2025

Xe Bang Hieng River Basin

Optioneering Report for flood and drought risk reduction

Aluvium and Hydrotech Consulting

Contents

1 Introduction

1.1 Project scope and goal

The UNDP-GEF "Integrated Water Resource Management and Ecosystem-based Adaptation in the Xe Bang Hieng River Basin and Luang Prabang city" (the project) aims to support the Government of Lao PDR in strengthening the climate resilience of communities in two particularly vulnerable areas of Lao PDR – namely Savannakhet Province and Luang Prabang city. The project focusses on the impacts of floods and droughts, both of which are projected to become more intense and frequent under future climate scenarios, through promoting the integrated management of land and water resources at target sites in the Xe Bang Hieng River Basin and in Luang Prabang city. In the Xe Bang Hieng River Basin of Savannakhet Province, the project focuses on five target districts – the lowland districts of Songkhone, Champhone and Xonnabouly and the upland districts of Sepone and Nong. The project will be implemented over a period of four years from December 2022 to December 2026 by the Department of Water Resources (DWR) of the Ministry of Natural Resources and Environment (MONRE).

A key component of the project is to develop protective infrastructure options for 15 target villages (three villages in each of the project's five target districts) in order to inform investment in capital works for addressing flood and drought impacts (Figure 1 and Table 1). The project has a budget of approximately $1.1 m USD for flood and drought infrastructure options across all five target districts.

1.2 Purpose of this report

The purpose of this report is to document the results of the optioneering process for identifying and prioritising protective infrastructure options in the 15 target villages.

To achieve the goal of the project – i.e. to strengthen the climate resilience of communities to the impacts of floods and droughts through Integrated Catchment Management and Ecosystem Based Adaptation – infrastructure options were developed to address the following objectives as relevant to each village:

- **Objective 1:** To reduce riverine flooding and erosion risks
- **Objective 2:** To reduce drought risks and secure water supply
- **Objective 3:** To reduce pressures on and protect ecosystems functions and services

1.3 Optioneering

The optioneering process has followed the following steps:

1. **Situational assessment** in each target village in terms of understanding:
    - Flood and drought impacts
    - Water ecosystems and resources that the community relies on
    - Security of water supply (quantity and quality)
    - Pressures on ecosystems and services that they provide
2. **Identification of infrastructure options** to reduce flood and drought impacts in each village
3. **Ranking of the infrastructure options** using multi-criteria analysis (MCA)
4. **Selection of infrastructure investments** to meet project budget of approximately $1.1 m USD.

The results of each step are presented in the following chapters.

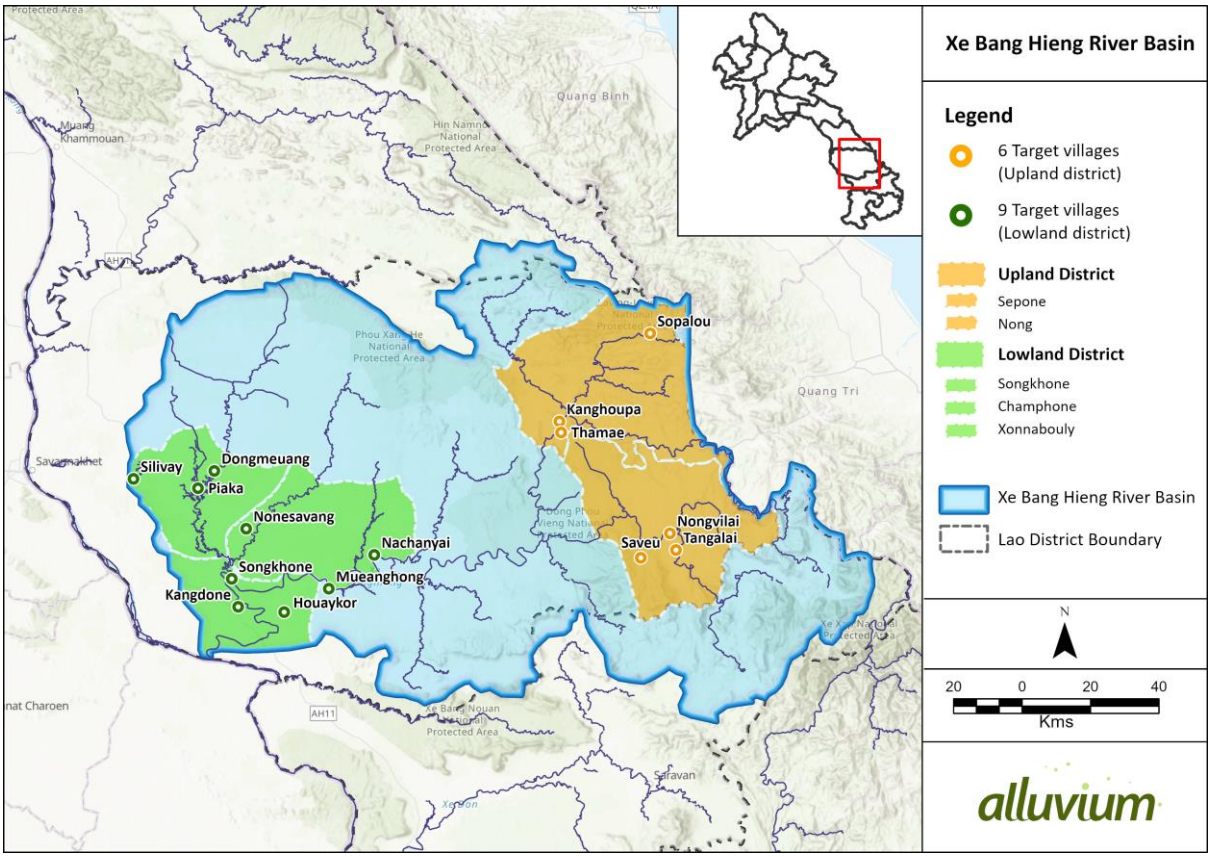


Figure 1. *Project target districts and villages in the Xe Bang Hieng River Basin*

Table 1. Summary of target villages

No.	Target village	# households	# people	Target district	Basin location
1	Songkhone	227	1264	Songkhone	Lowland
2	Kangdone	187	1255		
3	Houaykor	110	674		
4	Mueanghong	378	1115	Xonnabouly	
5	Nonesavang	545	3333		
6	Nachanyai	223	1095		
7	Donmeuang	118	910	Champone	
8	Piaxa	104	689		
9	Sivilay	280	1683		
10	Nongvilay	483	2640	Nong	Upland
11	Saveu	164	657		
12	Tangalai Niua	95	455		
13	Thamae	110	674	Sepone	
14	Kanghoupa	200	935		
15	Sopsalou	68	302		

2 Situation assessment

The situation assessment in the basin and target villages has been informed by a brief literature review, the report from the "Technical Support for modelling and development of risk maps in Lao PDR" project (Antea, 2024), and the village stakeholder meetings and field inspections undertaken by the Alluvium-led team. In particular, the consultation with stakeholders was designed to understand relevance of the three objectives (see section 1.2) for each village. A summary of findings on the situation assessment in each village is provided in Appendix A. The list of stakeholders who were consulted with for each village is provided in Appendix B.

2.1 Context

Savannakhet Province is located in the Southern part of Lao PDR with a total land area of approximately 22,000 km^2 and sharing borders with Quang Tri Province of Vietnam to the East, Khammouan Province in the North, Salavan Province to the South, and Thailand in the West. Savannakhet Province consists of 15 districts 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 agriculture for their 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. A considerable amount of the total area of Savannakhet Province (approximately 6,070 km^2) comprises of dry dipterocarp forests within which more than 20 foreign companies operate industrial agriculture and plantation forestry (Russell et al., 2015). The four largest concession holders accounted for i) 410 km^2 for a eucalyptus plantation; ii) 100 km^2 for a sugarcane plantation; iii) 120 km^2 for another sugarcane plantation; and iv) 100 km^2 for a rubber plantation (Russell et al., 2015). Combined agriculture and forestry accounts for 66% of the investment into Savannakhet Province, with timber and wood products being the third most significant export from the province, followed by copper and gold (UNDP, 2015).

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. From there, the river flows into the Mekong River which flows south along the western border of the province towards Cambodia. The western sub-catchments of the Xe Bang Hieng River Basin have the highest rates of rice paddy cultivation, while the more central and eastern sub-catchments are more highly forested. The major tributaries of the Bang Hieng River that flows past or close to the target villages include Xe Champone River and Xe Xangxoy River in the lowland region, and Xe Lanong River in the upland region (NRERI, 2020).

Savannakhet province has a tropical monsoon climate influenced by typhoons from the southwest and monsoons from the northeast. The dry season is from October to April and rainy season from May to October with about 70% of rainfall occurring during the wet season. The average annual rainfall is about 1,445 mm with average number of rain days varying between 80-100 days. The average annual evaporation is about 1,250 mm. Savannakhet has a hotter and drier climate than other provinces in Lao PDR.

The hydrology of the Xe Bang Hieng River Basin is driven by annual monsoon rainfall, characteristic of the lower Mekong River Basin, and backwatering effects from the Mekong River during the wet season. The resulting hydrological regime is highly seasonal and has high interannual variability, with 90% of river discharge occurring during the wet season (NRERI, 2020). Given the seasonality of rainfall, it is possible that rainfall driven systems such as ponds, wetlands and small watercourses cease to flow or dry up at some point in the dry season. Groundwater contribution however maintains flow in the Xe Bang Hieng River and other major tributaries in the dry season.

Climate change is projected to shift temperate and rainfall patterns in the province. Observed temperature changes for Lao PDR indicate an increase in the average annual temperature of ~0.05°C per annum between 1970 and 2010. In addition, the frequency of months with average rainfall greater than 600 mm has increased over this period, while monthly rainfall within the range of 300–500 mm has been decreasing (GoL, 2013). This indicates a general increase in rainfall intensity. These trends are expected to continue, with long-term climate projections predicting: i) a mean annual in temperature increase of 1.2 to 2.4 °C by 2100 for RCP 2.6 and RCP

6.0 respectively; ii) an increase in the number of days over 35°C iii) a 10–30% increase in mean annual rainfall — particularly in the southern and eastern parts of the country, and concentrated in the wet season iv) an increase in the number of days with more than 50 mm of rain; v) a 30–60% increase in the amount of rain falling on very wet days and vi) changing rainfall seasonality resulting in a longer dry season (https://climateknowledgeportal.worldbank.org).

2.2 Flood risks

Flooding in the Xe Xangxoy, Xe Champone and Xe Bang Hieng Rivers are known to largely affect the three target lowland districts of Songkhone, Champhone and Xonnabouly. The flood risk maps from the "Technical Support for modelling and development of risk maps in Lao PDR" report (Antea, 2024) shows that the lowland region is more exposed to flooding. As such, flood impacts on infrastructure and population is higher in the lowland districts compared to the upland districts. Whilst the target villages in the upland districts face flooding challenges, the potential impacts in the lowland villages are higher, in particular:

- Songkhone, Dongmeuang and Piaxa are impacted by regular flooding that happens every 2 to 10 years (Figure 2).
- Kangdone village is impacted by less frequent floods with a 50-year to 100-year return period (Figure 3).
- Nonesavang and Nachanyai villages are also exposed to flooding but are less impacted due to lower exposure and flood depths.

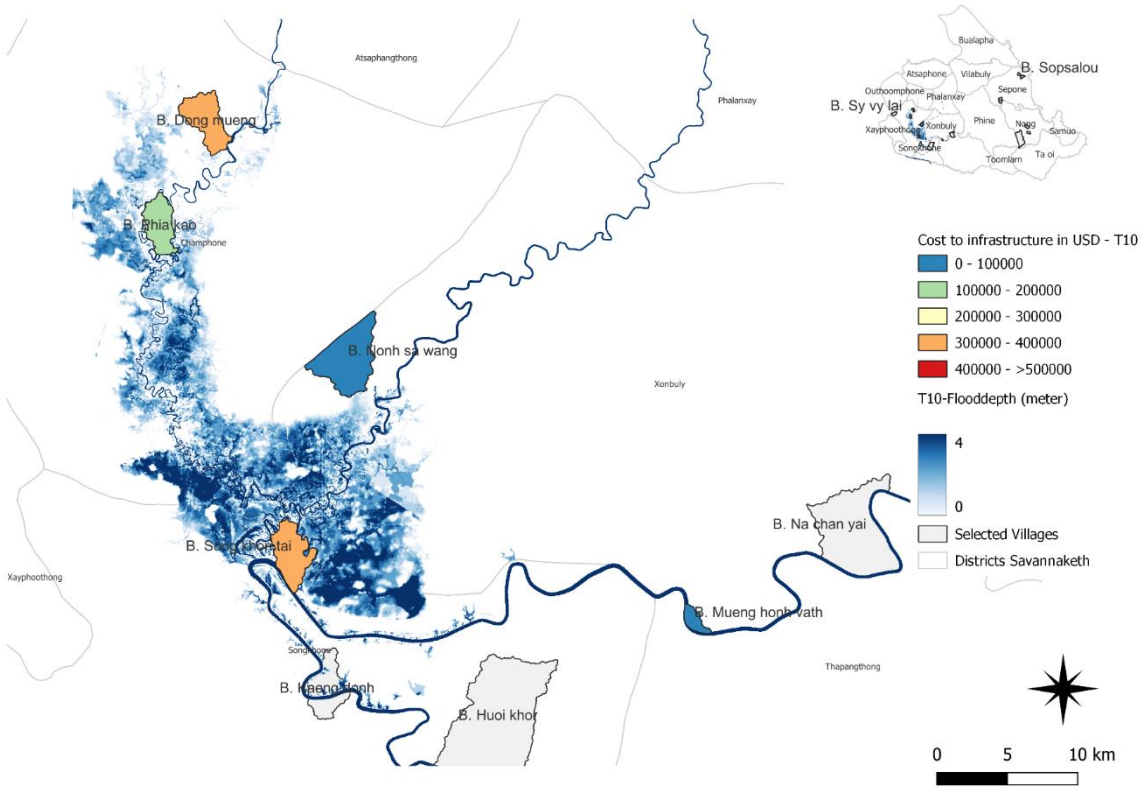


Figure 2. *Impact map of the cost of flood damage in USD aggregated by village for a 1 in 10-year event (Source: Antea, 2024)*

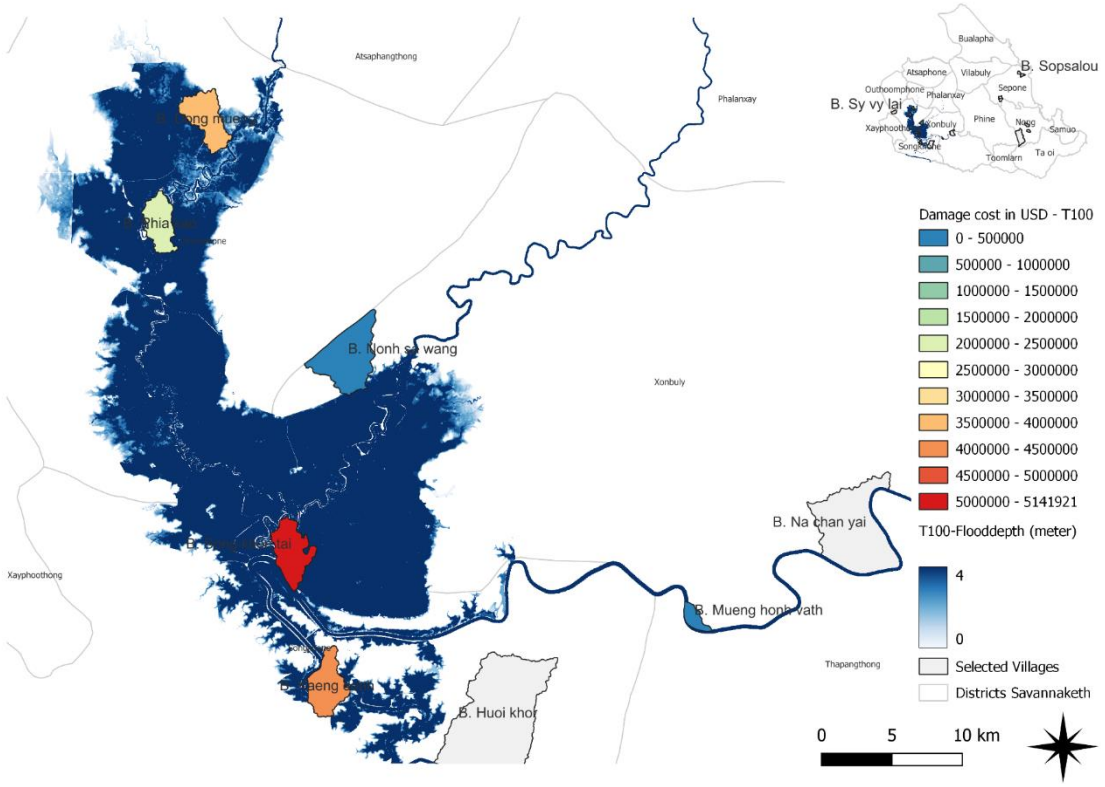


Figure 3. *Impact map of the cost of flood damage in USD aggregated by village for a 1 in 100-year event (Source: Antea, 2024)*

2.3 Drought risks

The outputs in the "Technical Support for modelling and development of risk maps in Lao PDR" project report (Antea, 2024) shows that rainfall pattern in the lowland region is different to the highland region, with longer duration of consecutive dry days (i.e. periods without any rainfall) in the lowland region for the 5, 10, 50 and 100-year return periods (Figure 4). The lowland target districts have the longest dry periods in the Xe Bang Hieng River Basin, which are generally 25-30 days longer than the target upland regions regardless of return periods. This reflects the rainfall pattern differences between the two regions. The analysis also suggests that the security of water supply from rainfall driven systems such as wetlands, ponds, small local watercourses and shallow springs is more vulnerable in the lowland region. During the field visit in March 2024, it was observed that small local watercourses in the target villages had ceased to flow in the lowland region, but similar watercourses had low flows in the upland region (Figure 5 and Figure 6).

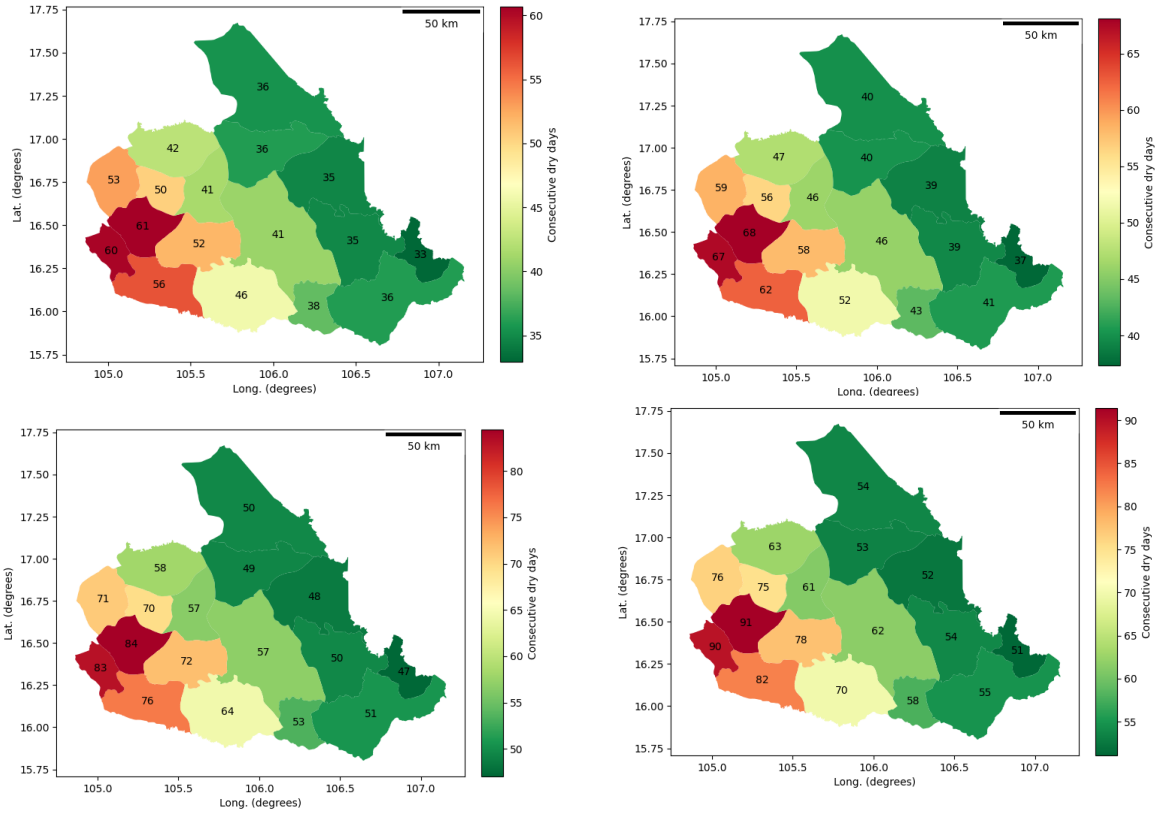


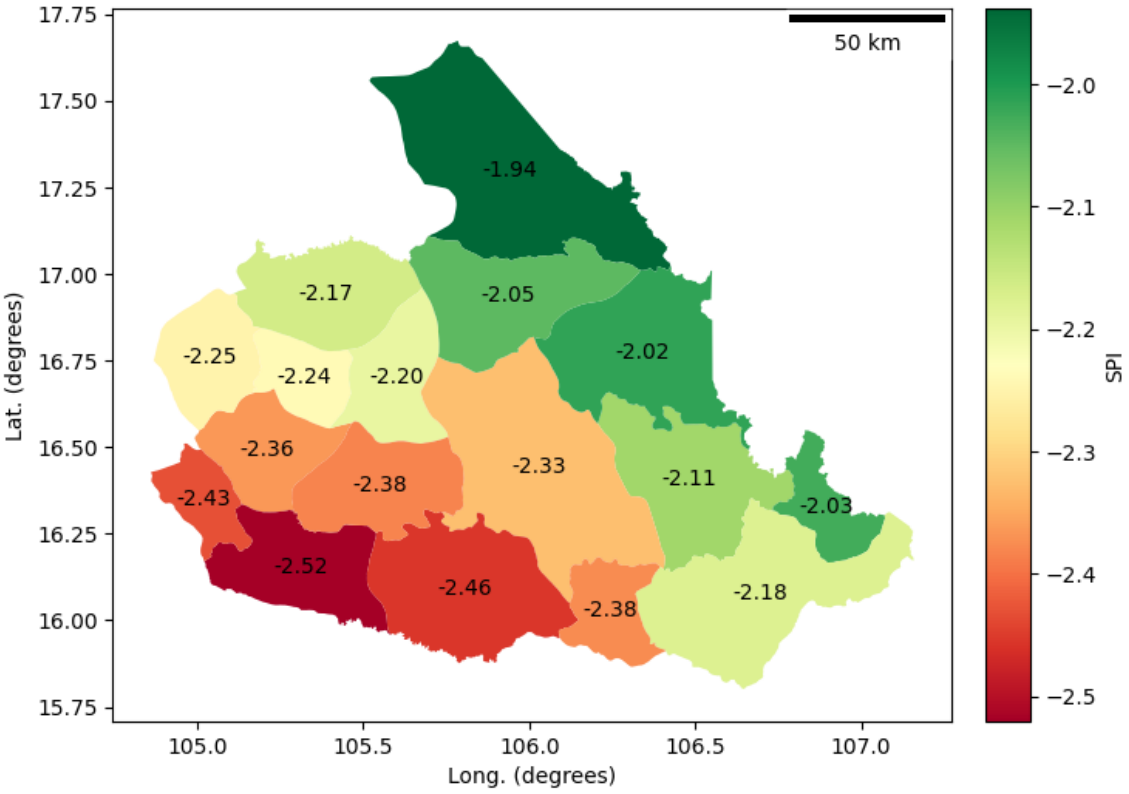
Figure 4. *Consecutive dry days (yearly mean per district) for a 5-year (left top), 10-year (right top), 50-year (left bottom), and 100-year (right bottom) return period (Source: Antea, 2024).*

Figure 5. *Local watercourse in lowland Houaykor village cease to flow in dry season (March, 2024)*

Figure 6. *Local watercourse in upland Tangalai Niua with baseflow in dry season (March, 2024)*

The Standardized Precipitation Index (SPI) – an index that can be used to determine the rarity of a meteorological drought relative to the normal local climate at a particular location, thus allowing comparison across regions with different climates – shows that: 1) the longer dry period in the lowland region tends to occur during the dry season and is less divergent from a normal year compared to the upland region; 2) the upland region is therefore more likely to face a short drought (3-month period) of higher intensity than the lowland region; and 3) however the lowland region is more likely to face a drought of higher intensity (over a 6-month or 12-month period) – see Figure 7). For drought impacts on agriculture, the three-month and six-month periods are usually most relevant.

