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TECHNICAL REPORT

Benefit-Cost Ratio (BCR) Analysis of Agroecological Trials in Attapeu Province, Lao PDR

Interim Results from the First Year of Operation of Two Pilot Systems

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CGIAR Multifunctional Landscapes Program

Multifunctional Landscapes is a CGIAR Science Program that aims to enhance the resilience, productivity, and sustainability of agricultural landscapes by integrating diverse land uses, ecosystem services, and livelihood strategies. The initiative supports evidence-based policies and innovations that balance food production with climate adaptation, biodiversity conservation, and social inclusion. By working with local communities, governments, and partners, it promotes landscape-level approaches to managing natural resources for long-term ecological and economic benefits. To learn more about the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar researchporfolio-2025-2030.

Project

As part of the CGIAR Initiative on Agroecology, several agroecological trials, including integrated rice-fish culture (IRFC) and red rice, were tested in Attapeu Province, Lao PDR. These interventions aimed to assess the economic performance of these varieties and integrated systems in real farm conditions while also seeking help to improve productivity and resilience. To monitor and evaluate its effectiveness, this study assesses the system's performance, including broader benefits such as environmental sustainability, as well as a primary financial benefit-cost analysis, after one year of operation and a full crop cycle.

Citation

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Front cover photo: Integrated Rice Fish Culture (IRFC) trial in Inthee village, Sanamxay District, Attapeu Province, Lao PDR, showcasing the agroecological system - rainfed rice, and a rice-fish pond (*photo*: Pacem Kotchofa/ IWMI).

Back cover photo: IWMI researcher Somphasith Douangsavanh administering the survey questionnaire to a female farmer and her young child in front of the groundwater site in Donephay Village, Sanamxay District, Attapeu Province, Lao PDR. (*photo:* Pacem Kotchofa/ IWMI).

Disclaimer

This publication has been prepared as one of the outputs of the CGIAR Multifunctional Landscapes Program and has not been independently peer reviewed. Responsibility for opinions expressed and any possible errors lies with the authors and not the institutions involved.

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Executive Summary

This report presents an economic and technical performance assessment of some agroecological trials conducted in Attapeu Province, Lao PDR, under the CGIAR Multifunctional Landscapes (MFL) initiative in May 2025. The study evaluates two major trials: the Red Rice (RR) variety and the Integrated Rice-Fish Culture (IRFC); the latter's results are contrasted with local farming practices such as the Loum Pa or Loumpa (traditional fishponds) and Rice-Only monoculture farms. The primary objective of the report is to analyze the benefit-cost ratio (BCR) after one year of operation and a full crop cycle of these trials to determine their economic viability, scalability potential, including their broader benefits, such as environmental sustainability, as well as farmers' food and nutrition security.

- **Red Rice (RR) Variety**

Rice production is vital in Attapeu, with yields averaging 2.9 tons/ha, below the national average of 4 tons/ha. Traditional varieties such as Kao Ma Li, Thasano, Thadokkham, and Kao Kang usually yield 2-3 tons/ha and sell for 5,000-7,000 LAK/kg ($0.22 to $0.32). The Red Rice variety, introduced by IWMI and the Lao Farmer Network (LFN), offers higher yields (up to 5 tons/ha) and sells at 8,000-10,000 LAK/kg ($0.37 to $0.46), nearly double the price of local varieties. The Red Rice initiative also includes farming groups that facilitate knowledge sharing and commercial opportunities, with adoption rates at 100% among initial trial farmers. RR challenges include pest susceptibility and longer cooking times, which contribute to low household consumption, nearly 5-6%, as the crop is mainly produced for sale under contract farming managed by the LFN. Fish are also raised alongside RR, with most fish consumed rather than sold.

- **Integrated Rice-Fish Culture (IRFC)**

IRFC is an innovative system that integrates rice and fish production to enhance ecosystem balance, soil fertility, and income diversification. By increasing land-use efficiency, recycling waste, and reducing the need for external inputs, this innovative system has the potential to significantly improve the socioeconomic conditions of farmers while also enhancing local ecosystems and biodiversity. Despite these benefits, adoption is limited due to high initial costs, technical knowledge requirements, and farmers' reluctance to allocate land for fish trenches. To enable a better appreciation of the IRFC advantages, we also include two others commonly found farming practices, including the Loumpa and rice-only farms. Loum Pa refers to traditional interconnected fishponds near rice fields, providing natural fish catchments and food security, and has served the local community for many decades. The Rice-Only system represents monoculture rice production. Comparing these systems allows assessment of productivity and resource efficiency.

