborated with the Korea International Cooperation Agency (KOICA) to survey the hydrometeorological network and upgrade and install new infrastructure within several districts in the basin as shown in Table 2 and Figure 9 (KOICA, 2024). In Nong District, there are three rain gauge stations in the district – one established in 1991 by provincial DMH section and another two stations more recently by the KOICA project. There are also two water level gauge stations in Nong district along the Xe Lanong River (Table 2).

Table 2. List of Meteorology and hydrology station in Nong District, Savannakhet Province

No	Station name	Location			Coordination		Installed Year
		Village	District	Province	Latitude	Logitude	
II	**Rainfall stations**						
1	Nongvilay	Nongvilay	Nong	Savannakhet	16.370000	106.513333	PMH 1991
2	Asing sanae	Asing sanae	Nong	Savannakhet	16.502963	106.572710	KOICA 2024
3	Lapid	Lapid	Nong	Savannakhet	16.515507	106.337368	KOICA 2024
III	**Water level stations**						
1	XeLanong	Nongvilay	Nong	Savannakhet	16.368056	106.496111	ADB 2016
2	XeLanong	Nongvilay	Nong	Savannakhet	16.375313	106.493970	KOICA 2024
III	**Warning Post**	Nongvilay	Nong	Savannakhet	16.375313	106.493970	KOICA 2025
sources: Provincial Natural resources and Environment of Savannakhet Province							

Warning service

Early warning service is crucial for safeguarding communities and ensuring resilience against floods and droughts. However, the system of early warning in provinces and districts across the country is not well established. Early warning messaging as often advice is too broad, has a large geographic area and does not use easily understood language as to the expected timelines, impacts and actions communities should take. For instance, in Nong District, flood warnings are issued via mobile phones or in the form of an official letter from the responsible agencies. However, these are generally issued during the storm event or when river water levels are already high. Furthermore, the early warning system information is not widely known among local people,

despite government and project efforts to improve these systems in the Xe Bang Hieng River Basin. Specific gaps in early warning are outlined in Table 3. Addressing these gaps is essential for improving the overall effectiveness of flood and drought risk management systems and ensuring the safety and resilience of vulnerable communities.