The drought risk assessment in the "Technical Support for modelling and development of risk maps in Lao PDR" project has focused on agriculture. Impact of droughts in terms of damage cost to agriculture is found to be higher in the lowland region of the province given the higher intensity of agriculture compared to the upland region (Figure 8 and Figure 9). Damage costs in the lowland increases to the west of the province where there is higher intensity of rice paddy cultivation. Sivilay village to the west for instance could incur damage to crops of about 500,000 USD. Upstream villages like Tangalai Niua and Nongvilay could incur damages in the range of 50,000USD (a factor 10 smaller) given the smaller amount of agriculture. This is despite the actual drought in the upland region being more intense for the three-month moving average.



SPI index	Description
2.00 and above	extremely wet
1.50 to 1.99	very wet
1.00 to 1.49	moderately wet
-0.99 to 0.99	near normal
-1.00 to -1.49	moderately dry
-1.50 to -1.99	severely dry
-2.00 and below	extremely dry

Figure 7. *Drought Hazard map giving the mean SPI per district for a six-month moving average with return period 1/100.*

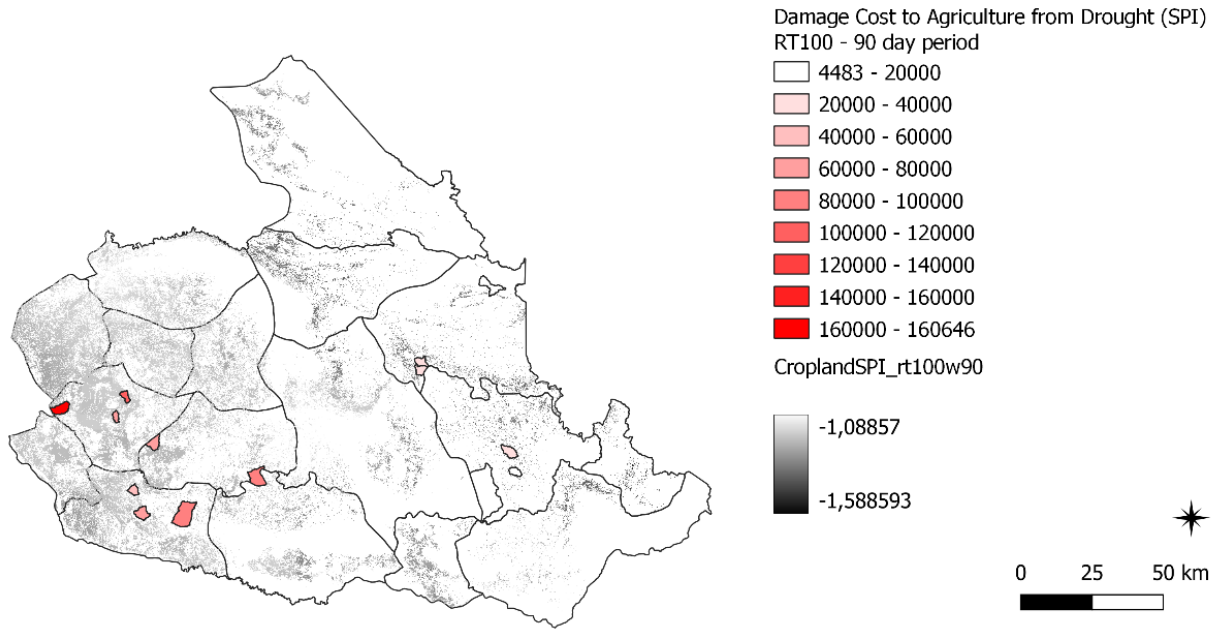


Figure 8. *Damage Cost to Agriculture for a 1 in 100-year event and a three-month period (Source: Antea, 2024)*

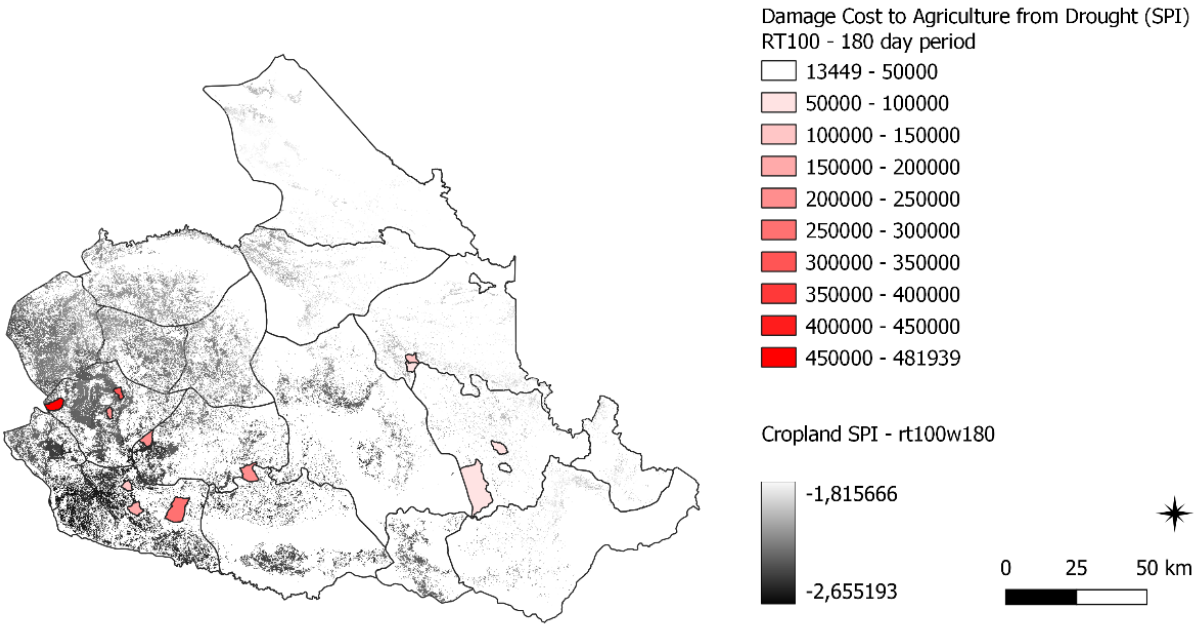


Figure 9. *Damage cost to agriculture for a 1 in 100-year event and a six-month period (Source: Antea, 2024)*

Other impacts of droughts in Savannakhet Province include loss of pasture, damage to fisheries (e.g. drying up of ponds, wetlands, and small watercourses), and degradation of forests, all of which are known to impact on household food security. Droughts can also affect domestic and agriculture water supply affecting households and agriculture.

A preliminary assessment of water supply for the target villages and security of these water sources is provided in Table 2. This is based on data collected during the field mission and our understanding of water resources in the basin. Groundwater extraction via community wells or household tube wells is the predominant source of water supply for domestic use in the target villages except in Songkhone, Donmeuang, Piaxa and Nongvilay where piped water supply has been implemented, Nachanyai where 62% of households rely on Xe Bang Hieng River, and in Sopsalou where households rely completely on the local watercourse. For drinking water supply, there is preference for bottled water in the lowland target villages with the exception of Mueanghong and Nachanyai where water is collected from springs. In the upland region, villages rely on local watercourses for drinking (Saveu, Tangalai Niua and Sopsalou), bottled water in Nongvilay, and boiled groundwater in Thamae and Kanghoupa. There is generally uncertainty on the water quality of river water (Xe Bang Hieng River and its major tributaries) and villagers in both lowland and upland regions often do not see it fit for drinking water.

In terms of water supply for rice paddy irrigation in the lowland region, there are irrigation schemes operating in Songkhone, Donmeuang and Piaxa (extraction from Xe Champone River). Constructed waterbodies fed by local watercourses supply irrigation water for small scale rice paddy fields in Kangdone and Nongvilay. Otherwise, it is common to see rice paddy fields developed on flat land along watercourses and sometimes within the natural watercourses themselves given the favourable environment for rice production and possibilities for local-scale irrigation (for instance in Mueanghong, Tangalai Niua, Nongvilay). In the upland region, there is pattern of rice cultivation between hillslopes on more-accessible land with gentle slopes. Natural waterbodies or constructed ponds fed by rainfall and/or local watercourses is also common for fishing and livestock water supply. It was noted that access of livestock to waterbodies including drinking water sources (e.g. springs and dug-out wells) has potential to affect water quality from bank erosion and animal waste.

2.4 Pressures on ecosystems

A considerable amount of the total area of Savannakhet Province and Xe Bang Hieng River Basin, particularly the central and eastern sub-catchments (which include the upland region), are highly forested. The ecosystem services provided by forested land in regulating the catchment hydrology and protecting water quality is important to 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 can also use less water than agricultural land, protecting yield in surface water systems like the Xe Bang Hieng River for downstream uses.

The increasing risk to rice cultivation from floods and droughts has led lowland communities (e.g. Nachanyai village in Xonnabouly district) turning to slash and burn agriculture and cassava plantations in forested areas. In the upland region, issues of low agricultural productivity, food insecurity and limited alternative livelihood opportunities have also led to small-scale farmers practising unsustainable farming techniques, such as swidden agriculture, leading to deforestation and degradation of forested land. Land exposed to slash and burn generates more sediment and pollutants that affect water quality in receiving waters. It is also common practice for rice paddy fields on flat or gently sloping lands to be developed adjacent to local watercourses without a riparian buffer which would normally serve to capture pollutants and sediments, protecting water quality in the watercourses. Similar, land undergoing slash and burn agriculture often are not left with a riparian buffer to local watercourses. These practices are placing pressures on forested land and in turn on the ecosystem services that they provide in regulating the catchment hydrology and protecting water quality across the basin.

Climate change will also place greater pressure on forested ecosystems and the services they provide. Long-term climate projections indicate higher mean annual rainfall concentrated in the wet season and increase in rainfall intensity which will worsen flooding. This reinforces the need to protect and restore forested catchments. The changing rainfall seasonality resulting in a longer dry season will also reduce security of surface water systems particularly rainfall dependent systems like local-scale ponds, wetlands, and seasonal watercourses which will tend to dry out earlier in the dry season. Where communities rely on such systems,

their drinking water supply and food security will be impacted (e.g. less water available in dry season and droughts for drinking, irrigation, fishing and livestock water supply).

Figure 10. *Forested area being converted for cassava plantations*

2.5 Summary

Based on a brief literature review, the outputs from the "Technical Support for modelling and development of risk maps in Lao PDR" project report (Antea, 2024), and the village stakeholder meetings and field inspections undertaken by the Alluvium-led team, a summary of risks and relevance of project objectives to each village is provided in Table 3.

Table 2. Current water supply in target villages (highlighted red cells are villages with risk to water security)

No.	Village	Drinking water supply	Domestic water supply	Agricultural water supply	River in proximity
1	Songkhone	Bottled water	Piped water supply	Champone River: Rice paddy irrigation Natural wetland: Fishing and livestock	Xe B. Hieng River
2	Kangdone	Bottled water	Groundwater Back up: Rainwater	Constructed waterbody: Small-scale rice paddy and garden plot irrigation, fishing and livestock water supply	Xe B. Hieng River
3	Houaykor	Bottled water	Groundwater (back up: Rainwater)		Local watercourse
4	Mueanghong	Two springs	Groundwater	Rice paddy fields fed by small watercourse Natural ponds: Fishing and livestock	Xe B. Hieng River
5	Nonesavang	Bottled water (back up: rainwater	Groundwater (back up: Rainwater)	Numerous constructed ponds*: Fishing and livestock	Local watercourse
6	Nachanyai	Two springs Back up: rainwater	Groundwater (38% households) Xe Bang Hieng River (62% households)	Irrigation infrastructure not in operation Constructed pond: Fishing and livestock	Xe B. Hieng River
7	Donmeuang	Bottled water	Piped water supply	Sui Reservoir: Rice paddy irrigation (potential extraction from RAMSAR listed wetland)	Xe Champone River
8	Piaxa	Bottled water Back up: rainwater	Piped water supply (63% households) Groundwater and river water (37% households)	Champone River: Rice paddy irrigation Piped water or river water for livestock	Xe Champone River
9	Sivilay	Bottled water	Groundwater	Two ponds for fishing and livestock water supply	Local watercourse
10	Nongvilay	Bottled water	Piped water supply (Groundwater, river water in emergency)	Two reservoirs on local watercourses: Rice paddy irrigation, fishing and livestock water supply	Xe Lanong River
11	Saveu	Spring water Groundwater (boil)	Groundwater	Groundwater for livestock water supply Constructed pond: Fishing and livestock	Local watercourse
12	Tangalai Niua	Spring water Groundwater (boil)	Groundwater	Groundwater for livestock water supply Springs* also accessible to livestock	Xe Lanong River
13	Thamae	Groundwater (boil) Back up: Xe Bang Hieng River	Groundwater	Groundwater for livestock water supply Existing village pond: Fishing and livestock	Xe B. Hieng River
14	Kanghoupa	Groundwater Back up: Xe Bang Hieng River	Groundwater	Groundwater for livestock water supply	Xe B. Hieng River
15	Sopsalou	Local watercourses (existing cluster and focus zone)	Local watercourses (existing cluster and focus zone. Planned diversion works in focus zone)	Existing cluster: Local watercourse (diversion works in progress)	Xe B. Hieng River

Table 3. Summary of risks and relevance of project objectives to each village (highlighted red cells identifies where risk exist)

To strengthen the climate resilience of communities to the impacts of floods and droughts through Integrated Catchment Management and Ecosystem Based Adaptation				
No.	**Village**	**Objective 1: To reduce riverine flooding and erosion risk**	**Objective 2: To reduce drought risks and secure water supply**	**Objective 3: To reduce pressures on and protect ecosystems functions and services**
1	Songkhone	Flood and erosion risk		
2	Kangdone	Flood risk		
3	Houaykor		At risk given village is a reasonable distance from a secure surface water source and there is limited community groundwater supply infrastructure	
4	Mueanghong	Flood risk	At risk given reliance of drinking water on seasonal springs and uncertainty of river water quality (Xe Bang Hieng River).	Slash and burn agriculture are not left with a riparian buffer to local watercourses in drinking water catchment
5	Nonesavang	Flood impact less due to lower exposure and flood depth	At risk given village groundwater level is dropping and there is limited community groundwater supply infrastructure, and village is a reasonable distance from a reliable surface water source (Xe Xangxoy River)	
6	Nachanyai	Flood impact less due to lower exposure and flood depth	At risk given reliance of drinking water on seasonal springs and limited community groundwater supply infrastructure. There is uncertainty of river water quality (Xe Bang Hieng River).	Cassava plantations are often not left with a riparian buffer to local watercourses in drinking water catchment
7	Donmeuang	Flood and erosion risk		
8	Piaxa	Flood risk	At risk given uncertainty of river water quality and lack of access to bottled water for drinking during floods	
9	Sivilay		At risk given village is a reasonable distance from a secure surface water source and there is limited community groundwater supply infrastructure	
10	Nongvilay	Dwellings are close to Xe Lanong river high water level. Potential erosion risk		Rice paddy fields adjacent to local watercourses in water supply catchment without a riparian buffer

To strengthen the climate resilience of communities to the impacts of floods and droughts through Integrated Catchment Management and Ecosystem Based Adaptation

No.	Village	Objective 1: To reduce riverine flooding and erosion risk	Objective 2: To reduce drought risks and secure water supply	Objective 3: To reduce pressures on and protect ecosystems functions and services
11	Saveu		At risk given reliance of drinking water on seasonal springs, limited community groundwater supply infrastructure, and a reasonable distance from a reliable surface water source (Xe Lanong River)	Cassava plantations in drinking water forested catchment areas not left with a riparian buffer to local watercourses.
12	Tangalai Niua	Dwellings close to Xe Lanong River have moved to higher ground	At risk given reliance of drinking water on seasonal spring, limited community groundwater supply infrastructure and uncertainty of river water quality (Xe Lanong River)	Rice paddy fields adjacent to local watercourses in drinking water catchment without a riparian buffer
13	Thamae	Dwellings close to Xe Bang Hieng River have moved to higher ground	At risk given limited community groundwater supply infrastructure and uncertainty of river water quality (Xe Bang Hieng River)	Rice paddy fields adjacent to local watercourses without a riparian buffer
14	Kanghoupa	Based on flooding in 2019 and 2020	At risk given limited community groundwater supply infrastructure and uncertainty of river water quality (Xe Bang Hieng River)	Rice paddy fields adjacent to local watercourses without a riparian buffer
15	Sopsalou	Flash flooding and erosion risk at focus zone	At risk given reliance of domestic water supply on local watercourses and uncertainty of river water quality (Xe Bang Hieng River)	Slash and burn agriculture and cassava plantation are often not left with a riparian buffer to local watercourses in planned water supply catchment

3 Identifying options

This chapter documents the infrastructure options developed for the target villages to address the goal of the project and the following objectives as relevant to each village:

- **Objective 1:** To reduce riverine flooding and erosion risks
- **Objective 2:** To reduce drought risks and secure water supply
- **Objective 3:** To reduce pressures on and protect ecosystems functions and services

3.1 Infrastructure options

Infrastructure options have been categorised into the following four intervention types:

- Flood defence
    - Riverbank stabilisation
    - Village ring levee
    - Flood channel
    - Flood retardation
- Flood hazard elimination or mitigation
    - Protection of floodplain and forested land
    - Restoration of floodplain and forested land
    - Relocation of infrastructure or restriction of land uses
- Flood adaptation
    - Early Warning system
    - Evacuation and temporary shelter
    - Flood resilient building
- Securing water for drought
    - Water supply
    - Water quality
    - Demarcation of water supply catchments

A long list of potential infrastructure measures was developed covering all four intervention types (Table 4). The project team undertook field inspection and consultation with village stakeholders to understand relevance of the three objectives to each village and to test the stakeholders' level of support for relevant infrastructure measures. The list of stakeholders who were consulted with for each village is provided in Appendix B. A general summary of discussion is provided in Table 4.

Based on the objectives relevant to each village and stakeholder inputs, a list of infrastructure options was developed for each village (see Appendix C). For drought risk reduction, infrastructure measures were often combined for example: 1) household rainwater tanks combined with household filters, 2) community groundwater wells combined with distribution pipe to garden plots for drought food security, and 3) securing water supply to sustain waterbodies combined with waterbody rectification works to support its beneficial uses for drought.

Table 4. Long list of potential infrastructure measures

ID	Infrastructure measures	Purpose and application
1	**Flood defence**	
1A	Riverbank stabilisation	Applicable in Songkhone and Dongmeuang villages where riverbank erosion has potential to impact village infrastructure in the future. Also applicable in Sopsalou focus zone.
1B	Village ring levee	Applicable in Songkhone, Kangdone, Dongmeuang and Piaxa to reduce impact of flooding on village infrastructure and population
1C	Flood channel	Flood channels are important to convey flood water around and within the village to reduce impact on infrastructure and population. This requires more detailed understanding of floodwater movement.
1D	Flood retardation (e.g. retarding basins)	Given village flooding in the lowland region is related to riverine flooding rather than stormwater, this infrastructure option was not discussed. In Sopsalou, flash flooding from hillslope runoff was identified in the focus zone. There is potential for bypass channels to be constructed with appropriate land allocation for such works to be included in the land use plan under development.
2	**Flood hazard elimination or mitigation**	
2A	Demarcation to protect natural floodplain and forested land	These infrastructure options should be developed in conjunction with land use planning. Recommendations for land use planning to: • Protect or restore natural floodplain and forested catchments for flood regulation • Relocation of infrastructure above the 1 in 100-year flood level (where possible) or restriction of land uses in flood prone areas
2B	Restore natural floodplain and forested land	
2C	Relocate homes to higher ground or restrict land uses	
3	**Flood adaptation**	
Early Warning system		
3A	Megaphone	Preliminary discussion with villages stakeholders were undertaken. An initial list of infrastructure proposals has been developed in chapter 4. Proposals under this category will be refined in another project report deliverable.
3B	Staff gauge for flood alert and warning	
3C	Signage post at flood prone areas	
3D	Hydro-meteorological equipment	
Evacuation area and temporary shelter		
3E	Identify site and allocate land for flood evacuation	This option should be developed as part of land use planning (and approval with district authorities). For villages experiencing significant flood risk, flood evacuation area has been identified in Songkhone (2.5 km

ID	Infrastructure measures	Purpose and application
		from village) and Kangdone (school and site adjacent to school) but not in Donmeuang and Piaxa. Sites for livestock evacuation will be investigated in a separated EWS report.
3F	Construct flood pad for flood evacuation	This infrastructure option was not discussed but is relevant for villages such as Dongmeang and Piaxa where there is no land higher than the 1 in 100-year flood level in proximity of the village. The construction of a flood pad at a surface level higher than the 1 in 100-year flood should be considered, and nominated as the flood evacuation area for people and livestock.
3G	Infrastructure at flood evacuation zone (electricity/groundwater well/toilet/safeguard)	Preliminary discussion with villages stakeholders were undertaken. An initial list of infrastructure proposals has been developed in chapter 4. Proposals under this category will be refined in a separate EWS report deliverable.
3H	Building renovation for temporary flood emergency shelter	
3I	Motorboat for evacuation (people/small animals)	
3J	Livestock temporary or permanent shelter	This infrastructure option was not discussed. Proposals under this category will be developed in a separate EWS report deliverable.
Flood resilient building		
3K	Climate resilient building design	These infrastructure options should be developed in conjunction with land use planning. Recommendations for land use planning to: • Allocate (and demarcate) flood evacuation zone • Develop building design, construction and use code for flood prone areas
3L	Building with stilts or elevate floor level	
3M	Repurpose use of upper and lower storeys of buildings	
3N	Installation of waterproofing fittings on building	
3O	Strengthen foundation, walls and roofs	
3P	Building code/construction code	
4	**Securing water for drought**	
Water supply		
4A	Solar pump and pipe to extract and distribute water from a secure water source (surface or groundwater)	To extract water from a “secure” water source to fill or top-up a community storage (pond or tank) for droughts needs (e.g. small local-scale irrigation, livestock water supply, aquaculture). There was generally more interest from stakeholders to extract from surface water source.
4B	Solar pump and pipe to extract and distribute water from community storage	To extract and distribute water from community storage for drought needs (small local-scale irrigation, livestock water supply).

ID	Infrastructure measures	Purpose and application
4C	Community groundwater wells with solar pump, elevated storage and distribution pipe	Provide a secure water supply for domestic water use. In conjunction with household filters (see option 4L), this option also provides alternate water supply for drinking reducing reliance on less secure sources (e.g. springs and local watercourses). Elevated storage is proposed so that water is available when needed by the community, reducing waiting time for water collection and pressure on pumps. Distribution pipe is also proposed to support drought needs (e.g. small local-scale irrigation, livestock water supply, top-up of waterbodies for fishing). This option was generally requested by stakeholders in villages where there is no piped water supply and insufficient number of groundwater wells to meet village domestic water supply.
4D	Household rainwater tanks with roof connection	In conjunction with household filters (see option 4L), this option also provides alternate water supply for drinking during dry season reducing reliance on less secure water sources such as springs, but also to preserve groundwater and reduce reliance on bottled water. Provide an alternate water supply for domestic water use in wet season preserving groundwater resource. Household rainwater tanks were specifically requested in Mueanghong and Sivilay villages. A number of villages already rely on rainwater for drinking or domestic water use (refer to Table 2) where improvement in rainwater harvesting infrastructure presents an opportunity. This option is also recommended where there is no piped water supply or drinking water sources are less secure (e.g. from springs and local watercourses). A rainwater tank of 4-5 KL is proposed for each household. A drainage plug and pipe is proposed at the bottom of the tank to enable desilting.
4E	Groundwater recharge pits	This option assists to preserve groundwater resources and is applicable in Nonesavang where lowering of groundwater level was reported.
4H	New community storages	Constructed waterbody or tanks to support drought needs (e.g. small local-scale irrigation, livestock water supply, aquaculture). To be installed in conjunction with solar pumps and distribution pipes (Option 4A and option 4B).
4I	Offline livestock water storages	To protect water quality of waterbodies and drinking water sources by providing an alternate water supply for livestock. To be installed in conjunction with solar pumps and distribution pipe (see option 4B).
4J	Waterbody rectification	Rectification works to existing waterbodies (e.g. hydraulic structures, sediment removal, bathymetry shaping to create deep refuge pools for fish) to support community beneficial uses for droughts (e.g. small local-scale irrigation, livestock water supply, aquaculture). To be undertaken in conjunction with Option 4A.
Water quality		
4J	Waterbody rectification	Rectification works to existing waterbodies (e.g. bank repairs and vegetation) to protect/improve water quality to support community beneficial uses for droughts (e.g. irrigation of garden plots, livestock water supply, aquaculture). To be undertaken in conjunction with Option 4G.
4K	Fencing	To protect water quality of waterbodies and drinking water sources by restricting livestock access. Offline livestock water storages to be proposed instead (see option 4I).