The evaluation of these trials uses a single-season benefit-cost ratio (BCR) as the main metric. The study acknowledges that relying solely on a BCR can be misleading and should be supported by other indicators for a comprehensive assessment.

Key Findings:

- Red Rice System: None of the red rice farms achieved a BCR above 1 in the first year; this is mainly due to high initial fixed investments. These capital costs are expected to be amortized over several years, likely improving the BCR in future seasons. These findings are accentuated by the estimations of BCR "without fixed cost", which resulted in all farms except one with a BCR above 1, highlighting the significance of these capital costs. The analysis also emphasizes that farmers are highly motivated by the long-term income potential of red rice over local rice varieties, and its other significant benefits, such as improved food and nutrition security.
- Integrated Rice-Fish Culture (IRFC) and Loum Pa: These two farming systems showed lower BCRs due to high operational costs, larger land requirements, and a mix of technical and financial inefficiencies. Key challenges include fish theft, inadequate farmer training, and a lack of proper fish feeding practices, which prevent fish from reaching their full market value before being home consumed.
- Rice-Only System: Farmers operating on rice-only farms showed stronger economic performances with higher BCR up to 3, indicating their short-term profitability and economic viability.

The main limitation of this study is the estimation of BCR using a single-season dataset, which might have overemphasized the cost elements and failed to capture the full value and benefits of these farming systems, especially considering the high upfront investment for the IRFC or RR. Nonetheless, the findings emphasize the importance of taking a comprehensive approach to evaluating farming systems. Hence, for a more comprehensive understanding of farm performance, BCR analysis should be complemented with technical performance metrics, such as yield, as well as non-monetary or other benefits, including food and nutrition security, as well as environmental aspects, like biodiversity restoration.

Based on these interim results, we recommend policymakers and development organizations:

- To provide support for long-term capital investments, such as the high upfront costs farmers face with promising systems, such as IRFC and red rice, which offer long-term sustainability and biodiversity restoration on top of the agricultural productivity.
- To provide additional training to enhance farmers' technical abilities in aquaculture and fishery, with extension services to improve the management and efficiency of integrated systems, such as IRFC.
- To strengthen value chains, support institutional contracts and market linkages for red rice farmers, ensuring preferential prices and attenuating any risk of price volatility.

Introduction

Like most developing countries, agriculture and food systems form the backbone of rural livelihoods in Laos; however, they face similar challenges, such as increasing climate vulnerability, environmental degradation, and often chronic food insecurity and poverty (Clayton et al., 2023). In some instances, traditional farming methods lead to extensive deforestation and soil erosion, threatening the long-term sustainability of the landscapes on which these communities depend for their livelihood. Recognizing these complexities, the CGIAR Multifunctional Landscapes (MFL) program was launched as a multistakeholder initiative to support ongoing national efforts to transform and drive positive systemic changes. By focusing on holistic, co-created, and co-designed solutions, the MFL science program aims to enhance communities' food security and income while also fostering environmental and social resilience, providing a critical path toward a more sustainable and equitable future.

Given the CGIAR's Multifunctional Landscapes (MFL) program objectives and its activities in Laos, several trials and experiments have been conducted to encourage the transformation toward more sustainable agroecological practices. These trials are conducted in "living landscapes" in Attapeu province, focusing on co-creating solutions with various stakeholders, including the Provincial Agriculture and Forestry Office (PAFO) of Attapeu Province, the District Agriculture and Forestry Office (DAFO) of Sanamxay and Samakkixay, the Lao Farmers Network (LFN), as well as the local farmers. These trials include solar-powered groundwater pumping systems, integrated rice-fish culture (IRFC), organic Red Rice (RR) farming, community-led sustainable management of the Nong Lom wetland, soil improvement techniques through legume farming, and some specific gender action learning. These trials are not just about introducing new technology or innovation; they are a collaborative process of testing, socio-ecological, organizational, and institutional innovations that are specifically suited to the local context of agricultural development in Attapeu.

Hence, the importance of thoroughly assessing the performance and conducting a benefit-cost (BC) analysis of some of these trials, for which data are available. This report focuses mainly on the RR and the IRFC. The primary objective of the report is to analyze the benefit-cost ratio (BCR) after one year of operation and a full crop cycle of these trials to determine their economic viability, including their broader benefits, such as environmental sustainability, as well as food and nutrition security, scalability, and investment potential beyond the pilot phase. Achieving these objectives involves gathering evidence of what works best, where, for whom, and why. Beyond environmental and social impacts, a cost-benefit analysis offers the necessary financial data to identify profitable business models and attract potential investors. By continuously monitoring and evaluating these co-designed solutions, the project can adjust its strategies based on feedback and ensure that the innovations are truly sustainable, scalable, and suitable for the communities in Attapeu.

