Synthesis Report 2024 on Co-designing Agroecology Innovations for Lao PDR

INITIATIVE ON Agroecology

CGIAR

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Abstract

The agroecology living landscape (ALL) in Attapeu province, Lao PDR, represents a significant initiative aimed at promoting agroecological transitions through innovative water management, crop diversification, and community-driven practices. Situated in the southern part of Laos, Attapeu is characterised by a diverse landscape, whose population is primarily engaged in subsistence farming. This report explores the implementation of key agroecological practices within two primary sites in the province: Ban Inthee and Nong Lom. In 2023, six key initiatives were identified that could support both environmental and socioeconomic sustainability in the region: i) solar powered groundwater pumping; ii) rice-fish systems; iii) organic red-rice cultivation, iv) wetlands management; v) soil improvement, and vi) gender action learning. This report details the methods used to implement these initiatives, highlighting the importance of participatory approaches and collaboration with local communities. The report then evaluates the results of these initiatives, and their contribution to key agroecological principles including diversity, efficiency, resilience, and cultural relevance. The outcomes demonstrated positive environmental impacts, including improved soil health, enhanced biodiversity, and more efficient use of water resources. Socially, the initiatives empowered women and fostered inclusive decision-making, while economically, they contributed to food security and diverse livelihoods. The report concludes with recommendations for scaling up these practices, emphasising the need for infrastructure investment, capacity building, and long-term monitoring to ensure sustainability.

Contents

1. Introduction

The Agroecology Living Landscape (ALL) in the southern province of Attapeu, Lao PDR, spans ten villages within the Samakhixay and Sanamxay districts (Figure 1). Attapeu province, which borders Vietnam and Cambodia, covers an area of 10,320km2 and has a population of 160,000. The region is characterised by a diverse landscape, which includes rivers, streams, wetlands, lowland floodplains, and mountainous areas that provide spring water for nearby communities. The local population is ethnically diverse, with minority groups primarily engaged in subsistence farming. The majority of farm households practice rainfed rice farming integrated with fish trap ponds, while off-season activities include the cultivation of cash crops such as cassava or seasonal labour on banana and sugarcane farms. The district also has abundant fisheries and aquaculture resources.

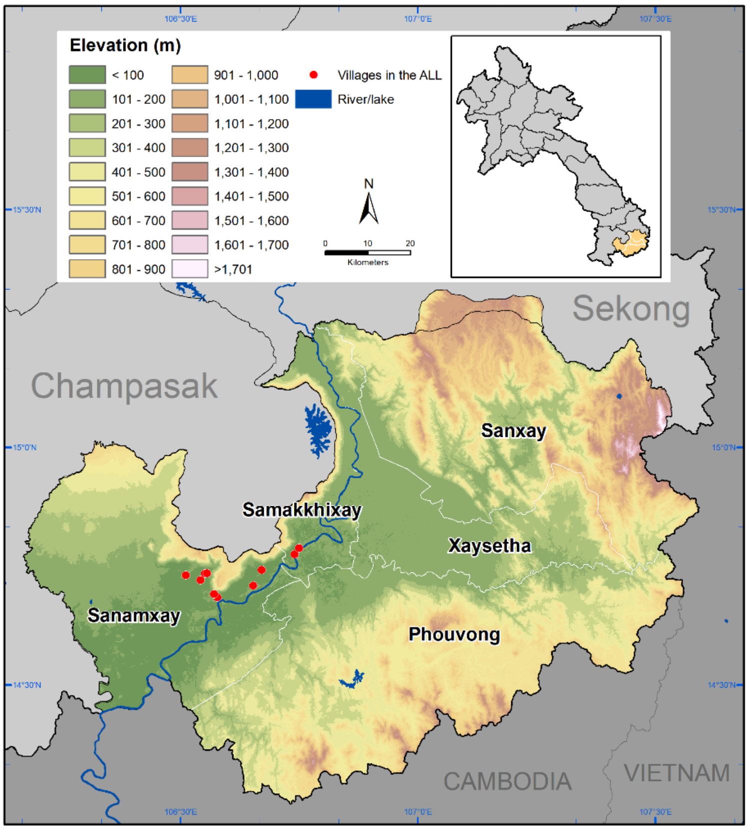


Figure 1: The location of the Attapeu ALL in Laos. (Data source: modified and adjudged from the MRC's data by IWMI-Laos)

The Attapeu ALL is an initiative aimed at fostering agroecological transitions through innovative practices in water management and crop diversification. Located across two adjacent districts, the ALL includes two primary sites: Ban Inthee, a floodplain area with integrated rice-fish culture, and Nong Lom, near a natural lake, where fishing and irrigated rice cultivation are central practices. Water resources and rice cropping systems are central to the landscape's agricultural activities, and integrated wetlands management plays a key role in shaping these systems.

In late 2023, an AEI team was established to address pressing agricultural, environmental, and social challenges in the Attapeu ALL. The team's efforts centred on understand and diagnosing the diversity of agricultural practices, and the needs of vulnerable communities in low-income areas. Through a series of co-design workshops, four key agroecological initiatives were identified that could support improved environmental and socioeconomic outcomes in the region. These included: i) solar pumping of groundwater; ii) rice-fish system irrigation; iii) organic red rice growing; and iv) wetlands management. Additionally, soil analysis and improvement and gender action learning were identified as key principles to ensure successful and equitable outputs from agroecology initiatives.

The initiatives have contributed to the Attapeu ALL's environmental sustainability and socioeconomic stability. Where implemented, solar pumping systems provided reliable water sources and supported irrigation. Rice-fish systems improved land and water efficiency, boosted food security, and offered additional income. Organic red rice growing increased yields, while wetland management ensured sustainable water and fish habitats. Soil analysis highlighted the benefits of diversified farming systems in improving soil fertility. Finally, gender action workshops empowered communities to address inequalities and promote inclusive development.

The initiatives align with the 13 principles of agroecology, evaluated against the Characterization of Agroecological Transitions (CAET) framework, as described by Mottet et al. (2020). The initiatives excelled in areas such as diversity, synergies, efficiency, recycling, resilient, and cultural relevance. The introduction of integrated rice-fish systems, organic red rice cultivation, and diversified cropping patterns significantly boosted biodiversity and ecological balance. These practices also fostered social diversity, with gender-inclusive governance mechanisms ensuring equitable participation. Synergies between ecological and socioeconomic systems were evident, with rice-fish systems combining ecological pest control with enhanced soil fertility, and wetland management supporting fish migration and ecological connectivity.

The use of solar-powered groundwater pumps and the reduction of chemical inputs enhanced efficiency, eliminating energy costs and reducing dependency on external resources. Nutrient recycling, such as using fish waste for fertilization, played a critical role in sustainability, while diversified cropping systems promoted organic matter cycling. Resilience was strengthened through diversified income sources and community-driven governance structures that reduced vulnerability to environmental and economic shocks. Furthermore, the promotion of organic red rice supported local food traditions, while participatory approaches such as the Gender Action Learning Systems aligned with cultural values of inclusivity and community collaboration.

The successful implementation of these initiatives provides valuable insights for future scaling and adaptation. Key lessons learned include the importance of infrastructure investment, capacity building, strengthening local seed systems, and long-term monitoring and adaptive management. Future recommendations focus on expanding wetland management, improving soil health, and incorporating gender-sensitive approaches to encourage broader adoption of climate-smart agricultural practices. These efforts will enhance the sustainability and resilience of farming systems, ultimately improving livelihoods for rural communities in Attapeu and beyond.

2. Process and Steps Followed for Co-designing Innovations

2.1 Consolidation of the Co-Design Team and Initial Focus

In late 2023, a functional Agroecology Initiative (AEI) team was established to address pressing agricultural, environmental, and social challenges in Laos. The team's early efforts primarily centred on understanding and diagnosing the diversity of agricultural practices and systems at the watershed level. Recognising the immediate needs of vulnerable communities in low-income areas, the team initiated a co-design process to identify and implement agroecological technologies that could effectively address these challenges.

2.2 Co-Design Process Overview

The co-design process in Laos comprised a participatory, collaborative approach to tackling agricultural and environmental challenges. It brought together diverse stakeholders to develop innovative, sustainable solutions tailored to the local context. By focusing on inclusivity, the process also aimed to ensure equitable outcomes for the rural communities engaged in AEI technologies. Visioning was a central and iterative process in creating the ALL in Attapeu province. Visions were developed through a series of collaborative steps that engaged multiple stakeholders including producers, private sector actors, policymakers, government officials, and technical experts (Figure 2). This process emphasised consultation, inclusivity, and alignment with local contexts. Below we list key activities included in the visioning process.

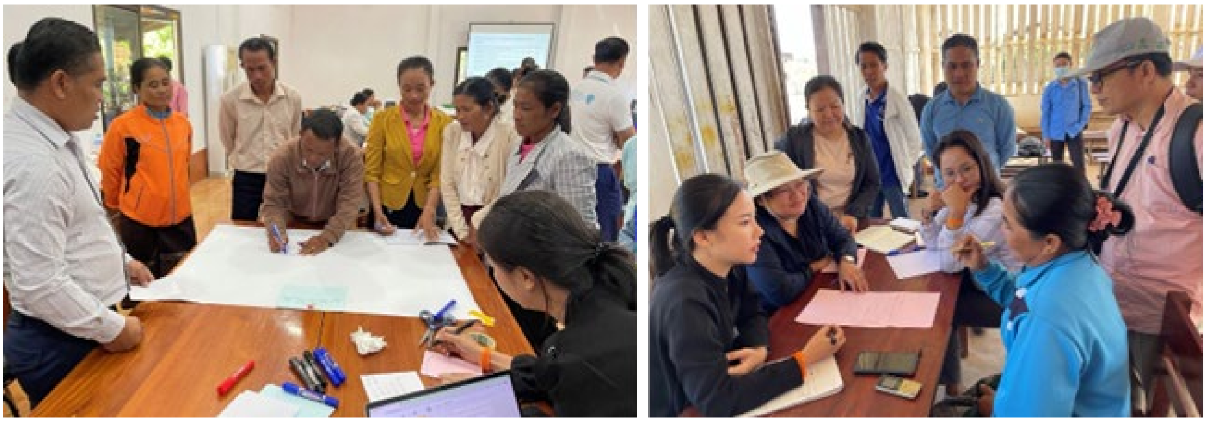


Figure 2: Visioning exercises attended by Attapeu ALL stakeholders during the inter-provincial consultation workshop co-hosted by NAFRI, the 1CG team and the Laos Farmers Network in Attapeu region.