ID	Infrastructure measures	Purpose and application
4L	Household water filters	To treat rainwater, groundwater or river water and increase diversity of water supply for drinking reducing reliance on less secure sources or to preserve groundwater. A number of vendors supply household water filters, for instance: https://www.abundantwater.org/ https://www.myclimate.org/en/get-active/climate-protection-projects/detail-climate-protection-projects/laos-water-7233/ A communal water filtration system is also a potential option, however we are not aware of a successful pilot in Laos to recommend it for this project. Furthermore, a communal option using gravity filtration may need to be of reasonable size to treat water at a rate that is fast enough to provide drinking water supply for a whole village every day. Treatment performance (or perception of inadequate treatment) may also undermine success of a communal asset.
4M	Riparian buffers	To protect water quality in village water supply catchments (including at water sources) from land disturbances (e.g. cassava plantations).
Demarcation of water supply catchments		
4N	Demarcation posts to protect water supply catchments	To protect water supply catchments from land use change and therefore protect catchment yield and water quality. This should be developed in conjunction with land use planning.

4 Ranking options and selecting infrastructure investments

The infrastructure options were compared and ranked across the 15 target villages using a multi-criteria analysis (MCA). MCA is a multiple objective decision support system that allows the comparison of a range of options according to a variety of objectives and criteria. MCA can be further defined as “a formal method that can combine technical input and stakeholder values to systematically support decision making”.

MCA allows decision makers to identify the preferred option amongst a portfolio of potential options, assessed against weighted criteria that can be non-uniform and non-quantitative. This approach provides a robust framework for decision-making that is transparent in its development of preferred options. Critical to the effective implementation is the definition of meaningful criteria in the assessment, and in some cases also the weighting assigned to each criterion. The following sections describe the process that has been implemented for the MCA for the 15 villages.

The criteria in the analysis were developed in discussion with UNDP and the Department of Water Resources (DWR). Weightings were developed through pairwise comparison of each criterion (Appendix D). The adopted criteria and their percentage weightings (in brackets) are presented in Table 5. High level capital costs were developed for each infrastructure option based on estimated quantities and unit costs (see Appendix E).

The MCA was set up to compare and rank the infrastructure options across the 15 target villages. The MCA can equally be used to rank options within each district or within each village if required. Based on the ranking and the available project budget, a list of options has been selected and recommended for funding in the next section.

Table 5. Prioritisation objectives, criteria (weightings in brackets) and description

Objective	Criteria	Description
Strategic fit	Project fit (17%)	Proposal is aligned to approaches of ICM, IWRM and EbA for reducing flood and drought risks
	Integration (5%)	Proposal is aligned with relevant jurisdictional (provincial) strategies and mandates, and has potential to integrate with relevant plans and projects
	Stakeholder support (11%)	Proposal is supported by stakeholders
Climate resilience	Flood resilience (11%)	Proposal's magnitude of resilience benefits to the impacts of floods to infrastructure and population
	Drought resilience (11%)	Proposal's magnitude of resilience benefits to the impacts of droughts in terms of securing fit-for-purpose water supply through increasing diversity of water sources, reducing reliance on vulnerable water sources, and protecting/improving water quality
	Ecosystem resilience (11%)	Proposal's magnitude of benefits to reducing flood and drought risks by protecting and improving ecosystem health, function and services
Deliverability	Risk of failure (11%)	Proposal's risk of failure based on implementation complexity, level of difficulty, technology familiarity, uncertainties, and capacity to operate and maintain
	Capital cost (11%)	Proposal's capital cost
	Timeframe (11%)	Proposal's implementation timeframe

4.1 Selection of infrastructure investments

Based on the MCA results, the list of infrastructure options was ranked top-down from highest to lowest score. Based on the ranking, infrastructure investments have been selected when the project budget of approximately $1.1m USD was met.

The complete list of infrastructure investments selected and recommended for funding and implementation under this project (i.e. higher ranked investments) is provided in Appendix F. The selected investments are summarised in:

- Table 7 for those related to flood adaptation (early warning system, evacuation and temporary shelters)
- Table 8 for those related to securing water for drought (riparian buffers)
- Table 9 for those related to securing water for drought (domestic water supply)
- Table 10 for those relation to securing water for drought (small-scale agriculture water supply).

Village maps identifying infrastructure options are provided in Appendix G. The maps also show locations of infrastructure needs identified by stakeholders but that were not considered as options for this project as they did not align with the project objectives.

In general, the MCA analysis shows that the highest rank infrastructure measures for reducing flood risk are early warning systems and implementing evacuation zones and temporary shelters (Table 6). A list of prioritised infrastructure options is provided for implementation across both lowland and upland villages (see Table 7). Whilst construction of flood pads for evacuation in Piaxa and Dongmeuang is relatively expensive and has not been selected for implementation, it is an effective option for safe evacuation of the population at a location in proximity of the village. Similarly, whilst construction of flood defence infrastructure (e.g. village ring-levee or riverbank stabilisation works) are effective in reducing impacts of flooding and riverbank erosion on infrastructure and population, estimated costs are prohibitively high for this project. Such options therefore have low MCA scores and have not been selected for implementation under this project.

In terms of securing water for drought, establishing riparian buffers along watercourses to protect water quality in supply catchments generally have higher MCA scores than other drought risk reduction options (Table 6). Riparian buffers interventions have been selected for implementation in Nachanyai and Nongvilay (Table 8). Riparian buffer options in Saveu, Tangalai Niua, Kanghoupa and Sopsalou have not been selected for implementation despite having higher MCA scores than other options as they are relatively costly ($320,000 USD in total) and can potentially be funded under another UNDP project budget (land use change project component).

In terms of securing water for domestic water use, the selected infrastructure options in Table 8 address water security (quantity and quality) in the target villages. In Tangalai Niua, community groundwater wells and household rainwater tanks have the same scores – however community groundwater wells were selected for implementation given familiarity of the technology within the communities.

Securing water for agriculture has been prioritised for small-scale applications (drought food security) with water supply infrastructure such as solar pump proposed for extraction from a secure surface water source or groundwater. For most options, water supply infrastructure supports sustaining water in an existing waterbody (filling or top-up deep pools) to support uses for drought (e.g. fish and livestock water supply). Where needed, waterbody rectification works are proposed to support beneficial uses for drought (Table 10). A new community pond is proposed in Tangalai Niua. Community groundwater wells are also proposed with distribution pipe to support community garden plots.

Table 6. Average scores for each type of measure. Average score is calculated as the average of all scores for that particular measure across villages where it proposed as an option (noting however that the ranking of options was based on individual scores rather than averaged scores).

ID	Infrastructure measure	Intervention type	Average score
4N	Demarcation posts	Demarcation of water supply catchments	1.34
3A	Megaphone	Early Warning System	1.28
3B	Staff gauge	Early Warning System	1.28
3C	Flood signage	Early Warning System	1.28
3E	Land for flood evacuation	Evacuation and temporary shelter	1.28
3G	Infrastructure at evacuation zone	Evacuation and temporary shelter	1.28
3I	Motorboat for evacuation	Evacuation and temporary shelter	1.28
4M	Riparian buffers for water supply catchments	Water quality	1.24
4L	Household water filters	Water quality	1.11
4C	Community groundwater wells	Water supply	1.10
	Water supply + waterbody rectification works	Water supply	1.00
4D	Household rainwater tanks	Water supply	0.94
	Water supply + new waterbody	Water supply	0.93
3H	Flood emergency shelter*	Evacuation and temporary shelter	0.89
3F	Flood pad for flood evacuation**	Evacuation and temporary shelter	0.84
4E	Groundwater recharge pits***	Water supply	0.67
1B	Village ring levee	Flood defence	0.67
1A	Riverbank stabilisation	Flood defence	0.56

*School extension and ring levee around school ground in Kangdone to protect from 1 in 100-year flood event

** Flood pads in Piaxa and Dongmeuang as entire village and surrounding area is inundated for the 1 in 100-year flood event.

*** Groundwater recharge pits in Nonesavang where groundwater level is reducing

Table 7. Selected infrastructure investments for flood adaptation (early warning system, evacuation and temporary shelter options)

Village	Infrastructure options
Songkhone	Megaphone (X1)
	Motorboat (X1)
	Groundwater well and toilet block at flood evacuation zone (X1). Potential for permanent shelter for people and livestock evacuation.
	Staff gauge (X1)
Kangdone	Motorboat (X1)
	Flood evacuation area site preparation and permanent shelter (next to school).
	Community borewell at flood evacuation area (X1)
Mueanghong	Megaphone (X1)
	Repair staff gauge/hydrological station (X1)
	Motorboat (X1)
Nachanyai	Motorboat (X1)
	Megaphone (X1)
	Staff gauge (X1)
Donmeuang	Megaphone (X1)
	Staff gauge (X1)
Piaxa	Staff gauge (X1)
Nongvilai	Megaphone (X1)
Tangalai Niua	Motorboat (X1)
	Megaphone (X1)
	Staff gauge (X1)
Thamae	Megaphone (X1)
	Staff gauge (X1)
	Motorboat (X1)
Kanghoupa	Motorboat (X1)
	Staff gauge (X1)
Sopsalou	Megaphone (X1)

Table 8. Selected infrastructure investments for securing water for drought (riparian buffer options)

Village	Infrastructure options
Nachanyai	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (0.5 km)
Nongvilay	Riparian buffers (2 km in Reservoir A catchment) + Reservoir solar pump for small scale irrigation
Saveu	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (2.5km) + drinking water source in village
Tangalai Niua	Riparian buffers along watercourses next to rice cultivation in drinking water supply catchments (1.5km)

Table 9. Selected infrastructure investments for securing water for drought (domestic water supply)

Village	Infrastructure options
Houaykor	Community borewells (X 3)
	Household rainwater tanks and water filters (X 110 households)
Mueanghong	Household water filters (X 378 households)
	Community borewell (X 1)
Nonesavang	Community borewells (X 3) + rectify elevated storage (X 1)
Nachanyai	Community borewells (X 3) + household water filters (X 223 households)
Piaxa	Elevated 15 KL storage tank on piped water supply
	Household water filters (X 104 households)
Sivilay	Community borewells (X 2) + household water filters (X 280 households)
Saveu	Community borewells (X 2) + household water filters (X 164 households)
Tangalai Niua	Community borewells (X 2) + household water filters (X 95 households)
Thamae	Community borewells (X 2) + household water filters (X 110 households)
Kanghoupa	Community borewells (X 2) + household water filters (X 200 households)
Sopsalou	Household rainwater tanks and water filters (X 68 households)

Table 10. Selected infrastructure investments for securing water for drought (small-scale agriculture water supply)

Village	Infrastructure options
Songkhone	Water supply to sustain natural wetland and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert and spillway)
Kangdone	Water supply to sustain existing waterbody and beneficial uses (river water extraction solar pump, bank repairs, riparian vegetation, livestock offline storages, spillway with stop logs)
Houaykor	Water supply to sustain existing waterbody and beneficial uses (solar pump to extract water from Houay Kai River, groundwater solar pump for top -up, offline livestock storages)
Nonesavang	Water supply to sustain existing waterbody (pond B) and beneficial uses (solar pump to extract water from local tributary, groundwater solar pump for top -up, offline livestock storages)
Nachanyai	Groundwater solar pump (next to existing pond) for pond top-up
Piaxa	Water supply to sustain existing waterbody and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages)
Sivilay	Water supply to sustain existing waterbody (Pond A) and beneficial uses (groundwater extraction solar pump, sediment removal, riparian vegetation, livestock offline storages, culvert and spillway with stop logs)
Tangalai Niua	New community pond (in village) + water supply to sustain pond and beneficial uses (river water extraction solar pump, riparian vegetation, livestock offline storages, overflow swale)
Thamae	Water supply to sustain existing waterbody and beneficial uses (river water extraction solar pump, riparian vegetation, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert)

5 Conclusion and next steps

This report has documented the results of the optioneering process undertaken for identifying and prioritising protective infrastructure options in the 15 target villages of the Xe Bang Hieng River Basin, for the ”Integrated Water Resource Management and Ecosystem-based Adaptation in the Xe Bang Hieng River Basin and Luang Prabang city” project. The infrastructure options were compared and ranked across the 15 across the villages using a multi-criteria analysis (MCA), and a list of infrastructure investments were selected and recommended for funding and implementation under this project.

It should be noted that the infrastructure costing developed for this optioneering process was completed at a high level only for the purpose of the MCA analysis. It is recommended that surveys, engineering designs and detailed costing are developed before options are implemented on the ground. As such, it is possible that fewer or more investments may be possible with the budget available.

Finally, it should be noted that the options for hydrometeorological infrastructure upgrades identified in this project will be refined and a list of recommendations will be provided in a separate report.

6 References

1. Aaron J. M. Russell, Joost Foppes, Diji Chandrasekharan Behr, Sounthone Ketphanh, Serge Rafanoharana. 2015. How Forests Enhance Resilience to Climate Change: The Case of Smallholder Agriculture in Lao PDR. Washington DC: Program on Forests (PROFOR)

2. GoL. 2013. Second National Communication to the UNFCCC (SNC)

3. Natural Resources Environment Research Institute (NRERI). Xebanghieng River Basin Water Resources: Assessment and Modelling Report (2020)

4. UNDP. 2015. GEF Project Document: Sustainable Forest and Land Management in the Dry Dipterocarp Forest Ecosystems of Southern Lao PDR.

7 Appendix A: Village summaries

Songkhone village

Songkhone village is located along the Bang Hieng River about 70 km from the confluence with the Mekong River. The village is home to 1264 people living in 227 households.

Based on the flood hazard maps, the village infrastructure and dwellings are largely exposed to flooding for the 1 in 50-year event or higher under historical climate scenario. Exposure for the 1 in 10-year event is significantly increased under the future climate scenario. The area of rice paddy fields managed by the village 344 ha. Agricultural land is exposed to flooding for the 1 in 2-year event (or larger) under historical climate scenario.

Over the past decade, flooding has been a prevalent climate hazard. Stakeholders noted that water scarcity is not a significant issue in the village given access to piped water supply for domestic water use. There is also an existing irrigation scheme of rice paddy fields with extraction from the Champone River.

There is erosion along the Bang Hieng River which is damaging existing infrastructure (dwellings and buildings) and has potential to cause further damage in the future (site photo C). There is also an important wetland area that is used for fishing and for livestock water supply (site photos B). The wetland is fed by rainfall and potentially on a near annual basis from backwatering and spilling of the small tributaries (of Champone River) connected to the waterbody.

Kangdone village

Kangdone village is located along the Bang Hieng River about 55 km from the confluence with the Mekong River. The village is home to 1255 people living in 187 households.

Based on the flood hazard maps, the village infrastructure and agricultural land is significantly exposed to flooding for the 1 in 50-year event (or larger) under historical climate scenario. Under future climate scenario, the village infrastructure and agricultural land become significantly exposed to flooding for the 1 in 10-year event. The village school is used as a flood shelter area (site photo A) noting that the existing school building is exposed to flooding for the 1 in 100-year event under historical and future climate scenario. As such, the site adjacent to the school (on higher ground) proposed as an additional flood evacuation zone by the village stakeholders is worth pursuing. Flood early warning system in the village is being addressed under the KOICA project. Over the past decade, flooding has been a prevalent climate hazard.

Villagers rely on bottled water for drinking and cooking, and on groundwater for washing. Each home has a groundwater tube well (40-60 m deep).

The area of rice paddy fields managed by the village is 104 ha. There was an existing irrigation scheme in the past that extracted water from Bang Hieng River to a high point at the south of the village for distribution to rice fields to the east and west. However, the scheme is no longer operational, and the transfer pipe has been removed.

There is an existing waterbody (site photo B) which the villagers use for fishing, livestock water supply, boat racing in October, and irrigation of small garden plots (for cash crops) and several rice fields in proximity of the waterbody. The waterbody is fed by rainfall and the forested catchment. The waterbody has an existing spillway and typically overflows in the months of September-October (site photo C).

Houaykor village

Houaykor village is on the Houay Kai River, approximately 6 km from the confluence with the Bang Hieng River. The village is home to 674 people living in 110 households.

Based on the flood hazard maps, the village is not impacted by flooding from the Bang Hieng River. The smaller Houay Kai River breaks its banks for short duration every year; however, flooding is localised and does not have significant impacts on agricultural land or village infrastructure.

Villagers rely on bottled water for drinking, and groundwater for cooking and washing. Households have groundwater tube wells (30-45 m deep) and rainwater harvesting storages (see site photos A and B). Groundwater quality is generally fit-for-purpose; however, supply is intermittent with 1-hour availability and 2-hr waiting period for groundwater to replenish. The village is a reasonable distance from a permanent surface water source. The Houay Kai River is understood to be a seasonal river ceasing to flow from December onwards, until the wet season arrives around May or June (site photos C and D).

The area of rice paddy fields and cassava plantation managed by the village is 326 and 110 ha respectively. At the stakeholder meeting, it was also noted that rice cultivation is impacted by rainfall reliability. The village also does not have access to a close surface water source for irrigation or for emergency domestic water needs.

There are two existing privately owned ponds in the village. They have been used for irrigation of cash crops and for fishing. The pond to the north was recently constructed and is owned by the village head. It collects rainfall and local catchment runoff.

Mueanghong village

Mueanghong consists of two village clusters – one to the north and another to the south – both along the Bang Hieng River. The village is home to 1115 people living in 378 households.

Based on the flood hazard maps, flood risks from the Bang Hieng River is lowest in Mueanghong (compared to other flood-prone villages) with only the first or second row of dwellings closest to the river exposed to flooding for the 1 in 2-year event (or larger). Flooding has occurred twice in the past decade in the village.

The villagers rely on household borewells for cooking and washing, and on nearby springs for drinking water (site photo A and B) with spring water also supporting rice cultivation further downstream. Villagers do not see groundwater as fit for drinking but would consider it if filters are available. Villagers carry water in buckets or large drums (on tuk-tuk) from springs. There is flow from the springs year-round, however during the site inspection it was observed that the flow rate was low, and it took time to fill buckets/drums. The village stakeholders requested support for protection of spring catchment area (5 ha and 20 ha forested areas). Land clearing and burning in the catchment was observed during the site visit (see site photo C).

The area of rice paddy fields managed by the village is 350 ha. The village does not have an irrigation scheme for rice cultivation, however rice paddy fields to the south are fed by spring water (site photo D). The villagers rely on the ponds in the vicinity of the rice paddy fields for fishing and livestock water supply.

Nonesavang village

Nonesavang is 2 km from the Xe Xangxoy River which is about 16 km from the confluence with the Xe Champone River. The village is home to 3333 people living in 545 households.

Based on the flood hazard maps, most houses in the villages are not impacted by riverine flooding up to the 1 in 100-yr event for both historical and future climate scenarios. However, agricultural land to the south of the village is exposed to riverine flooding for the 1 in 10-yr event (or larger) with the area exposed increasing under the future climate scenario.

The Villagers rely on bottled water for drinking, and groundwater for cooking and washing. They also rely on household rainwater harvesting during the wet season. Groundwater availability has reduced over the last 20 years, with groundwater no longer available in general within the first 45 m below ground surface. Groundwater can be collected at five wells in the village – one well is accessible at no charge; another four wells are operated by private operators supplying water at a cost of 10,000 Kip per drum (see site photo A).

There are many privately-owned constructed ponds within the village fed by rainfall and overland flow and providing a source of irrigation water for small-scale farming and other uses such as fishing. There are also two public ponds in the village – one owned by the Cabinet office (see Pond A), and another pond to the north (see Pond B) owned by DAFA noting a privately owned groundwater well (40 m deep) is located in proximity of that pond. The local tributaries of Xe Xangxoy River are likely to be seasonal ceasing to flow during parts of the dry season.

The area of rice paddy fields managed by the village is 406 ha. There is no irrigation scheme for rice cultivation.

Nachanyai village

Nachanyai is situated in the eastern part of Xonnabouly district. It consists of two clusters – a larger cluster along the Bang Hieng River and a smaller cluster further inland. The village is home to 1095 people living in 223 households. Flood mapping show no significant risk of flooding from the Bang Hieng River in Nachanyai.

The villagers rely on two springs, which are about 4 km from the larger cluster, for drinking water (see site photo A). In the wet season, they also harvest rainwater for cooking and washing (instead of river water which is considered less clean than rainwater). However, about 50 households do not have a drum for collecting rainwater. Villagers use a filter cloth to treat the rainwater. There is no issue known with rainwater quality, however it has not been tested. In the dry season, 60/156 households have access to groundwater for cooking and washing using groundwater tube wells (35-40m deep). Groundwater has iron content which villagers find unsuitable for drinking. The remaining households rely on river water in the dry season. There are three community groundwater wells, however they are not functional. Villages also grow food in small plots (vegetables/cassava) on the banks of the Bang Hieng River using river water for irrigation.

The area of rice paddy fields managed by the village is 88 ha. There is an existing irrigation scheme with pump system to extract water from the Bang Hieng River for irrigation of rice fields (site photo B). The scheme is not being operated as the benefit (income) does not meet the operational cost (electricity cost for pumping).

Other observations during the site visit include:

- Areas in the spring forested catchment (source of drinking water) were being cut down for cassava plantation (site photo D). It is understood that about ½ ha has been allocated per family (40 ha for 80 families).
- There is successful demonstration of an existing community pond constructed along a local creek for livestock water supply and for fishing.
- It was observed that the village has very few remaining trees and thus a lack of shade for relief from heat (site photo C). It is understood that trees were removed when electricity lines were installed. There are also fewer household garden plots compared to other villages.

Donmeuang village

Donmeuang village is located along the Xe Champone River more than 50 km from the confluence with the Bang Hieng River. The village is home to 910 people living in 118 households.

Based on the flood hazard maps, the village infrastructure is significantly exposed to flooding for the 1 in 50-year event (or larger) under historical climate scenario, with some dwellings also exposed to flooding for the 1 in 10-yr event. Under future climate scenario, the village infrastructure become significantly exposed to flooding for the 1 in 10-year event. It is also noted that for the 1 in 100-year event under historical climate scenario or the 1 in 50-year event under future climate scenario, there are limited areas in proximity of the village that are not exposed to flooding. A small proportion of agricultural land is exposed to flooding for the 1 in 2-year event, but significant areas are exposed to flooding for the 1 in 10-year event (or larger) under historical climate scenario.

Over the past decade, there were two occurrences of floods. Flood water depth was generally around 30-50 cm in 2011 lasting for 10 days, and 80 cm in 2019 lasting for a few days (see site photo D). There was no need for households to move to flood shelter area. Instead, families moved to upper floor of their homes. In 2011, eleven homes were lost as a result of riverbank erosion. Similarly, two homes were lost in 2019.

The village has access to piped water supply. Water demand is not fully met during peak times (morning and evening) in the months of March, April and May as the pipe water supply pressure head is limited.

The area of rice paddy fields managed by the village is 266 ha. Villages rely on the nearby Sui Reservoir for irrigation water supply for dry season cropping around the reservoir as shown in site photo C (noting pump on Champone River has not been used since 2008). Eleven villages currently undertake agriculture around the reservoir.