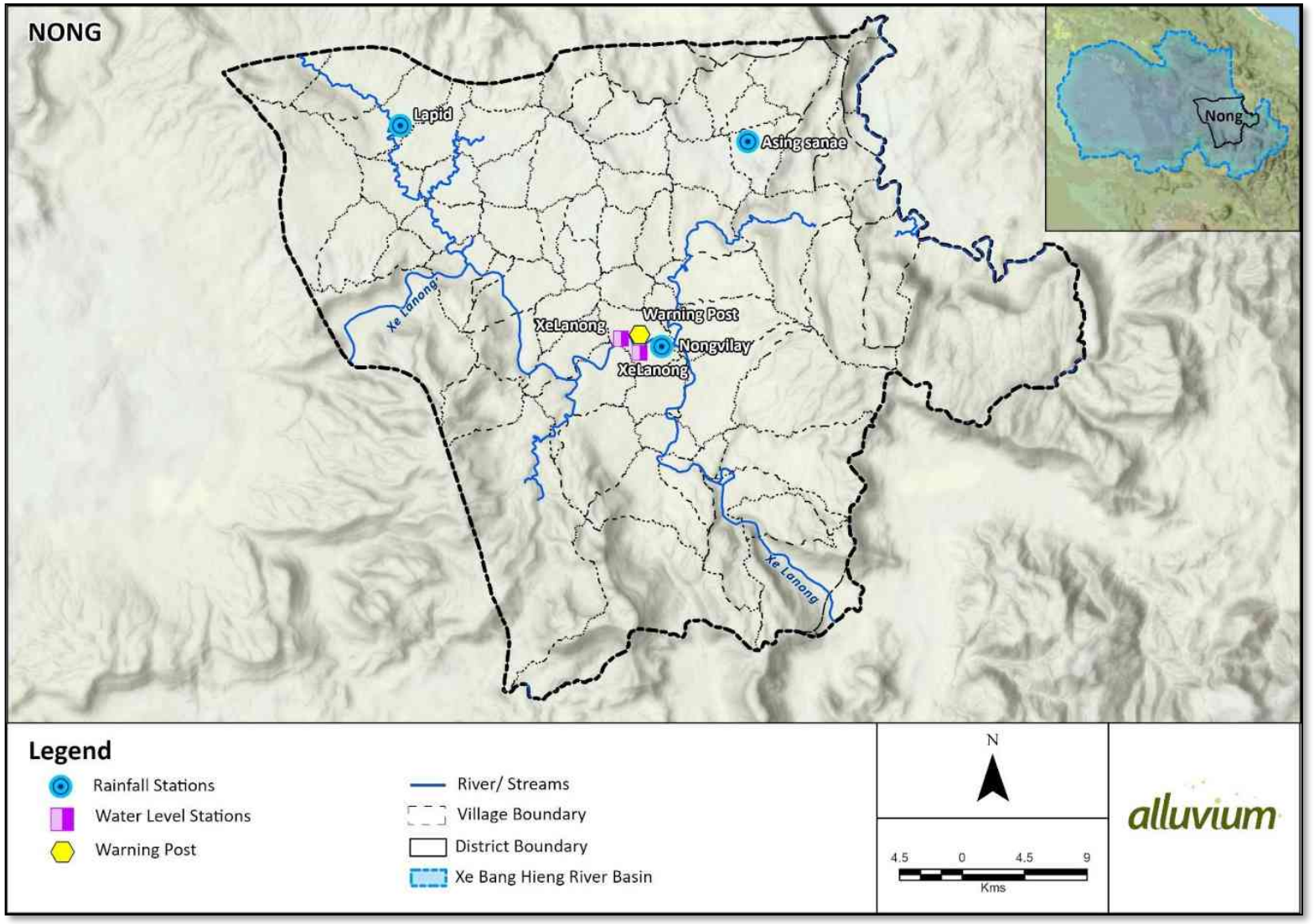

Figure 9. *Meteorology and hydrology station in Nong District, Savannakhet Province*

Table 3. Gaps in Nong District Early Warning System (EWS) for flood and drought hazards

Component of EWS	Gaps
Risk knowledge	• Communities lack knowledge about drought risks and appropriate responses. • Insufficient mapping and assessment of areas vulnerable to floods (flash and riverine flooding) in the district.
Monitoring and warning service	• Flood warning messages cover general weather forecast only are not specific enough to be an early warning for any particular area. • Misunderstanding and lack of access to bulletin information issued by responsible agencies. • Warnings are only cautionary and are not clear on what actions to take • No early warning system for drought. • Limited hydro information to support flood and drought forecasting. In Nong District, consider installing new rain gauges and water level gauges in TangAlai Neua Villages. • Hydrometeorological equipment is outdated. • Fragmented monitoring responsibilities between central, provincial, and district levels. Responsibility is largely confined to DMH. • Limited number of trained staffs for data collection and analysis (for forecasting) and limited annual budget for equipment maintenance. • Village leadership do not understand the need for hydrometeorological monitoring and do not play a role in maintaining infrastructure and in data collection.
Dissemination and communication	• Limited phone coverage and difficult road conditions can limit dissemination of information and warnings to at-risk villages. • Forecast and warning messages can be too technical for many users particularly community representatives. • Lack of sufficient trained staff in interpreting forecast and warning messages at provincial and district level. • There is limitation and lack clarity regarding the coverage and reach of forecast and warning messages in the district. Early warning system information is not widely known among local people. • There is no mechanism to verify that warnings have been received at the village level, communicated to residents, and how and if the information has been used. • Gaps exist in the community's understanding of the specific roles of technical agencies in providing early warning alerts and messages.
Response capability	• No common procedure at village level to respond to floods and droughts. • There is a general lack of capacity and knowledge how to respond to droughts, including water conservation in agricultural production. • Community awareness and preparedness to droughts is limited. • Inadequate early interventions to mitigate impacts of droughts (e.g. Anticipatory Actions)

3 Action Plan 2025-2029

3.1 Goal

A 5-year Action Plan (2025-2029) is proposed for Nong District to strengthen the climate resilience of communities to flood and drought risks.

3.2 Objectives and actions

This Action Plan will achieve this goal through the following objectives:

1. Raise awareness of flood and drought risks, and improve community preparedness and capability to respond
2. Improve hazard forecasting and early warning services
3. Protect, restore and manage ecosystem functions and services
4. Secure water for drought
5. Improve flood defence.

Infrastructure and non-infrastructure related actions have been developed for the district to address these five objectives. Table 4 provides a description of each objective together with an estimated budget for actions under each objective over the phase of this Action Plan i.e. 2025-2029. The actions are further detailed in Table 6. Infrastructure investment has been estimated for the district in Table 5. The Action Plan (2025-2029) proposes to cover part of the infrastructure investment need. The gap in infrastructure investment can either be covered through additional funding during this action plan phase or part of the next action plan beyond 2029.

The proposed actions and budget for this Action Plan have been informed by consultation with a range of stakeholders, as well as the following two studies:

1. Infrastructure investment recommendations for addressing flood and drought risks in target villages in the Xe Bang Hieng River Basin (Alluvium and Hydrotech consulting, 2024a). The recommended infrastructure investments for Nongvilai, Saveu and TangAlai Neua villages are provided in Appendix A.
2. Investment recommendations for hydrometeorological network upgrades and Early Warning System updates for flood and drought (Alluvium and Hydrotech consulting, 2024b).

During implementation of the Action Plan, it is important that prioritisation of interventions in the district is guided by the flood and drought risk spatial mapping (Antea, 2024) as well as any interventions that already exist.