Key Activities in the Visioning Process

Stakeholder Mapping and Initial Engagement: The National Agriculture and Forestry Research Institute (NAFRI), in partnership with international organisation (CIAT, IWMI, and

WorldFish), conducted a feasibility study across four southern provinces (Attapeu, Champasak, Salavanh, and Sekong). This study identified agroecology stakeholders, food system across, existing policies, market mechanisms, and platforms already in place.

Planning and Design Workshops: A planning session held in Vientiane involved NAFRI and the international team (1CG) identifying tools, approaches, and partnerships. Roles and responsibilities were clearly defined among stakeholders to streamline collaboration.

Follow-Up Virtual Sessions: Regular virtual sessions allowed teams to adapt methods and agendas to the local context, incorporate feedback, and identify new stakeholders and food system actors.

Participation in National Events: Team members attended national events such as a Theory of Change workshop hosted by Groupe de Recherche et d'Échanges Technologiques (GRET) under the Agroecology and Safe Food System Transitions (ASSET) project, and a Green Growth Forum organised by the Ministry of Planning and Investment, WorldBank, and Global Green Growth Institute. These events informed the codesign process by integrating broader policy insights.

Field Visits and Local Consultations Multiple site visits were conducted to key locations, including the Green Earth Centre (GEC) and Indochina Development Partners (IDP) in Salavanh Province. These visits provided an on-the-ground perspective of existing agricultural practices and market dynamics. A further site visit to Attapeu province was held where field observations, semi-structured interviews and group discussions were applied to further understand the ALL context (Figure 3).

Figure 3: Consultation meetings with key agroecology stakeholders including food producers, private sectors, government departments, research institutions, policy, and decision makers during feasibility studies in Laos.

The visioning exercise culminated in a multi-stakeholder consultation event co-hosted by NAFRI held in Attapeu Province. Participants, including farmers, private sector actors, government officials, and technical experts, collaboratively developed a preliminary 10 year vision for the Attapeu ALL. Tools such as SWOT analysis, stakeholder mapping, focus group discussions, and interviews were used to identify priority interventions and actionable steps described in section 2.3.

2.3 Selected Agroecological Technologies

The co-design process resulted in the selection of experiments with four agroecological technologies. These included:

1. **Solar Pumping of Groundwater**
2. **Integrated Rice-Fish System Culture (IRFC)**
3. **Organic Red Rice Growing**
4. **Wetlands Management**

Table 1 details the domain of focus, key agroecological principle, origins and methods used for implementing each of these technologies.

Table 1: The agroecological domain, principles, origins and methods used for project initiatives.

Technology	Domain	Key Principles	Origin	Method
Solar Pumping of Groundwater	Renewable energy, water management, dry season crops / productivity, and household water consumption	Input reduction, economic diversification	Codesign	*Not an actual experiment*, but solar pump specifications were codesigned and provided to private providers + survey conducted, implementation underway
Integrated Rice-Fish Culture	Integration crop-animal, resource efficiency, production, nutrition, soil fertility	Economic diversity, input reduction, biodiversity, diets	Co-design	*Experiments designed, composite – statistical design, implementation underway.*
Organic Red Rice Growing	Productivity, soil health	Economic diversity, input reduction, diets	Co-design	30 demo plots (10.16 ha each) of red rice managed with organic manure and no chemical inputs. No design per se at this initial stage.
Wetlands Management	*Natural resource management*	*(Participation)*	*Not applicable*	*No experiment yet. Diagnosis survey: drone mapping + truth-grounding of wetlands, landscape/habitat connectivity; Monitoring of water abstraction underway*

Additional agroecology initiatives conducted during the project cycle included i) soil analysis and improvement, and ii) gender action learning. Across all activities, significant emphasis was placed on training farmers and stakeholders to ensure effective implementation, adoption, and sustainability. The following sections provide an overview of these initiatives in relation to their underlying rationale, objectives, activities, and methods for implementation. Detailed documentation of initiative activities is provided in

Appendix 2, while Appendix 3 details the intervention's adherence to the 13 principles of agroecology. Appendix 1 provides a list of documents related to co-design and outputs documents from the project, including field reports, working papers, and fact sheet/briefs.

2.3.1 Solar Pumping of Groundwater

Laos faces significant seasonal fluctuations in water availability, with acute water scarcity, during the dry months of March and April. This scarcity severely impacts agriculture and daily life, especially for rural communities. This initiative focused on introducing solar-powered groundwater pumping systems to address water scarcity for farming, domestic, and school consumption. The key objectives were:

- Promote renewable energy use as a sustainable water management solution.
- Improve water availability for dry season crop productivity.
- Reduce input costs and support economic diversification.
- Foster community-managed water resources for long-term sustainability.

The initiative employed a mixed-methods approach, integrating participatory community engagement and technical interventions to address water management practices. Community consultations were held to co-design groundwater wells equipped with solar-powered pump systems and water tanks, ensuring sustainable water access. To monitor groundwater conditions, automatic groundwater level data loggers and water quality monitoring systems were installed. A field survey was conducted to assess the connectivity between wetlands and groundwater systems, providing insights for improving water management. Groundwater user groups were established through inclusive participatory processes that accounted for gender and ethnicity. Additionally, co-designed dry season vegetable trials were initiated using solar powered irrigation systems to explore the potential for cultivating crops during the dry season.

2.3.2 Integrated Rice-Fish Culture

Rural communities in Attapeu Province often face challenges in improving agricultural productivity, enhancing nutrition, and achieving economic diversification. Traditional farming systems which rely on resource intensive practices struggle to address key agricultural issues, such as soil fertility. Integrated rice-fish culture offers a sustainable alternative by combining rice cultivation with fish farming. This practice uses rice as the primary crop and fish as an additional food and income source, promoting land-use efficiency and waste recycling.

The primary objectives of the IRFC initiative included assessing its potential to:

- Increase the availability and value of nutritious food for rural households.
- Evaluate the sustainability of IRFC systems by quantifying benefits in terms of food diversification, improved soil fertility, and reduced reliance on external inputs.
- Scale RFC to other farmers in Attapeu.
- Support farmers in achieving economic diversification and self-sufficiency.

The initiative employed a participatory approach to implement and evaluate IRFC. Activities were organised into three key phases: co-design, implementation, and monitoring. The co-design and implemented phases focused on selecting suitable fields and constructing fish trenches. Practical training was provided on producing fish feed and reducing input costs. In the monitoring phase, fish and rice growth were tracked, with data collection templates and technical support provided to farmers. Data analysis was conducted to assess crop yields, food diversification, and the potential for scaling to other regions.

2.3.3 Organic Red Rice Growing

The cultivation of organic red rice was introduced to enhance agricultural productivity, improve soil health, and promote dietary diversity. The initiative aimed to reduce dependency on chemical input and foster economic diversity by using organic farming methods. The Attapeu ALL, with its low organic carbon content and soil compaction faces challenges in traditional rice cultivation. In response, a short-growth variety of red rice was introduced to increase yield while requiring minimal fertiliser. The initiative also focused on capacity building for farmers through knowledge exchange and technical support.

The primary objectives of this initiative included:

- Increase agricultural productivity by improving soil health and reducing the dependency on chemical inputs.
- Enhance dietary diversity and improve nutrition through the promotion of red rice as a nutritious food source.
- Promote economic diversification by introducing a high-value crop that can be sold at a higher price than traditional rice.
- Improve soil fertility and reduce compaction through organic farming practices.
- Strengthen community-based farming knowledge and practices to promote sustainable agricultural techniques.

The concept of red rice was introduced through farmer consultations, and suitable participants selected. In the implementation phase, 30 demonstration plots were established using organic practices, and farmers cultivated red rice with manure-based fertiliser. Training sessions were held and focused on rice planting techniques, organic fertiliser, and cost management with 115 participants trained. The monitoring phase involved farmers tracking crop yields, input use, and economic outputs, with regular visits by project staff. Data collected was analysed to assess the initiative's success and inform recommendations for scaling to other regions.

2.3.4 Wetland Management

The sustainable management of wetlands is critical to supporting local livelihoods in the Attapeu ALL. This initiative focused on improving wetland management through natural resource planning and participation, aiming to enhance habitat connectivity and promote sustainable water use. By engaging local communities and stakeholders, the initiative aimed to map the wetland ecosystems and develop an inclusive management plan that addressed both ecological and socioeconomic concerns.

The primary objectives of this initiative were:

- Improve the sustainability of wetland ecosystems by promoting effective water management and habitat connectivity.
- Enhance community involvement in resource management through participatory processes.
- Develop a comprehensive, demand-led management plan for the wetland informed by local knowledge and needs.
- Engage relevant stakeholders to identify critical components of the food system for innovation and resource management.

To map the wetland, a survey with drone mapping and ground truthing assessed habitat connectivity, identified wetland areas, and monitored water abstraction to inform sustainable management. A participatory approach was used to develop the wetland management plan, involving co-design teams and key stakeholders like government, non-government actors, and local communities. Stakeholder engagement identified management objectives, balancing conservation with community needs. Ongoing monitoring of wetland conditions ensured the effectiveness of management actions, with ongoing support for stakeholders in adapting the plan.

2.3.5 Soil Analysis and Improvement

In Attapeu ALL, soil degradation is a growing concern, particularly in areas used for paddy rice and cassava cultivation. Soil health is critical for maintaining agricultural productivity and supporting sustainable farming practices. However, intensive monoculture systems, such as those used for rice, often result in reduced soil quality, affecting key indicators such as organic carbon, microbial biodiversity, and soil porosity. This initiative aimed to diagnose the level of soil degradation in those fields and assess the impact of agroecological practices on soil health.