The RAMSAR listed wetland close to Sui Reservoir is not demarcated. It is assumed that the existing irrigation channel to the north of the village is extracting water from the wetland for irrigation of the rice paddy fields. It is understood that DAFO has a limit on water extraction from the wetland, but it is not enforced.

Piaxa village

Piaxa village is located along the Champone River more than 40 km from the confluence with the Bang Hieng River. The village is home to 689 people living in 104 households.

Based on the flood hazard maps, the village infrastructure is significantly exposed to flooding from the Champone River for the 1 in 50-year event (or larger) under historical climate scenario, with some dwellings also exposed to flooding for the 1 in 10-yr event. However, the proportion of dwellings exposed to flooding is significantly higher under future climate scenario for the 1 in 10-year event. It is also noted that for the 1 in 100-year event under historical climate scenario or the 1 in 50-year event under future climate scenario, there are limited areas in proximity of the village that are not exposed to flooding. A significant proportion of agricultural land is exposed to flooding for the 1 in 2-year event (or larger) under historical climate scenario from backwatering and spilling of the small tributary of the Champone River to the south of Piaxa village. The extent of flooded agricultural land is similar for the 1 in 10-year event (compared to the 2-year event) under historical climate scenario, but there is a marked increase in flooded area for the 1 in 10-year event under future climate scenario with the Champone River breaking its banks at several locations.

The villagers rely on bottled water for drinking. There is a perception that river water is not fit for drinking. During wet season, access to the village is impacted which affects supply of bottled water with villagers shifting to rainwater for drinking. The village has a new pipe water supply (installed 3 months ago). Only 66 households have access to piped water. Piped water is used for cooking, washing, and livestock water supply. Households without piped water rely either on household ground water tube wells or Champone River for cooking and washing (approx. 50 households). Community groundwater wells have also worked successfully in the past.

There are large areas of irrigated rice paddy fields with water extracted from the Champone River. Rice is also grown in proximity of the wetlands such as Nongvai and Nongten. The wetlands are also used for fishing.

Sivilay village

Sivilay is situated in the western part of Champone district about 25 km from Xe Champone River. It consists of four clusters. The village is home to 1683 people living in 280 households. Flood mapping show no significant risk of riverine flooding in Sivilay.

The villagers rely on household groundwater borewells for cooking and washing and bottled water for drinking. Only 93 households have borewells, but water is shared with all households. Groundwater supply is lowest March-May when 20 litres is collected every hour. Some groundwater wells have iron content. The participants requested support for a new community groundwater (site photo C). The participants also requested support for household rainwater tanks.

The area of rice paddy fields managed by the village is 575 ha. The village does not have an irrigation scheme for rice cultivation. At the Houy Bak reservoir, the Bru Ethnic group community grow crops on the edge of the reservoir.

The village has two community ponds built to capture rainfall and overland flow.

- Pond A within the village is used for fishing and community events. On inspection, the pond needs desilting and repairs to eroded banks and embankment section. A new outlet with gate would provide control on water storage and depth (see site photo A).
- Pond B further away is used for fishing, livestock water supply and irrigation of crops on private land surrounding the pond (e.g. for cash crops such as watermelon) – see site photo B. The participants requested support to increase storage capacity in the Pond B to improve irrigation water supply for irrigation of dry season crops (potential for 20 ha). A community agreement could be set up to allow the community to grow crops on private land during the dry season and thus benefit from the renovated pond. During site inspection, the pond had a water depth of about 50-80 cm. Water stops flowing into the pond in the month of January. The spillway could be raised to increase the pond water storage capacity.

It is also observed that numerous farm storages are present outside the village (fed by rainfall and overland flow) potentially supporting fishing and livestock water supply.

Nongvilay village

Nongvilay village is along the Xe Lanong River in the upland region. The village is home to 2640 people living in 483 households.

Whilst the flood mapping undertaken does not show flooding in the village, stakeholders have mentioned flooding challenges. The last significant flood was in 2009 when some households moved to relatives on higher ground. In 2019, river water level rose but did not reach house floor level – nevertheless 17 families living in proximity of the river sought shelter at the school as a precaution. There was discussion that the construction of the upstream dam on the Xe Lanong River may have exacerbated flooding risk in the village. Nongvilay village receives disaster information from line agency. The existing slope gauge also needs to be cleaned and repaired. Currently, households living close to the river prepare all belongings when flood warning is received, and vulnerable groups of people are moved first by car.

The village has piped water supply. 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. Only 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.

- For the first storage (reservoir A), it was observed that the weir stoplogs were missing. This reduces the storage capacity of the reservoir. The offtake irrigation canal invert level is also elevated, limiting drawdown of reservoir. It is possible to install new stoplogs to increase storage capacity. It is possible to increase reservoir drawdown by installing a solar pump system or to install a new irrigation canal that allow

drawdown of the reservoir by gravity. These measures would need consultation with DAFO and reservoir/downstream water users who may be impacted.

- For the second storage (reservoir B), it was similarly noted that the offtake irrigation canal invert level is elevated, limiting drawdown of reservoir. It is possible to construct an additional (lower) offtake pipe with sluice gate to access additional storage volume in the reservoir. This would need consultation with DAFO and reservoir/downstream water users who may be impacted.

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 planning to control and manage development and uses along the riverbanks in order to reduce erosion.

Saveu village

Saveu village is along the Xe Lanong River in the upland region. The village is home to 657 people living in 164 households.

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 (measured flow rate about 0.1 L/s) – see site photo A. The spring is surrounded by private land. There are four groundwater community wells for drinking, washing, cooking, gardening, and livestock water supply (see site photo C); however; two wells are not functional. One household of seven people typically collects about 100 litres from the community wells every day. Groundwater supply is intermittent, with waiting period of about 20 mins for wells to replenish. Participants have requested project support for two new community wells with elevated storage and pump. There is also a concrete storage at the school which is fed by a pipe by gravity from a nearby creek (location of source unknown). Overall, water supply infrastructure can be improved to support domestic water uses and irrigation of small village garden plots.

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 into the spring (see site photo B). 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. Village leader recognised the pressure of cassava production on the sacred forest land and water resources and request support for demarcation of the forest land.

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). This supplies about 2 months of rice for the households.

There is also an existing pond that was built in 2012 (see site photo F). Other households need permission for fishing in the pond. Livestock are allowed to move through this land during the dry season. The village stakeholders requested support for another community pond for fishing and livestock water supply, and irrigation water for dry season cropping. Dry season baseflow observed in Sanor River could support the community pond.

Tangalai Niua

Tangalai Niua village is along Xe Lanong River in the upland region. The village is home to 455 people living in 95 households.

Whilst the flood mapping undertaken does not show flooding in the village, stakeholders mentioned flooding occurrences and impacts including 20 households affected by flooding for 2 days in 2009. There was discussion that some homes have moved to higher ground since the 2009 flooding event, and that the construction of the upstream dam on the Xe Lanong River may have exacerbated flooding risk in the village.

Villagers rely on a combination of natural 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. They have no buffers to rice cultivation and are accessible to livestock. Water is collected from these watering holes in 18 litre bottles typically. One of the springs is in private land but it is considered as a community water resource. There are four groundwater wells in the village supplying water for cooking, washing, livestock and garden irrigation. One well has a broken pump. Villagers identified need for two new community groundwater wells.

The participants requested support for a community pond within the village for fishing, livestock water supply and for garden irrigation. The proposed site for the pond is heavily treed. The pond design would need to consider retaining the trees. It is understood that groundwater is about three metres deep at the proposed site. Water sources for the pond need further investigation (direct rainfall, local runoff, pumping water from river, groundwater).

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 Niua village own and manage about 20 ha of rice fields next to the Houay Tabon River for rice. There has been previous discussion to put a weir across the Houay Tabon River for dry season cropping irrigation.

Thamae

Thamae is along the Bang Hieng River in the upland region. The village is home to 674 people living in 110 households.

Whilst the flood mapping undertaken does not show flooding in the village, stakeholders mentioned flooding occurrences and impacts including 20 households affected by flooding from the Bang Hieng River in 2020. Several families and homes have moved to higher ground since the 2020 flooding event.

Villagers rely on groundwater for household drinking, washing, cooking and livestock water supply. Groundwater is boiled before drinking. When groundwater is not sufficient, villagers collect water from the Bang Hieng River. A family of four would collect 150 litres per day using buckets. Villagers also bathe and undertake general cleaning in the river (see site photo B). There are two groundwater wells, however only one supplies good quality water with the other well supplying water with sediments. Participants identified need for new groundwater wells. The need for groundwater well extension was also identified in the previous field mission by UNDP.

Participants also identified improving the existing community pond in the middle of the village (see site photo A) and increase its storage capacity for livestock water supply, fishing and irrigation of household gardens and community gardens. High litter was observed in the village around the pond (see site photo C).

The area of rice paddy fields managed by the village is 28 ha, while swidden land is 215 ha.

A pattern of rice cultivation on more-accessible land with gentle slopes such as valley floors was noted as they provide favourable environment for rice production where it can be grown under flooded conditions and there are possibilities for local-scale irrigation.

Kanghoupa village

Kanghoupa is along the Bang Hieng River in the upland region. The community was relocated to the current site in 2020. The previous village site was located on the other side of the river and was affected by flooding in 2019 and 2020. There was also flooding in Kanghoupa village in 2009. In terms of flood early warning and response, vulnerable households move to higher grounds into family homes or flood shelter (school). During emergency response, vulnerable groups including women, children and elderly people are moved first to higher ground by boat. Flood early warning system is not essential at the new village site because it is located closed to KOICA proposed investments for Sepon district and the nearby Sunpaper mill also has a staff gauge for observing changing water level in Xe Bang Hiang River near its river pumping station. The village has one motorboat that was provided by the district. A flood evacuation area has also been identified to the north of the village, which will be shared by seven villages during flood emergency.

Villagers rely on groundwater for household drinking, washing, cooking, gardening, and livestock water supply. When groundwater is not sufficient, villagers collect water from Bang Hieng River. In the wet season, villagers collect rainwater in drums. There are three community borewells. Participants requested project support for three new community wells and individual household wells. Inspection of one borewell showed that the borewell pump is not used to fill the elevated storage tank. Instead, it is operated every time a user needs water (see site photo A). This approach means waiting time at the point of collection. This also puts pressure on the pump which is failing frequently. The operation of the borewell pump and storage tank needs improvement.

The area of rice paddy fields and cassava managed by the village is about 50 ha and 49 ha respectively. Five families undertake rice farming close to the current village site (5ha) whilst all other cropping (50 ha) occurs on the other side of the river where the previous village site was located. Villagers travel across by boat every day. Most young people from the village are however employed by the Sunpaper mill.

Sopsalou

Sopsalou village consist of an existing cluster and a focus zone site. The focus zone is intended to become the central socio-economic and settlement area and will include 6 villages each with 2 clusters. Sopsalou will be one of the 6 villages. It will have 1) Sopsalou cluster and 2) Talua cluster. DONRE land sector has been developing the land use plan for Sopsalou focus zone. DONRE has also started clearing of land and developing individual land titles. At this stage, community land has been allocated, but not individual household land titles.

Both Sopsalou existing cluster and focus zone sites are also adjacent to the Bang Hieng River. Flooding is not an issue in the existing cluster. However, at the focus zone site, flash flooding occurs as a result of runoff from surrounding hillslopes. Project team proposed drainage channel to bypass hillslope runoff with appropriate land allocation for drainage works marked in the land use plan. Erosion of Xe Bang Hieng bank at the focus zone site is also evident with lateral movement of the river impacting existing rice paddy areas (see site photo B). Nine homes were lost from riverbank erosion in the 2019 and 2020 floods. The village has no access to telephone network. There is no early warning system or hydrological monitoring network in the area.

The villagers in the existing cluster rely on river water for cooking, washing and drinking water. There is a large irrigation project planned in the existing cluster. The headworks has been completed (see site photo C). Distribution pipes from the weir to the agricultural land (145ha) will be completed in the future. There was reasonable dry season flow observed in the river during the site inspection. The irrigation project design documentation should be reviewed to understand how dry season river flow is likely to be impacted and in turn affect village water supply.

A project is planned for the focus zone for domestic and agricultural (30 ha) water supply. Survey of Salou River has been undertaken already, and design completed (construction cost for headworks, distribution and water storage estimated at $85K USD). Dry season flow was observed in the river during the site inspection (see site photo A).

The impact of sediment generation and accumulation into the proposed river weir pools is generally understood. The participants have to think about measures related to land use practices to address this issue.

Songkhone

A. Wetland embankment

B. Riverbank erosion

C. Riverbank erosion

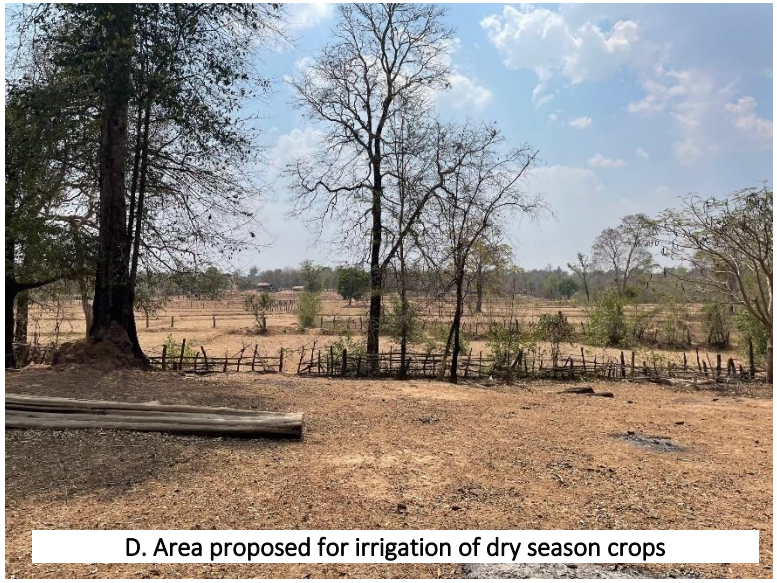
D. Existing irrigation canal

Kangdone

A. Existing school

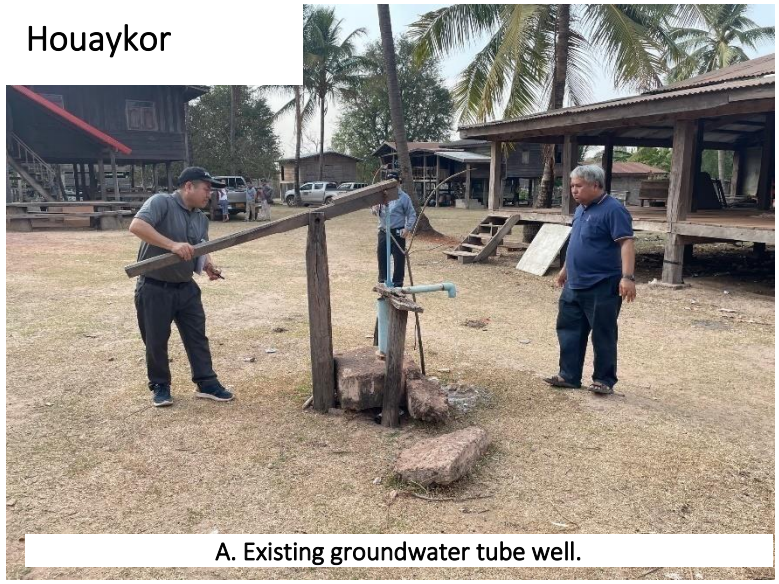
B. Waterbody

C. Waterbody spillway



D. Area proposed for irrigation of dry season crops

Houaykor



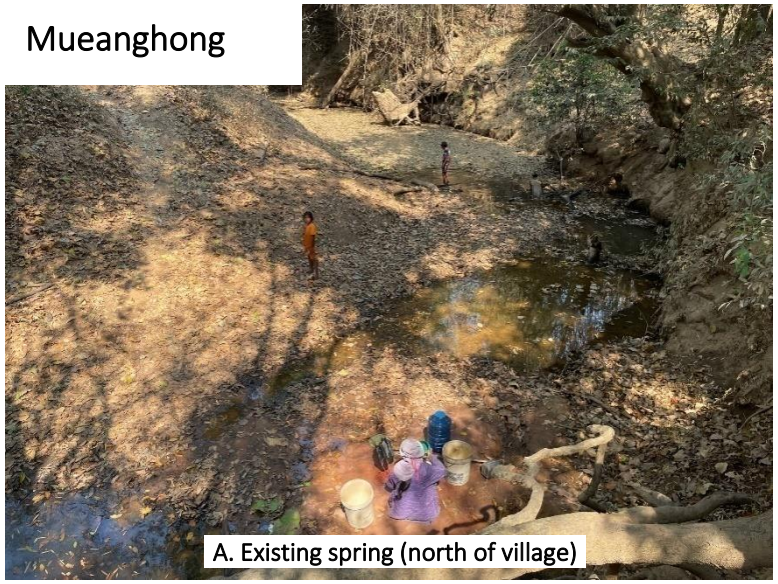
A. Existing groundwater tube well.

B. Existing household rainwater storage

C. Houay Kai River (cease to flow)

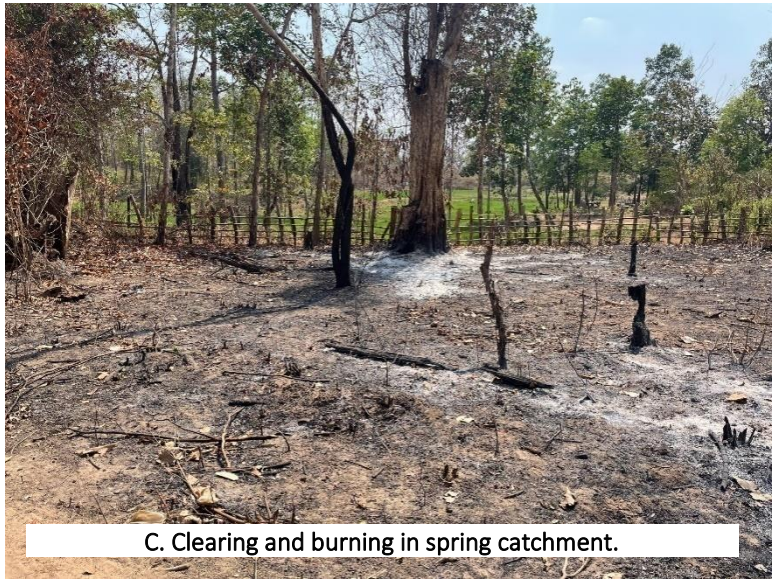
D. Pools in Houay Kai River during dry season

Mueanghong



A. Existing spring (north of village)

B. Existing spring (south of village)



C. Clearing and burning in spring catchment.

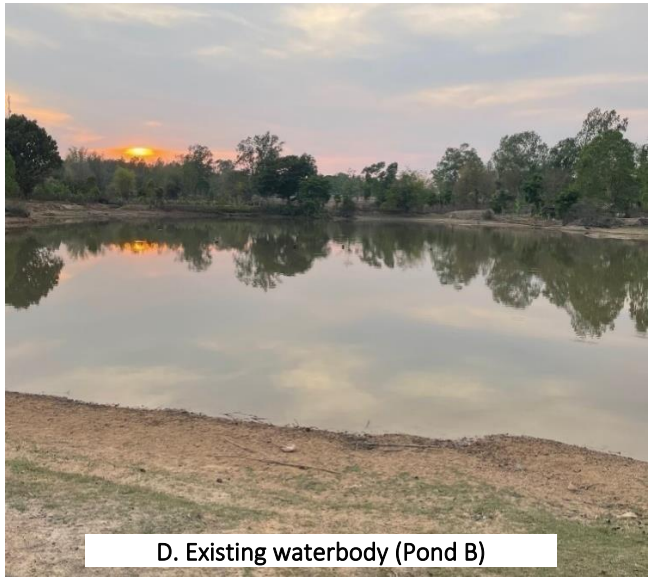
D. Downstream rice fields rely on spring water.

Nonesavang

A. Private bore well

B. Local watercourse (cease to flow)

C. Existing groundwater well/elevated storage at village temple



D. Existing waterbody (Pond B)

Nachanyai

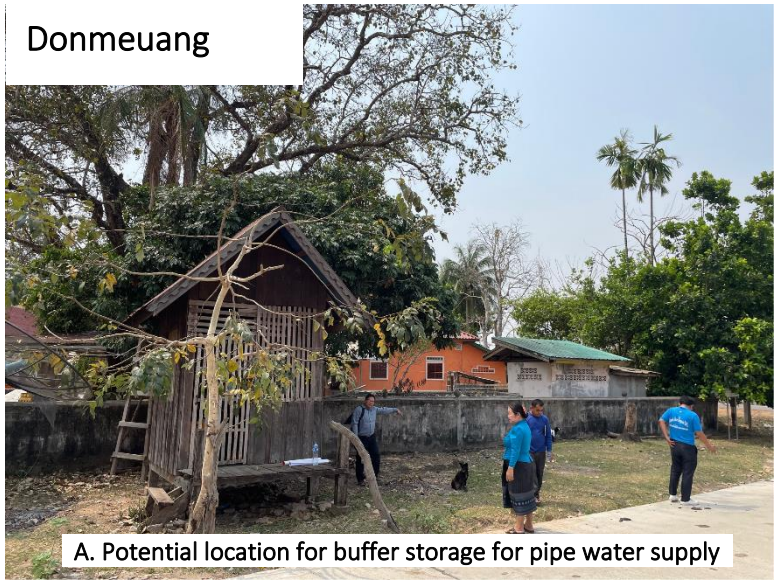
A. Village drinking water supply (spring)

B. Large irrigation scheme not being used by village

C. Lack of trees (shade) and household garden plots in

D. Forested area being converted to cassava plantation

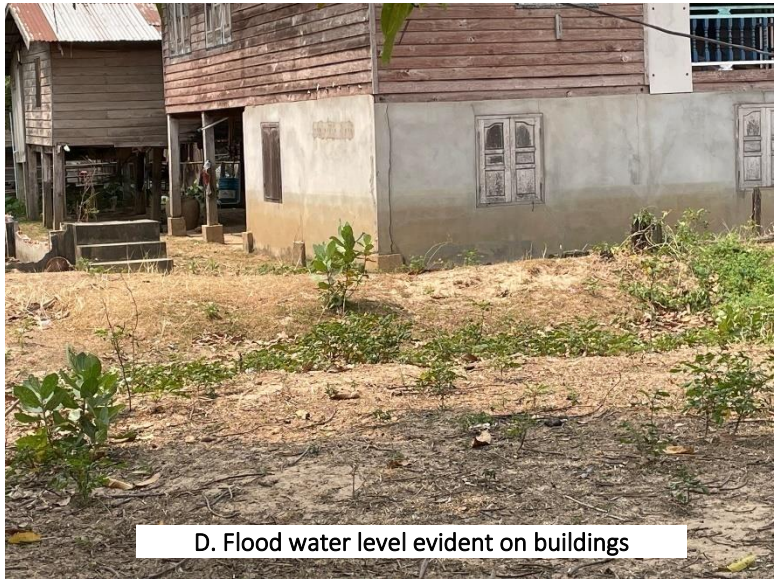
Donmeuang



A. Potential location for buffer storage for pipe water supply

B. Location for proposed riverbank embankment

C. Solar pump system extracting water from channel for irrigating rice



D. Flood water level evident on buildings

Piaxa

A. Site where overbank flow occur

B. Location for water storage connected to village pipe water supply

C. Irrigation channels

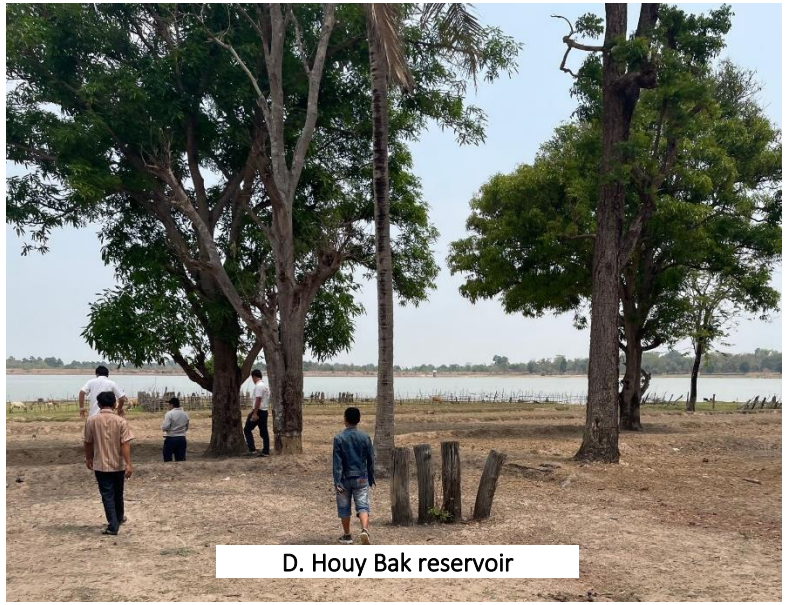
D. Small waterbody (in background)

