Appendix 4: Summary of Findings from three Model Case Site (MCSs)

4.1 MCS-Fiji

Regional partnership for localization of NDC [Nationally Determined Contributions] through community led 'adaptation innovation hubs' in the Asia Pacific: Fiji Case Study

Patrick Nunn (Professor of Geography, University of the Sunshine Coast)

Roselyn Kumar (Research Assistant, University of the Sunshine Coast)

Lasarusa Cawanibuka (Research Assistant, University of the South Pacific)

Binaya Shivakoti (Senior Adaptation Specialist, Institute for Global Environmental Strategies) in consultation with

Ratu Sairusi Nagata (*Taukei Gusuituva*, Vusama Village)

Saula Nadokonivalu (Vusama Village)

and the **people of Tikina Malomalo**, Nadrogā District, Viti Levu Island, Fiji

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Context

Adaptation to climate change is commonly expressed at a nation level through Nationally Determined Contributions (NDCs), reported regularly to meetings of the United Nations Framework Convention on Climate Change (UNFCCC). In many developing countries in the Asia-Pacific region, most adaptation is place-specific (local) so there is a need to integrate such localised adaptation initiatives to make them able to be expressed as part of the regular reporting of NDCs. In addition, the inclusion of localised adaptation initiatives in NDC reporting underlines for local stakeholders the importance of their practices and their knowledges. This is based on the appreciation of the fact that local stakeholders are often pioneers in designing and utilising place-based adaptation solutions (Havukainen et al., 2022; Reiter et al., 2021).

Identifying and communicating local (place-anchored) initiatives for climate-change adaptation is often challenging, showing a need for a more consistent and coherent framework for the documentation of localised adaptation, its successes and failures. To this end, this project (part of a region-wide enterprise) sought to identify in the Republic of the Fiji Islands (southwest Pacific Ocean) an area in which locally-led adaptation was so widespread and apparently comparatively effective that it would be possible to isolate a hub of local adaptation innovation. Based on prior knowledge, it was felt that the Tikina Malomalo in the southwest part of Viti Levu island would be a suitable location for this, so this report summarises the nature and extent of local adaptation to climate-driven livelihood stressors in this area with the aim of strengthening local adaptation planning, implementation and governance to ensure inclusiveness, participation, transparency and better localization of NDCs.

The results below represent preliminary data and demonstrate that considerably more work of value to the overarching research questions could be obtained by deeper and more sustained engagement with the residents of Tikina Malomalo and similar districts within the Fiji Islands.

Geography of the study area

The Fiji Islands (Figure 1) are an island group in the southwest Pacific Ocean that has been occupied for more than three thousand years and today, like all other Pacific Island countries, is more exposed to climate changes than most other inhabited parts of the world. Similar climate changes affected Fiji and its peoples in the past and they developed a range of responses that allowed their continued occupation of these islands, giving a degree of resilience to Pacific Island societies that is often sidelined in contemporary discussions of vulnerability (Kelman, 2020; Nunn & Kumar, 2018).

Figure 1. The Fiji Islands showing the main inhabited islands and cities, together with the location of the study area (red box) named Tikina Malomalo.

The location of the study area (Tikina Malomalo) is shown in Figure 1 and given in more detail in Figure 2. Tikina Malomalo is home to about 2300 people (2023 estimate) scattered through the area from Togobula Village in the north to Naidiri Village in the southeast; it excludes people living along the sides of the highway (Queens Road) including those in the communities of Nabau and Semo. The main population clusters are in villages, including those of Batiri, Malomalo, Naidiri, Naveisabasaba, Nalele, Sanasana, Togobula and Vusama and in less- clustered farming communities such as Natadola. Vusama is the seat of *Taukei Gusuituva*, the paramount chief of the district, who is in support of this project.

A largely unsealed road network connects the population centres in the area, although a sealed road that services a group of hotels northwest of Sanasana was built a decade ago. Many roads are rendered impassable in heavy rain, leaving villages cut off for sometimes days at a time.
Horses are used for transport at such times. There is a bus service between Malomalo and the main highway twice daily except on Sundays.

The country is gently undulating, cut by a number of rivers, the largest of which is the Tuva which is tidal as far as Nabau and Semo. Large areas of mangrove forest cluster around the mouth of the Tuva. Most of the coastline (except where there is a lot of fresh water entering the sea) is fringed with coral reef; that southwest of Vusama is one of the widest continuous fringing reefs in Fiji and was the site of Fiji's earliest-known settlement (Bourewa), dating from about 3100 years ago (Nunn et al., 2004; Nunn & Petchey, 2013).

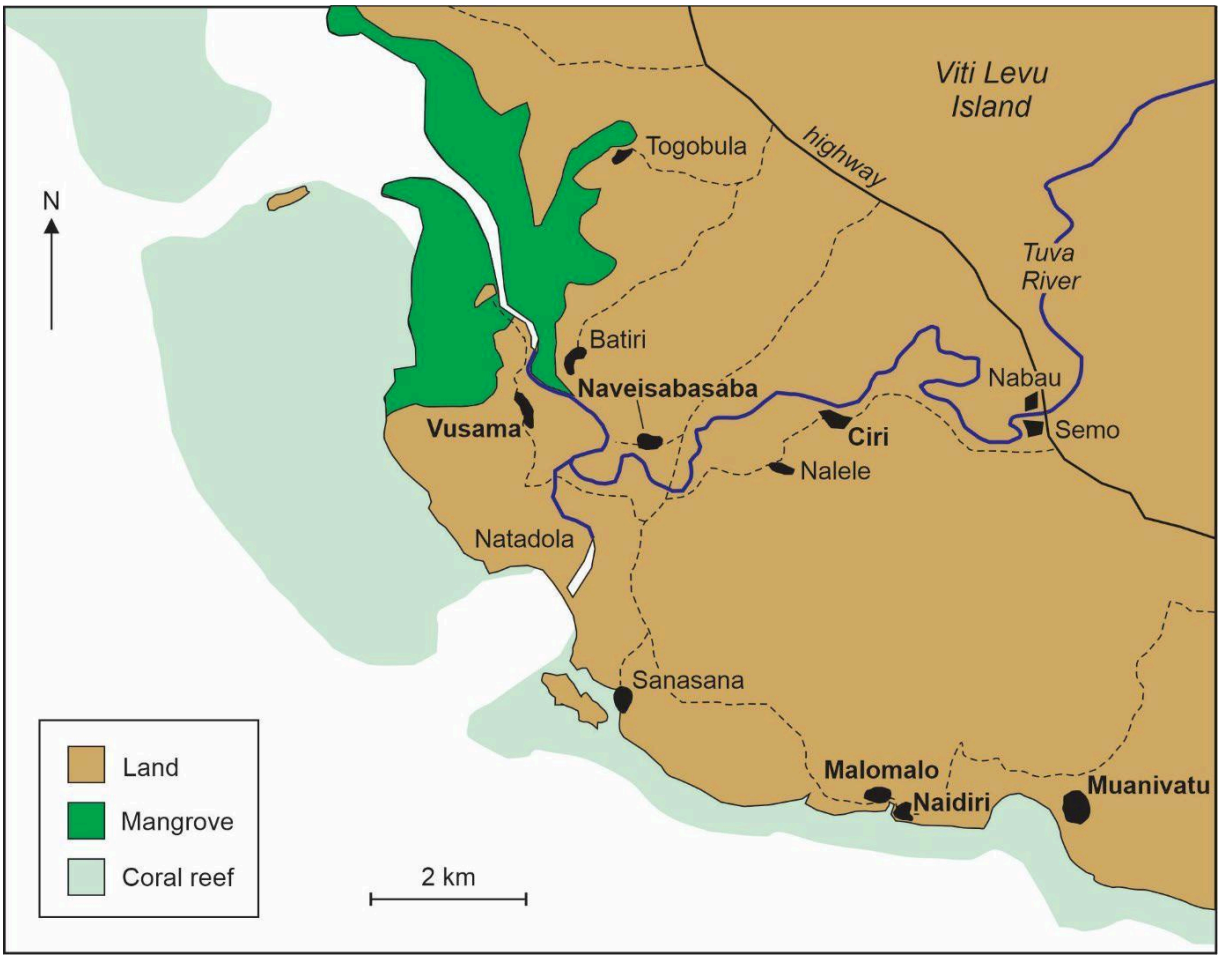

Figure 2. The Tikina Malomalo showing the nature of the environment, the river and road network and the principal population centres.

While some residents of Tikina Malomalo (especially in Sanasana) are employed in local hotels, most engage in subsistence-dominated livelihoods, acquiring most of the food they consume every day from local environments. Seafood plays a major role in people's diets, supplemented by foods obtained from mangroves (especially crustacea) and rivers. The land is generally fertile, supporting a range of crops for domestic consumption (especially cassava and taro and green leafy vegetables) as well as for sale (including sugar cane and specialized crops like tomatoes and eggplant). There is a sense of community within Tikina Malomalo that straddles ethnicity and language and religion. Most adults in the area speak 2-3 languages fluently.
Religions include Christianity, Islam and Hinduism. There are four primary schools and two secondary schools in the area. The closest hospital is in Sigatoka (see Figure 1), a 40-minute drive away.

Methods of study

The four village communities selected for the field project are Naidiri, Malomalo, Vusama, and Naveisabasaba while the two farming settlements are Ciri and Muanivatu. Naidiri, Malomalo and Muanivatu are coastal communities, whereas Vusama, Naveisabasaba, and Ciri are

located slightly inland along the Tuva river catchment area. The geographical landscapes of these

communities significantly influence their daily livelihood patterns. These communities depend on their land, river, and ocean resources to achieve positive livelihood outcomes.

As customary in rural Pacific Island contexts, in all communities we held talanoa sessions – equivalent to focus groups but more open-ended – that involved, commonly in separate sessions, consultations with community elders, women's group representatives, youth group representatives, and the community headman (*turaga-ni-koro* or equivalent) and other important figures in the community including religious leaders and education leaders. The informed consent of each community was acquired before consultation, as per ethics approval.

In addition, photographs were taken to document evidence of livelihood patterns, climate- related stressors, and specific coping strategies implemented by the communities. Field observations were also done to complement the consultation.

Climate risks and other livelihood vulnerabilities in Tikina Malomalo

Climate-driven risk is something that Fiji Island peoples have lived with ever since they came to occupy these islands more than three millennia ago. The two potentially most impactful risks are those posed to livelihood sustainability by tropical cyclones and by droughts. Tropical cyclones often destroy crops and buildings and infrastructure by strong winds and floods while droughts, commonly associated with El Niño events, will impact agriculture and water supply. Fiji peoples evolved many solutions for sustaining livelihoods in the face of such hazards, including the use of food preservation and 'cyclone foods' as well as knowledge of water sources, often in inland caves, that could be accessed in emergency. Other (non-climate) risks also affect the Fiji Islands, including earthquakes and tsunamis but the impacts of these are generally less than for climate risks.

The situation has changed markedly since the 1970s, plausibly as a result of climate change (Mycoo et al., 2022). Tropical cyclones have today become fewer yet their average strength has increased, resulting in more damage to livelihoods; Tropical Cyclone Winston (February-March 2016), which packed the strongest winds ever recorded in the southern hemisphere, tore a path through central Fiji (Nichols, 2019). And the coastline of Fiji has become subject to an accelerating rate of sea-level rise that is currently around 4-5 mm/year, above the global average of 3.2 mm/year (Becker et al., 2012). Sea-level rise is implicated in coastal land loss, groundwater salinisation, and increased frequencies and extents of coastal-lowland flooding (Nunn et al., 2020). Sea-level rise has also led to a number of community responses, commonly the construction of sea walls – a much-criticized solution (Nunn et al., 2021) – but also relocation upslope beyond the existing settlement (Piggott-McKellar et al., 2021).

Much of Tikina Malomalo is unusually dry, especially the Vusama-Natadola area, and because of the limestone bedrock there is little surface water. Drought conditions are therefore more usual and people have solutions (like use of water tanks and wells and river water) that can be called upon as needed. Tropical cyclones affect the area but, as most approach Fiji from the northwest, it is comparatively sheltered; local residents claim they are affected less frequently by tropical cyclones than was the case twenty years and more ago. Sea-level rise affects the coasts of Tikina Malomalo but where there is a fringing coral reef or a mangrove forest offshore, these act as physical protection against extreme wave damage, a comment that also applies to tsunami impacts. Sanasana Village has a well-designed sea wall while Naidiri has a small one. All other villages are (slightly) inland. An account of perceived climate risks in each of the six case-study communities follows.

1.1. Muanivatu

Extensive drought conditions greatly affect livestock and crop health. Therefore farmers have experienced a slight decline in farm production. The two main water sources are the well and rainwater harvesting tanks which normally dry up quickly due to high demand. The community does not have access to government water supply but it does have access to its piping system only. Children are the most affected by skin diseases and diarrhoea. There was no mention of any major health impacts on adults.

Residents continue to observe a constant rise in sea level. The major concern is the increasing threat of saltwater intrusion via ocean currents and strong winds. Residents are able to gauge the difference in sea level via natural markers. Coastal erosion and the continued deposition of sand inland provide sufficient evidence of the extensive and intensive wave action happening over time. According to the residents, coastal erosion occurs often nowadays due to the absence of coastal vegetation and trees that once existed and acted as barriers. Stormy weather exacerbates erosional processes, leading to coastal retreat over time. Figure 1 and 2 below depicts evidence of the shoreline (marked by the high-tide mark) retreating by approximately 15-20 m along the coast within the past 20-30 years.

Figure 3. Shoreline erosion at Muanivatu.