The primary objectives of this initiative were:

- Diagnose the level of soil degradation in paddy rice and cassava fields by analysing soil quality indicators, with a focus on microbial biodiversity and physical properties, and compare these with non-cultivated systems which are assumed to have optimal soil conditions in this specific environmental context. (first sampling campaign across 29 fields at two soil depths: 0-5 and 15-20 cm)
- Evaluate the impact of diversified agroecological systems on soil organic carbon (SOC) content as a key indicator of soil health (second sampling campaign (within the HOLPA survey) across 491 fields at on soil depth: 0-20 cm)

This initiative involved extensive soil sampling and analysis across different agricultural systems at the landscape level to establish a baseline on soil health by assessing a set of key indicators (carbon, microbial diversity, compaction levels, …). Initially, a total of 174 soil samples were collected from paddy rice,cassava fields and non-cultivated areas in Sanamxay and Samakhysay districts at two depths (0-5cm and 15-20cm) from 29 fields. From these samples, we analysed the diversity of soil microbial communities along with the physical and chemical soil properties. Additionally, we collected 570 additional soil samples in diversified systems versus monoculture systems to assess soil organic carbon (SOC) under the HOLPA survey. For this sampling, the agroecology assessment focused on comparing diversified production systems to monoculture using soil organic carbon as a key indicator of soil health. A total of 491 SOC data points were collected from 8 villages, with SOC content measured in December 2024 using the loss-by-ignition method at the DALAM lab in Vientiane.

2.3.6 Gender Action Learning

In May 2024 a gender workshop was organised, and interviews were conducted to explore gender roles and norms in relation to the adoption of new technologies and climate resilience. This work is part of a broader effort to integrate gender equality and social inclusion into agroecological initiatives. The initiative aims to address the gender dynamics in rural communities, particularly in how men and women are involved in decision-making.

The main objectives of the research were:

- Explore how people learn about new technologies and the best ways to support their adoption and management.
- Understand how men and women are involved in decisions regarding the adoption of new technologies.
- Examine gender norms within selected ethnic communities in Lao.
- Contribute to better gender equity and social inclusion in agroecological practices.

This initiative focused on communities in Samakhyxay and Sanamxay districts in Attapeu ALL. The 'Resilience Pathways Conceptual Framework' developed under the CGIAR Initiative on Gender Equity (HER+) was field tested during workshops in several communities.

3. Key Results Obtained

The following sections document key results across the six different agroecological initiatives as described in Section 2.

3.1. Solar Pumping of Groundwater

Groundwater wells were successfully constructed in four villages, each equipped with solar-powered pump systems, water tanks, and groundwater level monitoring systems (Figure 4). The following key outcomes were observed in relation to environmental and socioeconomic benefits:

Environmental:

- Wells helped to address climate variability and prolonged drought periods, supplementing rainfed agriculture and ensuring more consistent water access for farming.

Social:

- Reliable water sources were established for both domestic use and crop irrigation.
- Water user groups were formed, strengthening community governance structures and enhancing quality of life, particularly by reducing the water collection burden on women and young girls.

Economic:

- By incurring zero electricity costs, the solar powered systems provided a cost-effective solution for rural households.
- The ability to cultivate subsistence vegetables year-round contributed to household food security and economic stability.

Figure 4: Solar powered pump system and water tank installed in trial village in the Attapeu ALL.

3.2. Integrated Rice-Fish Culture

Integrated rice-fish culture systems were implemented across seven plots in the Attapeu ALL, significantly improving food security, nutrition, and economic stability for farmers. The approach enhanced land and water use efficiency, increased productivity per unit of land, improved soil fertility, and reduced pests. Key environmental and socioeconomic results included:

Environmental:

- The practice helped reduce the use of chemical fertilisers and pesticides. Fish waste naturally fertilised the rice fields, and fish (such as the silver barb) controlled pests and aided in soil plowing, promoting healthier ecosystems (Figure 5).
- Compared to traditional monoculture for rice farming, rice-fish plots yielded higher production (Table 2). Although the initial investment was higher due to infrastructure setup, the system required less financial input in subsequent farming cycles, with only minor maintenance of irrigation channels needed.

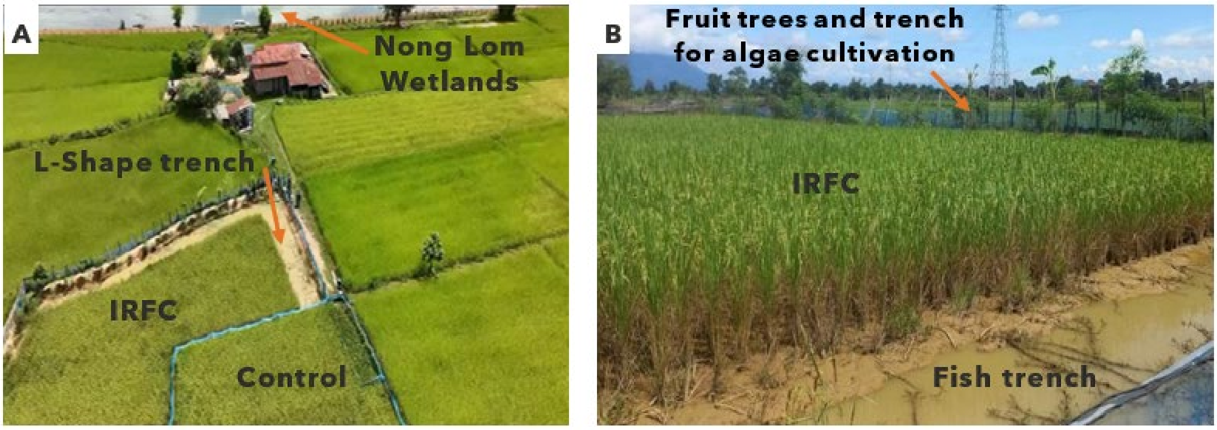


Figure 5: A) General View of the plot at the Hom Village at the vicinity of the Nong Lom with the L shape of fishpond trench, the IRFC and Control plot. B) IRFC plot with fruit trees at the

Table 2: Differences in rice yield production using monoculture and rice-fish systems.

Plot_ID	Name of farmer	Planted Area (sqm)	Before IRFC Yield (kg)	After IRFC Yield (kg)	Control plot Yield (kg)
Trail 01	Mr. Bounnoy	1,875	280	400	280
Trail 02	Mr. Wethong	875	No rice was planted	200	220
Trail 03	Mr. Thongsouk	700	80	70	70
Trail 04	Mr.Khamloun	1,750	No rice was planted	90	50
Trail 05	Mr. Bounserm	1,200	No rice was planted	200	80
Trail 06	Mr. Saidand	2,000	240	440	400
Trail 07	Mr. Bounyoung	900	160	200	150

Social:

- Farmers who participated in the IRFC trials shared their experiences and knowledge with neighbouring villages, facilitating wider adoption of the practice. Additionally,

some of the fish produced were sold within the community, reducing the need for farmers to travel for fish purchases.
- The implementation of IRFC fostered peer-to-peer learning, where farmers gained technical skills and practical knowledge benefiting the broader community.

Economic:

- IRFC led to lower ongoing costs by reducing the need for chemical fertilisers and pesticides. Over time, farmers experienced a more cost-effective farming model.
- Beyond rice production, fish harvesting provided an additional income stream for farmers, which improved food security and contributed to household financial stability.

3.3. Organic Red-Rice Growing

Farmers were satisfied with the yields from organic red rice cultivation and have expressed plans to expand the area dedicated to growing red rice. The success of the crop has encouraged them to continue experimenting with sustainable farming practices, with a focus on scaling up organic production.

Yield performance outcomes demonstrate the effectiveness of organic production in improving yield (Figure 6). The experiment found a trial involving 3 hectares of transplants yielded an average of 3 to 3.2 tons per hectare. Additionally, 2.2 hectares of paddy fields sown with organic red rice produced yields of 2.5 to 2.8 tons per hectare, further confirming the viability and productivity of the organic farming approach.

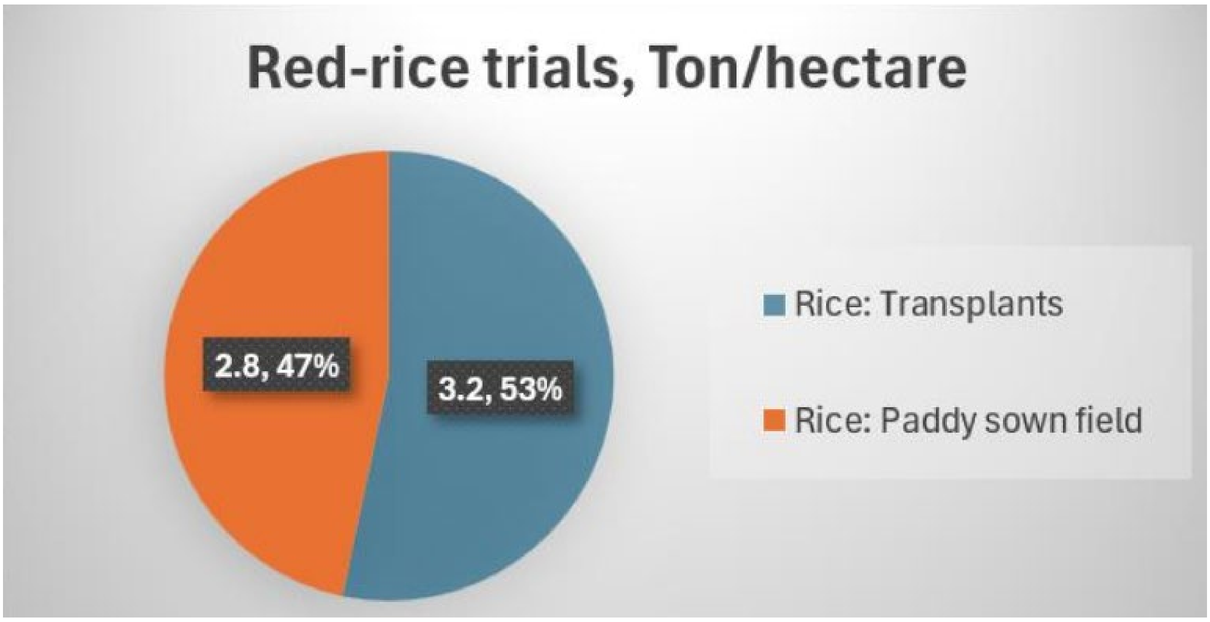


Figure 6: Differences in yield (ton/hectare) between red-rice transplant trials and paddy sown field trials.