Sivilay

A. Potential for new outlet with gate (Pond A)

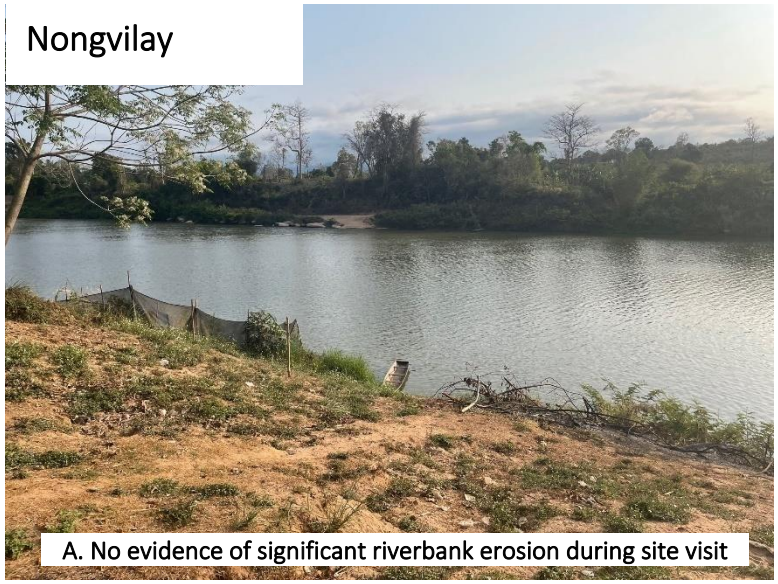
B. Potential to raise road/spillway to increase capacity (Pond B)

C. Community borewell



D. Houy Bak reservoir

Nongvilay



A. No evidence of significant riverbank erosion during site visit

B. Stop logs missing on weir

C. Elevated outlet on reservoir reducing access to stored water.

Saveu

A. Spring in the middle of village

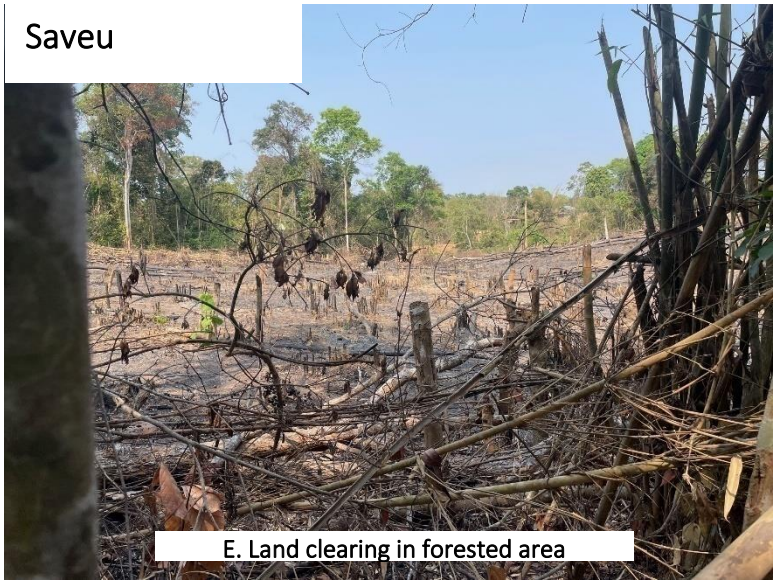
B. Land clearing at village impacting on another spring

Saveu

C. Community well with solar pump and elevated storage

D. Sanor River

Saveu



E. Land clearing in forested area

F. Community pond

G. Gravity pipe water supply from creek to concrete storage

Tangalai Niua

A. Natural spring for drinking water supply

B. Natural spring for drinking water supply

C. Existing community well

D. Houay Tabon River

Thamae

A. Central village pond

B. Bang Hieng River

C. High amount of litter around village pond

D. Sa Nong Creek

Kanghoupa

A. Existing borewell and storage

B. Water supply for paper mill

Sopsalou

A. Location of proposed water supply project for forecast zone

B. Bang Hieng riverbank erosion

C. Headworks for irrigation project at existing cluster

D. Bang Hieng River

8 Appendix B: Stakeholder consultation meeting – participant details

No	Districts	Village	Number of participants	Women
1	Songkhone	Songkhone	9	3 (33.3%)
		Kangdone	16	8 (50.0%)
		Houaykor	11	4 (36.4%)
2	Xonnabouly	Mueanghong	17	8 (47.1%)
		Nonesavang	12	4 (33.3%)
		Nachanyai	19	9 (47.4%)
3	Nong	Nongvilay	5	2 (40.0%)
		Saveu	18	6 (33.3%)
		Tangalai Niua	24	10 (41.7%)
4	Champhone	Donmueang	8	0 (0.0%)
		Sivilay	15	9 (60.0%)
		Piaxa	26	11 (42.3%)
5	Sepone	Thamae	4	2 (50.0%)
		Kanghoupa	10	7 (70.0%)
		Sopsalou	21	4 (19.1%)

Songkhone, Champhone and Xonnabouly and the upland districts of Sepone and Nong

Songkhone village

Registration Form

ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	09/03/2024 with Xonbouly

Voucher Number:	IWRM2024.0005	**Date Issue:**	09-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	[illegible]	Khanthong	[illegible]	[illegible]	[illegible]	98909516		☑ Yes ☐ No	[signature]
2	[illegible]	Mr Som PHANE Sithisak	[illegible]	[illegible]	[illegible]	22314153		☑ Yes ☐ No	[signature]
3	[illegible]	Phasouk	[illegible]	[illegible]	[illegible]	99649879		☑ Yes ☐ No	[signature]
4	[illegible]	Sisaard	[illegible]	[illegible]	[illegible]	22[illegible]1348		☑ Yes ☐ No	[signature]
5	[illegible]	Mr Songaleun Vongthana	M	Consult	Hydro dev	56285388	vongthanas@yaho.com	☑ Yes ☐ No	[signature]
6	[illegible]	Mr. Oukham.	[illegible]	Consult	Hydrotech	56011280		☑ Yes ☐ No	[signature]
7	[illegible]	Mr Vongsin VONGINKHAM	M	[illegible]	[illegible]	22141222		☑ Yes ☐ No	[signature]
8	[illegible]	Mr. Saykham SITHAVONG	M	Consultant	Hydrotech	96654455		☑ Yes ☐ No	[signature]
9		Harry Virchsawmy	M	Consultant	Allluvium	0411855665	harry.virchsawmy@alluvium.com.au	☑ Yes ☐ No	[signature]

…mber: IWRM2024.0005 Date Issue: 09-Mar-24

#	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
23	[illegible]	Thipphakone XAYASITT	ພ	[illegible]	HTC	[illegible]		☑ Yes ☐ No	[signature]
24	[illegible]	[illegible]	ຍ	[illegible]	HTC	55665923		☑ Yes ☐ No	[signature]
25								☐ Yes ☐ No	
26								☐ Yes ☐ No	
27								☐ Yes ☐ No	
28								☐ Yes ☐ No	
29								☐ Yes ☐ No	
30								☐ Yes ☐ No	
31								☐ Yes ☐ No	
32								☐ Yes ☐ No	
33								☐ Yes ☐ No	
34								☐ Yes ☐ No	
35								☐ Yes ☐ No	

Kangdone village

5.3.2024

Voucher Number: IWRM2024.0005 Date Issue:

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ ຮັບຜິດຊອບ	Work Place ມາຈາກ ພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
60			ช			95828055		☑ Yes ☐ No	
61			ช			92864112		☑ Yes ☐ No	
62			ช			22344358		☑ Yes ☐ No	
63			ช			8e31 ep153		☑ Yes ☐ No	
64			ช					☑ Yes ☐ No	
65			ช				97955889	☐ Yes ☐ No	
66			ช					☑ Yes ☐ No	
67			ช			91480828		☑ Yes ☐ No	
68			ช			97818003		☑ Yes ☐ No	
69			ช			96576442		☑ Yes ☐ No	
70			ช			57506682		☑ Yes ☐ No	
71			ช			95071070		☑ Yes ☐ No	
72			ช			95115120		☑ Yes ☐ No	
73			ช			97437478		☐ Yes ☐ No	
74			ช					☑ Yes ☐ No	
75			ช					☑ Yes ☐ No	

Houaykor village

Registration Form

ໃບລົງທະບຽນ

5.3.2024 ບ. ຫ້ວຍຄໍ້
ມ. ຊຽງຮອນ

Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. – Task 2 Conduct protective infrastructure
Location & Duration:	03-17 March 2024 at Savannakhet Province
Voucher Number:	IWRM2024.0005
Date Issue:	

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	ທ. ຄຳປຸ່ນ ໄຊຍະວົງ		ຊ	ປ/ຊ	ຫ້ວຍຄໍ້			☑ Yes ☐ No	ຄຳປຸ່ນ
2	ທ. ຄຳເຫຼັກ ລາດຊູລິນ		ຊ	ປ/ຊ	ຫ້ວຍຄໍ້	0304583967		☑ Yes ☐ No	ຄຳເຫຼັກ
3	ທ. ລົມ ພັນພັນທະດີ		ຊ	ປ/ຊ	ຫ້ວຍຄໍ້	02095703778		☑ Yes ☐ No	ລົມ
4	ທ. ຈານ		ຊ	ປ/ຊ	ຫ/ຄ			☑ Yes ☐ No	ຈານ
5	ທ ນວັຍ	ແສງທະວົງ	ຊ	ນາຍບ້ານ	ຫ/ຄ	95695220		☑ Yes ☐ No	[illegible]
6	ນ ແດງ		ຊ	[illegible]	ຫ/ຄ	0309486624		☑ Yes ☐ No	ແດງ
7	ນ ຄົງ ໄຊຍະວົງ		ຍ	ປ/ຊ	ຫ/ຄ			☑ Yes ☐ No	ຄົງ
8	ນ ເຕັ້ [illegible]		ຍ	ປ/ຊ	ຫ/ຄ			☑ Yes ☐ No	ເຕັ້
9	ນ ລີ [illegible]		ຍ	ປ/ຊ	ຫ/ຄ			☑ Yes ☐ No	ລີ
10	ນ ເພັງ [illegible]		ຍ	[illegible]	ຫ/ຄ	02099523029		☑ Yes ☐ No	ເພັງ
11	ທ. [illegible]		ຊ	[illegible]	ຫ/ຄ	02096498368		☑ Yes ☐ No	[illegible]

Page 1 of 6, Registration Form

5.3.2024 ບ. ຫ້ວຍຄໍ້ 2.
ມ. ເຊໂປນ

Registration Form

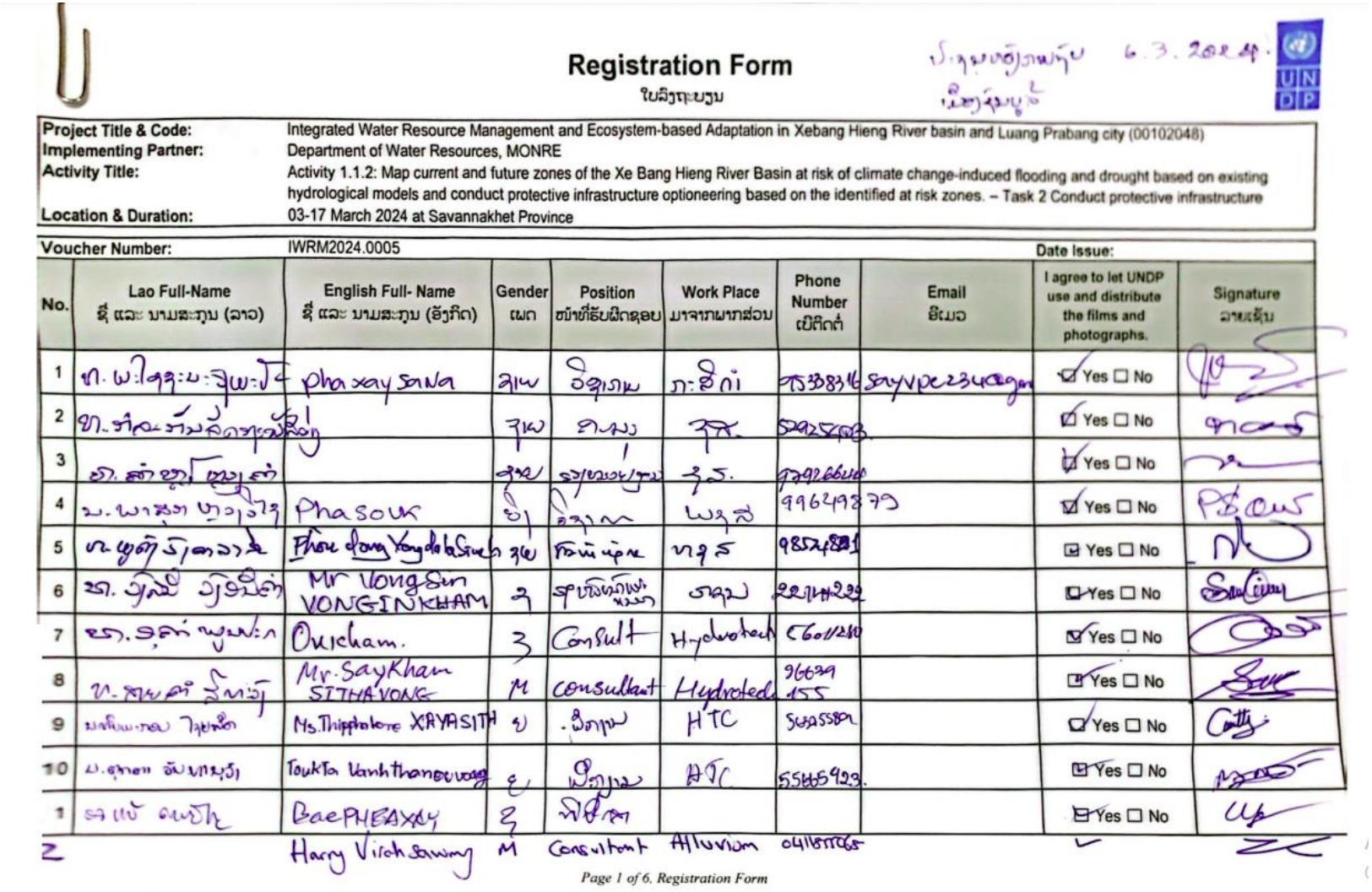
ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. – Task 2 Conduct protective infrastructure
Location & Duration:	03-17 March 2024 at Savannakhet Province
Voucher Number:	IWRM2024.0005
Date Issue:	

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	ນ ຕ່ອຍ ແສງເກະລິງສາ		ຍ	ປຸງ	ຫ້ວຍຄໍ້			☑ Yes ☐ No	ຕ່ອຍ.
2	ນ. ຕົ້ມ ແສງເກະລິງສາ		ຍ	ປຸງ	ຫ້ວຍຄໍ້	92289635		☑ Yes ☐ No	ຕົ້ມ.
3	ນ ແສງ ພະສີະຫັດ		ຍ	ປຸງ	ຫ້ວຍຄໍ້	96754420		☑ Yes ☐ No	ແສງ
4	ນ ເພີ່ອນ ພົມຫັດ		ຍ	ປຸງ	ຫ້ວຍຄໍ້	49932068		☑ Yes ☐ No	ເພີອນ
5	ນ ສົມພ່ານ ລາດສະພວນ		ຍ	ປຸງ	ຫ້ວຍຄໍ້			☑ Yes ☐ No	ສົມພ່ານ
6	ທ. ເລັງ ຈອມພະເຣີງ		ຊ	ປຸງ	ເທດ.	96343862		☑ Yes ☐ No	ເລັງ.
7								☐ Yes ☐ No	
8								☐ Yes ☐ No	
9								☐ Yes ☐ No	
10								☐ Yes ☐ No	
11								☐ Yes ☐ No	

Page 1 of 6, Registration Form

Mueanghong village



Registration Form

ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. – Task 2 Conduct protective infrastructure
Location & Duration:	03-17 March 2024 at Savannakhet Province

Voucher Number: IWRM2024.0005 **Date Issue:**

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1								☑ Yes ☐ No	
2								☑ Yes ☐ No	
3								☑ Yes ☐ No	
4		Phasouk						☑ Yes ☐ No	
5								☑ Yes ☐ No	
6		Mr Vongsin VONGSINKHAM						☑ Yes ☐ No	
7		Oulcham.		Consult	Hydrotech			☑ Yes ☐ No	
8		Mr. SayKham SITHAVONG		consultant	Hydroteck	96639 155		☑ Yes ☐ No	
9		Ms.Thipphalone XAYASITH			HTC			☑ Yes ☐ No	
10		Toukta Vanthanouvong			HTC			☑ Yes ☐ No	
1		BaePHEAXAY						☑ Yes ☐ No	
2		Harry Virak Sawmy	M	Consultant	Alluvium				

Page 1 of 6. Registration Form

Registration Form

ໃບລົງທະບຽນ

6. 3. 2024

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. – Task 2 Conduct protective infrastructure
Location & Duration:	03-17 March 2024 at Savannakhet Province

Voucher Number: IWRM2024.0005 Date Issue:

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1								☑ Yes ☐ No	
2								☑ Yes ☐ No	
3								☑ Yes ☐ No	
4								☑ Yes ☐ No	
5								☑ Yes ☐ No	
6								☑ Yes ☐ No	
7								☑ Yes ☐ No	
8								☑ Yes ☐ No	
9								☑ Yes ☐ No	
10								☑ Yes ☐ No	
11								☑ Yes ☐ No	

Registration Form

ໃບລົງທະບຽນ

[illegible] 8.3.2024

...ect Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
...plementing Partner:	Department of Water Resources, MONRE
...ctivity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. – Task 2 Conduct protective infrastructure
Location & Duration:	03-17 March 2024 at Savannakhet Province

Voucher Number: IWRM2024.0005 **Date Issue:**

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	[illegible]		[illegible]	[illegible]	[illegible]			☑ Yes ☐ No	[illegible]
2	[illegible]		[illegible]	[illegible]	-//-			☑ Yes ☐ No	[illegible]
3	[illegible]		[illegible]	[illegible]	-//-			☑ Yes ☐ No	[illegible]
4	[illegible]		[illegible]	[illegible]	-//-			☑ Yes ☐ No	[illegible]
5	[illegible]		[illegible]	[illegible]	-//-			☑ Yes ☐ No	[illegible]
6	[illegible]		[illegible]	[illegible]	-//-			☑ Yes ☐ No	[illegible]
7								☐ Yes ☐ No	
8								☐ Yes ☐ No	
9								☐ Yes ☐ No	
10								☐ Yes ☐ No	
11								☐ Yes ☐ No	

Nonesavang village

Registration Form

ໃບລົງທະບຽນ

ບ. ໂພນສະຫວ່ າງ ມ. ຫຼວງພຣະ.
6. 3. 2024.

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	09/03/2024 with Champhone

Voucher Number: IWRM2024.0005 Date Issue: 09-Mar-24

No.	Lao Full-Name ຊື ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1								☑ Yes ☐ No	
2								☑ Yes ☐ No	
3								☑ Yes ☐ No	
4								☑ Yes ☐ No	
5						3093576998.		☐ Yes ☐ No	
6								☑ Yes ☐ No	
7								☑ Yes ☐ No	
8								☑ Yes ☐ No	
9								☐ Yes ☐ No	

[illegible] 21 / 6.3.2024.

cher Number: IWRM2024.0005 **Date Issue:** 09-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	ນ. ດີ		ຍ.	ປ/ກ	[illegible]			☑ Yes ☐ No	[illegible]
11	ນ. [illegible]		ຍ.	ປ/ກ	-"-	02094134650		☑ Yes ☐ No	[illegible]
12	ນ. [illegible]		ຍ	ປ/ກ	-"-			☑ Yes ☐ No	[illegible]
13								☐ Yes ☐ No	
14								☐ Yes ☐ No	
15								☐ Yes ☐ No	
16								☐ Yes ☐ No	
17								☐ Yes ☐ No	
18								☐ Yes ☐ No	
19								☐ Yes ☐ No	
20								☐ Yes ☐ No	
21								☐ Yes ☐ No	
22								☐ Yes ☐ No	

Nachanyai village

[illegible] 2.3.2024-

	IWRM2024.0005							Date Issue:	09-Mar-24
	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	**English Full- Name** ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	**Gender** ເພດ	**Position** ໜ້າທີ່ຮັບຜິດຊອບ	**Work Place** ມາຈາກພາກສ່ວນ	**Phone Number** ເບີໂທ	**Email** ອີເມວ	**I agree to let UNDP use and distribute the films and photographs.**	**Signature** ລາຍເຊັນ
23	[illegible]		ຍ	ປ/ຊ	ນາຈານໃຫຍ່	020 97 42 6997		☑ Yes ☐ No	[illegible]
24	[illegible]		ຍ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
25	[illegible]	[illegible]	ຊ	[illegible]	—"—		02098653663	☑ Yes ☐ No	[illegible]
26	[illegible]	[illegible]	ຊ	[illegible]	—"—		02099529744	☑ Yes ☐ No	[illegible]
27	[illegible]	[illegible]	ຊ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
28	[illegible]		ຊ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
29	[illegible]		ຊ	ປ/ຊ	—"—	02097224977		☑ Yes ☐ No	[illegible]
30	[illegible]		ຊ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
31	[illegible]		ຊ	[illegible]	—"—			☑ Yes ☐ No	[illegible]
32	[illegible]		ຍ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
33	[illegible]		ຍ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
34	[illegible]		ຍ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]
35	[illegible]		ຍ	ປ/ຊ	—"—			☑ Yes ☐ No	[illegible]

Registration Form

ใบลงทะเบียน

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	04/03/2024 with Songkhone

Voucher Number: IWRM2024.0005 Date Issue: 04-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ຕໍາແໜ່ງໜ້າທີ່	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1								☑ Yes ☐ No	
2								☑ Yes ☐ No	
3								☑ Yes ☐ No	
4								☑ Yes ☐ No	
5								☑ Yes ☐ No	
6								☑ Yes ☐ No	
7								☐ Yes ☐ No	
8								☐ Yes ☐ No	
9								☐ Yes ☐ No	

Donmeuang village

[illegible]

Voucher Number:	IWRM2024.0005							Date Issue:	04-Mar-24
No.	**Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)**	**English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)**	**Gender ເພດ**	**Position ໜ້າທີ່ຮັບຜິດຊອບ**	**Work Place ບາຈານພາກສ່ວນ**	**Phone Number ເບີໂທ**	**Email ອີເມວ**	**I agree to let UNDP use and distribute the films and photographs.**	**Signature ລາຍເຊັນ**
23	[illegible]	Mr VONGSIN VONGINKHAM	ຊ	[illegible]	[illegible]	22144222		☑ Yes ☐ No	[signature]
24	[illegible]	Phasouk	ຍ	[illegible]	[illegible]	99649879		☑ Yes ☐ No	[signature]
25	[illegible]	Mr. Sengaloun Vongkham	M	[illegible]	Hydrodev	5628 7382	[illegible]	☑ Yes ☐ No	[signature]
26	[illegible]	Bac PHEAXAY	M	Consultant	HTC	2880566	—	☑ Yes ☐ No	[signature]
27		Harry Virabsaung	M	Consultant	[illegible]	04 11855 068	—	☑ Yes ☐ No	[signature]
28	[illegible]	Oukham	M	Consult	HTC	76011210	—	☑ Yes ☐ No	[signature]
29	[illegible]	Thipphakone XAYASITH	ຍ	[illegible]	HTC	56377589		☑ Yes ☐ No	[signature]
30	[illegible]	Phongsalisao sithiengtham	M	Coordinator	IWRM Project	91557494		☑ Yes ☐ No	[signature]
31	[illegible]	[illegible]	ຍ	[illegible]	HTC	55665993		☑ Yes ☐ No	[signature]
32	[illegible]		ຍ	[illegible]	[illegible]	22011927		☐ Yes ☐ No	[signature]
33	[illegible]	Mr Khonesavanh	ຊ	[illegible]	[illegible]	5506[illegible]		☑ Yes ☐ No	[signature]
34								☐ Yes ☐ No	
35								☐ Yes ☐ No	