The proposed investment in the Action Plan do not cover personnel costs within the lead organizations which have been nominated to be responsible for delivering the actions. It is assumed that this delivery function is covered within existing resources and staffing of the lead organisations.

Table 4. Action Plan objectives and proposed investment for 2025-29 phase

Objectives	Description	Proposed investment for 2025-2029 (USD)
Raise awareness of flood and drought risks, and improve community preparedness and capability to respond	• Raise awareness and understanding of flood and drought risks (and the effects of climate change on floods and droughts), including related information and warnings sent by responsible agencies • Improve public and institution preparedness to respond to floods and droughts, including access to essential equipment and facilities during emergencies	$230,000 ($100,000 in on infrastructure)
Improve hazard forecasting and early warning services	• Upgrade infrastructure that delivers forecasts and warnings • Improve dissemination of clear and actionable warning messages to those at risk	$270,000 ($110,000 in on infrastructure)
Protect, restore and manage ecosystem functions and services	• Actions to reduce threats to and improve management of ecosystems (such as floodplains, wetlands, swamps, rivers, riparian areas, forests, etc.) to sustain their hydrologic functions and reduce effects of floods and droughts (e.g. baseflow protection and peak flow buffering) • Includes capacity building on conservation and management of ecosystems and sustainable land use practices	$1,040,000 ($775,000 in on infrastructure)
Secure water for drought	• Implement village-scale infrastructure to secure water for drought targeting drinking water and domestic water needs, and local-scale gardens plots and livestock needs (e.g. community borewells, household rainwater tanks, water filters, community ponds and associated water supply infrastructure such as groundwater and river water pumps.	$1,545,000 ($1,000,000 in on infrastructure)
Improve flood defence	• Implement village-scale infrastructure to protect dwellings and infrastructure from flooding (e.g. flood channels and flood retardation basins).	$850,000 ($500,000 in on infrastructure)
	Total	**$3,935,000**

Table 5. District infrastructure investment estimates with proposed investment for 2025-2029 phase

Objective	Infrastructure examples	Estimated investment required per village (USD)	# villages	Estimated investment required in district (USD)	Proposed investment for 2025-2029
Improve community preparedness and capability to respond	Staff gauge for flood alert and warning, distributing drought-tolerant crop varieties, providing animal feed etc	$2,000	69	$138,000	$100,000
Improve hazard forecasting and early warning services	Communication and hydrometeorological monitoring equipment	$15,000	15	$225,000	$110,000
Protect, restore and manage ecosystem functions and services	Works to protect or improve condition of floodplains, wetlands, riparian areas, forests, water supply catchments	$25,000 - $50,000	69	$1,725,000 - $3,450,000	$775,000
Secure water for drought	Community borewells, household rainwater tanks, water filters, community ponds etc.	$22,500 - $50,000	69	$1,500,000 - $3,450,000	$1,000,000
Improve flood defence	Flood channels and flood retardation basins	$50,000	15	$750,000	$500,000
	Riverbank stabilisation	$500,000	1	$500,000	