Flooding occurs from time to time and this includes both inland and coastal flooding. The wet months would bring prolonged days and weeks of heavy rainfall with strong winds that increase flooding. This leads to increased soil erosion, crop damage, and extensive coastal erosion.

Human induced stressors are a major concern for residents of Muanivatu as they directly experience their repercussions. Picnickers who frequently visit these areas tend to cut tree

branches for firewood to cook their meals. Sometimes, people do not put the fire out completely so dry conditions and strong winds would accelerate the spread of fire and burning of trees. Furthermore, an Australian investor who had purchased land along the coastal front had large portions of trees on his property removed. Both the extensive burning and cutting of trees have exposed the coastal environment to potential climate stressors.

Poor road accessibility is a major challenge for Muanivatu residents. There is only one main road access to the farming community. The road is not properly constructed and is not safe for use during heavy rainfall. If there is an emergency during bad weather, movement is a major challenge. This settlement is greatly disadvantaged especially during times when they needed Water Authority of Fiji (WAF) to cart water and it could not happen because of the poor road condition. Figure 3 shows the tramline which residents use nowadays. It is not safe but residents use it due to the condition of the existing road.

Figure 4. Tramline at Muanivatu is often used instead of the road which is often in a poor state of repair.

Water storage facilities in Muanivatu settlement include a well, water tanks, drums and large water containers. The well was constructed by the men but is not big enough to cater for the daily needs of all households. Water from the well is used to fill up the water tanks to which every household has access. The community allows only one family household to access water from the well each day. This has become a norm and the community has learned to conserve water, not waste it. Despite all the stress, there are no conflicts. The pictures below depict the different water storage methods used in the community.

Figure 5. Muanivatu water storage – rainwater tanks linked to roof catchment (left) and moveable storage drums linked opportunistically to roofs (right).

1.2. Malomalo

Extreme changes in the weather patterns significantly affects the natural environment, ecosystems and biodiversity in the Malomalo area. Livelihood opportunities are compromised, thus affecting livelihood outcomes. The villagers had to endure months of long sunshine hours, excessive heat, high humidity and lack of rainfall. Farmers are feeling the impact of climate change as soil fertility, crop health, and crop yield continues to decline due to the more frequent and prolonged drought conditions.

Impacts of sea-level rise and coastal erosion led to the permanent loss of a few graves and partial damage to others at the chiefly burial site known as the *Sautabu*. The figure below depicts the place where the graves used to be. Today, it is used as a road access into the village. The loss and damage to this heritage site caused emotional and psychological distress, particularly to the immediate families as memories, stories, and significant spiritual meanings are lost.

Figure 6. The Sautabu (chiefly burial site) at Malomalo.

To connect Malomalo to neighbouring Naidiri Village (see below), a bridge was previously constructed but was washed away three times due to sea-level rise and coastal erosion. The remaining structure still exists but has been washed downstream, as shown in Figure 7 (left). Today there is no bridge and no proper road, as evident in Figure 7 (right) below.

Figure 7. Left shows the remains of the bridge connecting Malomalo and Naidiri, washed downstream from its original location. Right shows the existing river crossing between Malomalo and Naidiri that proves impassable in bad weather and at times of flood.

Coastal flooding occurs especially during heavy rainfall, high tide and storm surges. Poor drainage exacerbates flooding particularly for homes located near the mouth of the estuary. The village chief who is also the head of the *tikina* of Malomalo resides in this part of the village.
Families affected and especially people with disability are evacuated at such times to the village hall while others remain in their homes. No casualties or deaths have ever occurred at times of flood. Water level normally reaches the doorsteps of these houses when flooding occurs.

Drought conditions affect the quality of pasture and water supply for the livestock. It also impacts crop production for those actively engaged in farming. Streams and other water sources usually dry up quickly and remain dry for long periods. Sections of streams with very low water level may accumulate high concentrations of pollutants that increase the risk of stagnation and multiplication of disease-carrying insects like mosquitoes.

Conflicts occur due to the absence of proper fences for cattle farms as this leads to extensive crop damage. This creates a lot of distress and anger for villagers whose farms are affected. Warnings are given to cattle farmers yet, if nothing is done, conflict occurs. Physical confrontation may occur at times before reconciliation. Fencing is too expensive to cover large areas of rugged terrain. Farmers prefer to give their livestock the freedom to move around for easy access to food and water sources.

Lifestyle changes are happening in most traditional Fijian villages like Malomalo. According to key participants, most village men (particularly the younger generation) seem to have lost interest in farming. The decline in farming activity has affected food supply for domestic use and for various traditional obligations. Customary practices have been altered such as when there is a death in a family, men from all households would once have provided a bag of cassava or *kumala* (sweet potato) as their contribution. Nowadays, rice (*palau*) has replaced the tradition

of root crops. This has caused shame to the village elders as the younger male generation fail to meet their family and traditional obligations to their family households and the village.

Declining stock of various fish species - namely *ta*, *sivisivi* and *kacika*[1] - and seafoods like *cawaki*, *nama* and *lumi*[2] - which used to be easily accessible before are now hardly seen. In the past, fishers could fish for these in the shallow waters. Nowadays, they have to go out to the reef edges and beyond. Most divers are no longer able to get a decent income and provide sufficient fish stock as before where they would feed their families for days and share with extended families as well. This creates psychological and emotional stress on these young men as they have very little option apart from fishing to sustain their families. The diminishing fish stock and low farming outputs affect food security. Therefore, most households depend on those who are working and/or the social welfare assistance for their daily livelihood outcomes. This leads to the increase in buying processed foods which causes unhealthy eating habits, hence, the increase in non-communicable diseases (NCDs).

Human-induced stressors such as poaching are said to be one of the major causes for the vast decline in fish stock. Excessive fishing occurs with the use of gas by poachers; one of the *talanoa* participants who is also a diver shared his experience of being out at the reef on a particular night when he came across poachers whom he said had come from as far away as the Yasawa Islands (>80 km). Furthermore, the consequences of logging activities over the past decades and all other uncontrolled and unsustainable deforestation activities and burning that occurred in the highlands have now taken effect on their coastal marine resources; sediment has been washed downstream and filled river channels, causing rivers to flood more easily than was once the case.

Water scarcity problems continue to be a concern despite the people of Malomalo having access to government sourced (piped) water supply. At times when the government water supply is disrupted, the whole village is affected as there is no other source of water for domestic use. The participants highlighted the need to repair the piping system to the old water source from the hills (pictured below) which both Naidiri and Malomalo villages once used. If a proper piping system was installed, neither village would have water problems, residents said.

Figure 8. The former inland water source used by Malomalo and Naidiri villages.

[1] *Ta* and *Sivisivi* are two names for the unicorn fish (*Naso brevirostris*); *Kacika* is the yellow-lip emperor (*Epinephelus caeruleopunctatus*).[2] *Cawaki* is the sea urchin (*Tripneustes gratilla*); *Nama* and *Lumi* are common names for edible seaweeds, often *Gracilaria maramae*.

1.3. Naidiri

Sea-level rise and persistent wave action have led to shoreline erosion, removing huge vilumes of sand and exposing scattered patches of limestone bedrock along the village beachfront (Figure 9). Changes in tidal patterns are evident in the increasing frequency and height of waves, which now reach further inland, particularly during high tide. The beach, once a safe playground for children, has become hazardous. According to a key participant, the area was once covered with white sandy beaches where children enjoyed playing and young people were able to play team sports (like rugby). Yet today much of the beachfront is dominated by exposed limestone bedrock, making it unsafe for such activities.

Figure 9. Shoreline at Naidiri used to be covered with sand.

Coastal high winds continue to increase in intensity and frequency and this greatly impacts house structures and vegetation. Villagers nowadays are reluctant to grow crops and vegetables due to fears of saltwater intrusion. The villagers planned on planting coconut trees along the beachfront as a mitigating strategy for the strong high winds. Approximately nine hundred coconut seedlings were planted but all perished. Civil servants from various government ministries in Sigatoka visit Naidiri village at times for their wellness program where they get to plant coastal trees such as *dilo*, *vutu*, *buevu*, and *sivi*. Most of these trees could not sustain the high levels of salt spray, strong winds, and waves.

High wave action impacts coastal ecosystems and house structures in the village. A few participants highlighted the observed increase in intensity and frequency of waves. Recurring wave surges tend to expose the foundation structures of homes along the coastline. The pictures below provide markers indicating the extent of wave reach. During the discussions, villagers expressed fear yet were reluctant to accept the idea of relocation. Furthermore, the villagers opposed the construction of a seawall, fearing it would accelerate sand erosion along the coastline, making the area deeper and more hazardous especially for the younger children. Considering the extent of climate impacts experienced by these coastal dwellers, planned relocation would be the ideal, solution-oriented measure to be taken.

Figure 10. Yellow arrows show where seawater reaches at high tide along the coast of Naidiri Village.

Changes in weather patterns have been experienced by Naidiri residents where the cooler months are becoming warmer and the warmer months are apparently becoming cooler. At times, when they least expect rainfall, it rains heavily. Shifts and alterations in the weather patterns impact their livelihood practices and outcomes. This affects marine resources and farm production and yield. Food security and stability are affected if these changes worsen over time.

Low fish stock due to climate change impacts and human induced activities is a major concern for villagers. Fish species namely, *sivisivi, nareba, balagi, donu* and *ta,* have almost disappeared from their marine resources. Fish nets of approximately five inches are used for both subsistence and for sale. Two and a half inch nets are only used for traditional functions or in desperate situations where food is needed quickly. Unsustainable, unethical and illegal fishing methods also contribute to the depletion of fish stock. People once used *duva* (plant roots for fish poisoning), Janola (commercial bleach), and chain dragging for quick fish harvests without thinking of their long-term effect on their marine resources.

Flooding occurs here due to torrential rainfall and poor drainage (poor outlet) for homes located slightly inland. Flooded waters would remain stagnant for days before subsiding. Septic tanks would overflow and both human and animal waste would be exposed when water resides. There were two cases of leptospirosis recorded here in 2023 resulting from such flooding.

Animal invasion continues to be a major problem as livestock owners are unable to erect fences. A few farmers have fences but are not sufficient enough to cover the whole area. At times, animals would be slaughtered, butchered and shared among villagers when caught invading farms. This normally causes conflicts and physical confrontation.

Lifestyle changes are affecting a majority of the younger male generation who do not take part in farming activities. Although animal invasion is often used as an excuse, some participants consider the real issue is a lack of mental resilience and motivation to fulfil their responsibility of ensuring food security for their households and the village. Climate change is another factor that prompts the decline in farming activities. Therefore, many households depend on those who are in employment for their livelihood. With the increase in accessibility to transportation and shops, people favour modern processed foods rather than traditional nutritious foods. This has led to an increase in non-communicable diseases in the village.

1.4. Vusama

Vusama is a ridge-top settlement on the left (east) bank of the nearby Tuva River that relocated from a river-bank location more than 70 years ago (from 2024). Human induced erosion is a major problem for its residents. Tourist boats that travel the Tuva river daily create large destructive waves which erode the banks of the river. The river continues to become shallower compared to the past. The participants expressed disappointment at the rate of erosion which leads to the loss of habitats and shifts in the ecosystem. Furthermore, female participants also identified the increase in logging and deforestation activities from the upper Tuva River as another major concern which is affecting their marine stock.

Diminishing mangrove sourced foods is due to climate impacts and human induced activities. In the past, women would walk short distances to catch land crabs. Today, they have to walk longer distances. The quality and quantity of crabs has declined. They also highlighted the rapid recurrence of high wave action, something they never used to experience before. This contributes to the washing away of sediments along the banks of the river and the loss of habitats.

Drought conditions, similar to those experienced by other village communities in Tikina Malomalo, periodically impact their daily livelihood patterns and outcomes. Participants highlighted the significant decrease in the quality and quantity of crops produced compared to the past. Climate impacts are not only affecting crop health but are also taking a more significant toll on human health.

Water shortage has been a persistent problem for decades. The villagers rely on groundwater sources which they access by digging wells. These wells dry up quickly during the dry season. Water is available at 6 am but usually runs out by 11 am. It remains scarcer during prolonged dry periods. There would be no other water source so villagers have to travel to other villages to fetch water. Families would pitch in to pay for the water cartage. The lack of water causes significant psychological and emotional stress, especially when there is none at all. Mothers worry about providing food for their families, and children often miss school due to the situation. That said, the Vusama community had a solar-powered pump linked to a well (Figure 11, left) and are just about to have a piped water system installed (Figure 11, right), a Government response to repeated requests for assistance (see also Figure 16).

Figure 11. Water supply at Vusama.

Limited farming space is a problem as large parcels of freehold land outside the village boundary belong to Shangri-la Fijian Resort. Villagers of Vusama cannot expand their farms beyond the available land. They can only grow enough for subsistence needs which limits their economic opportunities. This also limits their ability to meet numerous household and village obligations.

Health and hygiene impacts represent a major concern for villagers. The severity of water problems affects the safe disposal of human waste, accessibility to clean water supply and hygiene practices. There needs to be proper household waste disposals, toilet amenities with proper ventilation, deeper pit holes and improved water seal systems to prevent mosquitoes and flies. The water sources are located downhill and are prone to contamination during heavy rainfall because toilets are located at elevated areas along the hill. Human waste, bacteria and pathogens from toilets tend to be transported downhill when it rains heavily. This leads to the spread of waterborne diseases such as skin infections, diarrhoea, and other related sicknesses and diseases. There were three cases of leptospirosis recorded here in 2024.

Animal invasion has become a common issue for all village communities in Tikina Malomalo. Similar to Naidiri village, cattle and horses not only invade farms but also enter homes in search for water during drought conditions. Conflicts occur and the Turaga ni Koro (village headman) would call out the names of the owners of the livestock in the village and they would be instructed to look after their cattle better to avoid unwanted conflicts in the village.