3.4. Wetland Management

Drone surveys and ground-truthing methods were used to produce a digital surface model of the Nong Lom wetland (Figure 7). As s a result of this mapping several key observations in relation to fish migration were observed. For example, the survey found infrastructure like box culverts were present and provided safe fish passage. However, fish traps in some sections were found to capture fish of all sizes without selectivity. During large floods, fish were able to bypass these traps. Smaller streams draining from paddy fields into the main river were identified as critical for maintaining ecological connectivity and supporting fish habitats.

The wetland committee was successfully formed with an emphasis on gender and ethnic inclusion, and involved diverse groups from water users, agriculture, and fisheries sectors. A knowledge hub was also created for peer-to-peer learning. As a result of these groups, the Nong Lom draft management plan was developed. This was comprised of two parts, one focusing on the biophysical, environmental, and socioeconomic governance of Nong Lom, and the second outlining a long-term plan centring around five objectives. These included:

- Promotion of more sustainable uses of water.
- Mitigation of potential pollution from agricultural runoff.
- Enforcement of sustainable fishing practices.
- Restoration of ecological functions of the area and its surroundings.
- Development and operationalisation of local management mechanisms.

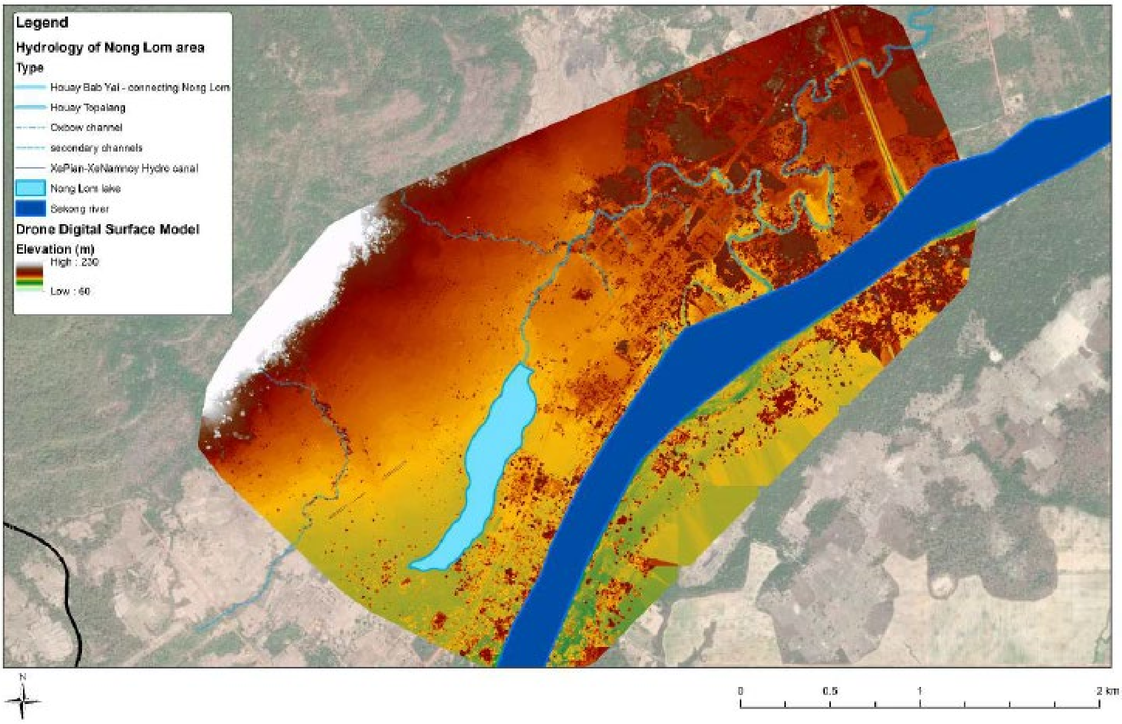


Figure 7: Digital surface model of Nong Lom wetland from drone data and hydrology (Viossanges and Xaydala 2023).

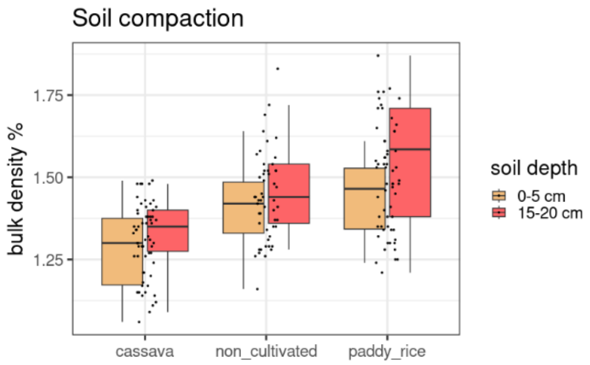
3.5. Soil Analysis and Improvement

The assessment of soil health and microbial biodiversity across different land-use systems in the Attapeu region provided valuable insights into the current situation of soil fertility, compaction, and the potential for improving agricultural sustainability. This included insights into soil compaction, microbial biodiversity, and soil organic carbon content. Several key results were observed including:

Soil Compaction: Soil compaction was more pronounced in paddy rice fields than in cassava fields. The higher soil compaction in paddy fields was due to flooding for most of the year, which compressed the soil. In contrast, cassava fields showed lower soil density, likely due to ploughing prior to planting. At both shallow and deeper soil depths, the density remained similar within each land-use type (Figure 8A). Overall, density values were high which can be explained by the sandy textured soils in the region.

Microbial Biodiversity: Microbial biodiversity varied considerably, with the number of bacterial species ranging from 500 to 2000 at deeper soil depths. However, little difference was observed in microbial diversity at the shallower soil depth (0-5 cm) across land-use types. The higher bacterial species count in deeper soils suggests greater microbial activity and diversity in those areas, although variations existed between land-use types (Figure 8B).

A)



B)

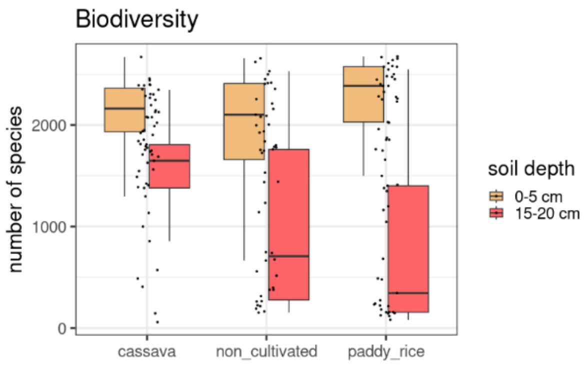


Figure 8: Differences in results between cassava, non-cultured, and rice paddy fields at soil depths of 0-5cm (yellow) and 15-20cm (red).

Soil Organic Carbon (SOC) Content: Diversified agricultural systems generally had a tendency to higher soil organic carbon (SOC) content (2.3%) compared to monoculture systems (1.6%) (Table 3). SOC values below 1% were considered very low, typically associated with poor fertility and minimal water retention, common in sandy or degraded soils. In Attapeu, where sandy soils dominated, some locations had SOC values below 1%, reflecting poor soil fertility in these areas. Overall, SOC content ranged from 1% to 3%, considered low but indicative of the region's transition toward more sustainable agricultural practices. Diversified systems showed slightly higher SOC levels than monocultures, suggesting that agroecological improvements are underway, though there is still much potential to enhance soil health. Ongoing activities, including the implementation of legumes, rice-fish systems, and greenhouses, are expected to contribute to improved soil organic carbon over time and further promote sustainable agriculture in the region (Figure 9).

Table 3: Average and standard deviation of SOC under the different production systems. For each household, we sampled soil in three parcels. The SOC value of each parcel was measured on a composite of three sub-samples. Soil samples were collected at 0-20 cm depth.