ບ. ດົງເມືອງ . [illegible] 7. 3. 2024

...mber:	IWRM2024.0005						Date Issue:	04-Mar-24
Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	**English Full- Name** ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	**Gender** ເພດ	**Position** ໜ້າທີ່ຮັບຜິດຊອບ	**Work Place** ບ່ອນເຮັດວຽກ	**Phone Number** ເບີໂທ	**Email** ອີເມວ	**I agree to let UNDP use and distribute the films and photographs.**	**Signature** ລາຍເຊັນ
10 ທ. [illegible]	[illegible]	ຊ	[illegible]	ດົງເມືອງ.		[illegible]	☑ Yes ☐ No	[illegible]
11 ທ. [illegible]		ຊ	[illegible]	ດົງເມືອງ	02091[illegible]		☑ Yes ☐ No	[illegible]
12 ທ. [illegible]		[illegible]	ຮອງບ້ານ	—〃—	02098[illegible]329.		☑ Yes ☐ No	[illegible]
13 ທ. [illegible]		ຊ	ແນວໂຮມ	—〃—	0		☑ Yes ☐ No	[illegible]
14 ທ. [illegible]		ຊ	ຮອງບ້ານ	—〃—	0209[illegible]35.		☑ Yes ☐ No	[illegible]
15 ທ. [illegible]		ຊ	ປ/ກ	—〃—	02055[illegible]008		☑ Yes ☐ No	[illegible]
16 ທ. [illegible]		ຊ	[illegible]	—〃—	020 9[illegible]96.		☑ Yes ☐ No	[illegible]
17 ທ. [illegible]		ຊ	ແນວໂຮມ	—〃—	4193[illegible]05		☑ Yes ☐ No	[illegible]
18							☐ Yes ☐ No	
19							☐ Yes ☐ No	
20							☐ Yes ☐ No	
21							☐ Yes ☐ No	
22							☐ Yes ☐ No	

Piaxa village

Registration Form

ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	04/03/2024 at SVK PONRE

Voucher Number: IWRM2024.0005 **Date Issue:** 04-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1								☑ Yes ☐ No	
2								☑ Yes ☐ No	
3								☑ Yes ☐ No	
4								☑ Yes ☐ No	
5								☐ Yes ☐ No	
6								☑ Yes ☐ No	
7								☑ Yes ☐ No	
8								☑ Yes ☐ No	
9								☑ Yes ☐ No	

2 ບ້ານ ເພັຍກ່າ ມ ... 4. 3. 2024

IWRM2024.0005								Date Issue:	04-Mar-24
	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	ນ. ຄານ ສຸພັນທະວົງ		ຍ.	ປ/ກ	ເພັຍກ່າ			☑ Yes ☐ No	ຄານ
11	ນ. ແພງ ສີພັນທະວົງ		ຍ	ປ/ກ	-"-			☑ Yes ☐ No	ແພງ
12	ທ. ຄູຄຳ ສີວິໄລ		ຊ	...	ເພຍກ່າ	02054508705		☑ Yes ☐ No	ຄູຄຳ
13	ທ. ສຸລິພົນ ສຸບວົງ.		ຊ.	ປ/ກ	-"-			☑ Yes ☐ No	ສຸລິພົນ
14	ທ. ສົມລິດ		ຊ	ໝໍໂຮມ	-"-			☑ Yes ☐ No	ສົມລິດ
15	ທ. ແຫຼ້		ຊ.	ປ/ກ	-"-			☑ Yes ☐ No	ແຫຼ້
16	ທ. ວິລຸດ		ຊ	ປ/ກ	-"-			☑ Yes ☐ No	ວິລຸດ
17	ທ. ມົນ.		ຊ	ປ/ກ.	-"-			☑ Yes ☐ No	ມົນ
18	ທ. ລີ.		ຊ	ປ/ກ	-"-			☑ Yes ☐ No	ລີ
19	ທ. ບຸນມີ.		ຊ	ປ/ກ.	-"-			☑ Yes ☐ No	ບຸນມີ
20	ທ. ຄຳສະຫວາງ		ຊ	ປ/ກ.	-"-			☑ Yes ☐ No	ຄຳສະຫວາງ.
21	ທ. ລີດ.		ຊ	ປ/ກ	-"-			☑ Yes ☐ No	ລີດ
22	ທ. ຂວໍ.		ຊ	ປ/ກ.	-"-			☑ Yes ☐ No	ຂວໍ

3 . ບ. ແພນທ່ . ມ. [illegible] 9. 3. 2024

...ber:	IWRM2024.0005							Date Issue:	04-Mar-24
#	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
23	ທ. ແອ.		ຊ.	ນ/ຊ.	ແພນທ່.			☑ Yes ☐ No	ແອ.
24	ທ. [illegible]		ຊ	ນ/ຊ.	-"-			☑ Yes ☐ No	[illegible]
25	ທ. [illegible]		.		-"-			☑ Yes ☐ No	[illegible]
26	ທ. [illegible]		ຊ	[illegible]	-"-	030[illegible]831[illegible]46		☑ Yes ☐ No	[illegible]
27								☐ Yes ☐ No	
28								☐ Yes ☐ No	
29								☐ Yes ☐ No	
30								☐ Yes ☐ No	
31								☐ Yes ☐ No	
32								☐ Yes ☐ No	
33								☐ Yes ☐ No	
34								☐ Yes ☐ No	
35								☐ Yes ☐ No	

Sivilay village

ບ້ານສີວິໄລ ເມືອງສອງຄອນ 10.3.2024.

UNDP

Registration Form

ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	05/03/2024 with Songkhone

Voucher Number: IWRM2024.0005 — Date Issue: 05-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	[illegible]		[illegible]	[illegible]	[illegible]	96431259		☑ Yes ☐ No	[signature]
2	[illegible]		[illegible]	[illegible]	[illegible]	0308032119.		☑ Yes ☐ No	[signature]
3	[illegible]		[illegible]	[illegible]	[illegible]	030971564		☑ Yes ☐ No	[signature]
4	[illegible]		[illegible]	[illegible]	[illegible]	96478815		☑ Yes ☐ No	[signature]
5	[illegible]		[illegible]	[illegible]	—	02091150838		☑ Yes ☐ No	[signature]
6	[illegible]		[illegible]	[illegible]	—	97180502		☑ Yes ☐ No	[signature]
7	[illegible]		[illegible]	[illegible]	—	0307447744		☑ Yes ☐ No	[signature]
8	[illegible]		[illegible]	[illegible]	—			☑ Yes ☐ No	[signature]
9	[illegible]		[illegible]	[illegible]	—	02096265626		☑ Yes ☐ No	[signature]

2 ບ້ານ ສີວິໄລ [illegible] [illegible]

...er Number:	IWRM2024.0005							Date Issue:	05-Mar-24
No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	[illegible]		ຍິງ	[illegible]	ສີວິໄລ	95092771		☑ Yes ☐ No	[illegible]
11	[illegible]		ຍ.	[illegible]	—״—	9436 9153.		☑ Yes ☐ No	[illegible]
12	[illegible]		ຍ	[illegible]	—״—	0304631128.		☑ Yes ☐ No	[illegible]
13	[illegible]		ຍ	[illegible]	—״—			☑ Yes ☐ No	[illegible]
14	[illegible]		ຍ	[illegible]	—״—			☑ Yes ☐ No	[illegible]
15	[illegible]		ຍ	[illegible]	—״—			☑ Yes ☐ No	[illegible]
16								☐ Yes ☐ No	
17								☐ Yes ☐ No	
18								☐ Yes ☐ No	
19								☐ Yes ☐ No	
20								☐ Yes ☐ No	
21								☐ Yes ☐ No	
22								☐ Yes ☐ No	

Nongvilay village

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
Voucher Number:		IWRM2024.0005						Date Issue:	05-Mar-24
23	[illegible]	Souksun Ounphasengthong	ຍິງ	[illegible]	[illegible]	7675927		☑ Yes ☐ No	
24	[illegible]	Sakhone SAYASONE	ຊາຍ	[illegible]	[illegible]	91594976		☐ Yes ☐ No	
25	[illegible]	Mr Vongsin VONGINKHAM	ຊາຍ	[illegible]	[illegible]	[illegible]		☑ Yes ☐ No	
26	[illegible]	CHANTHACHOU	ຊາຍ	[illegible]	[illegible]	7954[illegible]		☑ Yes ☐ No	
27	[illegible]	Mr. SayKham SITHAVONG	M	consultant	Hydrotech	9663455		☑ Yes ☐ No	
28		Peter Hanington	M	CTA	UNDP	20[illegible]		☑ Yes ☐ No	
29		Harry Virahsawmy	M	Consultant	Alluvium	0411855[illegible]		☑ Yes ☐ No	
30	[illegible]	Bao PHEAKAY	M	Consultant	HTC	2880565		☑ Yes ☐ No	
31	[illegible]	Phasouk	W	[illegible]	[illegible]	99649879		☑ Yes ☐ No	P$aus
32	[illegible]	Sookh[illegible]	ຍ	[illegible]	HTC.	55659593		☑ Yes ☐ No	
33	[illegible]	Thipphatone XAYASIHT	ຍ	[illegible]	HTC	56345889		☑ Yes ☐ No	
34	[illegible]	Ouchan	ຊ	Consult	HTC	5601128[illegible]		☑ Yes ☐ No	
35	[illegible]	Sakham	ຊ	[illegible]	[illegible]	97955499		☐ Yes ☐ No	

ບ. [illegible] 11. 3. 2024

Registration Form

ໃບລົງທະບຽນ

Project Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
Implementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	06/03/2024 with Xonbouly

Voucher Number: IWRM2024.0005 **Date Issue:** 06-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	[illegible]	[illegible]	ຊ	[illegible]	[illegible]	030[illegible]3566		☑ Yes ☐ No	[illegible]
2	[illegible]	[illegible]	ຍ	[illegible]	-"-	55[illegible]4825		☑ Yes ☐ No	[illegible]
3	[illegible]		ຊ	[illegible]	-"-	94251185		☑ Yes ☐ No	[illegible]
4	[illegible]	[illegible]	ຊ	[illegible]	[illegible]	03040884870		☑ Yes ☐ No	[illegible]
5	[illegible]		ຍ.	[illegible]	-"-	030 9964784		☑ Yes ☐ No	[illegible]
6								☐ Yes ☐ No	
7								☐ Yes ☐ No	
8								☐ Yes ☐ No	
9								☐ Yes ☐ No	

Saveu village

ບ. ສະອື້ ເມືອງ ມຽງ. 12.3.2024 -

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	[illegible]		ຍ	ນາຍບ້ານ	ສະອື້	030 967 4848		☑ Yes ☐ No	[illegible]
11	[illegible]		ຍ	[illegible]	[illegible]	020 98460878		☑ Yes ☐ No	[illegible]
12	[illegible]		ຍ	[illegible]	ສະອື້	02024570786		☑ Yes ☐ No	[illegible]
13	[illegible]		ຍ	[illegible]	ສະອື້			☑ Yes ☐ No	[illegible]
14	[illegible]		ຍ	[illegible]	ສະອື້			☑ Yes ☐ No	[illegible]
15		Peter Harrington	M	CTA	UNDP			☑ Yes ☐ No	[signature]
16	[illegible]	Thipphakone XAYASITH	W	HTC	HTC	56375589		☑ Yes ☐ No	[signature]
17	ທ. ແສງ		ຍ	ປ/ກ	ສະອື້			☑ Yes ☐ No	ແສງ
18	[illegible]		ຍ	ປ/ກ	ສະອື້			☑ Yes ☐ No	[illegible]
19	[illegible]		ຍ	[illegible]	ສະອື້			☑ Yes ☐ No	[illegible]
20	[illegible]		ຍ	ປ/ກ	ສະອື້			☑ Yes ☐ No	[illegible]
21	[illegible]		ຍ	ປ/ກ	ສະອື້			☑ Yes ☐ No	[illegible]
22	[illegible]		ຍ	ປ/ກ	ສະອື້			☑ Yes ☐ No	[illegible]

Number: IWRM2024.0005 — Date Issue: 06-Mar-24

ບ. ຜະອື ເມືອງຊອງ 12.3.2024ປ.

nber:	IWRM2024.0005							Date Issue:	06-Mar-24
No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
23	ນ. ເປັດ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ເປັດ.
24	ນ. ແສງ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ແສ.
25	ນ. ຄຳຮຽນ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ຄຳຮຽນ
26	ນ. ຮີ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ຮີ.
27	ນ. ບົວພັນ		ຍ	ຫົວໜ້າແມ່ຍິງ	ຜະອື			☑ Yes ☐ No	ບົວພັນ
28	ນ. ລີ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ລີ
29	ນ. ແພັດ		ຍ	ປ/ກ	ຜະອື			☑ Yes ☐ No	ແພັດ.
30	ນ. ຍົ່ງ		ຍ	ປ/ກ	— " —			☑ Yes ☐ No	ຍົ່ງ.
31	ທ. ວິດ ໄຊຍະວົງ		ຊ	ຮອງນາຍບ້ານ	— " —	020 94808332.		☑ Yes ☐ No	ວິດ
32								☐ Yes ☐ No	
33								☐ Yes ☐ No	
34								☐ Yes ☐ No	
35								☐ Yes ☐ No	

ບ. [illegible] 13.3.2024.

Voucher Number:	IWRM2024.0005							Date Issue:	

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ ຮັບຜິດຊອບ	Work Place ມາຈາກ ພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
28	[illegible]		ຊ	[illegible]	[illegible]	030 01153 3713		☑ Yes ☐ No	[signature]
29	ທ. [illegible]		ຊ	[illegible]	[illegible]	030 4210892.		☑ Yes ☐ No	[signature]
30	ທ. [illegible]		ຊ	[illegible]	–/–	03096280584.		☑ Yes ☐ No	[signature]
31	ທ. [illegible]		ຊ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
32	ທ. [illegible]		ຊ	[illegible]	–/–			☑ Yes ☐ No	[signature]
33	ທ. [illegible]		ຊ	[illegible]	–/–			☑ Yes ☐ No	[signature]
34	ທ. [illegible]		ຊ	[illegible]	–/–			☑ Yes ☐ No	[signature]
35	ທ. [illegible]		ຊ	[illegible]	–/–	0304303147		☑ Yes ☐ No	[signature]
36	ທ. [illegible]		ຊ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
37	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
38	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
39	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
40	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
41	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
42	ນ. [illegible]		ຍ	ປ/ຊ	–/–			☑ Yes ☐ No	[signature]
43	ນ. [illegible]		ຍ	ປ/ຊ	–/–	02098621822		☑ Yes ☐ No	[signature]

Registration Form

ໃບລົງທະບຽນ

...ect Title & Code:	Integrated Water Resource Management and Ecosystem-based Adaptation in Xebang Hieng River basin and Luang Prabang city (00102048)
...mplementing Partner:	Department of Water Resources, MONRE
Activity Title:	Activity 1.1.2: Map current and future zones of the Xe Bang Hieng River Basin at risk of climate change-induced flooding and drought based on existing hydrological models and conduct protective infrastructure optioneering based on the identified at risk zones. -Task 2 Conduct optioneering
Location & Duration:	07/03/2024 with Xonbouly

Voucher Number: IWRM2024.0005 **Date Issue:** 07-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບ່ອນເຮັດວຽກ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
1	[illegible]		[illegible]	[illegible]	[illegible]			☑ Yes ☐ No	[signature]
2	[illegible]		[illegible]	[illegible]	—"—			☑ Yes ☐ No	[signature]
3	[illegible]		[illegible]	[illegible]	—"—			☑ Yes ☐ No	[signature]
4	[illegible]		[illegible]	[illegible]	—"—	030 9033996		☑ Yes ☐ No	[signature]
5	[illegible]		[illegible]	[illegible]	—"—			☑ Yes ☐ No	[signature]
6	[illegible]		[illegible]	[illegible]	—"—	030 49264 85		☑ Yes ☐ No	[signature]
7	[illegible]			[illegible]	[illegible]	020 96919393		☐ Yes ☐ No	[signature]
8	[illegible]		[illegible]	[illegible]	[illegible]	02058604779		☐ Yes ☐ No	[signature]
9								☐ Yes ☐ No	

Thamae

Voucher Number: IWRM2024.0005 Date Issue: 07-Mar-24

No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ຕໍາແໜ່ງຮັບຜິດຊອບ	Work Place ສາຖານທີ່ເຮັດວຽກ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	[illegible]	Mr Voug-Sim VONGSINKHAM	M	[illegible]	[illegible]	22141222		☑ Yes ☐ No	
11	[illegible]	Sukhone Sayasone	M	[illegible]	[illegible]	91594396		☑ Yes ☐ No	
12	[illegible]		M	[illegible]	[illegible]	54470103		☑ Yes ☐ No	
13	[illegible]	Phasouk	—	—	[illegible]	99649879		☑ Yes ☐ No	Phasouk
14	[illegible]	Mr. Saykham SITHAVONG	M	Consultant	Hydroteh	96[illegible]		☑ Yes ☐ No	
15		Harry Virah Sawmy	M	consultant	Alluvium	04[illegible]		☑ Yes ☐ No	
16	[illegible]	Ourham	M	Consultant	HTC	56[illegible]		☑ Yes ☐ No	
17	[illegible]	Sy noune	Male	[illegible]	[illegible]	99384555		☑ Yes ☐ No	
18	[illegible]	[illegible]	Male	[illegible]	[illegible]	92186230		☑ Yes ☐ No	
19	[illegible]	Bae PHEASAY	M	Consultant	HTC	2[illegible]		☑ Yes ☐ No	
20		Peter Hannigton	M	CTA	UNDP	20497[illegible]		☑ Yes ☐ No	
21	[illegible]	[illegible]	M	[illegible]	HTC	55[illegible]		☑ Yes ☐ No	
= ?								☐ Yes ☐ No	

WRM2024.0005 Date Issue: 09-Mar-24

	Full-Name ชื่อ นามสกุล (ลาว)	English Full- Name ชื่อ และ นามสกุล (อังกฤษ)	Gender เพศ	Position ตำแหน่งที่รับผิดชอบ	Work Place สถานที่ทำงาน	Phone Number เบอร์โทร	Email อีเมล	I agree to let UNDP use and distribute the films and photographs.	Signature ลายเซ็น
10			ช					☑ Yes ☐ No	
11			ญ					☑ Yes ☐ No	
12			ช					☑ Yes ☐ No	
13			ญ					☑ Yes ☐ No	
14			ช					☑ Yes ☐ No	
15								☐ Yes ☐ No	
16								☐ Yes ☐ No	
17								☐ Yes ☐ No	
18								☐ Yes ☐ No	
19								☐ Yes ☐ No	
20								☐ Yes ☐ No	
21								☐ Yes ☐ No	
22								☐ Yes ☐ No	

Kanghoupa village

[illegible] 14.3.2024

Voucher Number:	IWRM2024.0005						Date Issue:	07-Mar-24	
No.	Lao Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ບາຈາການພາກສ່ວນ	Phone Number ເບີຕິດຕໍ່	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
10	[illegible]	Mr Voung Sim VONGSINKHAM	[illegible]	[illegible]	[illegible]	22141222		☑ Yes ☐ No	
11	[illegible]	Sakhone Sayasone	[illegible]	[illegible]	[illegible]	91594396		☑ Yes ☐ No	
12	[illegible]		[illegible]	[illegible]	[illegible]	91470103		☑ Yes ☐ No	
13	[illegible]	Phasouk	-	-	[illegible]	99649879		☑ Yes ☐ No	
14	[illegible]	Mr. SayKham SITHAVONG	M	Consultant	Hydrotech	966[illegible]		☑ Yes ☐ No	
15		Harry Virah Sawmy	M	consultant	Alluvium	0418550[illegible]		☑ Yes ☐ No	
16	[illegible]	Oukham	M	Consultant	HTC	5601280		☑ Yes ☐ No	
17	[illegible]	Sy [illegible]	[illegible]	[illegible]	[illegible]	99384555		☑ Yes ☐ No	
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	92186270		☑ Yes ☐ No	
19	[illegible]	Bae PHEASAY	M	Consultant	HTC	2888665		☑ Yes ☐ No	
20		Peter Hanington	M	CTA	UNDP	2099799217		☑ Yes ☐ No	
21	[illegible]	[illegible] vanthanavong	[illegible]	[illegible]	HTC	5565993		☑ Yes ☐ No	
22								☐ Yes ☐ No	

ບ. ແກ້ງຫອປ. ມ. [illegible] 12.3.2024.