Table 6. Nong District Action Plan

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
Objective 1: Raise awareness of flood and drought risks, and improve community preparedness and capability to respond										
1	Risk awareness raising	Develop and disseminate awareness raising videos, audios, posters, pamphlets on flood and drought risks (including effects of climate change).	D/V	MoLSW, MoNRE		X	X	X	X	30,000
2		Conduct inclusive and accessible public awareness and education campaigns for target groups (e.g., Women, Children, Older People, Illiterate, and Persons with Disabilities).	V	MoLSW /MoNRE		X	X	X	X	30,000
3	Preparedness and capability to respond	Support establishment of District Disaster Preparedness and Response Plan and District Disaster Response and Recovery Fund. Conduct drills and simulation exercises periodically aligned with the District Disaster Preparedness and Response Plan.	D/V	MoLSW, NDMC, District Military		X		X		50,000
4		Develop Village level disaster response Standard Operating Procedures (SOP).	V	MoLSW, MoNRE, District Military		X	X	X		20,000
5		Identification, validation and planning for Anticipatory Action interventions to mitigate impacts of droughts (e.g. distributing drought-tolerant crop varieties, providing animal feed and health support, or making cash distributions before drought impacts materialise for vulnerable households)	V	MoNRE, District Military	X	X				100,000
Objective 2: Improve hazard forecasting and early warning services										
6	Institutional set up and capacity	Set up clear mandates, roles, responsibilities and coordination mechanisms for all stakeholders involved	D	MoNRE-DMH, MTC, MoLSW		X	X	X		30,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
		in hydrometeorological data collection and dissemination of forecasts and hazard warnings (including a feedback mechanism for two-way community engagement and real time reporting to the national-level warning authorities).								
7		Establish and operate a network of volunteers and the private sector to support early warning dissemination and communication.	D	MoNRE, MoLSW, MoICT		X	X	X		15,000
8		District staff allocation, training, and capacity building on hydrometeorological monitoring and data collection, understanding and relay of forecast and warning messages from central agencies.	D	MoNRE-DMH			X	X		30,000
9	Effectiveness of warning service including coverage and reach of warning system	Undertake study to understand coverage and reach of warnings within district.	D	PoNRE	X					15,000
10		Develop and disseminate simplified standard early warnings messages.	D	MoNRE		X	X			15,000
11		Upgrade or supply new warning equipment/tools (e.g. including Information Communication and Technology (ICT) infrastructure etc.).	D/V	MoNRE, MTC			X	X	X	75,000
12		Maintain early warning system infrastructure.	D/V	PoNRE			X	X	X	20,000
13		Conduct regular training and demonstration for local taskforces and villagers one per year.	D/V	MoNRE		X	X	X	X	20,000
14	Upgrade hydrometeorological infrastructure	Develop guidelines for hydrometeorological and warning system.	D/V	MoNRE	X					15,000
15		Improve hydrometeorological monitoring coverage by installing new stations where	D	MoNRE		X		X		35,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
		gaps exist. Upgrade or repair hydrometeorological equipment where needed.								
Objective 3: Protect, restore and manage ecosystem functions and services										
16	Implement reforestation and vegetation restoration	Protect and restore forested land (by planting native tree and shrub species and by demarcation works) to sustain hydrologic functions and ecosystem services.	D/V	DAFO		X	X	X	X	300,000
17		Utilize appropriate revegetation techniques, including seed dispersal, seedling planting, and natural regeneration.	D/V	DAFO		X	X	X	X	75,000
18		Monitor and maintain restored vegetation to ensure long-term success.	D/V	DAFO			X	X	X	50,000
19	Protect village local water supply catchments and water sources	Implement river and stream riparian buffers in local catchments to protect water quality from impacts of land use change. Avoid deforestation in local water supply catchments.	V	MoNRE		X	X	X		100,000
20		Demarcation and establishment of buffer zones around village water sources to protect them from local disturbances.	V	MoNRE		X	X	X	X	100,000
21	Rehabilitate watercourses and waterbodies	Improve condition and retention capacity of waterbodies (including wetlands, lakes, and ponds) sustaining village communities.	D/V	MoNRE		X	X	X	X	100,000
22		Restore natural drainage patterns and condition of degraded watercourses.	D/V	MoNRE		X	X	X	X	50,000
23	Land use planning and regulations	Undertake project to integrate flood risks into land use planning by considering options for restricting land uses in flood prone areas, regulations for flood	D	MoNRE		X		X		30,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
		resilient building designs, relocation of infrastructure to higher grounds (e.g. homes, buildings and key village assets) and statutory protection for floodplain areas and flood buffers								
24		Undertake project to integrate drought risks into land use planning by considering options such as protection (and demarcation) of village water supply catchments (e.g. small streams and waterbodies).	D	MoNRE			X		X	30,000
25		Identify conservation zones via conducting participatory river/wetland/waterbody land-use planning with the local community.	V	MoNRE	X	X				10,000
26	Capacity building	Develop and implement comprehensive capacity building plans on land use planning, ecosystem-based adaptation and ecosystem restoration.	D/V	MoNRE	X					30,000
27		Develop and implement protocol for taskforce to implement plans.	D/V	PoNRE	X					15,000
28		Training/workshop for local taskforce.	D/V	MoNRE	X					15,000
29	Promote sustainable river basin management and raising awareness	Training, awareness campaign and exchange knowledge on basin management.	D/V	MoNRE			X		X	20,000
30		Promotion and extension on by TV, Radio, U-tube, intervention in school lecture and other media channels.	D/V	MoNRE	X	X	X	X	X	10,000
31		Video, clip competition and drama show on sustainable river basin and local livelihoods.	V	MoNRE		X	X	X	X	10,000
32	Promote integration of socio-economic	Research and survey important natural sites for conservation in river catchments	D/V	MoNRE		X				15,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
	development and cultural elements in river basin management	for recreation (trekking/nature trails) and to support minority cultures.								
33		Strengthening permanent jobs for concern local communities.	V	MoNRE/ PoNRE			X		X	20,000
34		Exchange or lessons learnt excursion and study tour program for community leaders.	D/V	MoNRE				X		30,000
35		Demonstrate some circular economy plot for communities.	V	MoNRE		X	X			30,000
Objective 4: Secure water for drought										
36	Need assessment and survey of water sources	Survey and identify keys elements of livelihood in communities affected by droughts across the district.	D/V	MoNRE	X					100,000
37		Map and survey water resources including groundwater and surface water systems such as ponds and watercourses (including water quality).	D/V	MoNRE	X					100,000
38	Optioneering and infrastructure investments	Undertake infrastructure optioneering study to secure water for drought (drinking, domestic uses, livestock, and small-scale agriculture). Options can include community borewells, household rainwater tanks, water filters, community ponds/waterbodies and associated water supply infrastructure (e.g. groundwater and river water pumps). Identify priority projects in the district.	D/V	MoNRE	X					100,000
39		Undertake a feasibility study for priority projects.	V	MoNRE		X				100,000
40		Based on above study, design and implement priority projects ensuring	V	MoNRE		X	X	X	X	1,000,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
		consultation and participation of local taskforces.								
41		Monitoring of projects with local taskforces.	D/V	PoNRE			X	X	X	50,000
42	Collaboration and capacity building	Capacity building for local taskforces and engagement on key investments.	D/V	MoNRE		X	X	X	X	30,000
43		Undertake capacity building on operations and maintenance of water storage and supply systems (including household rainwater harvesting, and village-scale groundwater extraction systems, waterbodies and irrigation systems).	V	MoNRE/PoNRE			X	X		30,000
44		Undertake capacity building on water quality monitoring for household water uses including use of filtration devices.	V	MoNRE			X	X		15,000
45		Establish mechanisms for collaboration and information sharing (lessons learnt) among agencies and stakeholders.	D	MoNRE					X	20,000
Objective 5: Improve flood defence										
46	Optioneering and infrastructure investments	Undertake a Needs and Optioneering study (with prioritisation) for village flood defence infrastructure including flood channels and retardation systems for both riverine and flash flooding. Identify priority projects in the district.	D/V	MoNRE	X					100,000
47		Undertake a Needs and Optioneering study (with prioritisation) for riverbank stabilisation works to protect village infrastructure from erosion. Identify priority projects in the district where risks are highest.	D/V	MoNRE	X					50,000