Production Systems	**SOC (Average %)**
Diversified (=under AE transition) (n=109)	**2.3 ± 1.03**
Annual crops grown in diversified systems (ANN_div) (n=67)	2.3 **± 0.92**
Perennial crops grown in diversified systems (PER_div) (n=22)	2.4 **± 1.22**
Pasture with trees or shrubs (PAS_div) (n=20)	2.1 **± 1.20**
Monoculture (Traditional Systems) (n=382)	**1.6 ± 1.02**
Annual crops grown as monocultures (ANN_mon) (n=312)	1.5 **± 1.04**
Perennial crops grown as monocultures (PER_mon) (n=14)	2.1 **± 0.90**
Pasture without trees or shrubs (PAS) (n=56)	1.8 **± 0.88**

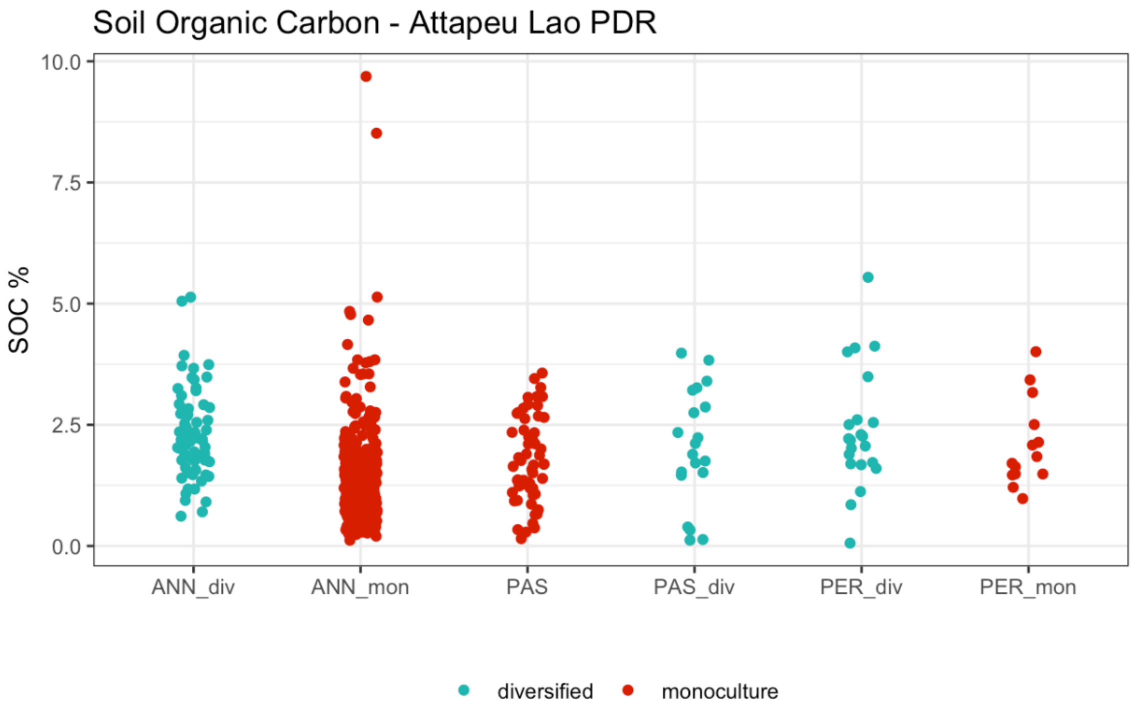


Figure 9: SOC values (%) across the different production systems. Diversified systems are highlighted in blue and monoculture systems in red. There is no statistical difference between the production systems. ANN_div: Annual crops grown in diversified systems (n=67), ANN_mon: Annual crops grown as monoculture (n=312), PAS: Pature without trees or shrubs (n=56), PAS_div: Pasture with trees or shrubs (n=20), PER_div: Perennial crops grown in diversified systems (n=22), PER_mon: Perennial crops grown as monoculture (n=14).

3.6. Gender Action Learning System

Training and workshops focused on Gender Equality and Social Inclusion (GESI) were implemented to help the country team and local stakeholders better understand the diverse roles that men and women play in creating pathways towards both economic and ecological resilience (Figure 10). These sessions provided insights into how gender dynamics influence resource management, decision-making, and community development.

Additionally, the Gender Action Learning System (GALS) tools were introduced to address issues of gender and social justice in economic development at the household and community levels. By using these participatory tools, communities were able to identify and reflect on gender inequalities, develop strategies to overcome these challenges, and promote more inclusive development practices. This approach ensured that both men and women had equal opportunities to contribute to and benefit from economic and ecological resilience-building activities.

Figure 10: Training and workshops focused on GEDSI

4. Agroecological Assessment of Technologies

The agroecological initiatives implemented in the Attapeu ALL have demonstrated significant alignment with the 13 agroecology principles, delivering a wide range of environmental, social, and economic benefits. Appendix 2 provides a detailed analysis of each interventions contribution to these principles. Below we assess the contribution of the Attapeu ALL agroecological initiatives in relation to the CAET framework (Mottet et al. 2020), focusing on four key elements: diversity, synergies, efficiency, and recycling. Additional elements, such as resilience and cultural relevance, are also considered.

Diversity: The introduction of integrated rice-fish systems, organic red-rice cultivation, and diversified cropping patterns significantly enhanced biodiversity in agricultural landscapes. These practices reduced monoculture dependence and fostered ecological balance by integrating multiple species (e.g., fish, legumes). The involvement of gender-inclusive governance mechanisms also enhanced social diversity, ensuring equitable participation.

Synergies: Agroecological practices demonstrated strong synergies between biophysical and socioeconomic systems. For example, rice-fish systems combined ecological pest control with enhanced soil fertility, while wetland management promoted fish migration and ecological connectivity. Social synergies were evident through peer-to-peer learning and community governance structures.

Efficiency: The adoption of solar-powered groundwater pumps and the reduction of chemical inputs in farming systems greatly improved resource use efficiency. Solar pumps eliminated energy costs, while natural fertilisation in rice-fish and organic red-rice systems minimised external input dependency, promoting cost-effective and sustainable farming models.

Recycling: Recycling of nutrients and resources was a central feature of agroecological practices. Fish waste in IRFC systems served as a natural fertiliser, while diversified cropping systems promoted organic matter cycling, enhancing SOC levels. Wetland ecosystems also supported natural resource cycling, contributing to long-term sustainability.

Resilience: Agroecological interventions increased resilience to climate variability by diversifying income streams (e.g., fish and organic crops), ensuring consistent water access, and fostering inclusive governance mechanisms. These approaches collectively reduced vulnerability to environmental and economic shocks.

Culture and Food Traditions: The promotion of organic red rice supported local food traditions while integrating sustainable practices. Additionally, participatory approaches, such as the Gender Action Learning Systems aligned with cultural values of inclusivity and community collaboration.

CAET Analysis of Rice-Fish Systems

A comprehensive CAET analysis was conducted for rice-fish systems to illustrate the comparative benefits of rice-fish with organic paddy cropping systems. The radar chart (Figure 11) provides an overview of rice-fish performance relative to the control. The rice-fish system demonstrated superior performance in most categories, particularly in responsible governance, circular economy and solidarity, diversity, and synergies. Notably, the rice-fish system appeared to foster stronger co-creation and knowledge exchange, reflecting the integration of multiple production components.

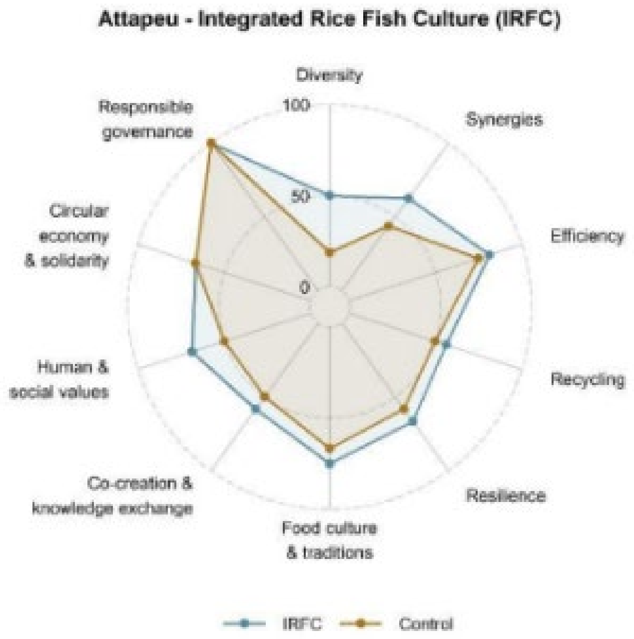


Figure 11: Characterisation for the integrated rice-fish initiative in Attapeu ALL. The control treatment comprises organic rice crop developed in Attapeu.

Figure12 further disaggregates agroecological performance based on the four key elements of CAET. The IRFC system exhibited higher diversity than paddy land by incorporating a range of crops, animals, and activities. This enhanced system resilience and productivity. Both the rice-fish and control system were similar in terms of efficiency, particularly in pest and disease management, soil fertility, and the use of external inputs. This suggests that rice-fish does not compromise efficiency while providing additional benefits. The rice-fish system demonstrated a slightly higher capacity for recycling, particularly in biomass and nutrient use, seeds and breed conservation, and water saving. This highlights the system's capacity to close resource loops and reduce external inputs. The rice-fish system outperformed the control in terms of synergies, particularly in fostering crop-aquaculture interactions, soil-plant system management, and connectivity with trees. These synergies contribute to greater resilience and ecological sustainability. Overall, the CAET analysis highlights the benefits of rice-fish systems in promoting a more diversified, resilient, and sustainable agroecological system while maintaining efficiency comparable to traditional organic paddy rice systems.

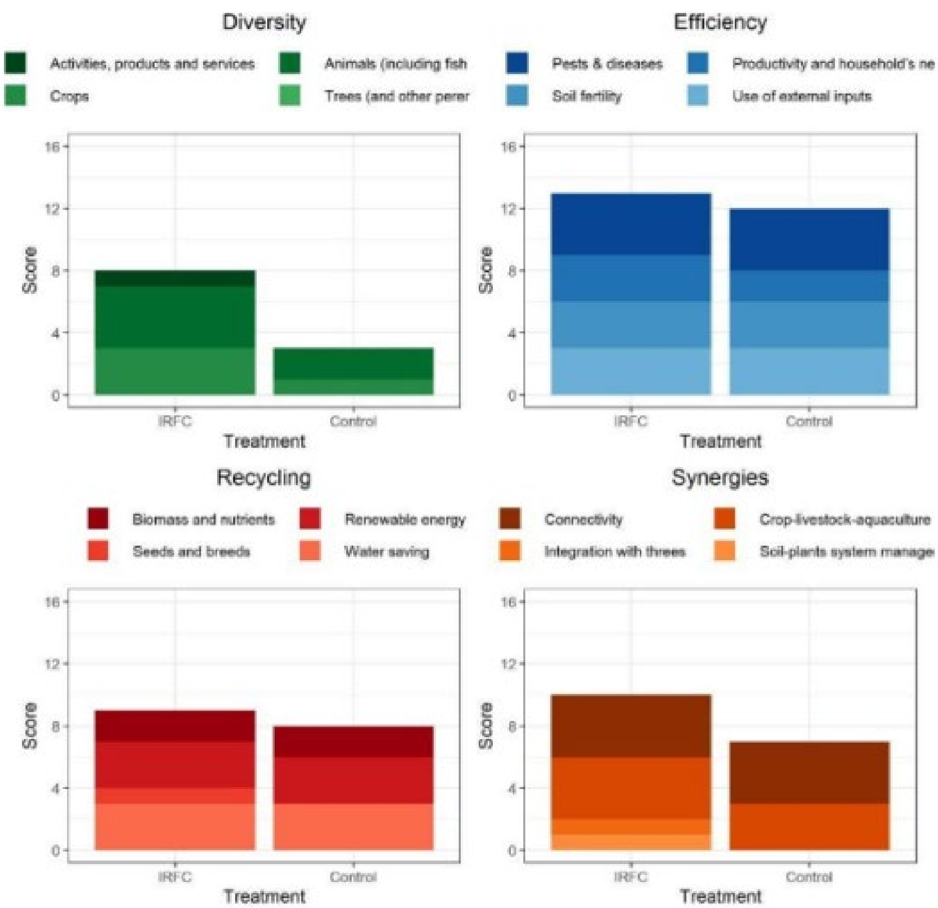


Figure 12: Comparison of rice-fish systems and paddy cropland in relation to the key agroecological principles of diversity, efficiency, recycling and synergies.