1. Description of the MFL Agroecological Trials: Red Rice, IRFC, Loum Pa, and Rice-Only

1.1. Red Rice (RR) Variety

The 2024 Agricultural Statistics Yearbook projects Laos's total rice production at 3.8 million tons across 916,616 hectares, with an average yield of 4 tons per hectare. Meanwhile, the Agriculture Department of Attapeu Province indicates that the rice field area in the same year was around 28,000 hectares, yielding an average of 2.9 tons per hectare. This information highlights two major points: rice production plays a significant role as both a staple food and a source of livelihood for many in the province. However, there is a critical yield gap compared to national productivity levels. Farmers in Attapeu primarily grow traditional rice varieties, including Kao Ma Li, Thasano, Thadokkham, and Kao Kang, which are used for brewing beer and making noodles. These rice varieties typically yield between 2 and 3 tons per hectare, with market prices ranging from 5,000 to 6,500 LAK or ($0.22 to $0.32) per kilogram. Nonetheless, there are promising efforts to improve agricultural yields, support sustainable food practices, and enhance the commercial worth of rice.

In 2023, the International Water Management Institute (IWMI) partnered with the Lao Farmer Network (LFN) to introduce a new high-value rice variety, called “Red Rice”, due to its reddish color, covering approximately 5 hectares (Chanthalath et al., 2025). This achievement marks a significant step forward in diversifying rice production systems, increasing overall production, and closing the yield gap. Red rice offers higher yields, a shorter growth period (110–120 days), which enables farmers to cultivate two crops per year and better market prices, selling for between 8,000 and 10,000 LAK ($0.37 to $0.46 USD per kilogram), making it an attractive option for farmers. From 2023 to 2024, during the trial phase, IWMI and LFN also established “Red Rice Groups” with members across five villages. These groups now serve as key hubs for sharing technical knowledge and helping farmers transition to commercial production of red rice. Red rice production is expected to produce up to 5 tons per hectare, nearly doubling that of traditional rice varieties, depending on farming practices and climate conditions. Due to the crop’s potential, in terms of yield, income, and sustainable farming practices, and the opportunity to engage in a well-organized and market-oriented producers’ group, more farmers are showing interest in joining the Red Rice Initiative, aiming to cultivate nearly 40 hectares and produce up to 200 tons of red rice in the coming year.

1.2. Integrated Rice-Fish Culture (IRFC)

The Integrated Rice-Fish Culture (IRFC) is an innovative agroecological approach that combines crops and aquaculture, e.g., rice and fish, to create a synergistic, resource-efficient production system. This method is particularly relevant for regions like Attapeu, where rice is a staple crop and a primary source of income and food. A large body of research suggests that IRFC offers significant benefits by promoting a more balanced ecosystem, which improves soil fertility, enhances water quality, and reduces the need for chemical fertilizers and pesticides (Clayton et al., 2023). From a socioeconomic perspective, IRFS also increases a farming

household's income, improves their food security, and nutrition by providing multiple income streams from both rice and fish, while also serving as a natural buffer against climate and market shocks. Despite these well-documented advantages, the adoption of IRFS remains limited due to the initial investment costs, the need for specific technical knowledge, and farmers' hesitance to allocate land for fish trenches, highlighting a critical gap between potential and practice.

To overcome these adoption barriers, a series of participatory and field-based demonstration approaches was implemented. This process began with the co-design of various fish trench models, including the "L-shape," "I-shape," "T-shape," and "square-shape," to suit farmers' needs, followed by a collaborative site selection process. The IWMI project team, working in collaboration with the Provincial Agriculture and Forestry Office (PAFO) of Attapeu Province, local service providers, and farmers, jointly supervised the construction of these trenches. Following the release of native fish fingerlings, farmers received consistent technical training to equip them with the necessary knowledge to manage their systems effectively. Throughout the trial, a comprehensive data collection strategy was maintained, using both quantitative and qualitative surveys to track knowledge gains, monitor the system's performance and productivity, and ultimately evaluate its viability. Additionally, a comprehensive strategy for co-monitoring and co-implementation was developed during this process. This included creating templates for monitoring and recording data, as well as training farmers to use these templates for both rice and fish production systems.