No.	Theme	Action	Scale D- District V - Village	Key Responsibility	Implementation timeline 2025-2029					Estimated budget ($)
					Y1	Y2	Y3	Y4	Y5	
48		Undertake a feasibility study for priority projects.	V	MoNRE	X	X				100,000
49		Based on above studies, undertake design and implementation of priority projects ensuring consultation and participation of local taskforces.	V	MoNRE		X	X	X	X	500,000
50		Monitoring of projects with local taskforces.	D/V	PoNRE			X	X	X	50,000
51	Collaboration and capacity building	Capacity building for local taskforces and engagement on key investments.	D/V	MoNRE		X	X	X	X	30,000
52		Establish mechanisms for collaboration and information sharing (lessons learnt) among agencies and stakeholders.	D	MoNRE					X	20,000
									Total	$3,935,000

3.3 Implementation mechanism

The Nong District ICFMS sets out actions for the district to strengthen the climate resilience of communities to flood and drought risks. Implementing these actions will require leadership and cooperation from Lao PDR Ministries at the central, provincial and district level.

MoNRE is responsible for multiple sectors related to the ICFMS including water resources, flood protection, hydrological monitoring and early warning, and environmental and land use planning. Therefore the success of the ICFMS rests on how effective MoNRE is in convening, engaging and coordinating all government and non-government stakeholders in the design, delivery and reporting on the proposed actions.

To avoid the risk of poor sectoral integration and coordination, a two-tiered coordination framework is proposed to provide the basis of coordination during the implementation of the ICFMS (Figure 10).

- A Coordination Team comprising representatives of central line agencies to provide high-level strategic oversight and advice to MoNRE
- A Working Group comprising government stakeholders and non-government stakeholders in Savannakhet Province and target districts.