1.5. Naveisabasaba

Prolonged drought conditions (in mid 2024) had caused major environmental issues, compromising

both water security and food production. The village waterway has completely dried up and the once green, lush plain adjacent to it today looked barren and depleted. This was once a wetland used daily as a source of livelihood. Women would go out daily to fish and gather green nutritious plants. The waterway used to be deep and no livestock could cross as they would drown. Today, it has become a cattle breeding ground as shown in Figure 12.

Figure 12. Dried-up wetlands at Naveisabasaba (August 2024).

Residents believe that the prolonged drought condition is the main cause for the decline in soil quality. The cracks in the dry and hardened soil surface because of the lack of rainfall lead to the absence of macro organisms such as earthworms which farmers usually reference as an indicator of healthy soil. They believe there are nutrient imbalances in the soil ecosystem, hence the decline in the quality and quantity of food produced. In addition, there is a major shortage of cassava seedlings. Crops also tend to have shorter lifespan and attract more pests and diseases. They are not generating such high yields as was once the case. Both the quantity and quality of seedlings are compromised due to climate impacts.

Sea-level rise continues to be felt by villages at Naveisabasaba even though they are located a few kilometres inland. Participants noted the rise in the river level and the increase in salt water intrusion in plantations located further away from the waterway. They believe that coastal wave action and the rise in sea level are two major contributing factors that push sea water further inland. This worsens during torrential rainfall and extensive river flooding.

The water crisis continued to worsen after WAF stopped carting water to the village. Young mothers and babies suffer the most in such circumstances. Groundwater sources have dried up and the villagers have to pay to cart water from other neighbouring communities that have access to water. The participants highlighted that such challenging circumstances at times leads to feelings of helplessness, depression, and anxiety. Yet they rely on spiritual guidance to be mentally strong and resilient and not to be easily defeated by these challenges.

Health related impacts of climate change are becoming increasingly evident, contributing to the increase in waterborne diseases and other illnesses, such as dengue fever and typhoid (with four reported cases in 2024). Since the borehole is no longer in use due to its high salt content, villagers have resorted to using an old groundwater source, which was previously banned by the health ministry. As shown in Figure 13, the well is extremely unsafe for domestic use, as animals also use it. Additionally, the grazing grasslands are no longer suitable for rearing livestock, leading to livestock

stress due to dehydration. As a result, animals move closer to the dried wetlands near the village in search of water. The extreme water crisis forces villagers to take their livestock to the well, significantly increasing the risk of water contamination.
Consequently, the residents face a heightened vulnerability to waterborne diseases and related illnesses.

Figure 13. Groundwater source in use at Naveisabasaba (August 2024).

Animal invasion is a significant challenge for villagers and farmers in Naveisabasaba. Cattle from the neighbouring village of Vusama invade their farms daily, causing loss and damage to crops. This not only disrupts the subsistence supply for the farmers' households but also hinders their ability to fulfill various obligations in the family and the village.

Conflicts occur when people do not adhere to water management rules where each family is only allowed two buckets of water each morning. This water is strictly for domestic use only. Some people fill more buckets instead. This creates bitter feelings and conflict arises among the villagers. As a result (August 2024), someone deliberately cut the outlet tap for the water tank so no one will have access to the water. WAF had to remove the water tank to avoid further conflicts. Furthermore, two other water tanks for the village borehole were deliberately damaged.

1.6. Ciri

Sea-level rise tends to generate high river water levels particularly during heavy rainfall and storms. Residents of Ciri settlement noted the intensity and frequency of flooding continues to increase. In the past, flooding would take a day to recede. Nowadays, it takes three to four days for flooded waters to recede. By then, crops and sugarcane are severely damaged. Poor drainage and blockages exacerbates the problem as the creek is too narrow. It takes time to discharge into the main river channel. Before, during high tide, water would reach the first row of their crop field. Nowadays, the water comes further inland and covers large areas of the crop field. That portion of their farmland is now barren owing to saltwater intrusion.

Climate variations and impacts are affecting the farming livelihood patterns for residents of Ciri settlement. Key participants highlighted that in the recent past, they would receive rainfall once a month or once in two weeks. Nowadays, they get rainfall once in two months. Most times, it only drizzles which is not sufficient for productive farming. Soil texture and structure is affected. Vegetable farming cannot be sustained with the current water problem the community faces.

Ciri settlement is located at the lower plains of the Tuva River catchment area. When rain falls extensively, flooding occurs and causes widespread damages to their agricultural production. This also leads to soil erosion along the banks as river-water level rises. Farmers experience an increase in crop failure due to climate change impacts. This affects their agricultural farming activities as they incur high financial losses. This is either due to the current extensive drought conditions or excessive flooding during the wet months. According to the farmers, more crop and financial losses are incurred during drought conditions compared to flooding.

The water crisis in Ciri settlement has been an issue for decades. The community does not have direct access to government-sourced water supply. Yet it has a borehole that caters for approximately twenty families. The borehole can be accessed only once in four days and it opens for an hour only. The Government provided 5000L water tanks to support the farmers. Yet on many occasions, the water in the borehole and the tanks dries up and they have to seek assistance for water cartage by Water Authority of Fiji (WAF). But most times WAF does not turn up until the residents pay two hundred dollars for cartage.

Reduction in livestock farming due to the widespread growth of invasive species, primarily the African Tulip (*Spathodea campanulata*), have taken up large areas of grasslands which deprive livestock of their food sources. Therefore farmers have been forced to reduce livestock rearing.

Pests, namely red ants, hinder crop germination rates, crop health and crop yield. Ant colonies were rarely found in the past. Nowadays, large colonies are seen in every crop line and they tend to forage aggressively in search for food and water in the current (August 2024) state of dry conditions.

Pollution and contamination of water sources continues to be an ongoing issue as people dispose of solid waste, including household garbage, food scraps, packaging materials, plastics, and diapers, into the Tuva River upstream of Ciri. Non-biodegradable waste tends to accumulate along the riverbanks and in crop fields. Undoubtedly, some of it has also been washed downstream into the ocean.

Locally-led adaptation in Tikina Malomalo

Although people living in Tikina Malomalo have been adapting to climate change (including climate variability and extreme weather events) for generations, this has never been labelled ‘locally-led adaptation’ (LLA). Yet this is what it is, as described below for each of the six communities discussed in the previous section. The body of LLA strategies described below satisfies many of the key goals of this project in that they are demonstrably robust, they are appropriate (yet not solely appropriate) for tackling the specific climate-linked livelihood stressors (described in Section 4), and they are worthy of dissemination.

1.7. Muanivatu

Improving drainage systems is one of the main priorities for Muanivatu farmers during the land preparation (pre-planting) phase. They ensure the construction of proper (adequate) drainage systems to avoid extensive crop damage and financial losses if flooding occurs. Farmers always anticipate rain intensity, velocity and frequency so they plan accordingly. Drains are made deeper and wider and align with the slope of the land.

Modern and traditional farming methods are used in an integrated manner. Machines are used mainly for land preparation. Bullocks are also used for ploughing and tilling purposes as they help

with weed control and enhance crop life by conserving moisture. Farmers have integrated commercial crops (like sugar cane) and vegetable farming with animal rearing such as cattle, poultry and goats. Animal rearing is done to support their daily livelihoods and is mainly for subsistence use.

Agroforestry is also practiced. Varieties of fruit trees such as mangoes, guava, citrus, soursop, avocado (to name but a few) are grown to support the community and provide shade for backyard animal rearing. Cattle and goat dung and poultry droppings are effectively used as manure for their vegetable plots and crop fields. Trees are left to grow in the buffer zones to protect the community from strong coastal winds that would potentially transport damaging saline sea spray inland. Mulching is done mainly for vegetable farming to increase soil fertility and productivity. All these measures help ensure food security for the community.

Disaster preparedness plays a crucial role in minimizing the potential impacts of climate- related events such as tropical cyclones and flooding. The community resorts more to modern communication technology via smartphones and radios for the latest weather updates. All houses are built according to standard building standards and methods that are cyclone resilient so that families do not have to evacuate unless the need is unavoidable. The elderly members of the community still have some traditional knowledge on how and when to anticipate natural disasters such as cyclones and floods (Nunn et al., 2024).

Climate resilient crops such as breadfruit, *kumala* (sweet potato) and cassava are grown for their tolerance and resistance to heat and heavy rainfall. These are comparatively low maintenance and climate-resilient crops that are easily managed from growth to harvest.
Farmers implement succession planting particularly for cassava and *kumala* to ensure they grow all year round. Breadfruit does not have to be replanted; they produce their first fruits after 3-4 years and they can live for more than fifty years. These crops provide the much needed support to ensure food security, especially during cyclones and droughts.

Oral tradition or knowledge sharing are vital aspects of survival for the community. The elders teach the younger generation about life and ways to counter the many challenges they experience. Since it is a farming community, most of the knowledge is imparted through practical learning. Traditional farming knowledge and life skills are also effectively shared during family time.

Government assistance will play a crucial role in supporting this community with infrastructure and essential resources that they need in order to have access to government sourced water supply. The existing piping system runs through their community and connects to other coastal village communities, schools and hotels. They have also requested assistance in the construction of a proper borehole facility as back-up particularly when government supply is restricted.

Diversifying livelihood opportunities is a way of ensuring positive livelihood outcomes. The community have sugar-cane, crops and vegetable farming as their primary products. In addition, they have livestock which is for both subsistence use and also sometimes for sale. Furthermore, they have family members who migrated overseas and continue to provide financial support that generates growth in the household. Despite experiencing low crop production at times due to climate impacts, there was no mention during discussions of food insecurity as they are able to manage from their different livelihood sources.

The Muanivatu community also understands the importance of collaboration. For coastal reforestation, the residents have a vision of collaborating with government and non-government agencies. They emphasised the importance of advocating coastal reforestation in deforested areas and putting a stop to the unnecessary cutting and burning of coastal trees and vegetation. They suggested the need to enforce strict environmental rules and having coastguards at all coastal

community picnic areas to enforce these rules.

As sugarcane farmers and members of the Sugarcane Farmers Union, Muanivatu residents collaborate with fellow farmers in the neighbouring communities on effective climate change adaptation (CCA) and climate change mitigation (CCM) strategies that support positive livelihood outcomes. They also collaborate with the Fiji Sugar Corporation for supply and processing agreements, technical support, fertilizer and input support, market access and pricing. Through such collaboration, they are well informed of mitigating measures to address climate-related stressors.

1.8. Malomalo

In terms of shoreline protection, the Ministry of Environment and Waterways provided the Malomalo community support in constructing the village seawall using boulders as shown in Figure 14. This action followed the washing away of graves from their chiefly burial site (*Sautabu*) shown in Figure 6. The seawall helps prevent possible recurrence of coastal erosion and sea flooding in the near future.

Figure 14. Seawall constructed at Malomalo by the Fiji Government.

To enhance water security for residents of Malomalo, villagers aim to access the old water source from the hills (see Figure 8) for domestic use when government water supply is disrupted. Additionally, a freshwater pond is available near the village but is primarily used for bathing. The water source from the hills never runs dry and even during heavy rainfall, the water remains clean. In terms of disaster preparedness, today most Malomalo residents rely on modern approaches (particularly radios and television) for latest news and information regarding weather forecast. Yet the elders still possess traditional knowledge regarding weather forecasting and post- disaster coping strategies such as food storing methods. The village men and youth prepare homes and ensure that reinforcements are done in preparation for a cyclone. Vulnerable families and physically challenged individuals are normally evacuated to the village hall for safety.

1.9. Naidiri

The bareness of the Naidiri coast is recognized by residents as contributing to their vulnerability, so coastal reforestation is a priority. Traditional coastal trees (namely *dilo*, *vutu*, *buevu* and *sivi*)[3] are grown for coastal rehabilitation and as a source of food for the villagers. These trees are prized as they both protect the environment and help food security. They have deep and strong roots that help stabilize soil and protect against coastal erosion and withstand harsh coastal conditions. They also

hold socio-economic importance and cultural significance that benefit peoples' livelihoods.

For active farmers, site selection is critical as they understand the need to plant further inland from the coast to avoid the high strong winds from the ocean. In addition, they are aware of animal invasion so they will need to fence their farms. Large scale faming is impossible as it will be too expensive to erect fences along all the boundaries. Both traditional and farming methods are used to ensure high production with good quality and yield during harvesting time.

For waste disposal, landfills have been created as part of the village conservation plan to conserve and preserve their marine and land resources. In the past, villagers used to pollute the ocean with all their household wastes. Today, the village has been thoroughly informed through many awareness workshops about the importance of safeguarding their environment.

Therefore, waste disposal sites have been well planned and constructed. All households strictly follow the village waste management rules. The two main climate resilient crops grown by Naidiri farmers are cassava and *kumala* (sweet potato). Wild yams and traditional yams are also harvested. Villagers follow the traditional farming methods from planting to harvesting. These crops are resilient to the many environmental changes to which they are exposed. They are ideal for food security, particularly during the hurricane season. Naidiri has a Village Integrated Development Plan.

[3] *Dilo* is *tamanu*, prized for its medicinal properties (*Calophyllum inophyllum*); *Vutu* is an evergreen with an edible nut (*Barringtonia edulis*); *Buevu* (or *evuevu*) is the endemic Chinese lantern tree (*Metrosideros* vitiensis); *Sivi* (or *ivi*) is the Tahitian chestnut tree (Ficus *obliqua*).

The youth group and women's group collaborated in a joint initiative to design an integrated development plan which mainly focused on capacity building through awareness programs for coastal villages in Tikina Malomalo and other neighbouring districts. Part of the initiative is to manage the Naidiri Marine Biodiversity Park that runs along the coastal side of the village.