IWRM2024.0005

Date Issue: 07-Mar-24

	Full-Name ຊື່ ແລະ ນາມສະກຸນ (ລາວ)	English Full- Name ຊື່ ແລະ ນາມສະກຸນ (ອັງກິດ)	Gender ເພດ	Position ໜ້າທີ່ຮັບຜິດຊອບ	Work Place ມາຈາກພາກສ່ວນ	Phone Number ເບີໂທ	Email ອີເມວ	I agree to let UNDP use and distribute the films and photographs.	Signature ລາຍເຊັນ
23	ນ. ຄຳເບີດ		ຍ	ປຊກ	ແກ້ງຫອປາ			☑ Yes ☐ No	[illegible]
24	ນ. ເພຍ ແກ້ວບຸນເຮືອງ.		ຍ.	ຫົວໜ້າໂຮງໃຫຍ່	—"—			☑ Yes ☐ No	[illegible]
25	ນ. ຕາ-ອາ / ຫາດສະຫວັນ		ຍ	ປຊກ	—"—			☑ Yes ☐ No	[illegible]
26	ນ. ລະເອຍ ວົງວິຈານ		ຍ	ປຊກ	—"—			☑ Yes ☐ No	[illegible]
27	ນ. ແກ້ດ		ຍ	ປຊກ	—"—			☑ Yes ☐ No	[illegible]
28	ນ. ຄຳສອນ ແກ້ວບຸນເຮືອງ		ຍ	ປຊກ	—"—			☑ Yes ☐ No	[illegible]
29	ນ. ແກ້ງອ່ອນ		ຍ	ປຊກ	—"—			☑ Yes ☐ No	[illegible]
30	ທ. ແປງ ສີວິຈານ		ຊ	ປກສ	—"—	03045 38726.		☑ Yes ☐ No	
31	ທ. ບຸນ ຊູ ຈັນ	ສອນພຸດ	ຊ	ນາຍບ້ານ	—"—	030 6002188		☑ Yes ☐ No	[illegible]
32	ທ. ຄຳ ເມີ		ຊ		ກ້ຳເບີນ	0309640765		☐ Yes ☐ No	[illegible]
33								☐ Yes ☐ No	
34								☐ Yes ☐ No	
35								☐ Yes ☐ No	

Sopsalou village

ກອງປະຊຸມວິຊາການກ່ຽວກັບການເພີ່ມທະວີຄວາມທົນທານຕໍ່ສະພາບອາກາດ ໂດຍຜ່ານການຄຸ້ມຄອງອ່າງເກັບນ້ຳແບບເຊື່ອມສານ ແລະ ການປັບຕົວພື້ນຖານລະບົບນິເວດ

Technical support for enhancing climate resilience through Integrated Catchment Management and Ecosystem Based Adaptation

ວັນທີ/ເວລາ (Meeting date and time):

ສະຖານທີ່ປະຊຸມ (Meeting location):

ລຳດັບ No.	ຊື່ First name	ນາມສະກຸນ Last name	ພາກສ່ວນ Organisation	ໜ້າທີ່ຮັບຜິດຊອບ Role	ເພດ Gender	ລາຍເຊັນ Signature
1						
2						
3						
4						
5						
6						

ลำดับ No	ชื่อ First name	นามสะกุล Last name	ພາກສ່ວນ Organisation	ໜ້າທີ່ຮັບຜິດຊອບ Role	ເພດ Gender	ລາຍເຊັນ Signature
7						
8						
9						
10						
11						

9 Appendix C: List of infrastructure options

Village	Measure ID	Infrastructure option
Songkhone	3A	Megaphone (X1)
	3I	Motorboat (X1)
	3G	Groundwater well and toilet block at flood evacuation zone. Potential for permanent shelter for people and livestock.
	3B	Staff gauge (X1)
	1A	Riverbank stabilisation
	1B	Village ring levee
	4A+4J	Water supply to sustain natural wetland and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert and spillway)
Kangdone	3I	Motorboat (X1)
	3H	School building extension for flood shelter + school ring levee
	3E	Flood evacuation area site preparation and permanent shelter (next to school)
	3G	Community borewell at flood evacuation area (X1)
	3A	Megaphone (X1)
	1B	Village ring levee
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4J+4M	Water supply to sustain existing waterbody and beneficial uses (river water extraction solar pump, bank repairs, riparian vegetation, livestock offline storages, spillway with stop logs)
Houaykor	4C	Community borewells (X3)
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4M	Water supply to sustain existing waterbody and beneficial uses (solar pump to extract water from Houay Kai River, groundwater solar pump for top -up, offline livestock storages)
Mueanghong	3A	Megaphone (X1)
	3B	Repair staff gauge/hydrological station (X1)
	3I	Motorboat (X1)
	4C	Community borewell

Village	Measure ID	Infrastructure option
	4L	Household water filters
	4D	Household rainwater tanks and water filters
	4N	Demarcate springs and ponds
	4N	Demarcate spring forested catchment (25 ha)
Nonesavang	4C	Community borewells + distribution (X3) + rectify elevated storage
	4D	Household rainwater tanks and water filters
	4E	Groundwater recharge pits
	4A+4B+4I+4M	Water supply to sustain waterbody and beneficial uses (solar pump to extract water from local tributary, groundwater solar pump for top -up, offline livestock storages)
Nachanyai	3I	Motorboat (X1)
	3A	Megaphone (X1)
	3B	Staff gauge (X1)
	4L	Household water filters
	4C	Community borewells
	4D	Household rainwater tanks
	4A	Groundwater solar pump (next to existing pond) for pond top-up
	4N	Demarcate spring forested catchment areas
	4M	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (0.5 km)
Donmeuang	3A	Megaphone (X1)
	3B	Staff gauge (X1)
	1A	Riverbank stabilisation
	1B	Village ring levee
	3F	Flood pad
Piaxa	3B	Staff gauge (X1)
	1B	Village ring levee
	4L	Household water filters
	4H	Elevated 15 KL storage on piped water supply with pump
	4D	Household rainwater tanks

Village	Measure ID	Infrastructure option
	4A+4J	Water supply to sustain existing waterbody and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages)
	3F	Flood pad
Sivilay	3A	Megaphone (X1)
	3C	Flood warning signs (Houy Bak Reservoir)
	4C	Community borewells (X2)
	4D	Household rainwater tanks
	4L	Household water filters
	4A+4B+4I+4J+4M	Water supply to sustain existing waterbody (Pond A) and beneficial uses (groundwater extraction solar pump, sediment removal, riparian vegetation, livestock offline storages, culvert and spillway with stop logs)
	4A+4B+4I+4J+4M	Waterbody improvement works and water supply to sustain beneficial uses (Pond B)
Nongvilai	3A	Megaphone (X1)
	3B	Clean and repair slope gauge
	4M+4B	Riparian buffers (2 km in Reservoir A catchment + downstream) + Reservoir solar pump for small scale irrigation + repair spillway stoplogs
	4M+4B	Riparian buffers (Reservoir B catchment + downstream) + Reservoir solar pump for small scale irrigation
Saveu	4C	Community borewells (X2) + household water filters
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4J+4H	New community pond (Sanor Creek) + water supply to sustain pond beneficial uses
	4M	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (2.5km) + drinking water source in village
Tangalai Niua	4C	Community borewells (X2) + household water filters
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4J+4H	New community pond (in village) + water supply to sustain pond and beneficial uses (river water extraction solar pump, riparian vegetation, livestock offline storages, overflow swale)
	4A+4B+4I+4J+4H	New community pond (Houay Tabon River) + water supply to sustain pond beneficial uses
	4M	Riparian buffers along watercourses next to rice cultivation in drinking water supply catchments (1.5km)
	3I	Motorboat (X1)
	3A	Megaphone (X1)
	3B	Staff gauge (X1)
Thamae	3A	Megaphone (X1)

Village	Measure ID	Infrastructure option
	3B	Staff gauge (X1)
	3I	Motorboat (X1)
	4C	Community borewells (X2) + household water filters
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4J+4M	Water supply to sustain existing waterbody and beneficial uses (river water extraction solar pump, riparian vegetation, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert)
	4A+4B+4I+4J+4H	New community pond (Sa Nong Creek) and water supply to sustain beneficial uses
	4M	Riparian buffers along watercourses next to rice cultivation (1.5 km)
Kanghoupa	3I	Motorboat (X1)
	3B	Staff gauge (X1)
	4C	Community borewells (X2) + household water filters
	4D	Household rainwater tanks and water filters
	4A+4B+4I+4J+4H	New community pond (La Lek Creek) and water supply to sustain beneficial uses
	4M	Riparian buffers along watercourses/La Lek Creek (1.5 km)
Sopsalou	3A	Megaphone (X1)
	3B	Staff gauge (X1) - Existing cluster
	1A	Riverbank stabilisation - Focus zone (600m)
	4D	Household rainwater tanks and water filters
	4M	Riparian buffers along watercourses (2.5 km) in planned water supply catchment

10 Appendix D: Development of weightings through pairwise comparison for MCA criteria

Assign weighting to each criterion using "Pairwise" approach

The relative importance of a given criterion within the scope of the decision context.
Weights are used to develop a weighted score for each of the defined criteria.
Steps:

1. Enter criteria on the vertical and horizontal axis.
2. Compare criteria on the horizontal axis (HA) against criteria on the vertical axis (VA).
   0 = Numeral is less important than alphabet
   1 = Numerals equally as important as alphabet
   2 = Numeral is more important then alphabet
3. Calculate weightings and rank criteria.

Criteria		Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe	Total	Weighting (%)	Rank
		a	b	c	d	e	f	g	h	i			
Project fit	**1**	1	2	1	2	2	2	1	1	1	13	16.0%	1
Integration	**2**	0	1	1	0	0	0	0	1	1	4	4.9%	9
Stakeholder support	**3**	1	1	1	1	1	1	1	1	1	9	11.1%	3
Flood resilience	**4**	0	2	1	1	1	1	1	1	1	9	11.1%	3
Drought resilience	**5**	0	2	1	1	1	1	1	1	1	9	11.1%	3
Ecosystem resilience	**6**	0	2	1	1	1	1	1	1	1	9	11.1%	3
Risk of failure	**7**	1	2	1	1	1	1	1	1	1	10	12.3%	2
Capital cost	**8**	1	1	1	1	1	1	1	1	1	9	11.1%	3
Timeframe	**9**	1	1	1	1	1	1	1	1	1	9	11.1%	3

11 Appendix E: Unit cost assumptions

Item	Unit	Rate (USD)
Infrastructure for adapting to flooding (Adapt)		
Megaphone	1 Unit	$ 10,000
Staff gauge for flood alert and warning	1 Unit	$ 1,000
Signage post at flood prone areas	1 Unit	$ 50
New building or building renovation for flood emergency shelter	1 Unit	$ 20,000
Motorboat for evacuation	1 Unit	$ 5,000
Construction of flood pad for evacuation (5 m high)	1/2 ha	$ 250,000
Infrastructure for flood and erosion risk reduction (flood defence)		
Riverbank stabilisation along major river	Linear metre	$ 1,500
Village ring levee (<1m high) with side slope 1:2 and planting	Linear metre	$ 280
Village ring levee (<3m high) with side slope 1:2 and planting	Linear metre	$ 1,000
Village ring levee (<5m high) with side slope 1:2 and planting	Linear metre	$ 2,000
Infrastructure for securing water supply (quantity and quality) for drought risk reduction		
Supply		
Solar pump for extraction from river and distribution for large-scale water supply application	1 Unit	$ 100,000
Solar pump for extraction from river to fill waterbody	1 Unit	$ 25,000
Solar pump for extraction of groundwater (tube wells included) for small-scale water supply application	1 Unit	$ 18,000
Solar pump for extraction from surface water for small-scale water supply application	1 Unit	$ 12,000
Community groundwater well with elevated storage (5KL) and solar pump	1 Unit	$ 12,000
Community groundwater well with elevated storage and solar pump + distribution (e.g. to garden plots)	1 Unit	$ 15,000
Household rainwater tank with roof connection + household water filter	1 Unit	$ 600
Groundwater recharge pits	1 Unit	$ 500
Distribution		
Delivery pipe (small)	Linear metre	$ 25
Delivery pipe (large)	Linear metre	$ 67.87
Small water diversion structure infrastructure at river	1 Unit	$ 3,000
Large water offtake structure from waterbody	1 Unit	$ 19,965
Storage		
Excavation costs	Cubic metre	$ 3.5
Elevated above-ground tanks with connection to pipe water supply including pump	1 Unit (15 KL)	$ 15,000
Offline livestock storage	1 Unit	$ 500
Water quality		
Fencing	Linear metre	$ 2.40
Household water filter	1 Unit	$ 100
Riparian buffer (20 metre setback on both sides of first and second order watercourses)	Linear metre	$ 40
Demarcation		
Demarcation post	1 Unit every 50 metres	$ 25

12 Appendix F: Selected infrastructure investments recommended for funding and implementation

12.1 Songkhone district

				Criteria												
				Strategic fit			Climate resilience			Deliverability						
				Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe				
Village	District	Measure ID	Description	Score	Score	Score	Score	Score	Score	Score	Score	Score	Total score	Rank	Cost ($ USD)	Cumulative cost
Songkhone	Songkhone	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$10,000
Songkhone	Songkhone	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$15,000
Songkhone	Songkhone	3G	Groundwater well and toilet block at flood evacuation zone (X1). Potential for permanent shelter for people and livestock.	2	1	1	1	0	0	2	2	2	1.28	5	$12,000	$27,000
Songkhone	Songkhone	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$28,000
Songkhone	Songkhone	4A+4J	Water supply to sustain natural wetland and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert and spillway)	1	1	1	0	1	0	2	1	2	1.00	56	$33,000	$61,000
Kangdone	Songkhone	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$66,000
Kangdone	Songkhone	3E	Flood evacuation area site preparation and permanent shelter (next to school)	2	1	1	1	0	0	2	1	2	1.17	38	$25,000	$91,000
Kangdone	Songkhone	3G	Community borewell at flood evacuation area (X1)	2	1	1	1	0	0	2	1	2	1.17	38	$12,000	$103,000
Kangdone	Songkhone	4A+4B+4I +4J+4M	Water supply to sustain existing waterbody and beneficial uses (Bang Hieng river water extraction solar pump, bank repairs, riparian vegetation, livestock offline storages, spillway with stop logs, solar pump to support irrigation)	1	1	1	0	1	1	2	0	2	1.00	56	$85,468	$188,468
Houaykor	Songkhone	4C	Community borewells (X3)	1	1	1	0	2	0	2	1	2	1.11	40	$45,000	$233,468
Houaykor	Songkhone	4D	Household rainwater tanks and water filters (X 110 households)	1	1	1	0	2	0	2	0	2	1.00	56	$66,000	$299,468
Houaykor	Songkhone	4A+4B+4I +4M	Water supply to sustain existing waterbody and beneficial uses (solar pump to extract water from Houay Kai River, groundwater solar pump for top -up, offline livestock storages, solar pump to support irrigation)	1	1	1	0	1	0	2	1	2	1.00	56	$37,500	$336,968

12.2 Xonnabouly district

				Criteria												
				Strategic fit			Climate resilience			Deliverability						
				Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe				
Village	District	Measure ID	Description	Score	Score	Score	Score	Score	Score	Score	Score	Score	Total score	Rank	Cost ($ USD)	Cumulative cost
Mueanghong	Xonbouly	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$346,968
Mueanghong	Xonbouly	3B	Repair staff gauge/hydrological station (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$3,500	$350,468
Mueanghong	Xonbouly	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$355,468
Mueanghong	Xonbouly	4C	Community borewell (X1)	1	1	1	0	1	0	2	1	2	1.00	56	$15,000	$370,468
Mueanghong	Xonbouly	4L	Household water filters (X 378 households)	1	1	1	0	2	0	2	1	2	1.11	40	$37,800	$408,268
Mueanghong	Xonbouly	4N	Demarcate springs and ponds	1	1	1	0	1	1	2	2	2	1.22	36	$1,250	$409,518
Mueanghong	Xonbouly	4N	Demarcate spring forested catchment (25 ha)	2	1	1	0	1	1	2	2	2	1.40	2	$1,250	$410,768
Nonesavang	Xonbouly	4C	Community borewells (X3) + rectify elevated storage	1	1	1	0	1	0	2	1	2	1.00	56	$55,000	$465,768
Nonesavang	Xonbouly	4A+4B+4I +4M	Water supply to sustain waterbody (Pond B) and beneficial uses (solar pump to extract water from local tributary, groundwater solar pump for top -up, offline livestock storages, solar pump to support irrigation)	1	1	1	0	1	0	2	1	2	1.00	56	$37,500	$503,268
Nachanyai	Xonbouly	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$508,268
Nachanyai	Xonbouly	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$518,268
Nachanyai	Xonbouly	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$519,268
Nachanyai	Xonbouly	4L	Household water filters (X223 households)	1	1	1	0	2	0	2	1	2	1.11	40	$22,300	$541,568
Nachanyai	Xonbouly	4C	Community borewells (X3)	1	1	1	0	2	0	2	1	2	1.11	40	$45,000	$586,568
Nachanyai	Xonbouly	4A	Groundwater solar pump (next to existing pond) for pond top-up (X1)	1	1	1	0	1	0	2	2	2	1.11	40	$15,000	$601,568
Nachanyai	Xonbouly	4N	Demarcate spring forested catchment areas	2	1	1	0	1	1	2	2	2	1.40	2	$5,000	$606,568
Nachanyai	Xonbouly	4M	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (0.5 km)	2	1	1	0	1	2	2	2	2	1.51	1	$20,000	$626,568

12.3 Champone district

				Criteria												
				Strategic fit			Climate resilience			Deliverability						
				Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe				
Village	District	Measure ID	Description	Score	Score	Score	Score	Score	Score	Score	Score	Score	Total score	Rank	Cost ($ USD)	Cumulative cost
Donmeuang	Champone	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$636,568
Donmeuang	Champone	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$637,568
Piaxa	Champone	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$638,568
Piaxa	Champone	4L	Household water filters (X104 households)	1	1	1	1	2	0	2	2	2	1.33	4	$10,400	$648,968
Piaxa	Champone	4H	Elevated 15 KL storage on piped water supply with pump	1	1	1	0	1	0	2	2	2	1.11	39	$15,000	$663,968
Piaxa	Champone	4A+4J	Water supply to sustain existing waterbody and beneficial uses (groundwater extraction solar pump, sediment removal, small deep refuge pools for fish, livestock offline storages)	1	1	1	0	1	0	2	1	2	1.00	55	$33,900	$697,868
Sivilay	Champone	4C	Community borewells (X2)	1	1	1	0	2	0	2	1	2	1.11	39	$30,000	$727,868
Sivilay	Champone	4L	Household water filters (X280 households)	1	1	1	0	2	0	2	1	2	1.11	39	$28,000	$755,868
Sivilay	Champone	4A+4B+4I +4J+4M	Water supply to sustain existing waterbody (Pond A) and beneficial uses (groundwater extraction solar pump, sediment removal, riparian vegetation, livestock offline storages, culvert and spillway with stop logs)	1	1	1	0	1	0	2	1	2	1.00	55	$43,500	$799,368
Sivilay	Champone	4A+4B+4I +4J+4M	Waterbody improvement works and water supply to sustain beneficial uses (Pond B)	1	1	1	0	1	0	1	1	2	0.89	69	$55,500	$799,368

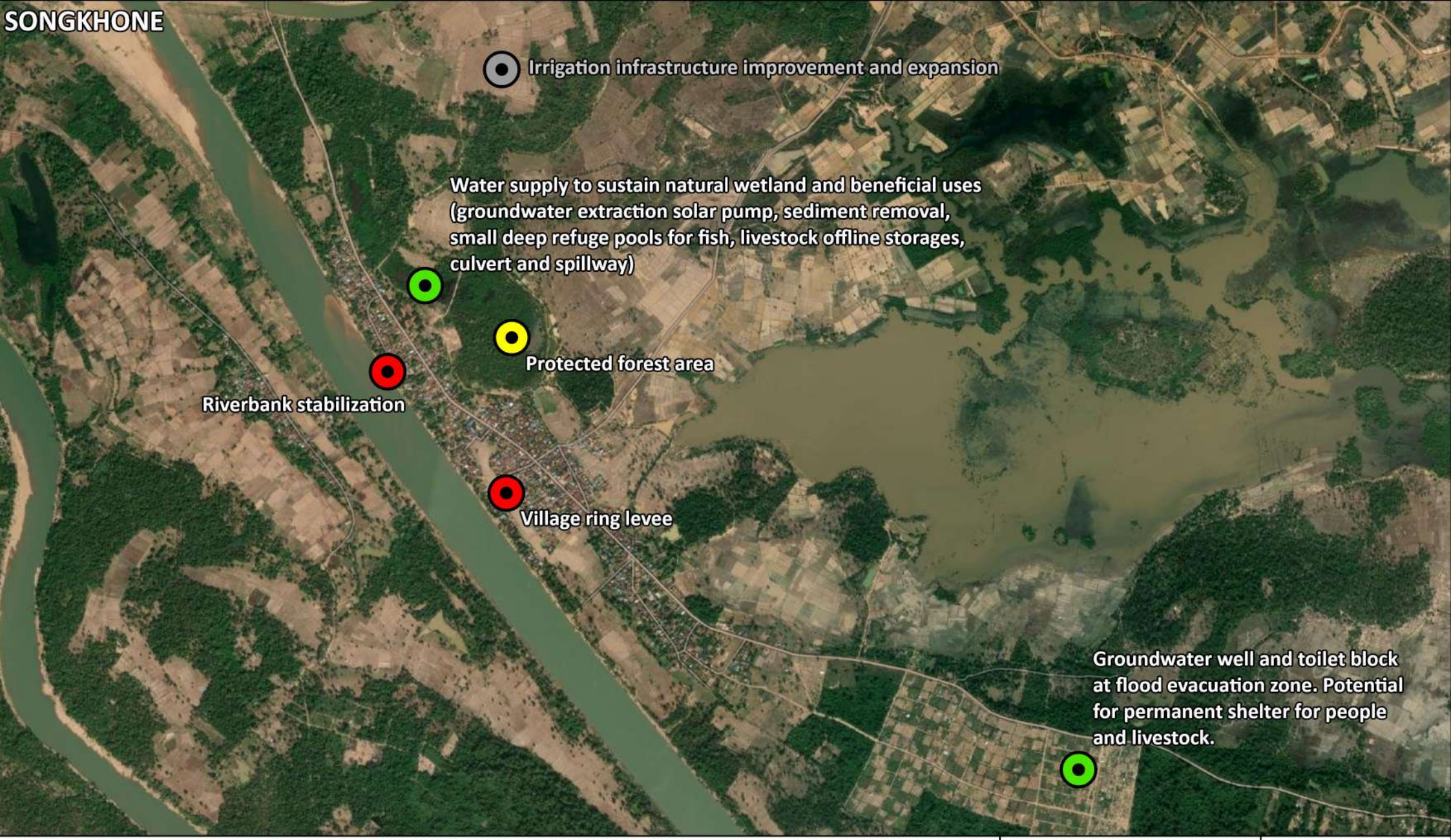
12.4 Nong district

				Criteria													
				Strategic fit			Climate resilience			Deliverability							
				Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe					
Village	District	Measure ID	Description	Score	Score	Score	Score	Score	Score	Score	Score	Score	Total score	Rank	Cost ($ USD)	Cumulative ($
Nongvilai	Nong	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$809,368
Nongvilay	Nong	4M+4B	Riparian buffers (2 km in Reservoir A catchment + downstream) + Reservoir solar pump for small scale irrigation + repair spillway stoplogs	2	1	1	0	1	2	2	0	2	1.28	5	$105,000	$914,368
Nongvilay	Nong	3B	Clean and repair slope gauge	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$924,368
Saveu	Nong	4C	Community borewells (X2)+ household water filters (X164 households)	1	1	1	0	2	0	2	1	2	1.11	39	$46,400	$970,768
Saveu	Nong	4M	Riparian buffers along watercourses next to cassava plantations in spring forested catchment areas (2.5km) + drinking water source in village	2	1	1	0	1	2	2	0	2	1.28	5	$100,000	$1,070,768
Tangalai Niua	Nong	4C	Community borewells (X2)+ household water filters (X95 households)	1	1	1	0	2	0	2	1	2	1.11	39	$39,500	$1,110,268
Tangalai Niua	Nong	4A+4B+4I +4J+4H	New community pond (in village) + water supply to sustain pond and beneficial uses (river water extraction solar pump, riparian vegetation, livestock offline storages, overflow swale, solar pump to support irrigation)	1	1	2	0	1	0	2	1	2	1.11	39	$58,500	$1,168,768
Tangalai Niua	Nong	4M	Riparian buffers along watercourses next to rice cultivation in drinking water supply catchments (1.5km)	2	1	1	0	1	1	1	1	2	1.17	36	$60,000	$1,228,768
Tangalai Niua	Nong	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$1,233,768
Tangalai Niua	Nong	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$1,243,768
Tangalai Niua	Nong	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$1,244,768

12.5 Sepone district

				Criteria											
				Strategic fit			Climate resilience			Deliverability					
				Project fit	Integration	Stakeholder support	Flood resilience	Drought resilience	Ecosystem resilience	Risk of failure	Capital cost	Timeframe			
Village	District	Measure ID	Description	Score	Score	Score	Score	Score	Score	Score	Score	Score	Total score	Rank	Cost ($ USD)	Cumulative ($
Thamae	Sepon	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$1,254,768
Thamae	Sepon	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$1,255,768
Thamae	Sepon	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$1,260,768
Thamae	Sepon	4C	Community borewells (X2)+ household water filters (X110 households)	1	1	1	0	2	0	2	1	2	1.11	39	$41,000	$1,301,768
Thamae	Sepon	4A+4B+4I +4J+4M	Water supply to sustain existing waterbody and beneficial uses (river water extraction solar pump, riparian vegetation, sediment removal, small deep refuge pools for fish, livestock offline storages, culvert, solar pump to support irrigation)	1	1	1	0	1	0	2	1	2	1.00	55	$61,250	$1,363,018
Kanghoupa	Sepon	3I	Motorboat (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$5,000	$1,368,018
Kanghoupa	Sepon	3B	Staff gauge (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$1,000	$1,369,018
Kanghoupa	Sepon	4C	Community borewells (X2)+ household water filters (X200 households)	1	1	1	0	2	0	2	1	2	1.11	39	$50,000	$1,419,018
Sopsalou	Sepon	3A	Megaphone (X1)	2	1	1	1	0	0	2	2	2	1.28	5	$10,000	$1,429,018
Sopsalou	Sepon	4D	Household rainwater tanks and water filters (X68 households)	1	1	1	0	2	0	2	1	2	1.11	39	$40,800	$1,469,818