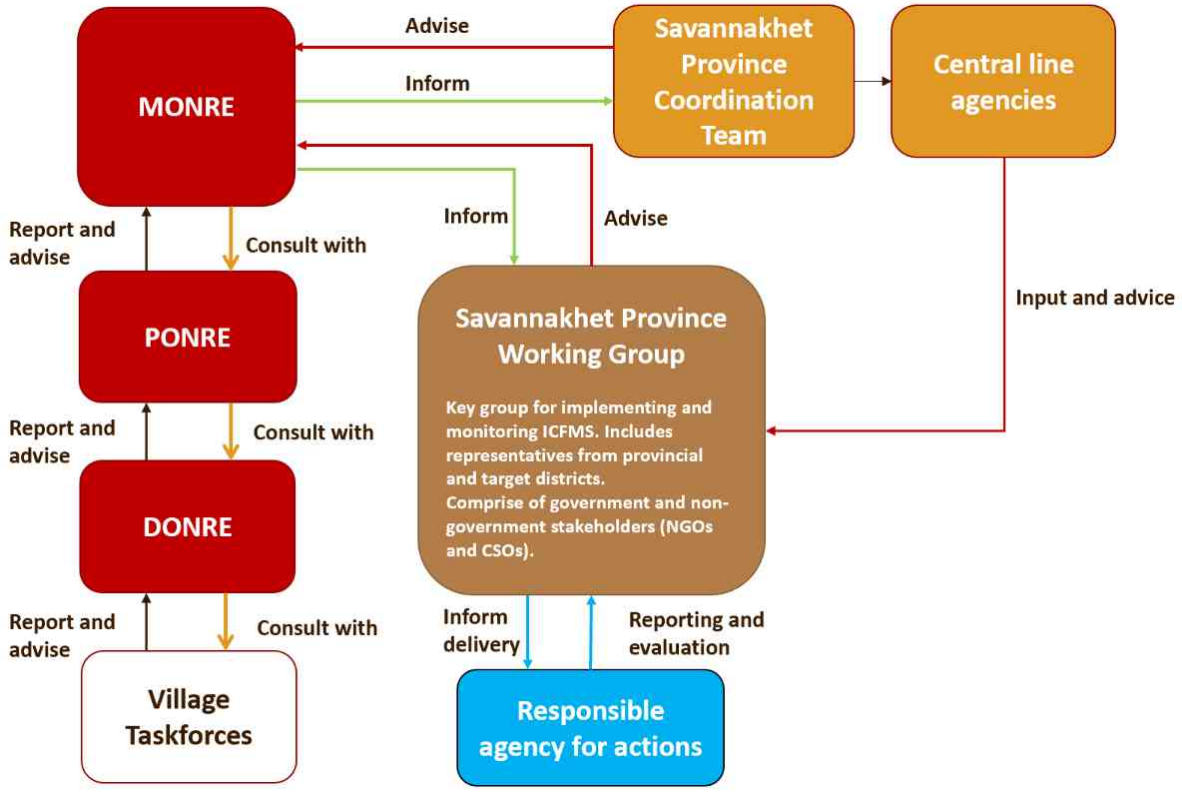

Figure 10. *Governance arrangement*

Coordination Team: The purpose of the coordination team is to involve other water-related sectors in the decision-making and implementation processes of the ICFMS. It is chaired by MoNRE and includes representatives from the central levels of water management and relevant line agencies (e.g. Ministry of Agriculture and Forestry, Ministry of Labour and Social Welfare, National Disaster Management Committee, Ministry of Technology and Communications, Ministry of Information, Culture and Tourism, and Ministry of Public Works and Transport). The Coordination Team makes decisions by consensus related to the implementation of the ICFMS.

Working Group: The purpose of the Savannakhet Province Working Group is to coordinate the on-ground activities, studies and analyses, and stakeholder collaboration which are needed to implement the Action Plan. This would include sharing of data, review of analysis and brainstorming discussion of implementation challenges. The Working Group is chaired by PoNRE and would involve technical managers from relevant agencies (e.g. provincial agencies responsible for agriculture, forestry, water resources, public works, disaster management, and communications). The Working Group can be used as the main forum for reporting and evaluating the success of implementation for the Action Plan.

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5 Appendix A – Target village infrastructure proposals