The idea was introduced by the youths owing to the increasing impacts of climate change in the village and the constant decrease in fish stock. The goal is to replenish fish stock in their *qoliqoli* (fishing ground) which is an important source of subsistence livelihood and cash income. Through awareness programs, they hope to increase knowledge among the coastal villages on the importance of maintaining sustainable fishing standards and preserving the reef biodiversity.

In 2009, the taboo (*tabu*) was traditionally introduced to the village. In 2011, the youths registered their group with the Ministry of Youth. In 2017, Naidiri became one of the seven villages out of the one hundred and twenty-two villages in the Nadroga-Navosa Province to have a committee that specifically looked at the affairs of their natural resources (*yaubula*). In 2022, the Minister of Environment officially declared the taboo site a Marine Biodiversity Park (Figure 15).

Figure 15. Youth-driven management of the Naidiri Marine Biodiversity Park.

The youth group prioritizes the teaching of the younger generation in the village about the importance of their marine resources and how to preserve/conserve these. They are currently learning the basics of coral planting from a very young age. Fish wardens are nominated and do routine reef checks every month. During these checks at the taboo fishing area, they normally remove crown of thorns star fish (*bula*) which kills the corals and octopus (*kuita*) which eats giant clams (*vasua*).

In 2024, the youths accomplished a three-month marine restoration project funded by the World Bank and the Fiji Ministry of Economy. There were two groups. One group had seven members which planted 10,000 mangrove plants while the other group had six members who planted 18,000 coral frames. The synergy between no fishing (taboo), coral planting, and nurturing of giant clams provides a pivotal change for the marine biodiversity of Naidiri. The future plans for the youth group is to have their own clam hatchery.

1.10. Vusama

Given their water insecurity (see Section 4.4), the Health Ministry advised the village to refrain from using the well water as a safety precaution. The InterContinental Fiji Golf Resort & Spa then supplied 1000L water tanks to each family household. They also funded the construction of a borehole. Every household were to have at least three drums. Each drum is used for drinking, washing and bathing (Figure 16).

Figure 16. Left – the solar-powered well at Vusama (also shown in Figure 11, left). Right – household water tanks donated by a local hotel (where many Vusama residents work).

Vusama villagers continue to resort to traditional medicine either to cure sicknesses or treat injuries (including COVID-19). Women in particular have a lot of traditional knowledge about traditional medicine and their uses. Traditional medicine can be sourced from the ridges to the reef. One particular traditional medicine highlighted in discussions was *namulomulo* which was used by caregivers when a close relative had passed on and the lingering smell of the deceased remained. The leaves would be cleaned and mixed with water before drinking. This removes the unpleasant odours.

In response to constant requests for assistance with water supply issue, Vusama village will shortly have access to government water supply shortly (see Figure 11, right) as infrastructural works done by WAF is near completion. This will have a significant positive impact on the livelihood outcomes for the village. All households will now have access to sufficient supply of clean and safe water for domestic use.

1.11. Naveisabasaba

Prayers and fasting are used as a coping mechanism for the village. All households join in prayer and fast every Wednesday from 6 am to 12pm. They strongly believe that this leads to divine intervention that helps them cope with the struggles they face daily.

Similar to Vusama village (previous subsection), infrastructural work is currently underway by Water

Authority of Fiji (WAF) in order to provide water supply to Naveisabasaba village. Once works are completed, all households will have access to consistent water supply as in urban areas. To counter ongoing water issues, the village has planned on constructing a bigger and better borehole facility at an elevated location which will be safe from salt water intrusion. They plan to use it as a reserve water source when government water supply is disrupted in future.

Cassava and *kumala* are the main climate resilient crops grown for subsistence use. Although they are facing problems with production and yield including planting material, Naveisabasaba residents are managing with the current supply they have.

Livelihood diversification is widely acknowledged as key to community and household sustainability. Most villagers are employed in the hotel industry and other sectors so this is a source of livelihood for them apart from subsistence farming. A few households have little tuck shops operating from their homes which assists them as well. Furthermore, some households also depend on social welfare assistance provided by government.

1.12. Ciri

Most coping strategies among Ciri residents focus on food security and the maintenance of cash-generating livelihoods. For example, most households in Ciri preserve foods for times of short supply and deliberately store surpluses of key foods (such as bora bean and dhal) for the same reason. Residents stated that they do not store food during cyclones as they have an abundant food supply in the field. Food can always be harvested when needed.

Ciri farmers construct their fences well to prevent livestock from going astray. This prevents potential damages to their own farms as well as other neighbouring farms. Livestock are usually marked for easy identification and would be taken to higher ground for shelter during cyclones or flooding with sufficient supplies of feed and water provided to them.

Farmers engage in both traditional and modern farming methods. Machines are mainly used during pre-planting or the land preparation phase. They are also used during harvesting for transporting harvested produce. Traditional tools are used daily from planting to harvesting. These farmers strictly follow a structured farm plan of succession planting and crop rotation. This improves soil health and increases soil fertility. It also enables them to get more returns when they have high production rates.

Discussion

Although outside interventions to improve livelihoods occur in the Tikina Malomalo, most of its residents have a tradition of locally-led (autonomous) adaptation that ranges from community-based disaster preparedness, which utilizes both western science and traditional knowledge, to coping with longer-term environmental stresses such as sea-level rise and (associated?) impacts on coastal landscapes and resources such as droughts and tropical-cyclone impacts. Certain communities in the area have had successes with other types of adaptation, including for improving food security the establishment of a locally-declared marine protected area (MPA) at Naidiri. This account considers only those types of adaptation which are directly attributable to climate changes, using the following **four** headings.

1.13. Anticipating disaster

People throughout the Tikina Malomalo utilize both traditional and ‘western’ ways of anticipating extreme events that might prove disastrous for their communities. These include ways of predicting

the nature of the wet season (November-March), often 2-4 months in advance of its start, by looking at where bees/hornets build their nests; if these are high in the tree branches (considered normal), then the wet season will be normal and not marked by excessive wind or rain (as in a tropical cyclone); yet if nests are built low, close to the ground, then the forthcoming wet season will be extreme and people need to take appropriate precautions. Shorter-term predictors of extreme wet-weather events include the curling of leaves on shooting plants (like plantain or *vudi*). Imminent predictors of such events include the sighting of sea birds (like frigate birds) over the land and the appearance of waves breaking along particular diagnostic stretches of coastline. Comparable indicators of drought are also known from this area. Similar predictors have been described from elsewhere in Fiji (Janif et al., 2016; Johnston, 2015; Nunn et al., 2024).

Use of 'western' methods for disaster prediction is also widespread, often preferred by younger community members who utilise television and radio warnings. Several communities appear to utilize both traditional and western knowledges side by side to anticipate and plan for disasters. This practice, we suggest, represents the optimal situation for the future, as it combines robust place-based knowledges (traditional and local knowledge) with generic (non-place based) scientific knowledge. The combination of these has been called on by many authors recently who (i) understand the deficiencies of the uncritical top-down application of western scientific knowledge for CCA in rural non-western contexts (like those in this report) and (ii) recognise the value and acceptability of place-based traditional knowledge but also worry about the dangers of its applicability to novel (unprecedented) situations (Balick et al., 2023; Granderson, 2017; Marrero & Mattei, 2022; Mercer et al., 2010; Nunn et al., 2024; Rantes et al., 2022; Ruehr, 2022).

1.14. Coping with disaster impact

Several older residents of Tikina Malomalo are well aware of recent changes in cyclonicity that refer not only to cyclone strength and frequency but also to the common track of these storms. Many communities in the area heed traditional signs of cyclones and droughts to grow and store extra food, clean and secure alternative water sources, and ensure all community members are adequately appraised of what is likely to happen. While different communities within Tikina Malomalo experience disaster differently and therefore have different coping priorities and mechanisms, all communicate effectively both within and between communities which gives this area a strong resilience to disaster.

That said, many traditional practices for coping with the aftermath of disasters are disappearing in the Tikina Malomalo as younger people leave the area (even the country) in search of income-generating opportunities that are more dependent than those involved in cultivating the land. There would be benefit in combining former practices, such as the intentional planting of food surpluses and the techniques of food preservation and storage that were common in this area until quite recently. With changes of diet and new opportunities for earning cash incomes, the favouring of shop-bought foods has led to a loss of knowledge about former practices. Their revival would cushion residents of the Tikina Malomalo in the face of future (economic) shocks.

1.15. Responding to land loss from sea-level rise

In several places along the coast of Tikina Malomalo, considerable land has been lost over the past few decades, plausibly as a result of sea-level rise. Areas most affected include Rove Beach west of Vusama and the coastline east of Naidiri where the old village of Naidiri once stood. The immediate response of the people living in these places was to relocate to others less exposed, which shows that 'relocation' as a response to sea-level rise is not as widely resisted as has sometimes been reported in Fiji. It is likely that many of the ridge-top villages in the area, like Batiri, Nalele and Vusama, were relocated from exposed coastal locations some time ago.

Elsewhere, as in Sanasana and (modern) Naidiri, seawalls have been constructed but the expense associated with building these and (more importantly) maintaining them on a regular basis has often proved prohibitive so some communities have been trialling the replanting of mangrove, as is common in other parts of Fiji. Malomalo has trialled this, as did Vusama in an area of cleared mangrove, increasingly affected by seawater flooding, just northwest of the village.

1.16. Responding to flooding from sea-level rise

Plausibly because of sea-level rise and increased cyclone intensity, waves and tides reach further inland than was once customary along the coast of Tikina Malomalo. Communities have responded in several ways, including wholesale relocation (see 4.3) but also incremental relocation – often the relocation of the 'front line' of houses, as occurred recently in Naidiri. For the same reasons, river levels are also higher than was once the case and river flooding reportedly deeper and more widespread than was once the case. This has affected several communities and residential concentrations throughout Tikina Malomalo, including Nalele which relocated to a ridge from the floodplain some decades ago and is now contemplating a second higher phase of relocation because recent floods overtopped the ridge. A normally- closed outlet of the Tuva River passes through the Natadola area (see Figure 2) but every few years bursts through the barrier beach at its terminus and floods the surrounding area – residents move to higher ground along with all their domesticated animals (cattle, goats). The people of Naidiri often experience flooding of the inner parts of the village and commonly take shelter elsewhere, often with relatives in Malomalo which is on higher ground.

Saltwater flooding is associated with increased saline groundwater intrusion in the lower Tuva River, especially around Ciri (and nearby Nalele Village). This is almost certainly a result of sea- level rise that has pushed the high tide further upstream that was once the case. The impact of this on river-side livelihoods is largely undocumented yet likely to be a major issue if sea level continues to rise and accelerate in the future.

1.17. Enhancing livelihood sustainability

Other ways of enhancing livelihood sustainability within the communities of Tikina Malomalo were identified in the course of this research. These are mentioned in eight separate paragraphs below.

More thorough consultations and awareness workshops need to be conducted on proper farm management practices. Workshops should outline specific information and solutions to loss of soil productivity, declining crop yield, pests and diseases, recommended chemicals and uses, land degradation and desertification, reduced water quality and supply, and change in cropping season.

Waste management practices need to be made more effective in many instances through clear regulations to be instituted along with enforcement officers to follow through, particularly with lifestyle changes that include dumping of household waste materials in the rivers. Relevant stakeholders need to conduct awareness workshops on sustainable waste management practices.

Strict rules need to be implemented.

All village communities would benefit from improved sanitation facilities. The location and type of toilet facilities, drainage systems, and wastewater treatment systems could be made better in many instamces. Health inspectors need to conduct frequent visits to villages.

Water is a basic necessity of life and key to successful livelihood outcomes. Vusama, Naveisabasaba, Muanivatu and Ciri settlements have been facing water problems for many years. Government assistance is urgently needed. This informs objective 3.3 of the National Adaptation Plan which is 'to secure equal and sustainable access to resources and services that support human health and wellbeing'.

Proactive adaptation and sustainable resource management practices should be instituted at community level. Residents need to discuss and implement taboos for their traditional fishing grounds and ensure strict observation of these taboos. Exploitation of natural resources needs to be at minimal levels. A suggestion put forward during the *talanoa* session was the need to have forest wardens for inland communities and fish wardens for coastal communities. This is to monitor the forest and marine resources and to reduce unsustainable harvesting and extraction of valuable resources for short term gain. This aligns to objective 3.2 of the National Adaptation Plan which is to increase ecosystem protection, natural resource redundancy, and environmental resilience through nature-based solutions

Mangrove reforestation programmes are vital particularly for Vusama and Naveisabasaba villages. Awareness is pivotal and strict enforcement of regulations needs to be consistent. There is a high reliance on mangroves for firewood and large portions of mangroves along the river banks get eroded through wake-induced erosion. Wake-induced erosion is a persistent problem for the people of Vusama and Naveisabasaba due to high tourist activity in the area. Relevant authorities should impose strict regulations and fines to prevent excessive speeding by tourist boats heading to and from Robinson Crusoe (Likuri) Island.

Green and brown rubbish/waste such as tree branches, fallen leaves, food peelings and cuttings are normally thrown into the waterways or plantations and piled and left idle which over time attracts flies, becomes an eyesore and releases bad odours. Relevant stakeholders need to conduct awareness and training workshops on composting techniques. Villagers must (re-)learn how to recycle waste through composting. This will positively impact farming activities through the use of organic manure.