5. Potential Adaptation and Adoption of Technologies Tested

The results from the agroecological initiatives in Attapeu ALL provide clear insight into potential adaptation and adoption opportunities grounded in principles of sustainability, equity and resilience.

Solar Pumping of Groundwater: The successful implementation of groundwater pumping systems offers a scalable solution for rural communities facing water scarcity due to climate variability. The potential for wider adoption exists, especially in regions with similar water accessibility challenges. The model of solar-powered systems, which reduce dependence on traditional energy sources, can be expanded to other villages or regions with appropriate solar infrastructure. Furthermore, the formation of water user group (which emphasised the importance of community governance in the sustainable management of water resources) can be adapted in other contexts to strengthen resilience and improve water security.

Integrated Rice-Fish Systems: The integrated rice-fish systems demonstrated the value of enhancing land and water productivity while promoting ecological health. Its success in improving food security and reducing agricultural input costs provides a compelling case for adoption in other rural areas with access to irrigation systems. The rice-fish system not only increased productivity but fostered peer-to-peer learning and knowledge sharing, facilitating wider adoption. The economic viability of rice-fish systems, including reduced reliance on chemical inputs, offers a model for sustainable aquaculture that can be replicated in similar agroecosystems.

Organic Red-Rice Growing: The positive outcomes of organic red rice cultivation suggest that this approach can be scaled up for broader adoption. Given the increasing interest in organic farming worldwide, the practice could attract both domestic and international markets, offering economic incentives for farmers. Adoption of organic methods could be particularly beneficial in areas with low soil fertility, as it encourages sustainable farming practices that improve soil health and reduce dependence on chemical fertilisers. The continued experimentation and expansion organic farming in the region highlights its adaptability to changing market demands and environmental conditions.

Wetland Management: The comprehensive approach to wetland management, including mapping, governance, and the formation of a diverse management committee, offers valuable lessons for ecosystem-based adaptation. The success of this model demonstrates the importance of inclusive, locally driven governance for managing natural resources. The long-term sustainability of the management plan can be ensured by continued incorporation of local knowledge and adjustment to local conditions. This approach could be adapted for other wetland areas or ecosystems that face similar challenges, particularly in regions where climate change threatens habitats.

Soil Analysis and Improvement: The soil health findings provide tentative insights for adapting agricultural practices to improve long-term soil fertility. Through the soil baseline survey and the implementation of the Soil Doctors Program for farmers in Attapeu province, we expect farmers to adopt several key practices and gain a comprehensive understanding of soil health, soil testing, soil improvement, EM production, composting, and soil management in agroecological manners to improve their productivities. The promotion of agroecological practices, such as intercropping and the use of legumes, could be adopted to improve soil health across a broader region. The integration of soil health management into broader agricultural extension programs can encourage the adoption of practices that enhance resilience to climate impacts, such as droughts and flooding.

Gender Action Learning System: The incorporation of gender equality and social inclusion into activities offers significant potential for adaption in diverse cultural contexts. By providing communities with tools to address gender inequality and promote inclusive development, this approach can be scaled to ensure that both men and women have equal opportunities to benefit from initiatives. The use of participatory tools like the Gender Action Learning System could be adapted to diverse sectors, such as water management, agriculture, and climate change adaptation.

6. Reflections, Lessons and Recommendations

The initiatives implemented in Attapeu ALL has demonstrated the potential of integrating agroecological principles to improve the sustainability and resilience of farming systems. Below are the key reflections and lessons learned from each of the initiatives.

6.1. Reflections and Lessons Learned

Solar Pumping of Groundwater: The introduction of solar-powered groundwater pumps has proven to be an effective solution for enhancing water access and irrigation in the Attapeu ALL. These systems reduced dependence on traditional energy sources, lowering operational costs and minimizing the environmental footprint of water extraction. Key reflections include the importance of infrastructure investment to ensure reliable and sustainable operation. Furthermore, community engagement in the installation and maintenance of these pumps proved essential for their success. Lessons learned indicate the need for capacity-building efforts to train local communities in managing solar systems and performing regular maintenance, ensuring long-term functionality and resilience.

Integrated Rice-Fish Culture: The IRFC initiative successfully reduced the dependence on chemical inputs and provided organic food production, ensuring food security and income generation. The co-designed approach, which involved local farmers, empowered them with the skills to manage integrated systems. However, the initial challenges (such as the significant infrastructure investment for irrigation channels and farmer reluctance) highlighted the importance of having clear, accessible pathways for farmers to transition to such practices. A major lesson was the need for long-term support in terms of infrastructure and capacity building to ensure that farmers fully embrace the model and can sustain its practices over time.

Organic Red-Rice Cultivation: The introduction of organic red rice cultivation demonstrated the benefits of agroecological practices for improving soil health and reducing input costs. The success of red rice as a high-value crop offers farmers an opportunity to diversify and enhance their income. However, ongoing support for seed selection, crop density optimization, and training on transplanting and harvest techniques is critical to scaling up the success of this initiative. Additionally, the ability to foster a local seed system will be crucial for sustaining red rice production in the region.

Wetland Management: The development of the Nong Lom Wetlands Management Plan was a notable achievement, with the local community playing a key role in its creation. This community-driven approach fostered a sense of ownership, helping to ensure the sustainability of water management and habitat preservation efforts. However, this initiative also revealed that the complexity of wetland ecosystems requires ongoing monitoring and adaptive management. Ensuring that all stakeholders continue to engage in the long-term maintenance and improvement of wetland health will be crucial for its continued success.

Soil Analysis and Improvement: The assessment of soil degradation underscored the need for comprehensive soil management practices in the region. The use of diversified farming systems to improve soil health has shown promise, but it requires continuous monitoring and adaptation based on trial results. Lessons learned include the importance of diagnosing soil health and using those insights to guide agroecological transitions. A key takeaway is that building local capacity to monitor and manage soil health is vital for the long-term sustainability of farming systems in the region.

Gender Considerations: The integration of gender considerations into the research highlighted the critical role that gender dynamics play in the adoption of climate-smart agricultural practices. The findings underscore the importance of designing gender-sensitive interventions to ensure that women, who often have primary responsibility for food production, are not excluded from new agricultural innovations. Ensuring that women have the knowledge and resources to adopt these practices is essential for enhancing both social inclusion and climate resilience.

6.2. Future Recommendations

By implementing the following recommendations, future scaling efforts can build on the successes of the Attapeu ALL initiatives, fostering greater resilience and sustainability in farming systems while improving livelihoods for rural communities.

- **Continued Infrastructure Investment for integrated rice-fish culture:** For rice fish to be more widely adopted, future efforts should include targeted support for farmers to reduce the initial infrastructure costs, such as building irrigation channels and procuring necessary inputs like fish fingerlings. Additionally, ensuring a reliable water supply throughout the implementation period is critical to maintaining the system's effectiveness.
- **Strengthen Capacity Building for Farmers:** Ongoing training and closely monitored field visits are essential to address the challenges farmers face in adopting new practices. More time should be dedicated to ensuring that farmers are equipped with the necessary skills and knowledge for both short-term and long-term success in agroecological practices, including crop selection, soil management, and pest control.
- **Support for Seed Systems and Crop Management:** For both the rice fish and red rice initiatives, ensuring a reliable local seed system is crucial for scaling up these practices. Additionally, research into rice seed varieties that can better integrate with fish farming practices, particularly those with longer lifecycles (e.g., 135 days or more), should be prioritized. This will ensure that crops and fish are both viable and profitable, contributing to farmers' overall success.
- **Scaling Up Wetland Management Plans:** The success of the Nong Lom Wetlands Management Plan provides a solid foundation for similar efforts in other regions. Future interventions should focus on strengthening cross-sectoral collaboration to ensure the sustainability of wetland ecosystems. Further investments in wetland education and the development of adaptive management plans are needed to ensure that these ecosystems continue to provide essential services.
- **Address Soil Health and Degradation:** Building on the findings regarding soil health, it is recommended to establish long-term trials for verification while to

continue promoting diversified farming systems as part of long-term soil management strategies. Additional research into effective agroecological practices, such as composting and organic fertilization, should be prioritised to improve soil fertility and combat soil degradation in the region.

- **Gender-Sensitive Approaches to Adoption:** To ensure the broad adoption of climate-smart agricultural practices, future interventions should adopt a gender-sensitive approach, empowering women farmers with the necessary skills and resources. Incorporating gender action learning systems (GALS) into community-based agricultural programs will ensure that both women and men can equally benefit from new agricultural practices.
- **Long-Term Monitoring and Adaptation:** The lessons from all interventions stress the importance of long-term trials, monitoring and adaptive management. It is crucial to establish clear systems for ongoing data collection and feedback loops to allow for continuous improvements to agroecological practices. This will help ensure that the interventions remain relevant and responsive to changing conditions.