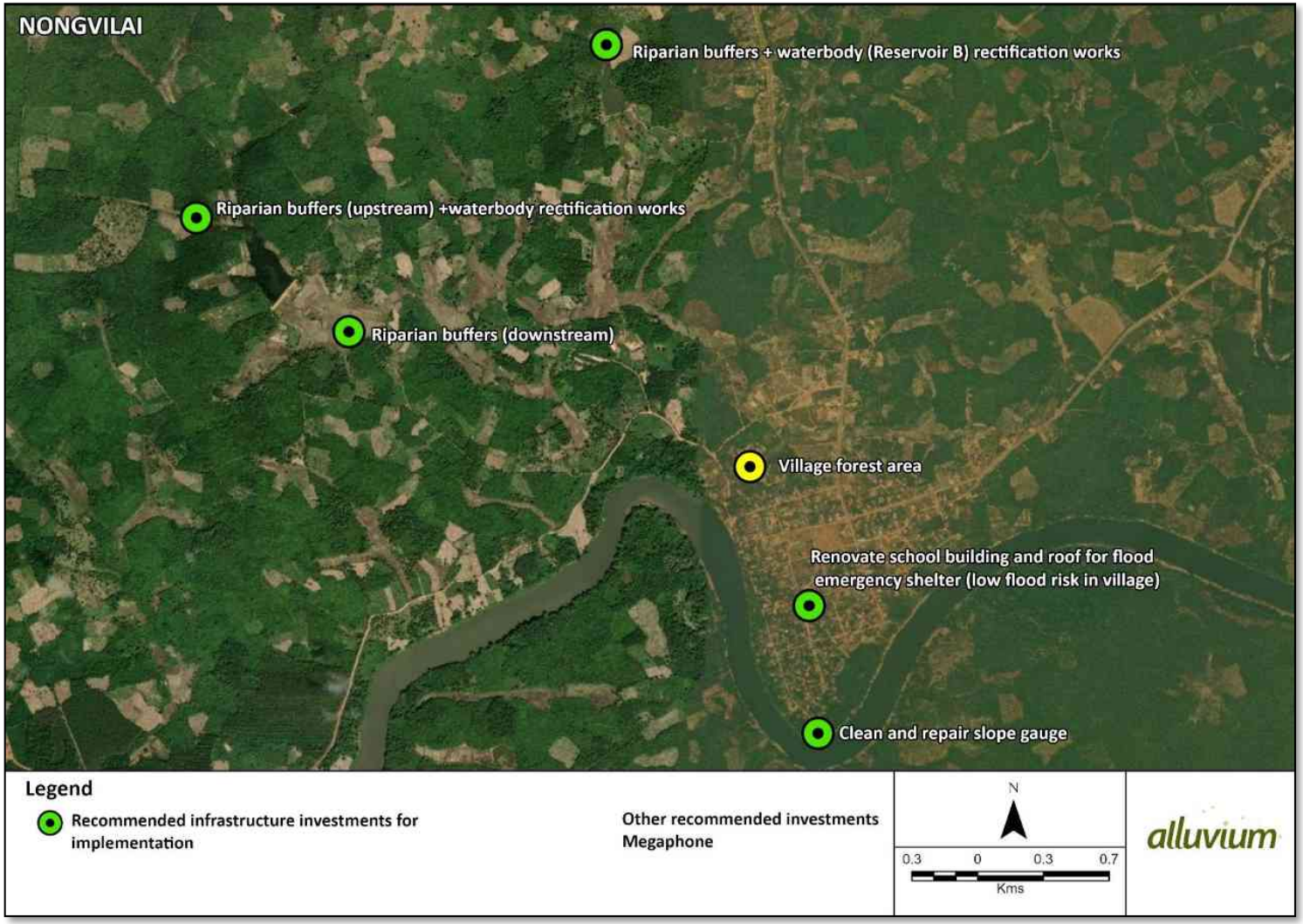

Figure 11. *Nongvilai Village – Recommended infrastructure investments for enhancing resilience to floods and droughts*