Both Traditional Knowledge (TK) and Traditional Ecological Knowledge (TEK) need to be thoroughly documented both in written and through audio recordings for all village communities and farming settlements in Tikina Malomalo. TK and TEK are vital tools for survival, so must be preserved and passed down to the younger generations to enhance their learning and improve livelihood outcomes. To do so effectively, documenting both English and vernacular languages must be considered the foundation for effective public education

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4.2 MCS-Nepal

Contributed by: Dr.Menila Kharel, Ms.Pooja Sharam, Mr.Min Malla from Practical Action Nepal with inputs from Dr. Chi Huyen Truong, AAMA and Dr.Binaya Raj Shivakoti, IGES

Introduction:

In recent times, climate change has become a highly concerning issue internationally, as it has caused negative impacts on the environment, ecosystems, and people dependent on natural resources for their livelihoods. Developing countries like Nepal, even though not significant contributors to climate change, are more vulnerable to its effects due to their limited adaptive capacity. Nationally determined contributions (NDC) are the major commitments set by Nepal under the Paris Agreement, along with the National Adaptation Plan of Action (NAPA). The federalized government has committed to implementing local adaptation plans of action (LAPA) based on the NAPA guidelines. These plans are formulated at the local level to integrate developmental plans with climate change considerations from the ground level.

The local population is at the forefront of climate change impacts and is often the first to respond and adapt to these challenges. They possess knowledge about their environment, changing weather patterns, ecological changes, and the impacts of climate change on their livelihoods. Through years of experience, they have developed solutions to adapt to these impacts. Integrating this local knowledge into adaptation plans ensures ownership, engagement, and sustainability, as well as helps the nation achieve its NDC goals.

Currently, the local adaptation plans adopted by communities are not fully aligned with the NDC. Therefore, it is necessary to create an environment where locally led adaptation interventions are fully recognized and supported with resources, technologies, scientific information, and decision-making tools. Locally Led Adaptation places local communities at the center of adaptation actions and interventions, supporting local institutions in building their capacity to cope with climate change.

Establishing a strong connection between the local community and the NDC is a critical point and can be achieved through raising awareness among the community, stakeholders, and local government about the goals of the NDC. Given that the community and local stakeholders are pioneers in creating adaptation plans based on the situation and rooted in indigenous, traditional, and local knowledge (ILTK), localizing the NDC among these people will be a significant catalyst for the nation to achieve its NDC goals. In conclusion, the active involvement of local communities in climate change adaptation plans is crucial for their success. By integrating local knowledge into adaptation plans, local communities can contribute to national climate change goals and mitigate the effects of climate change.

Objectives:

- Understanding of climate risks and vulnerabilities at the local level.
- Assess locally led adaptation innovations stressing the use of indigenous, traditional, and local knowledge (ITLK) systems.
- Co-develop bankable ideas towards establishing ‘local adaptation innovation hubs’;
- Conduct the capacity gap assessment of the local bodies and the community regarding the national commitments and adaptation plans,

Study area

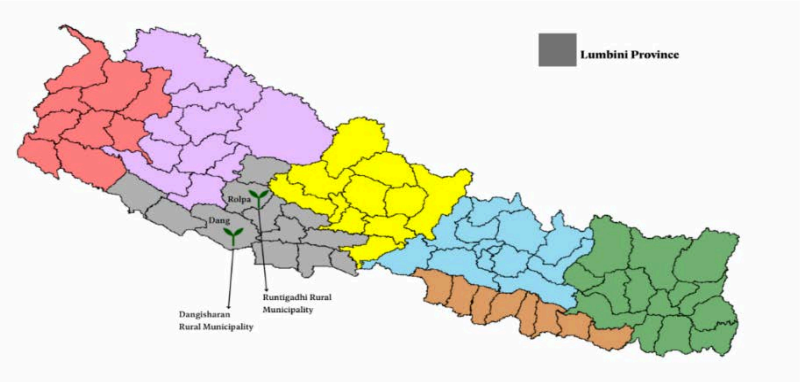
The study area lies in the Lumbini province of Nepal, it is in the western part of Nepal, constituting 14 districts. The total population of the province is 44,99,272 consisting of 2,140,316 male and 2,358,956 female. The province has 885,203 numbers of household, average size of which is 5.08 and sex ratio 90.73. The HDI of the province is reported as

0.563 lower than the national HDI that is 0.602 and the average life expectancy of 52 years, 18 years below the national average. The province has mainly Tharu as a main ethnic group and Magar as the second large ethnic group. The province mostly depends on the agriculture and tourism as the mainstay.

Dang and Rolpa district were selected from the Lumbini province. In Dang and Rolpa one municipality of each district was selected, Dangisaran Municipality from Dang and Runtigadi Municipality from was taken as a research site. From these municipality, three farmer groups were selected, namely Kumalgadi Farmer's Group, Bulbilaiya Farmer's Group, and Laubasta Farmer's Group from Dangisharan Municipality, and two farmer's group namely Sajha Farmer's Group and Janjagrit Farmer's Group from Runtigadi Municipality.

The study site predominantly depends upon the small-scale agriculture (maize, pulses, rice (in lowlands), vegetables and legumes and goat livestock as a main income generation source.

Dangisharan Municipality is in the Inner Terai region of Nepal, while Runtigadi Municipality is situated in the Middle Hill region of Nepal.



Methodology:

The methodology framework was developed prior to the research to guide the study. A combination of literature review, social surveys (FGDs and KIIs), and field observations were used to assess the capacity gaps in climate change adaptation in the selected study area. The questionnaire for the FGD and KII discussion was prepared based on 8 principles of **Locally Led Adaptation (LLA**). The findings from these methods were analyzed to identify gaps, challenges, and opportunities.

The methodology of the study included the following steps:

1. **Literature review:** A detailed study was conducted on the Vulnerability and Capacity Assessment (VCA) report and the project report of the Sammunati Project - Climate Adaptive Farming implemented by Practical Action in Dangisharan and Rungtigadi Municipality. This literature review provided a foundation of knowledge and insights into climate change adaptation practices in the study area.
2. **Social survey:**

a) Focus Group Discussions (FGDs): FGDs were conducted with five farmers' groups in Dangisharan Municipality and Rungtigadi Municipality in Dang and Rolpa districts. Each FGD consisted of 10-15 participants, primarily women farmers. These discussions allowed for an in-depth exploration of their perspectives on climate change impacts, adaptive measures, and challenges.

74.19% of participants of the Focus Group Discussion were female while 25.81% were the male participants.

The FGD conducted in the Dang district consist of the participants from the Tharu community and majority were females. Whereas the FGD conducted in Rolpa, Janajagrit Farmer's group was dominant of the females' participants from Chettri ethnicity and the Sajha Farmer's group the participants were mainly male of Magar community.

Overall, the FGD was conducted including the female and marginalized community. The participants were of the mix age group of youth and older generation. The perspective of the older generations helps us to take a deep insight of the changing the environmental condition of the area, and the youth were familiar with the technical terms.

b) Key Informant Interviews (KIIs): Interviews were conducted with key informants who held important positions and possessed knowledge relevant to the study area. The interviewees included individuals such as the disability chairperson, schoolteacher, school headteacher, leader of the community forest user group, and municipal chairperson. These interviews provided valuable insights into local governance structures, community dynamics, and existing initiatives related to climate change adaptation.
As a key informant the people with disability were included to get the information about their perspective on changing climate and involvement in policy making and reach in other governmental activities and services.

3. **Ground truthing:** Transect walks were conducted throughout the community for a general understanding of the local environment, resources and infrastructure, socio-economici condition, and adaptation practices.


Observation and Analysis:

Socio-economic status of the community:

The study site predominantly depends upon the small-scale agriculture (maize, pulses, rice (in lowlands), vegetables, legumes, and goat livestock as a main income generation source. About 59.3% of respondents reported agriculture as the main income source followed by livestock (12.4%), and wages (10.4%). On average highest income is generated from goat (NPR 38,927), followed by dairy (NPR. 22,847) and vegetables (NPR 17,575). The average income of the family is <£350 /year/HHs lower than annual national average £2,177. 34.5% of the population are moderately food insecure. The community mostly depends on the rain-fed irrigation, only 12.2% is using improved water management services. The community have limited access to the labor-saving devices, agriculture mechanization, agricultural input, financial services, and business development services. The aggregate score of women engaged in local government, influencing policies, and accessing services is 0.6 out of a total score of 3 or 0.21 index (21%). 68.4% of women reported that they had not engaged with local government in planning, implementation, and monitoring; 79.4% had not participated in any policy level discussions; and 81.9% had not accessed any services from the local government. Women Empowerment in Agriculture (WEAI) survey indicates that 29.3% of the women achieved adequate empowerment.

Community's perception of climate change and its impact:

Communities were found to be familiar with the term "climate change," but they expressed limited awareness about its details and impacts. However, during the focus group discussions, it became evident that the community has experienced the impacts of climate change on their daily lives and livelihoods. They have observed changes in weather patterns,

including alterations in precipitation intensity and timing, rising temperatures, and the emergence of new pests and diseases affecting crops.

The local community has noticed significant changes in the intensity and timing of precipitation. They have observed prolonged droughts during the planting season, which adversely affect crop growth, soil moisture levels, and water availability for irrigation. These changes pose challenges in planning and managing the timing of crop planting and harvesting. Additionally, the increase in temperature has various effects on day-to-day life and agriculture. One notable change or impact reported by the locals is the occurrence of more mosquitoes in the community. Furthermore, the emergence of new insects and crop diseases has become a significant concern for farmers. The rise in pests and insects results in crop losses, reduced yields, and increased reliance on chemical fertilizers and pesticides, despite their awareness of the associated negative impacts.

In Dang, recently the presence of frost (known as "tusharo") in the community has been observed, indicating a shift in weather patterns compared to the past. Extreme rainfall events during the harvesting period have caused crop and economic losses in the community. Prolonged droughts have led to the depletion of water resources, creating water scarcity issues that affect both agricultural activities and access to drinking water. Farmers are exploring alternative irrigation methods or adjusting their planting schedules to cope with the changing availability of water.

In Rolpa, the participants have observed a distinct change in the flowering season of the Rhododendron (*laliguras)* plant. Previously, it used to bloom in April (*Chaitra-Baisakh*), but now it blooms as early as February (*Magh-Falgun*). This early blooming indicates an increase in temperature. The community has not experienced snowfall in recent years. Participants mentioned that their children have never seen snow, indicating a significant change in the local climate. The participants highlighted the drying up of water resources, leading to water scarcity in the community. This has created conflicts among users sharing the remaining water resources. The participants also mentioned the decrease in the number of water resources over time, indicating long-term changes in water availability. The community faces the risk of fires during the summer season. Certain areas within the community have been identified as red zones due to the high risk of fires

Possible climate change risk or disaster:
In both Rolpa and Dang, the participant listed following as a main climate induced risk/ disaster:

- Increase in temperature
- Unpredictable rain (timing and intensity of precipitation; specially during the harvesting period)
- Prolonged drought (during plantation season)
- Drying up of water resources
- Emergence of new varieties of insect
- Hailstorm
- Storm

In Dang, some of the communities may affect from the flood and landslide. And in Rolpa, the community listed fire among the one of the most alarming risks in the community.

Adaptive measures in the community in Dang and Rolpa:

The community has adopted several adaptive measures to address the impacts of climate

change on agriculture and water resources in both districts. The adaptive measures adopted by both is somehow same. Here are some of the adaptive measures mentioned:

• **Shift to modern varieties of seeds:** Farmers have transitioned from traditional local seeds to modern varieties that are more resilient to changing climatic conditions. This adaptation strategy allows them to better cope with variations in temperature, precipitation, and pests, improving crop yields and ensuring food security.

• **Commercial agriculture and climate-adaptive practices:** Many farmers have shifted to commercial agriculture, which involves the commercial farming of vegetables and adopting climate-adaptive practices. These practices include implementing crop rotation and intercropping to improve resilience and reduce the risk of crop failure.

• **Use of tunnels:** Farmers have constructed tunnels to protect crops from extreme weather conditions, such as heavy rainfall, hailstorms, or excessive heat. Tunnels provide a controlled microclimate, minimizing the negative impacts of climatic variations on crop growth.

• **Adoption of irrigation techniques:** In response to extended drought periods and decreasing water resources, farmers have adopted alternative irrigation techniques such as solar-powered irrigation, and drip irrigation, which delivers water directly to the plant's root zone, are being employed to optimize water use and ensure efficient irrigation.

• **Use of biofertilizers and liquid fertilizers:** With the occurrence of new insects and pests in crops, farmers have started to use biofertilizers and liquid fertilizers. These organic alternatives reduce reliance on chemical fertilizers while maintaining soil fertility and promoting crop health.

Construction of well and Kuwa as a water resources: In Dang, to cope up with the decreasing water resources the community has constructed water wells in almost every household. These wells provide a continuous supply of drinking water and support other household activities throughout the year. Whereas, in Rolpa, a hole like structure (Kuwa) has constructed in the community in many places, to fulfill the need of water demand of the community.

Market strategy in Rolpa: The community has developed a market strategy to ensure a stable supply of vegetables. By planting vegetables during seasons when there is limited availability from the Terai region, they can meet market demand and potentially improve their economic outcomes.

Decrease in firewood consumption: In Runtigadi 7, the community has experienced a significant reduction in firewood consumption, with over 90% of the people using LPG gas as a cooking fuel. This shift to cleaner and more efficient cooking methods has led to a decrease in the demand for firewood, resulting in a positive impact on the forest. As firewood consumption decreases, forests can regenerate and grow, potentially leading to an increase in forest land cover. Even though the community has not purposely adopted this measure, the community is being benefitted by the increase in forest cover.

These adaptive measures demonstrate the community's proactive approach to addressing climate change and its impacts on agriculture and water resources. By adopting climate-resilient practices and utilizing available resources effectively, the community aims to enhance its resilience and livelihoods amidst the changing climate.