7. Conclusions

The Attapeu ALL has successfully implemented agroecological practices that enhance environmental sustainability, improve agricultural productivity, and strengthen community resilience. By introducing innovative practices, such as solar-powered irrigation, rice-fish systems, organic red-rice cultivation, and wetlands management, the project has demonstrated the potential for agroecology to address both environmental and social challenges. The integration of gender-sensitive approaches and the focus on soil health further ensures the long-term success of these initiatives. The lessons learned from this project provide a solid foundation for scaling up and adapting these practices to other regions, contributing to more sustainable and resilient farming systems in Lao PDR and beyond.

REFERENCES:

Mottet, A., Bicksler, A., Lucantoni, D., De Rosa, F., Scherf, B., Scopel, E., López-Ridaura, S., Gemmil-Herren, B., Bezner Kerr, R., Sourisseau, J.-M., Petersen, P., Chotte, J.-L., Loconto, A., & Tittonell, P. (2020). Assessing transitions to sustainable agricultural and food systems: A tool for agroecology performance evaluation (TAPE). *Frontiers in Sustainable Food Systems, 4*, 579154.

Appendix

Appendix 1: List of Documents related to Co-Design and Outputs

Bernard Triomphe (CIRAD), Vimbayi Chimonyo (CIMMYT), Lisa Fuchs (CIFOR-ICRAF), Udo Rudiger (ICARDA), Eric Vall (CIRAD), Banna Mbaye (ISRA), José Sánchez-Choy (Alliance Bioversity-CIAT), Mark Dubois (IWMI). December 2023. Co-designing technical innovations in the context of agricultural living landscapes. International Water Management Institute. 1-62.

Dyna Eam, Mark Dubois, Kosal Mam, Nhuong Tran, Phonevilay Sinavong, Somphasith Douangsavanh, and Daosavanh Bounphanousay. 2022. Visioning development report: Agroecology living landscape, Attapeu, Laos. International Water Management Institute. 1-7.

Terry Clayton, Somphasith Douangsavanh, Phonevilay Sinavong, Phoutthasinh Phimmachanh, Tran, Nhuong, Mam, Kosal ,Eam, Dyna, Mathieu Viossanges and Mark Dubois. June 2023. Lao PDR Contextualization Report. International Water Management Institute. 1-51.

Terry Clayton, Somphasith Douangsavanh, Phonevilay Sinavong, Phoutthasinh Phimmachanh, Tran Nhuong, Mam Kosal, Eam, Dyna, Mathieu Viossanges, and Mark Dubois. December 2023. Lao PDR Context Assessment: Analysis of the biophysical, sociopolitical, economic, and agroecological context in Attapeu Province Lao PDR. International Water Management Institute. 1-75.

Bernard Triomphe (CIRAD), Vimbayi Chimonyo (CIMMYT), Lisa Fuchs (CIFOR-ICRAF), Udo Rudiger (ICARDA), Eric Vall (CIRAD), Banna Mbaye (ISRA), José Sánchez-Choy (Alliance Bioversity-CIAT), Mark Dubois (IWMI). December 2023. Co-designing technical innovations in the context of agricultural living landscapes. International Water Management Institute. 1-62.

IWMI. Hi-Level Overview Agroecology in Laos. Presentation. International Water Management Institute. 1-26.

Vissonges, M. and Xaylada, V. 2023. Field Trip Report: Drone mapping and Houay Bab Yai channel survey. International Water Management Institute. 1-13.

Mam K. 2024. Nong Lom Wetlands Management Plan Development. Penang, Malaysia. WorldFish. Factsheet.

Degrune, D., Chanthalath, A., Sayalat, N., Peecha, S. and Hartmann, C. 2024. Fact Sheet: Soil degradation assessment in Attapeu cultivated fields. CGIAR. 1-5.

IWMI. 2024. Fact Sheet: Building resilience through sustainable groundwater use in Laos. International Water Management Institute. 1-4.

IWMI. 2024. Innovations in agricultural living landscapes: Red-rice trials, Attapeu Lao PDR. International Water Management Institute. 1-4.

Xaydala, V. 2024. Integrated rice fish and vegetable systems in Attapeu Province, Lao PDR. International Water Management Institute. 1-3.

IWMI. 2024. Enhancing nutritional and economic security through sustainable agroecology. International Water Management Institute. 1.

Degrune, F. and Chanthalath, A. December 2024. Field Report – Soil Survey, Soil Improvement. Agroecology Initiative Technical Report. International Water Management Institute. 1-6.

Dubois, M. Douangsavanh, S., Xaydala, V., Chanthalath, A., Viossange, M. (IWMI)., Sinaoung, P., Phomphackdee, S. (National Agriculture and Forestry Research Institute-NAFRI)., Phimmachanh, P. (Lao Farmer Network). November 2024. Lao PDR: Agronomic assessment of integrated rice fish culture (IRFC) at the Attapeu ALL. International Water Management Institute. 1-17.

Farnworth, C.R., Dougangsvanh, S., Chanthalath, A., Inphonephong, S., Sok, R., Kimala, V., Dubois, M. and Rietveld, A. November 2024. Navigating gendered resilience pathways: Lessons learned from Laos. Gender Impact Platform. International Water Management Institute. 1-41.

Douangsavanh, Somphasith; Viossanges, Mathieu; Xaydala, Viengxay; Dubois, Mark. 2024. Sustainable water management: community-managed solar groundwater in Laos. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Initiative on Agroecology. 4p.

Mam Kosith (World Fish)Degrune, F. and Chanthalath, A. December 2024. A short synthesis report on HOLPA soil health-SOC. Agroecology Initiative. International Water Management Institute. 1-6.

Ministry of National Resources and Environment. December 2024. One CGIAR National Policies and Strategies Initiative Support to the Laos PDR. Lao Ministry of National Resources and Environment.

Ou, P., Charry, A. December 2024. Agroecological business opportunities for Attapeu, Lao PDR. International Water Management Institute. 1-39.

Rizeldo, V.Q., Inphonephong, S., Phounvisou, L. and Dubois, M. December 2024. Diet diversity among women in Attapeu Province, Lao PDR. ASEAN-CGIAR Innovate for Food and Nutritional Security. World Fish and International Water Management Institute. 1-24.

Samaddar, A.2024. Integrated rice-fish farming gives farmers in Laos' Sanamxay region a new lease on life. WorldFish. 1-10.

Xaydala, V. and Dubois, M. 2024. Technical Report: Integrated rice fish and vegetable culture (IRFC). International Water Management Institute. 1-13.

Appendix 2: Activity Descriptions for Attapeu ALL Agroecology Initiatives

Initiatives	Objectives	Methods	Activities
Solar pumping of groundwater	• Promote renewable energy use as a sustainable water management solution. • Improve water availability for dry season crop productivity. • Reduce input costs and support	Mixed-methods approach, integrating participatory community engagement and technical interventions to address water management practices	**Groundwater Well Construction** • Development of groundwater wells equipped with solar-powered pump systems and water tanks. • The infrastructure was co-designed through community visioning consultations and participatory processes that ensured the designs reflected local needs. **Monitoring Systems Installation** • Automatic groundwater level data loggers and water quality monitoring systems were installed to track the sustainability of groundwater use.

	economic diversification. • Foster community-managed water resources for long-term sustainability.		**Hydrological Connectivity Survey** • A field survey was conducted to evaluate the hydrological interaction between the wetland and surrounding groundwater systems. This data informed resource management strategies and minimized pressure on surface water abstraction. **Establishment of Water User Groups** • Groundwater user groups were created with clearly defined rules and management principles. • Inclusive participatory approaches ensured representation of gender and ethnic diversity in decision-making processes. **Co-Designed Dry-Season Vegetable Trials** • Plot trials were initiated to explore the potential of solar-powered irrigation for vegetable cultivation during the dry season.
Integrated Rice-fish culture	• Increase the availability and value of nutritious food for rural households. • Demonstrate agroecological principles and evaluate the sustainability of IRFC systems. • Scale the practice to other farmers in Attapeu and other provinces. • Support farmers in achieving economic diversification and self-sufficiency.	Participatory, co-designed approach to implement and evaluate IRFC. Activities were organized into three key phases: co-design, co-monitoring, and co-implementation.	**Co-Design of IRFC Systems** • The concept of IRFC was introduced to communities through participatory consultations. • Farmers were presented with common fish-trench shapes (L, I, T, and square) and encouraged to choose designs best suited to their fields. • Farmers with suitable fields and willingness to participate were selected for the trials. • Service providers for digging fish trenches were identified, announced to the community, and engaged for construction. **Implementation of IRFC Systems** • IRFC systems were established in seven plots across the Agricultural Learning Landscape (ALL) using composite statistical designs. • Practical trainings were conducted on producing fish feed from locally available materials, helping farmers reduce costs, decrease reliance on inputs, and increase self-sufficiency. **Co-Monitoring and Data Collection** • Templates for monitoring fish and rice growth were developed and distributed to farmers. Farmers received training on data recording. • Project and government staff provided technical advice and conducted co-monitoring visits to ensure the successful implementation of IRFC systems. • Data on crop yields, fish growth, and food diversification were collected, cleaned, and analyzed by researchers. **Evaluation and Recommendations** • Researchers analysed the data to assess the impacts of IRFC on productivity, biodiversity, nutrition, and soil fertility. • Results were documented, and recommendations for scaling up IRFC were shared with farmers, local governments, and other stakeholders.