13 Appendix G: Village infrastructure options maps



Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.2 0 0.2 0.5
Kms

alluvium

Legend

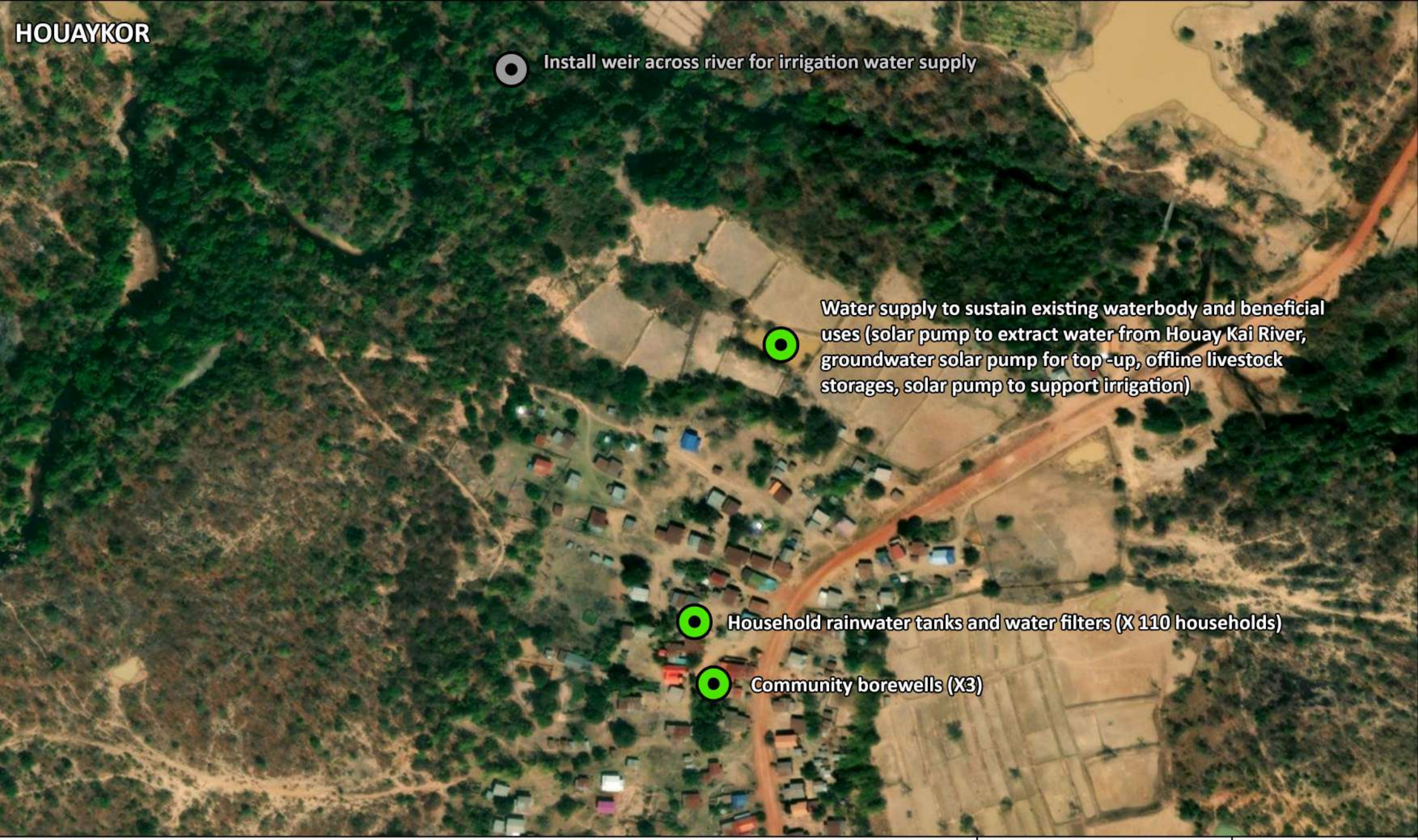
- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Motorboat

N

0.1 0 0.1 0.2
Kms

alluvium



Legend

- Higher ranked infrastructure investments recommended for implementation
- Infrastructure need identified by stakeholders not aligned with project objectives

N

0.1 0 0.1 0.1

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments

Megaphone
Repair staff gauge/hydrological station
Motorboat

N

0.1 0 0.1 0.1

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

Other recommended investments

Megaphone
Repair staff gauge/hydrological station
Motorboat

N

0.2 0 0.2 0.4

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

N

0.1 0 0.1 0.2

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

Higher ranked infrastructure investments recommended for implementation

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.1 0 0.1 0.3
Kms

alluvium

Legend

- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

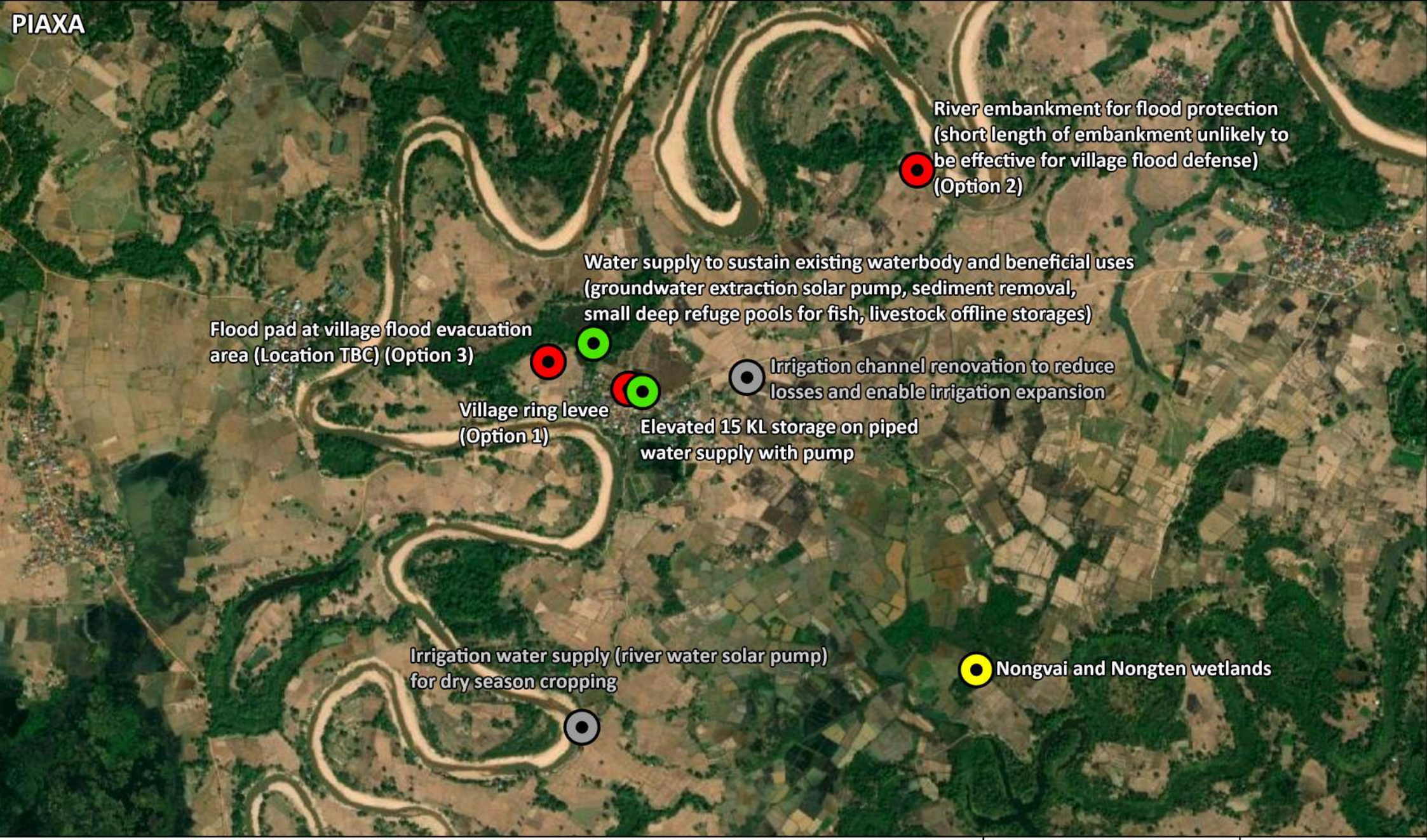
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone
Staff gauge

N

0.2 0 0.2 0.4
Kms

alluvium



Legend

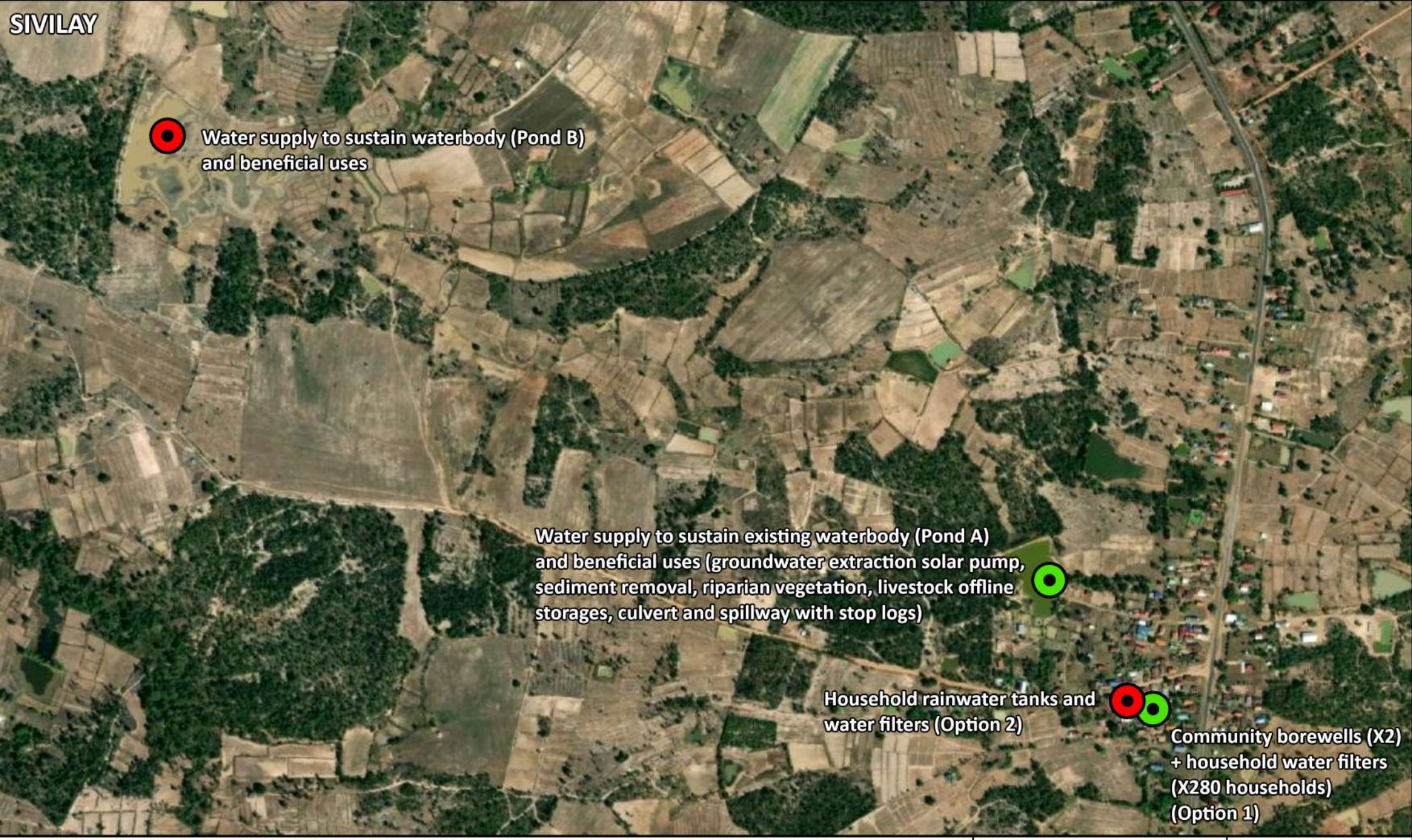
- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Staff gauge

N

0.2 0 0.2 0.5
Kms

alluvium



Legend

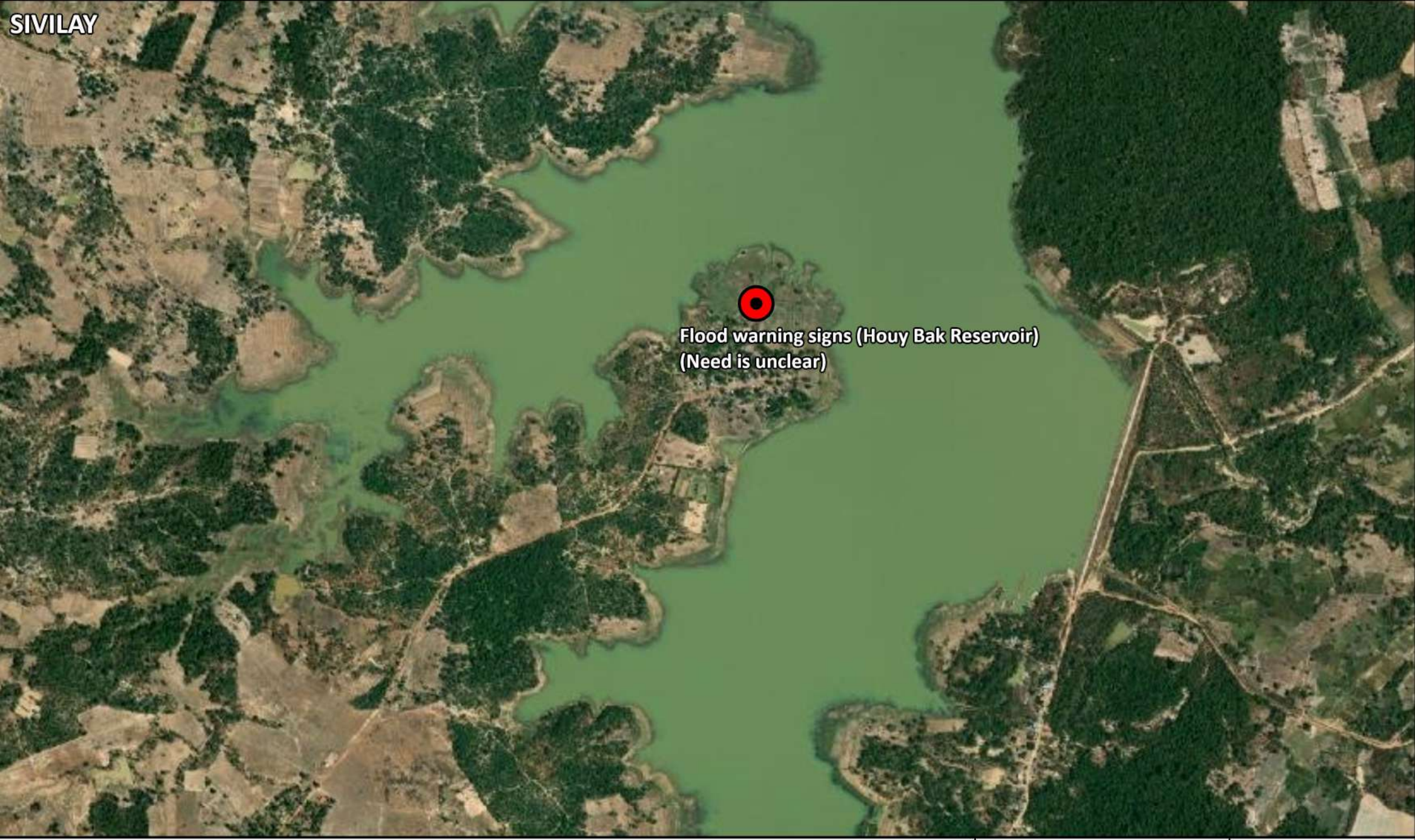
- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

N

0.1 0 0.1 0.3

Kms

alluvium



Legend

- Lower ranked infrastructure investments

N

0.2 0 0.2 0.4

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

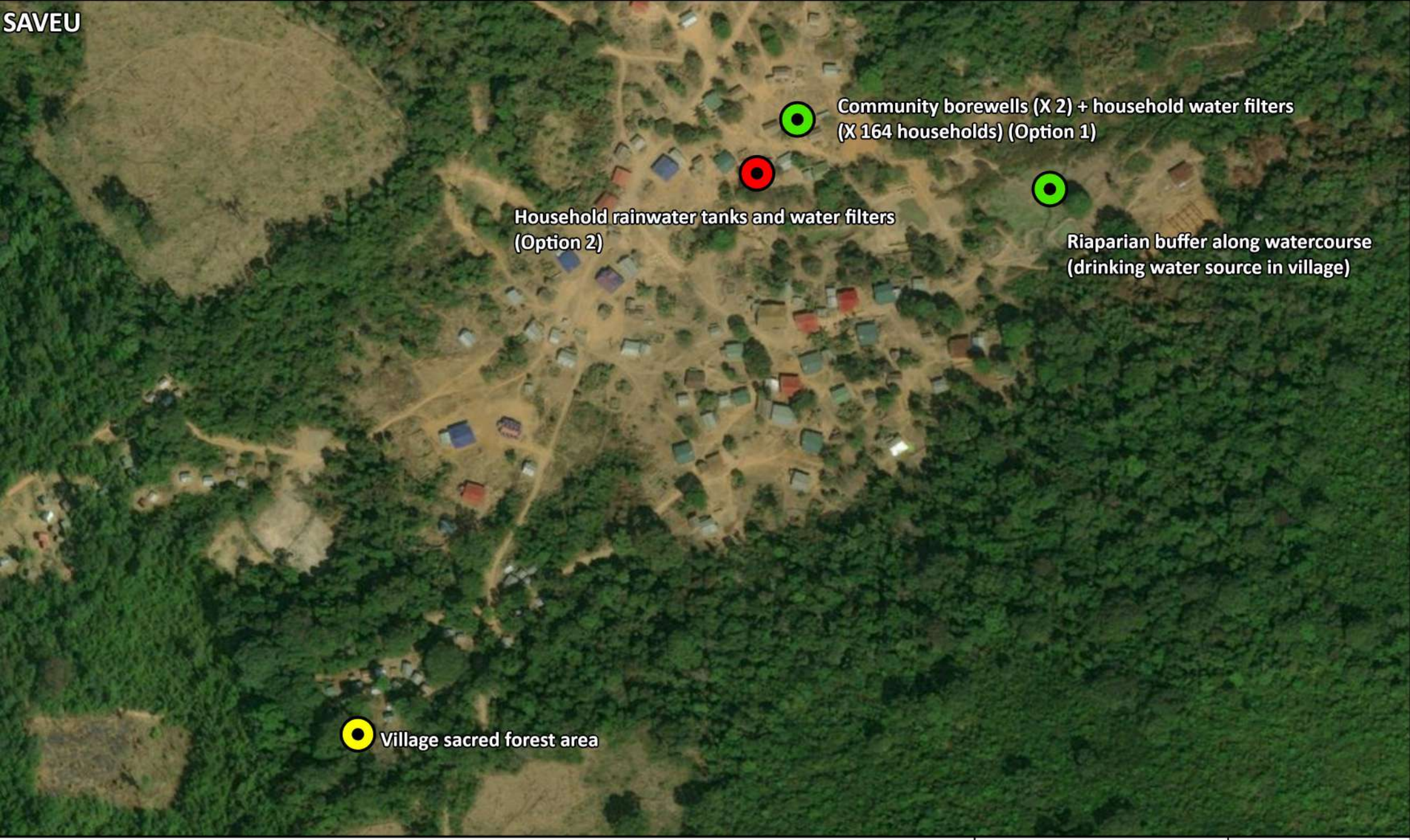
Other recommended investments
Megaphone

N

0.2 0 0.2 0.3

Kms

alluvium



Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

N

0 0 0 0.1

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Infrastructure need identified by stakeholders not aligned with project objectives

N

0.1 0 0.1 0.1

Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone Motorboat
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

Other recommended investments
Megaphone
Motorboat
Staff gauge

N

0 0 0 0.1
Kms

alluvium

Legend

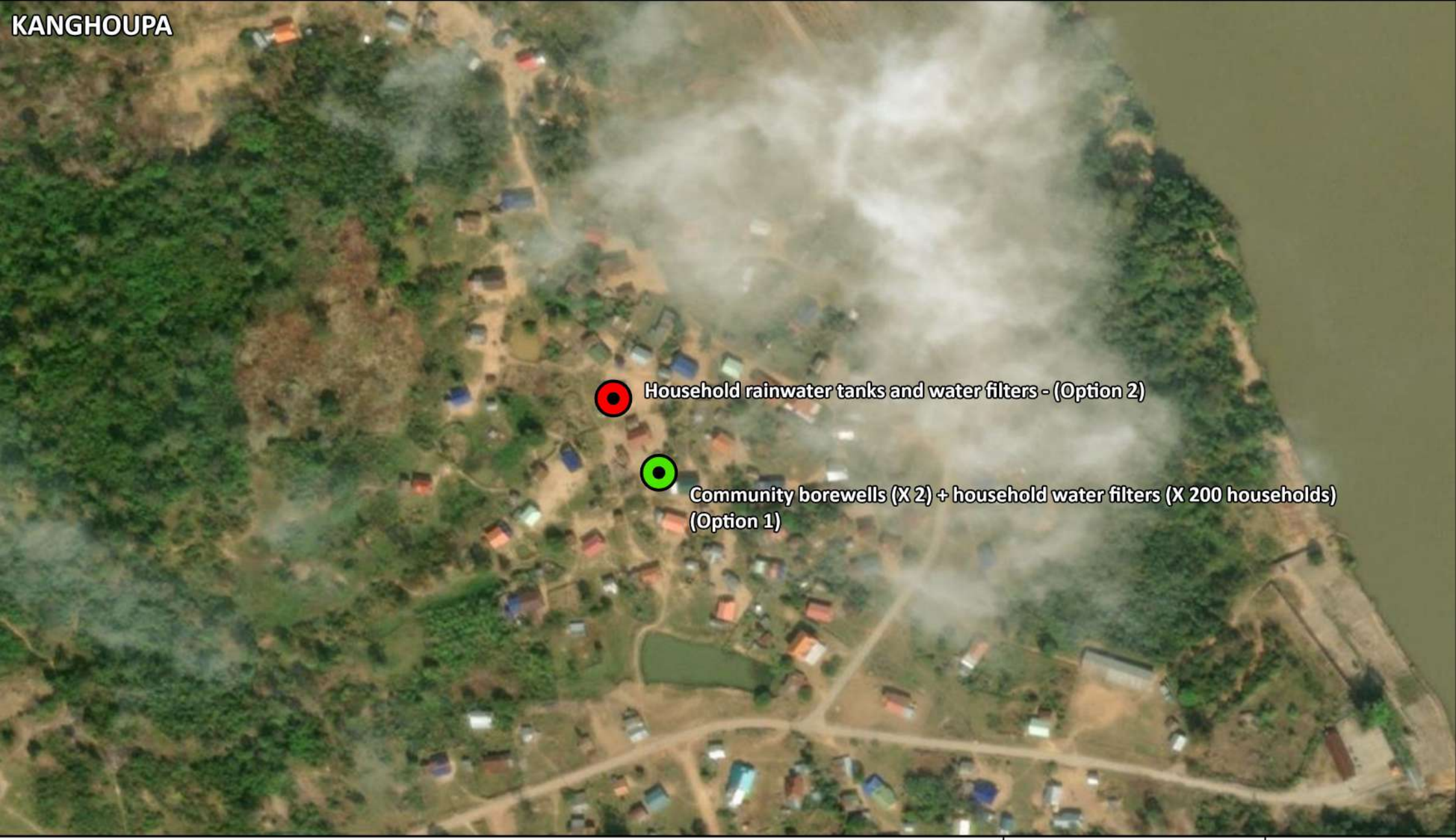
Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone
Motorboat
Staff gauge

N

0 0 0 0.1
Kms

alluvium



Legend

- Higher ranked infrastructure investments recommended for implementation
- Lower ranked infrastructure investments

Other recommended investments
Motorboat
Staff gauge

N

0 0 0 0.1
Kms

alluvium

Legend

- Lower ranked infrastructure investments
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Motorboat
Staff gauge

N

0.1 0 0.1 0.2
Kms

alluvium

Legend

- Higher ranked infrastructure investments recommended for implementation
- Infrastructure need identified by stakeholders not aligned with project objectives

Other recommended investments
Megaphone

N

0 0 0 0.1
Kms

alluvium

Legend

Lower ranked infrastructure investments

Other recommended investments
Megaphone

N

0.1 0 0.1 0.2
Kms

alluvium

IWRM-EbA Project

Project Management Unit

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IWRM-EbA Project

IWRM - EbA Project