Indigenous Knowledge in the Dang district:
The indigenous knowledge present in the community provides valuable insights and adaptive strategies for coping with climate change. Here are some examples of observed indigenous knowledge practices:

• **Intercropping and mixed cropping:** The community has been practicing intercropping and mixed cropping in agriculture. These methods involve growing different crops together, reducing the risk of crop failure and insect infestation. They also promote biodiversity, improve soil health, and increase overall crop yield.

• **Use of mud houses:** Many houses in the community are made of mud, which serves as a thermal insulator. Mud houses regulate changing temperatures, providing cooler interiors during summer and warmer interiors during winter. This traditional construction technique is cost-effective, environmentally friendly, and utilizes locally available resources.

• **Traditional grain storage structures (Dehari):** In the past, the *Tharu* community used *Dehari*, a pot-like structure, for grain storage. *Dehari* helps prevent grains from spoiling and protects them from insects and rats. However, with the increasing availability of plastics, this traditional practice has been replaced. Only a few households still use *Dehari.*

• **Wells for water supply:** The construction of wells in the area ensures a year-round water supply for drinking water and other household activities. Wells is an indigenous water management practice that contributes to water security and sustains the community's livelihoods.

• ***Sinki*** **(Dried Radish) as food:** *Sinki,* a dried radish, is a traditional food popular in the community. It was traditionally consumed during drought periods when fresh green

vegetables were scarce. Despite the availability of green vegetables throughout the year, *Sinki* is still eaten for its taste, and some community members even sell it in the market.

• **Community decision-making and resource management:** The *Tharu* community follows a traditional practice where the management of community natural resources is led by a *mukhiya* (community leader). In cases of cultural and social conflicts, the *mukhiya* makes the final decision, and everyone in the community agrees to it. This indigenous governance system promotes unity, collective decision-making, and the sustainable use of natural resources.

• **Community recharge ponds:** The community has constructed recharge ponds at several places that help in water supply for agriculture and livestock activities. These ponds also serve as rainwater harvesting systems, capturing, and storing rainfall for use during dry periods. Community recharge ponds contribute to water management and resilience against water scarcity.

Indigenous knowledge in Rolpa District:

The indigenous knowledge observed and shared in the community demonstrates the effectiveness of indigenous knowledge in adapting to climate change. Here are the indigenous knowledge practices shared by the participants:

- **Traditional house construction:** The community has recognized that houses made of mud with thatched roofs provide better storage conditions for grains compared to houses with CGI sheets. Mud houses act as thermal insulators, regulating the temperature inside and helping prevent grains from spoiling quickly. In the past, when grains were stored in mud houses covered by thatched roofs, they could last for a longer period compared to now when stored in houses with CGI sheets.

- **Digging *kuwa* for water:** The practice of digging *kuwa* (holes) is a common indigenous knowledge practice for accessing water resources. With the drying up of surface water sources due to prolonged drought, the community relies on groundwater from these *kuwas*. However, climate change poses a threat to the sustainability of these water resources as they too may eventually dry up.

- ***Perungo* (Bamboo Bags):** *Perungo*, a bag-like structure made from bamboo, was traditionally used for harvesting wild fruits. It is an eco-friendly practice deeply rooted in the community. However, modernization has led to the replacement of *perungo* with plastic as a carrier, which is less sustainable.
- **Use of animal manure:** Farmers in the community employ indigenous knowledge by using animal manure, such as cattle urine and decayed weeds (banmara jhar, seula), as biofertilizers in their fields. These natural fertilizers improve soil fertility and enhance crop growth. Additionally, if the intervention is done by using IP liquid, the decaying time of animal manure can be shortened to three months instead of a year, making it more convenient for farmers to use.
- **Wooden utensils:** In the past, wooden utensils were used for storing *dahi* (yogurt) and *mohi* (a fermented milk drink) as they helped keep the food cool and preserved for a longer time. However, the use of steel utensils has become more common, potentially leading to changes in food preservation practices.
- **Medicinal herbs:** Traditional knowledge of using medicinal herbs for treating various diseases was common in the community. However, with the lack of knowledge transfer to the new generation, this valuable information is being lost. The reliance on modern medicine has potentially replaced the use of traditional herbal remedies.
- **Mixed cropping and intercropping:** The community practiced mixed cropping and intercropping, which involves growing different crops together in the same field. This agricultural practice helps optimize land use, enhance biodiversity, and improve resilience against pests and diseases.
- **Natural pest control:** Cow dung, kerosene oil, and pina (a substance derived from plants) were used in the past to control insects in crops and seeds. These natural methods of pest control were likely more environmentally friendly compared to modern chemical-based pesticides.

Indigenous knowledge plays a crucial role in the community's resilience and adaptation to climate change. By incorporating these traditional practices and wisdom into their strategies, the community utilizes local resources and knowledge to mitigate the impacts of climate change on agriculture, water resources, and livelihoods.

Marginalized Community in Decision-making:

During the discussions, it appeared that marginalized communities have limited participation and representation in local-level decision-making processes. Marginalized communities are not actively involved in the decision-making process related to policymaking and budget allocations. They are often informed about decisions after the budget has already been allocated, which constrains their ability to contribute to the decision-making process. Disabled individuals have even less involvement in programs, plans, and policies. Their perspectives and needs seem to be not sufficiently considered, resulting in exclusion from important discussions and initiatives. More privileged communities have better access to local government and are more satisfied with the services provided by the government. On the other hand, marginalized communities feel unheard by the government, indicating a lack of representation and attention to their specific needs. The community seems to have limited awareness of any climate change adaptation plans and policies adopted by the local government. The community does not have emergency funds or clubs that can be utilized during times of crisis. In emergency situations, they may have to rely on loans from cooperatives, which can pose additional challenges for marginalized communities already facing financial problems.

After the federalization, community members have felt easier access to the government for various official work and concerns. Similarly, it is easier for the local community to obtain official information from the government. However, the community still expresses dissatisfaction with the overall work done by the local government, indicating possible gaps in performance and accountability. Since the participation of local people is nonexistent in the decision-making process and other activities, people seem to be less interested in the government's agenda and work in the community.

These findings highlight the need for greater inclusion, transparency, and equity in decision-making processes, particularly for marginalized communities. Efforts should be made to improve communication channels, raise awareness about budget allocations and policies, and ensure the meaningful participation of all community members, including women and marginalized groups.

Local government in the community:
The local government in the community appeared to have limitations and challenges in effectively addressing climate change and disaster management. Key observations regarding the role and performance of the local government are as follows:

- **Limited understanding of national plans and policies on climate change:** The local government has a general idea about national plans, policies, and commitments related to climate change but lacks in-depth knowledge and understanding of these plans. This indicates a gap in communication and information dissemination between the national and local levels.
- **Lack of stakeholder involvement:** in Dang, decision-making processes related to climate change and budget allocation are not inclusive and often exclude the participation of relevant stakeholders and local communities. This limited involvement affects the effective planning and implementation of climate change adaptation measures at the local level.

Whereas in Rolpa, the local government seeks the opinion of knowledgeable individuals and stakeholders in relevant sectors during decision-making processes, budget allocation, and policy formulation. This indicates a participatory approach to governance and decision-making.

- **Absence of local climate change action plans:** The local government has not developed specific action plans such as the Local Adaptation Plan of Action (LAPA) at the municipality level to address the impacts of climate change. This indicates a lack of proactive measures and strategies to mitigate and adapt to climate change at the local level.
- **Limited awareness and training:** Local-level training and awareness programs on climate change and disaster management are initiated by different organizations rather than being led by the local government. The local government seems to lag in taking proactive measures to raise awareness and provide training on these crucial topics.
- **Information Flow and Coordination:** The local government receives future climate predictions from the provincial level, indicating an information-sharing mechanism to inform local decision-making. Additionally, the establishment of the Women and Children Department shows a commitment to addressing the concerns of the inclusive community.

- **Disaster Risk Reduction and Management Department:** In both districts, the local government has a dedicated Disaster Risk Management department at the municipality level, responsible for mobilizing human resources and emergency funds during disaster events. The local government also acts as a coordinator between different organizations operating in the community to prevent project duplication. Additionally, the local government decides the communities where new projects proposed by organizations are to be implemented.
- **Revenue collection:** In Dang, revenue is collected from land tax and land excavation activities happening in the community. This revenue is included in the overall budget and allocated to different sectors. And as per in Rolpa, the revenue ids only collected from the land tax. The land excavation tax is collected by province level and the tax in waste management have been removed by the local government.

In Rolpa, since the community is vulnerable to the fire the disaster reduction and management department and the Red Cross society, along with other organizations in the community, are mobilized for rescue and relief operations during the emergencies like fire. The emergency funds for such situations are allocated from the disaster reduction management department.

Overall, the local government in the community has certain structures in place for disaster management and coordination among organizations. However, there are areas that need further attention, such as formulating a Local Adaptation Plan of Action (LAPA) and enhancing awareness and understanding of national climate change initiatives among local government officials.

Improving the performance of the local government in addressing climate change and disaster management requires enhanced knowledge sharing, stakeholder engagement, and the development of specific action plans tailored to the local context. Strengthening the capacity of the local government and promoting transparency and accountability can contribute to more effective climate change adaptation and resilience-building efforts at the community level.

Capacity gap analysis in two municipalities:

The analysis reveals a capacity gap at the local level in terms of integrating national climate change commitments and policies into local development plans. The community and local leaders are aware that the nation has taken actions on climate change, but they lack a clear understanding of the specific commitments and subjects involved. This indicates a lack of effective communication and knowledge transfer between the national and local levels.

Furthermore, the formulation of Local Adaptation Plans of Action (LAPA) under the guidelines of the National Adaptation Program of Action (NAPA) is found to be absent in both municipalities. This highlights a significant gap in planning and implementing adaptation measures at the local level.

There is also a lack of awareness and inclusion of marginalized communities in the decision-making processes related to climate change. This exclusion further widens the gap between local needs and the action plans of the local government.

To address these capacity gaps, it is crucial to enhance communication and coordination between the national and local levels. The local government should actively engage with the community to understand their specific needs and concerns related to climate change. This can be achieved through capacity-building initiatives, awareness campaigns, and

participatory approaches that involve marginalized communities in decision-making processes.

Proper assessment and understanding of local needs, as well as the effective integration of national commitments into local development plans, are essential to bridge the capacity gap and ensure effective climate change action at the local level.

Conclusion:
The study reveals that the community is aware of the impacts of climate change on their daily lives, particularly in the agriculture and water resource sectors. They have witnessed changes in precipitation patterns, increased occurrences of new insects and crop diseases, depletion of water resources, and shifts in the flowering season of plants.

While the community has adopted various measures to cope with these changes, there is a concerning trend of ITLK being replaced by new modern technologies. The invaluable indigenous knowledge, passed down through generations, is gradually disappearing due to a lack of knowledge transfer and documentation. This poses a risk of losing essential traditional practices and sustainable adaptation approaches.

The extinction of ITLK can have significant consequences since it often encompasses locally adapted and resilient practices refined over time. Therefore, it is crucial to recognize, document, and preserve indigenous knowledge systems. Efforts should be made to promote a culture of knowledge sharing between generations and to integrate indigenous knowledge with modern scientific approaches to address the challenges faced by the community due to climate change.

By acknowledging and valuing indigenous knowledge, traditional knowledge, and local knowledge, communities can benefit from a more holistic and integrated approach to climate change adaptation that combines traditional knowledge with innovative solutions. Proper documentation and recognition of indigenous knowledge can contribute to its preservation and ensure its continued relevance and application in climate change mitigation and adaptation efforts

Summary with respect to LLA principles

LLA principle	Findings
Principle 1: Developing decision making to the lowest appropriate level	● Marginalized communities are not involved in the decision- making process, ● Absence of LAPA in the community level.
Principle 2: Addressing structural inequalities faced by women, youth, children, disabled and displaced people, Indigenous peoples, and marginalized ethnic groups	● The department of women and children and for disabled people is in the community to hear their voice ● The need and perspective of the disabled people are left unheard. ● The community with more reach is benefited from different government programs whereas the marginalized community are bereft from the services.
Principle 3: Providing patient and predictable funding that can be accessed more easily	● Emergency fund for the emergency condition is not available in the community, ● The community in case of the emergency must seek the loan from the co-operatives ● The disaster reduction and management department of the local government have

	the emergency funding and the funding is released under the initiation of the government in emergency condition.
Principle 4: Investing in local capabilities to leave an institutional legacy	● The community have adapted the climatic adaptive agriculture and irrigation method to cope up with the climate change. ● The community is currently depending upon the ground water system for the water resources which may dry up in the future, so more sustainable way of managing the water resources needed.
Principle 5: Building a robust understanding of climate change risk and uncertainty	● The general understanding of changing climate, have observed change in the weather condition recently ● Have adapted the climate adaptive agriculture technique in the initiation of Samunnati Project ● Heavy rainfall, increase in temperature, hailstorm, pest infestation, are the main climate change risk ● Some of the community might face the flood
Principle 6: Flexible programming and learning	● Awareness programs are done by organizations but is not have been initiated by the government ● The future weather condition prediction is informed to the local government by the province government.
Principle 7: Ensuring meaningful transparency and accountability	● The local government members seem to be lacked about the in-depth knowledge about the commitments, plans and policy of the nation in climate change sector. ● The local community are not enough satisfied by the work of local government ● Lack of transparency and accountability.
Principle 8: Collaborative action and investment	● The co-ordination is done between the different organization working in same sector by the local government ● The local government takes the authority to select the ward or community where the proposed project will be implemented.