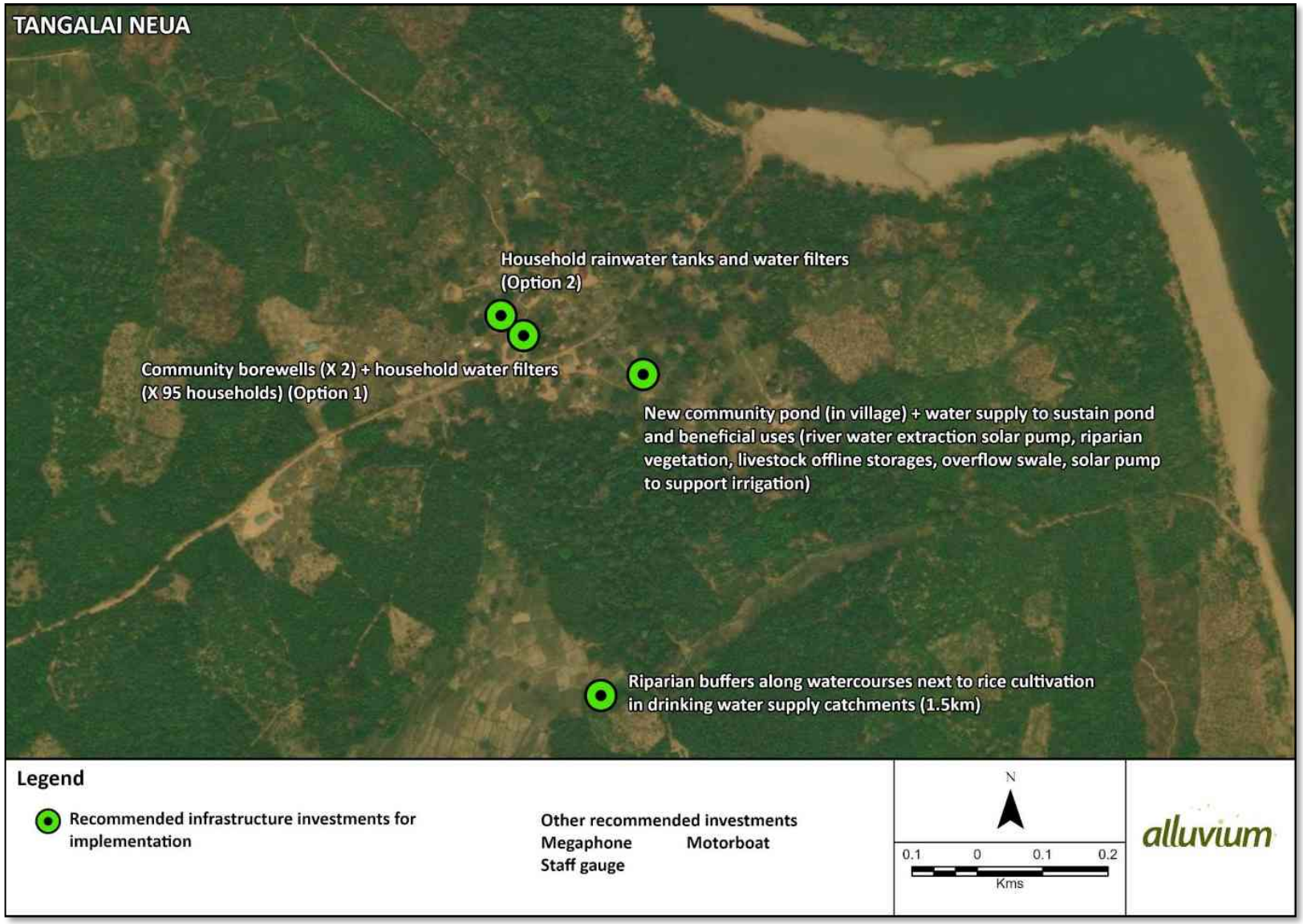

Figure 12. *TangAlai Neua Village – Recommended infrastructure investments for enhancing resilience to floods and droughts*

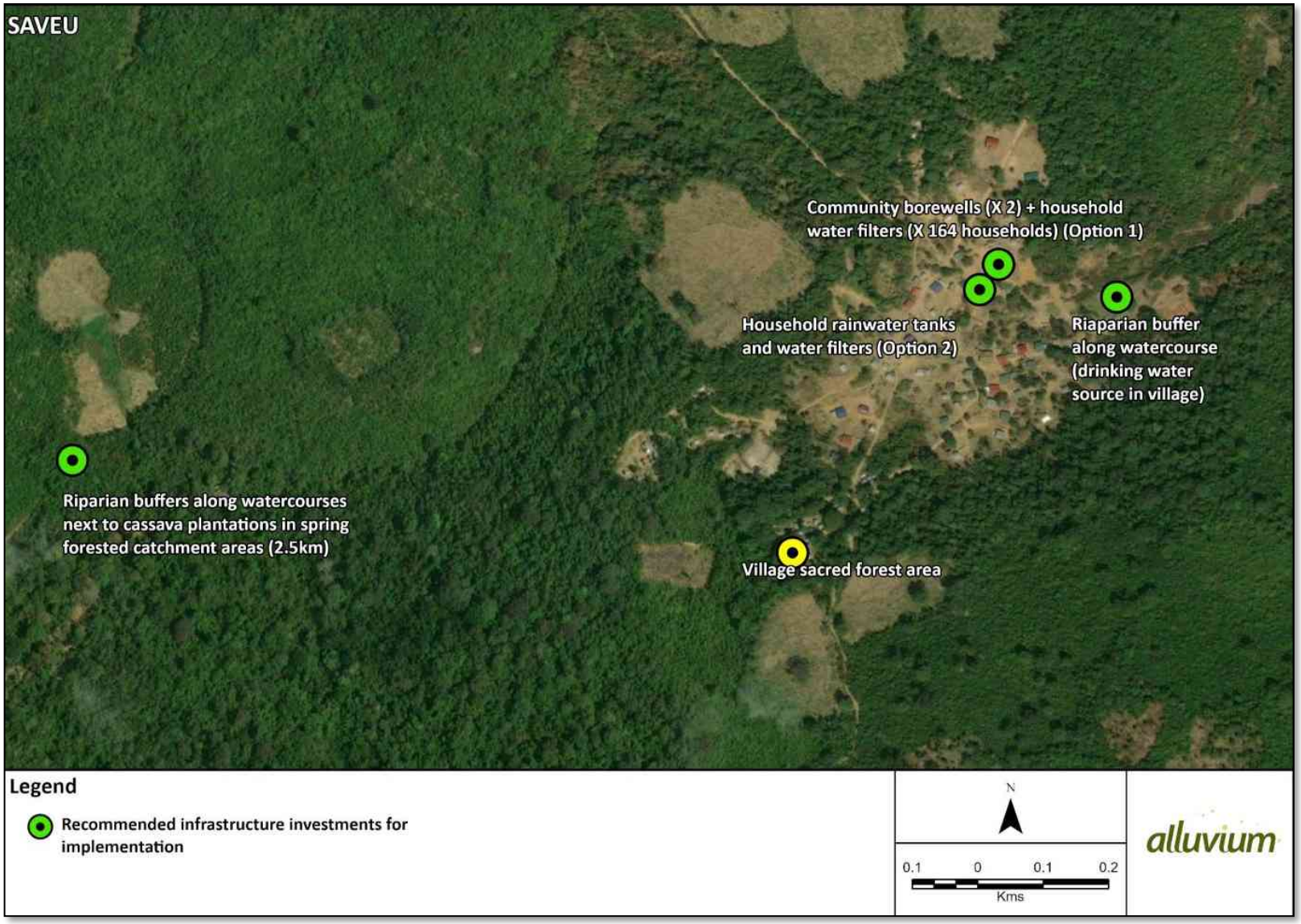

Figure 13. *Saveu Village – Recommended infrastructure investments for enhancing resilience to floods and droughts*

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