Organic Red Rice Cultivation	• Increase agricultural productivity by improving soil health and reducing the dependency on chemical inputs. • Enhance dietary diversity and improve nutrition through the promotion of red rice as a nutritious food source. • Promote economic diversification by introducing a high-value crop that can be sold at a higher price than traditional rice. • Improve soil fertility and reduce compaction through organic farming practices. • Strengthen community-based farming knowledge and practices to promote sustainable agricultural techniques.	Co-design and participatory processes.	**Co-Design of Red Rice Systems** • The concept of organic red rice cultivation was introduced to the community through farmer group consultations. • The short-growth red rice variety (100-110 days) was selected for its suitability for planting in low-quality soils and its ability to be grown in two seasons per year. • Farmers who were willing to participate in the trials were selected based on their available land and interest in adopting organic farming methods. • Seeds of the red rice variety, along with bio-fertilizers, were provided to participating farmers to promote the cultivation of organic rice. **Implementation of Red Rice Cultivation** • A total of 30 demonstration plots were established, covering 10.16 hectares, where red rice was cultivated using organic practices and manure-based fertilization. • A short-growth red rice variety was introduced to improve yield and reduce reliance on fertilizers. • Farmers implemented the cultivation of red rice on their plots and observed its growth under the new organic system. **Training and Capacity Building** • Practical training sessions were held to teach farmers about rice planting techniques, maintenance, record-keeping, and cost management. • Special emphasis was placed on the use of organic fertilizers and soil management practices to improve soil health. • A total of 115 participants, including 45 women, were trained on improving rice cultivation techniques and reducing input costs. **Monitoring and Data Collection** • Farmers were trained to monitor and record data on crop yields, input use, and economic outcomes to assess the effectiveness of the organic farming approach. • Regular monitoring visits were conducted by project staff to provide technical advice, ensure proper implementation of practices, and troubleshoot any challenges faced by farmers. • Data on productivity, input use, soil health, and economic outcomes were collected, cleaned, and analysed to assess the success of the initiative and its impact on farmers' livelihoods. **Evaluation and Recommendations** • Researchers analysed the data to assess the impacts of organic red rice cultivation on soil fertility, productivity, and economic diversification. • The findings were used to generate recommendations for scaling the practice of red rice cultivation to other farmers in Attapeu and other provinces. • The results of the project were shared with local governments, stakeholders, and farmer groups to encourage broader adoption of organic practices.

Wetland Management	• Improve the sustainability of wetland ecosystems by promoting effective water management and habitat connectivity. • Enhance community involvement in resource management through participatory processes. • Develop a comprehensive, demand-led management plan for the wetland, informed by local knowledge and needs. • Engage relevant stakeholders to identify critical components of the food system for innovation and resource management.	Participatory, co-designed approach, with multiple phases that involved assessment, planning, stakeholder engagement, and the development of a management plan.	**Diagnosis and Assessment** • A survey was conducted, including drone mapping and ground-truthing, to assess habitat connectivity and identify key wetland areas. • Water abstraction was monitored to understand usage patterns and improve sustainable management practices. • The survey helped identify key ecological issues and baseline data for the development of the management plan. **Co-Design of Wetland Management Plan** • A participatory, demand-led approach was used to develop the wetland management plan. Co-design teams, consisting of 15-20 people, were formed to ensure diverse community input. • Relevant stakeholders, including government and non-government actors, were engaged to share knowledge about local resources, challenges, and potential management actions. • Stakeholder engagement included village chiefs, the Lao Women's Union, youth groups, local fishers, local farmers, and representatives from district and provincial agriculture and forestry offices (DAFO and PAFO). **Stakeholder Engagement and Planning** • Stakeholders collaboratively identified key management objectives and actions for the wetland, focusing on balancing conservation goals with community needs. • The management plan was developed through discussions that allowed for the integration of both ecological data and local knowledge. • Proposed actions included measures to improve water management, enhance habitat connectivity, and address challenges related to land use and agricultural activities. **Monitoring and Implementation** • Ongoing monitoring of water abstraction and wetland conditions helped ensure that management actions were effective and adaptive. • The project provided continuous support for stakeholders in implementing the management plan and adapting it based on feedback and monitoring results.
Soil Analysis and Improvement	• Diagnose the level of soil degradation in paddy rice and cassava fields by analysing soil quality indicators. • Compare soil quality between cultivated fields and non-cultivated systems	Soil sampling, data collection, and analysis to assess soil quality across different agricultural systems in the region.	**Soil Degradation Diagnosis** • 174 soil samples were collected from paddy rice and cassava fields in Sanamsay and Samakhisay districts. • Soil samples were collected from two depths: 0-5 cm and 15-20 cm, across 29 fields. Three randomly chosen locations within each field were sampled, with approximately 5-10 meters between locations. • A total of 348 samples were collected, with 174 dedicated to microbial analysis and 174 for physical and chemical analysis. In addition, 570 samples were collected for organic carbon assessment at the Department of Agriculture and Landscape Management (DALAM) in Vientiane.

	assumed to have optimal soil conditions. • Evaluate the impact of diversified agroecological systems on soil organic carbon (SOC) content, as a key indicator of soil health.		**Agroecology Assessment (HOLPA)** • The assessment focused on comparing diversified production systems (which included multiple crops, trees, or shrubs) to traditional monoculture systems. • Soil organic carbon (SOC) was used as a key indicator to evaluate soil health, with the hypothesis that diversified systems would have higher SOC content than monoculture systems. • A total of 491 SOC data points were collected from 8 villages, with 3 fields sampled per household. SOC content was measured using the loss-by-ignition method, as per project guidelines, in December 2024 at the DALAM soil lab.
Gender Action Learning System	• Explore how people learn about new technologies and the best ways to support their adoption. • Understand how women and men are involved in decisions regarding new technologies. • Examine gender norms within selected ethnic communities in Laos. • Use this information to improve the AE-I's work and contribute to better gender equity and social inclusion in agroecological practices.	Gender workshops and interviews.	**Building Capacities** • Strengthening the capacity of IWMI, WorldFish, and partners, as well as the communities involved in the ALL project, to implement gender-inclusive agroecological innovations that support both women and men's climate resilience. **Testing the Resilience Pathways Framework** • The research field-tested the 'Resilience Pathways Conceptual Framework,' developed under the CGIAR Initiative on Gender Equality (HER+), to examine how adaptive and transformative resilience pathways can be developed with both women and men. **Preparing for GALS Intervention** • Laying the groundwork for the Gender Action Learning System (GALS), a transformative intervention that will be implemented in 2024 in Tammaleuy, Hom, and two other villages, Inthee and Donephay.

Appendix 3: Adherence to Agroecological Principles

Agroecological Innovation	Diversity	Co-Creation of Knowledge	Synergies	Efficiency	Recycling	Resilience	Human & Social Values	Culture & Food Traditions	Responsible Governance	Circular & Solidarity Economy	Input Reduction	Soil Health	Economic Diversification
Solar Pumping of Ground water	Expanded crop diversity through year-round irrigation	Enhanced farmer understanding of solar energy systems	Improved water availability supported ecosystem and crop synergies	Eliminated reliance on non-renewable energy sources	Indirectly supported nutrient recycling through improved irrigation	Increased resilience to drought conditions	Empowered farmers with reliable water access	Not directly related	Encouraged inclusive water management	Reduced water and energy costs	Reduced energy input costs	Improved irrigation supported crop growth	Year-round cultivation of subsistence vegetables and market sales
Integrated Rice-Fish System Irrigation (IRFC)	Enhanced agrobiodiversity by integrating rice and fish	Peer-to-peer learning fostered knowledge exchange	Fish contributed to natural pest control and fertilization	Reduced chemical fertilizer and pesticide usage	Fish waste recycled nutrients back into the soil	Dual outputs reduced vulnerability to economic and environmental shocks	Strengthened community collaboration	Supported traditional rice-fish integration	Promoted participatory governance in adoption of RFC systems	Created dual-income streams	Reduced external input reliance	Fish activity improved soil aeration and fertility	Increased income and food security through rice and fish production
Organic Red-Rice Growing	Promoted genetic diversity of rice varieties	Farmers shared organic cultivation techniques	Natural amendments supported crop-soil synergies	Eliminated synthetic fertilizer and pesticide use	Compost and organic residues recycled nutrients	Improved market access for organic products	Supported fair pricing and market inclusion	Reinforced cultural relevance of traditional red-rice farming	Strengthened networks for organic certification and marketing	Enhanced livelihoods through premium market prices	Eliminated synthetic input reliance	Improved soil fertility through organic amendments	High-value market opportunities incentivized expansion
Wetland Management	Conserved aquatic biodiversity	Wetland committees facilitated knowledge sharing	Fish migration preservation benefited surrounding ecosystems	Reduced need for engineered solutions	Maintained natural nutrient and water cycles	Supported adaptation to climate variability	Fostered inclusive governance of wetland resources	Encouraged ecotourism aligned with local traditions	Introduced inclusive and transparent decision-making frameworks	Created potential for ecotourism-based income	Reduced intervention costs	Supported adjacent soil health through ecological balance	Promoted alternative livelihoods through ecotourism
Soil Analysis and	Diversified cropping systems	Provided data to inform farmers	Integrated cropping systems	Reduced dependency on syntheti	Legume rotations recycled nitrogen	Diversified systems buffered	Empowered farmers with data-	Indirectly supported tradition	Enhanced local capacity for sustaina	Promoted sustainable	Reduced chemical	SOC increased from 1.6% to 2.3%	Diversified cropping systems

Agroecological Innovation	Diversity	Co-Creation of Knowledge	Synergies	Efficiency	Recycling	Resilience	Human & Social Values	Culture & Food Traditions	Responsible Governance	Circular & Solidarity Economy	Input Reduction	Soil Health	Economic Diversification
Improvement	, including legumes	on best practices	enhanced ecosystem functions	c fertilizers	into the soil	economic risks	driven soil management	al multi-cropping systems	ble land management	farming systems	fertilizer reliance	under diversified systems	improved resilience to market fluctuations
Gender Action Learning System	Indirectly promoted social diversity in decision-making	Strengthened local capacity through participatory tools	Holistic resource management improved synergies	Indirect impact	Enhanced social recycling through equitable resource management	Broadened adaptive capacity through inclusive planning	Promoted gender equity and shared resource control	Supported collaborative approaches to livelihoods	Encouraged participatory and inclusive governance	Fostered equitable access to economic opportunities	Indirectly reduced overuse of resources	Not directly targeted	Facilitated broader participation in income-generating activities

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