Annex:

Figure 3 Resource Map Kumalgadi Farmers group

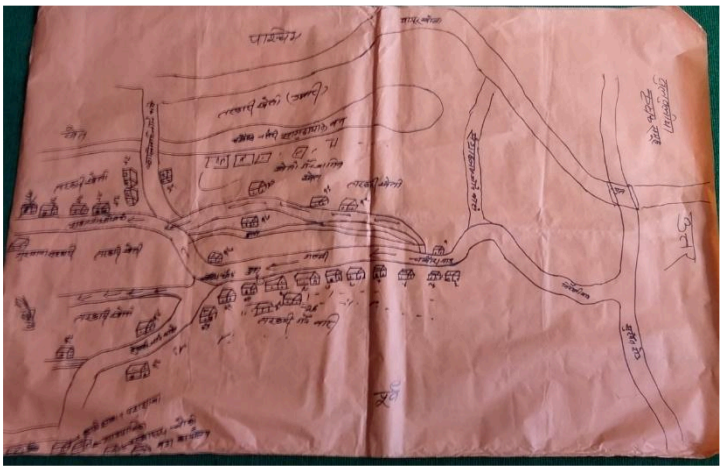


Figure 4 Resource Map of Bulbulaiya Farmers Group

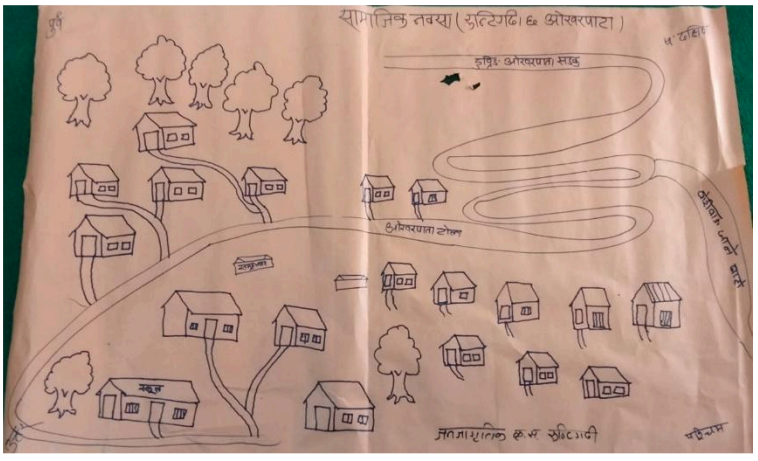


Figure 5 resource map janajagrit farmer group

Figure 6 resource map Sajha Farmer Group

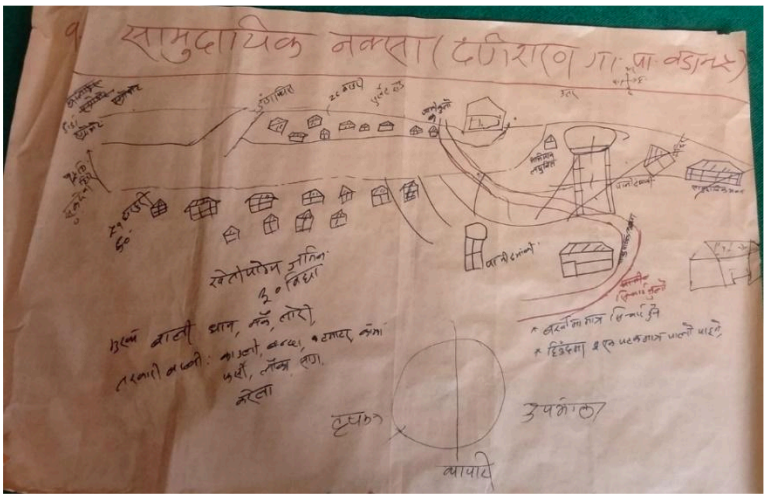


Figure 7 resource map of Laubasta Farmer Group

4.3 MCS-Vietnam

Contributed by: Dr Ho Ngoc Son, Thai Nguyen University of Agriculture and Forestry
Agriculture and Forestry Research & Development Centre for Mountainous Region with inputs from Dr.Binaya Raj Shivakoti, IGES

1. Background and Context

Van Ho district, situated in Son La province in Northwest Vietnam, is a predominantly mountainous area characterized by its rich agrobiodiversity and inhabited largely by ethnic minority communities. Local people and ethnic minority communities have developed complex agricultural systems rooted in Indigenous, Traditional, and Local Knowledge (ITLK) Systems. It possesses a rich reservoir of Indigenous knowledge related to agriculture, herbal medicine, agroforestry, and ecosystem stewardship.

The district faces high vulnerability to climate risks such as flash floods, landslides, and increasingly unpredictable rainfall. These challenges are exacerbated by limited adaptive capacity and a lack of integrated, locally led adaptation planning. Many interventions are maintained informally and are not integrated into commune development plans. There are fewer examples of cross-learning or systematic support for innovation and scaling. Robust monitoring tools to assess the effectiveness of local adaptation practices do not exist. Local communities have limited access to technical, institutional, and financial resources necessary for effective climate adaptation planning and implementation. Locally Led Adaptation (LLA) efforts must respond to these climate risks as well as build on and strengthen the local governance systems and institutional capacities that enable long-term adaptation.

Van Ho offers a unique opportunity to apply the principles of LLA in a way that is both inclusive and grounded in agroecological and cultural heritage. Van Ho was selected as a Model Case Site (MCS) to demonstrate the potential of Locally Led Adaptation (LLA) through the integration of Indigenous and scientific knowledge, participatory governance structures, and community-driven innovation. A structured capacity needs assessment and survey of existing adaptation interventions were conducted as the first step in developing LLA Innovation Hubs under the APN–IGES supported project. We emphasized co-learning, co-design, and co-ownership of adaptation planning processes through participatory approaches.

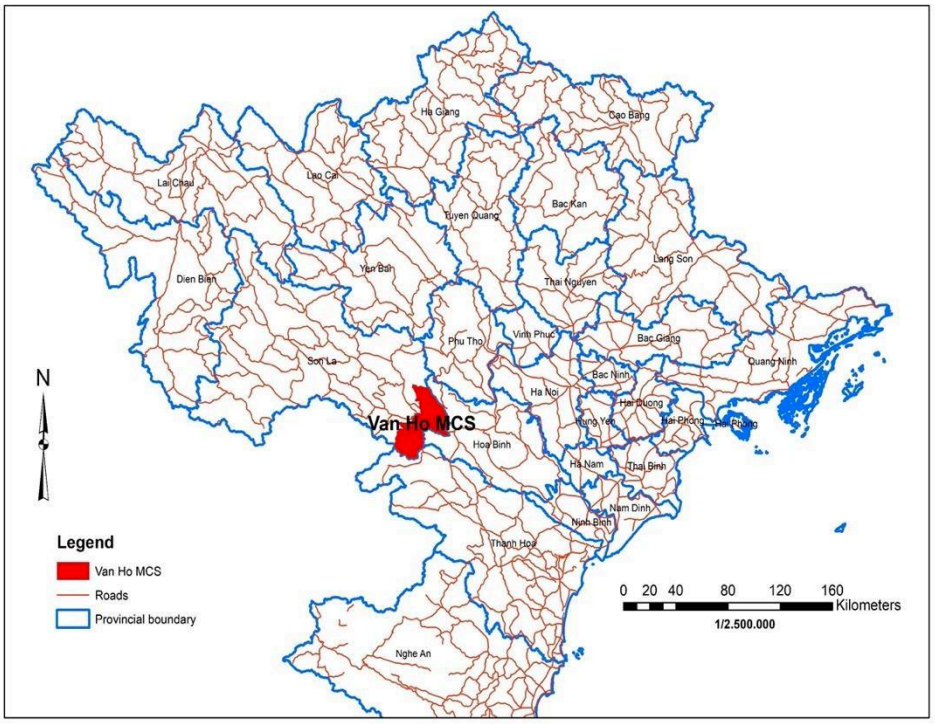


Figure 1: The map showing the location of Van Ho MCS

2. Activities and Findings

2.1 Establishment and Preparation of the MCS

Activities:

Initial Consultation: Discussions with commune officials, traditional leaders, cooperatives, village elders, women's groups, youth, and local leaders to identify priority climate risks, socio-ecological assets priorities, and cultural values. Surveys were carried out with 80 local households across 4 communes, complemented by FGDs with ethnic minority farmers and traditional knowledge holders, commune-level authorities and extension staffs, and women's unions, local cooperatives and community-based organizations, and youth groups.

Co-Design Workshops: Joint sessions to build consensus on adaptation actions, cultural priorities, and agroecological practices. Agreed with local partners on the institutional setup and objectives for the Innovation Hub.

Capacity Needs Assessment: Assessed capacities in four domains: (i) understanding climate risks, (ii) innovation capacity, (iii) adaptation implementation, and (iv) adaptation governance.

Conducted LLA Capacity Assessment Workshops engaging local actors including Commune People's Committees, Women's Union, Youth Union, and village elders, farmer cooperatives

and agroecological producers, representatives of Indigenous knowledge holders and herbal medicine practitioners, local NGOs and facilitators from the AGRITAGE Vietnam initiative. During the workshop, participants co-developed following tools with the help of conceptual foundation provided by the eight Principles of LLA and collected feedback for for practical usability.

Tool	Purpose
Community Vulnerability Mapping Guide	Identify local climate risks and capacities
Climate-Agrobiodiversity Calendars	Blend crop cycles with seasonal indicators
LLA Design and Evaluation Guide	Facilitate community-based reflection and planning

Piloting and Iteration: Implementation of selected practices in demonstration plots, with community feedback loops. Documented Indigenous, Traditional, and Local Knowledge (ITLK) practices (e.g., seed saving, climate signs, forest rituals, agroforestry), ,mapped existing and potential adaptation interventions such as indigenous weather prediction indicators, traditional cropping calendars and agroforestry practices, ritual-based land-use norms, community-led soil and water conservation techniques. The purpose was to refine the identified gaps, collectively define actionable solutions, and initiate a process for designing Locally Led Adaptation (LLA) interventions rooted in Indigenous, Traditional, and Local Knowledge (ITLK) systems.

Final Validation: Endorsement of the framework through a village meeting and agreement among stakeholders.

Main Findings:

While communities are highly aware of observable climate impacts (e.g., crop failure, shifting seasons), there is limited access to scientific information and interpretation support. Traditional forecasting methods are still widely used but increasingly perceived as less reliable due to changing climatic patterns. Youth and women expressed interest in learning about climate change but lack structured opportunities.

Local communities have shown significant innovation in areas like blending new crop varieties with traditional planting techniques, using local biodiversity (e.g., medicinal herbs, agroforestry trees) for climate-resilient farming. However, these innovations remain isolated and undocumented, and there is a lack of institutional support or platforms for sharing.

Implementation is constrained by limited technical knowledge, low access to funding, and lack of tools tailored to upland, ethnic contexts. Infrastructure for rainwater harvesting and erosion control is insufficient. Women, in particular, noted time and labor constraints limiting their participation in project implementation.

There is a weak integration of ITLK systems in commune-level climate and development plans. Decision-making is often top-down, with limited inclusion of farmers or traditional leaders in formal adaptation planning. Most commune leaders expressed interest in integrating locally led approaches into official strategies but lacked clear guidelines or training.

A Model Case Site (MCS) framework was co-developed and endorsed by the local community in Van Ho District, Son La Province. The framework is the result of a participatory process facilitated by project partners, aiming to integrate climate adaptation, cultural resilience, and agroecological transformation in a coherent and replicable model. It embodies the principles of Locally Led Adaptation (LLA) and builds on Indigenous knowledge systems, community values, and locally relevant innovations. There were four key aims of the MCS framework:

- Enhance local adaptive capacity to climate risks through tailored interventions.
- Preserve and revitalize ITLK and cultural identity.
- Promote agroecological practices for sustainable livelihoods and ecosystem resilience.
- Facilitate community leadership in planning, implementation, and knowledge sharing.

Following guiding principles were identified when co-developing the MCS framework

- Ownership and Participation: Community members are central actors, not passive beneficiaries.
- Hybridization of Knowledge: Combining Indigenous and scientific knowledge to develop context-specific solutions.
- Scalability and Flexibility: Framework is designed to be adapted for use in other upland ethnic minority regions.
- Sustainability and Livelihood Linkages: Ensuring that adaptation efforts generate tangible socio-economic co-benefits.

As a result, the MCS framework is organized around three integrated pillars:

Pillar 1: Climate Adaptation

- Risk Mapping and Seasonal Calendars: Community-led identification of key climate risks (e.g., flash floods, landslides) and their timing.
- Adaptation Practices: Diversified cropping, soil and water conservation, climate-resilient varieties, and early warning systems.
- Capacity Strengthening: Training for local adaptation planning, technical support, and institutional linkages with local government and research institutions.

Pillar 2: Cultural Resilience

- Revival of Indigenous and Local Knowledge: Documentation and intergenerational transmission of local ecological knowledge (e.g., herbal medicine, forest rituals, lunar-based farming calendars, community seed exchange and native seed preservation)
- Cultural Landscape Restoration: Protecting sacred forests, traditional water sources, and customary land-use zones.
- Youth and Women Engagement: Storytelling, rituals, and school-based activities to ensure cultural continuity and inclusion in adaptation.

Pillar 3: Agroecological Transformation

- Agroforestry and Mixed Farming Systems: Integration of local species in multistrata systems, composting and mulching using local biomass
- Sustainable Value Chains: Support for processing, branding, and market access for indigenous agro-products.
- Participatory Monitoring: Community-based monitoring of agroecological indicators using both traditional and scientific methods.

2.2 Synthesize and formulate a model of "Locally Led Adaptation"

Gaps and Barriers to LLA:

Participants identified several gaps and barriers to apply LLA principles. Those include, limited access to climate information and external funding, marginalization of ITLK systems in formal policy processes, low capacity for proposal development and technical implementation, and absence of frameworks for integrating local knowledge into commune plans. Following table summarizes key gaps and barriers as well as enabling actions to

overcome them were endorsed by community members and local authorities during the interactions.

LLA Principle	Identified Gaps and Barriers	Local Enabling Action
1. Devolved decision-making	Limited local authority in adaptation fund allocation and project design	Establish village-level adaptation committees
2. Inclusive participation	Marginalization of women and youth in formal planning processes	Target capacity-building for women's groups and youth
3. Accountability	Lack of transparent feedback mechanisms for adaptation outcomes	Set up small grant schemes within Local Adaptation Innovation Hubs
4. Flexibility and learning	Inadequate space for experimentation and adaptive management	Train local facilitators in climate communication and proposal writing
5. Local capacity strengthening	Limited technical training and weak access to extension services	Document and apply traditional calendars and agroecological practices
6. Collaborative governance	Disconnect between customary and formal governance structures	Use adaptive planning tools tied to seasonal variations
7. Patient and predictable funding	Short-term projects with little continuity or local control over resources	Develop community monitoring scorecards for LLA actions
8. Addressing structural inequalities	Land tenure insecurity and gender norms limiting participation	Facilitate farmer-to-farmer exchanges and learning camps

From the discussions, a set of priority adaptation interventions were identified. Many of these build directly on **ITLK** already in use but require support for scaling or formal integration. These include:

- Revitalization of **climate-agrobiodiversity calendars** combining traditional seasonal cues with scientific weather data
- Strengthening **agroforestry systems** using native species for soil conservation and slope stabilization
- Developing **herbal medicine trails** and **eco-learning farms** as part of agri-ecotourism and sustainable livelihoods
- Promoting **community seed banks** for local varieties with climate-resilient traits

- Piloting **women-led composting and circular farming enterprises** using traditional methods

In order to implement these priority adaptation actions an exercise was conducted to identify priority actions and lead actors as shown in table below:

Action Priority	Description	Lead Actors
1. Establish commune-level adaptation taskforces	Multi-stakeholder groups to coordinate local actions and decisions	Commune PCs, CSOs, village heads
2. Document and formalize Indigenous knowledge in planning	Integrate traditional calendars and farming practices into commune socio-economic development plans (SEDPs)	Elders, youth, district DARD
3. Create community-based monitoring and feedback systems	Develop visual and inclusive monitoring tools for adaptation outcomes	Youth groups, women's unions
4. Launch peer-to-peer farmer learning networks	Promote farmer-led extension models and agroecological practice sharing	Local farmers, mass organizations
5. Advocate for participatory budgeting	Engage community members in commune-level adaptation budget planning	CPCs, People's Councils, Women's Union

LLA Innovation Hub:

Based on above findings, a governance structures for the LLA Innovation Hub in Van Ho was co-developed which is grounded in community participation, cultural heritage, and agroecological principles. By integrating local voices, traditional wisdom, and the strategic objectives of AGRITAGE Vietnam, the resulting governance models are adaptive, inclusive, and capable of supporting sustainable, locally led climate adaptation and transformation. These methodologies not only provide a strong foundation for institutional sustainability but also serve as a replicable model for other upland and ethnic minority regions across Vietnam and Southeast Asia.

The LLA Innovation Hub is envisioned as a community-managed node to coordinate and support adaptation planning and innovation scaling, knowledge co-production and exchange (e.g., farmers + scientists), testing and incubating agroecological practices and ITLK-based

solutions, and facilitating access to micro-grants, climate finance, and public-private partnerships.

The hub will have multiple functions. It hosts as climate adaptation and agroecology demonstration sites, run youth training programs (eco-guides, farm managers), showcase indigenous food and herbal knowledge for ecotourism, or acting as a local clearinghouse for climate information and action.

A tiered structure was proposed for the operation of the hubs. At the village level, it manages day-to-day planning, knowledge sharing, outreach and problem solving as an innovation committee. Further, Commune Coordination Team will help connect multiples villages, links with local government and external stakeholders (such as NGOs), An advisory panel is suggested to include researchers, elders and knowledges holders of ITLK, youths, and women representatives. This tiered structure ensures that decision-making is guided by consensus, gender equity, and integration of local and scientific knowledge.

LLA Innovation Hub as a value addition to AGRITAGE Vietnam

The proposed LLA Innovation Hub in Van Ho, Son La is not only a strategy for climate adaptation but also a transformative mechanism aligned closely with the broader objectives of preexisting AGRITAGE Vietnam initiative. These hubs serve as a foundational pillar in actualizing the vision of AGRITAGE Vietnam, which seeks to revive agricultural heritage, promote sustainable and circular livelihoods, and build climate resilience through agroecological transformation. The synergies between the hub and AGRITAGE Vietnam are multi-dimensional, cutting across Indigenous knowledge revival, nature-based solutions, agri-ecotourism, and inclusive development. This section below elaborates on these critical linkages.

- Revitalizing Indigenous Knowledge for Resilient Farming: One of the central contributions of the hub is the systematic documentation, validation, and revitalization of ITLK systems that have evolved over generations in Van Ho. These systems, ranging from seed saving, land management, to weather forecasting, form the backbone of traditional agroecosystems. The hub function as **learning and experimentation spaces** where such knowledge is not only preserved but actively applied in the design of adaptation interventions. Such activities could be such as

curating **seasonal calendars** based on local climate indicators (e.g., flowering cycles, animal behavior), recording Indigenous methods of **soil fertility maintenance** through intercropping and organic composting, or reintroducing **forgotten crop varieties** and native species with climate-resilient traits. This aligns directly with AGRITAGE Vietnam core objective of conserving biocultural diversity, recognizing that climate resilience is embedded not just in technologies, but in the continuation and adaptation of Indigenous knowledge practices. By bridging ITK with scientific approaches such as integrating traditional flood indicators with digital early warning systems, the hub offers hybrid adaptation models that reflect the lived realities of ethnic minority farmers.

- Supporting Nature-Based Solutions (NbS) Through Local Stewardship: NbS form a critical pathway for climate adaptation, biodiversity conservation, and ecosystem restoration in mountainous regions like Van Ho. The hub helps translate the concept of NbS into context-specific community actions rooted in local stewardship traditions. Key examples include, **a**groforestry systems using native tree species for slope stabilization, soil erosion prevention, and income generation, **w**etland and water source protection through traditional taboos and spiritual beliefs that restrict over-extraction, or use of living fences, contour planting**,** and indigenous mulching techniques to enhance water retention and soil health. The hub supports communities in revaluing and institutionalizing these practices as part of formal adaptation planning. Committees within the hubs could be trained to monitor ecological indicators, track changes in biodiversity and land use, or organize collective actions (e.g., forest replanting days, composting drives). This operationalizes AGRITAGE Vietnam's goal of applying regenerative, low-emission land management systems that are informed by both cultural practice and ecological science. Moreover, by embedding these actions into governance structures, the hub reinforces custodianship roles of local communities, ensuring NbS are maintained over time and scaled sustainably.
- Promoting Community-Based Agri-Ecotourism: agri-ecotourism is a cornerstone of AGRITAGE Vietnam, linking cultural identity, food heritage, biodiversity conservation, and economic diversification. The hub serves as incubators for such models, positioning traditional agricultural systems not just as sources of subsistence, but as learning landscapes and experiential tourism assets**.** Key Agri-Ecotourism Activities Linked to the hub could be:

- Herbal Medicine Trails**:** Guided walks showcasing traditional medicinal plants, their cultivation, processing, and spiritual uses—guided by trained local youth and elders.
- Organic Food Processing Demonstrations**:** Community events and tourist packages that allow visitors to experience the making of traditional dishes, teas, or fermented foods using native ingredients and eco-friendly methods.
- Farm Stay and Landscape-Based Storytelling**:** Immersive experiences where visitors stay with farming families, participate in seasonal activities (planting, harvesting), and learn about the myths, songs, and stories associated with the land.
- Providing training in eco-guiding, safety protocols, and hospitality
- Creating partnerships between communities and external tour operators or cooperatives
- Ensuring cultural integrity and ecological limits are respected through locally developed tourism codes of conduct

Through this, the hub could help diversify rural income while reinforcing the value of local traditions and sustainable land management—creating a virtuous cycle of conservation and economic empowerment.

- Empowering Women and Youth in Value-Added Production and Climate Education: AGRITAGE Vietnam strongly emphasizes the need for gender-sensitive and youth-inclusive transformation of food systems. In upland areas like Van Ho, women and youth have historically held significant roles in food production, herbal medicine, seed keeping, and storytelling. However, formal governance and adaptation planning often overlook their leadership potential. The hub actively restructure participation frameworks to center women and youth as change agents, ensuring their contributions are visible, resourced, and institutionalized. The hub could empower women and youths through following pathways:
  - Women-Led Enterprises: Support for processing, branding, and marketing of traditional products like Shan tea, fermented bamboo shoots, herbal cosmetics, and medicinal oils.
  - Youth Eco-Leaders: Capacity-building programs training young people as eco-guides for tourists and school groups, digital communicators who document local climate signs and adaptation efforts, and community

facilitators for workshops on climate education, storytelling, and agrobiodiversity

- Cross-Learning Networks: Exchange visits, internships, and peer-to-peer mentoring supported by LAIHs, linking youth from Van Ho with other model sites in Vietnam or regional GIAHS landscapes.

This intentional focus on inclusion reinforces Agritage Vietnam's objective to build a new generation of custodians who are culturally grounded, economically resilient, and environmentally conscious.

3. Outcomes and Impacts

- **Community Ownership**: Local stakeholders gained capacity and confidence to lead climate adaptation planning using tools co-developed in their own language and context.
- **Knowledge Integration**: Successful examples of ITLK and scientific knowledge working in synergy (e.g., climate-agrobiodiversity calendars).
- **Institutional Innovation**: Establishment of Innovation Hub structures embedded in existing cooperatives and commune development planning processes.
- **Youth and Women Empowerment**: Youth served as eco-guides and digital mappers, while women led value addition (e.g., herbal processing and marketing).
- **Policy Relevance**: Methods and processes were aligned with national adaptation planning and sub-national NDC implementation pathways.

4. Lessons Learned

Key lessons learned from MCS project highlight the importance of inclusive, context-sensitive, and sustainable approaches to climate capacity building. Meaningful participation through co-creation with local communities, especially women, youth, and ethnic minorities, proved essential in fostering ownership and ensuring that tools and knowledge are practical and relevant to real-world needs. In terms of governanc**e**, harmonizing traditional community structures with formal administrative systems enhanced both legitimacy and effectiveness in implementation. The use of visual and multilingual tools significantly increased accessibility and understanding, especially in ethnically diverse areas

with varying literacy levels. For scaling and replication, modular and adaptable training formats allowed successful activities to be extended to other upland regions with similar socio-ecological conditions. Finally, integrating climate adaptation with livelihood opportunities and ecotourism emerged as a key pathway to sustainability, as it mobilized community investment, incentivized long-term engagement, and linked learning with tangible benefits.

5. Conclusion and Recommendations

The project has successfully established the groundwork for a localized, inclusive, and scalable adaptation governance model rooted in Indigenous knowledge, agroecology, and community innovation. By linking climate resilience with agricultural heritage and community-based ecotourism, the Local Adaptation Innovation Hubs in Van Ho offer a practical and culturally grounded approach to climate action. These hubs not only empower local actors—especially women and youth—but also align with national climate goals and global sustainability frameworks. As dynamic centers for learning, stewardship, and livelihood development, they hold strong potential to be replicated across upland regions in Vietnam and similar contexts globally.

This project has successfully demonstrated that Locally Led Adaptation (LLA) can be effectively localized, inclusive, and culturally grounded by positioning communities as central actors—planners, knowledge holders, and innovators. The Van Ho Model Case Site (MCS) now operates as a functional pilot site equipped with a robust governance structure, enhanced human capacity, and practical tools for ongoing adaptation planning and implementation. To build on this success, it is recommended to replicate the model in other upland districts with strong Indigenous and Traditional Local Knowledge (ITLK) systems. Engaging provincial policymakers is also crucial to integrate the Capacity Building Package (CBP) and tools and guides into official climate policy instruments and Nationally Determined Contribution (NDC) action plans. Furthermore, supporting resource mobilization through proposal-writing clinics and improved access to climate finance will empower communities to drive their own adaptation initiatives. Below are the recommendations:

1. Develop Community-Friendly Climate Risk Communication Tools to bridge the gap between scientific forecasts and local interpretation needs.
2. Support Innovation Platforms within LLA Innovation Hubs **by c**reating structured spaces where local innovators, women, and youth can co-develop and share adaptation ideas.

3. Strengthen Technical and Financial Capacities by providing hands-on training and small-scale grants to test and implement solutions at the farm and community levels. While Indigenous knowledge systems and community-based innovation provide a strong foundation, there are clear needs in governance, technical skills, and institutional support. These findings will directly inform the co-development of tools, training modules, and governance frameworks for the LLA Innovation Hubs ensuring that adaptation efforts are locally rooted, culturally relevant, and scalable**.**
4. Mainstream ITLK into Planning and Policy by developing templates and planning tools to help commune leaders integrate Indigenous practices into local adaptation and disaster risk reduction plans.

Annex. Some photos of project activities

Figure 1: A local woman presenting group discussion

Figure 2: Group discussion with villagers at MCS

	
Figure 3: VAC (Home garden, Fish pond and livestock barn) model as a nature-based solution to climate change at the MCS	Figure 4: Training on circular agriculture principles and practices for farmers