To better evaluate the performance of the IRFC fields, we included some local farming systems, such as monoculture rice-only fields and “Loum Pa.” Loum Pa are traditional interconnected fishponds located near or within paddy rice fields and are widely used in southern Laos provinces as a buffer against climate impacts, such as droughts. Loum Pa consists of small (3x4 meter) ponds that have historically supported rice-fish farming, providing natural fish catchments in floodplain areas, contributing to food security and biodiversity. According to PAFO statistics, approximately 9,000 Loum Pa, or “trap ponds,” existed in the region before the disastrous dam collapse of 2018. Including these two additional farming systems allows us to compare rice and fish productivity, promoting more efficient resource use and landscape potential.

2. Data and Methods

To evaluate the performance of these trials, we use a benefit-cost ratio (BCR) approach. A BCR serves as a key indicator of the economic viability of a trial or farming operation. First, we developed questionnaires tailored to each trial, followed by a series of semi-structured in-person interviews and focus group discussions with farmers from May 6 to 8, 2025, after piloting the data collection tools in February of the same year. IWMI staff based in Attapeu have led the interview process and the data collection. We interviewed approximately seven farmers for each farming type, selected based on their ongoing involvement in IWMI project activities in Attapeu, particularly the MFL initiative. The number of farmers interviewed is limited by the number of farmers involved in the trials, meaning only seven farmers participated in the project

to test the IRFC, for example. Then, we estimate the total costs and benefits to each farm and calculate the BCR of the farming operation.

The equation below summarizes the formula used to estimate each farm's BCR, which represents the ratio of total benefits to total costs. For example, for a rice-only farm, the total benefit is the sum of the values of rice sold, consumed, given away, or retained as seed. The same analogy is used for fish production in the IRFC and Loum Pa systems. The total cost comprises the farm's fixed costs, such as digging, machinery, equipment, and regular contracted labor, as well as variable expenses, which include seeds, fingerlings, nursery, and seasonal labor costs related to harvesting, which are a function of the areas planted. The complete list of each cost element can be found in the survey instrument provided in the annex section.

Each trial's questionnaire was translated into Lao, the local language spoken by the respondents, to facilitate a better understanding of the questionnaire. It was administered by IWMI research field staff who have a long history of working and collaborating with farmers and the community at large.

$$\boldsymbol{BCR} = \frac{\sum_{i=1}^{n=\pm 7}(\boldsymbol{R_i^{Sold}} * \boldsymbol{P_R} + \boldsymbol{F_i^{Sold}} * \boldsymbol{P_F} + \boldsymbol{V_i^{R.consumed}} + \boldsymbol{V_i^{R.seeds}} + \boldsymbol{V_i^{R.gifted}} + \boldsymbol{V_i^{F.consumed\&gifted}})}{\sum_{i=1}^{n=\pm 7}(\boldsymbol{C_i^{Fixed}} + \boldsymbol{C_i^{Variables}} + \boldsymbol{C_i^{Others}})}$$

- R_i^{Sold}, $V_i^{R.consumed}$, $V_i^{R.seeds}$, and $V_i^{R.gifted}$: respectively represent the quantities of rice sold, the value of rice consumed, and the value of rice gifted and kept as seed for the future growing season in any given Farm *i =1, 2, …, 7*.
- $V_i^{F.consumed\&gifted}$ represents the value of fish consumed and gifted reported in Farm *i.*
- Similarly, C_i^{Fixed}, $C_i^{Variables}$ and C_i^{Others} respectively represent Farm *i*'s fixed, variable, and other costs.
- P_R and P_F : respectively represent the average selling prices of rice and fish per trial, irrespective of the rice varieties and fish species reported in Farm *i*.

Unfortunately, for most farms, disaggregated quantities of rice or fish, such as those sold, consumed, or given as gifts, are missing or forgotten. Hence, we estimate the farm's total benefit by multiplying its total harvest by the average price per cultivated product. This method focuses on valuing production rather than profitability, which would require specific sales data that we could not obtain. Wherever possible, the remaining missing data are estimated based on the percentage of the harvest that is sold or consumed, depending on the case. To harmonize the estimate across trials and farms, we applied the production valuation method and calculated the total benefit by multiplying the total harvest by the average price per product, whether rice varieties or fish species.

A Benefit-Cost Ratio (BCR) exceeding 1 demonstrates that the aggregate benefits surpass the associated costs, thereby rendering the investment financially viable, *ceteris paribus*. Conversely, a BCR less than 1 suggests that total costs surpass benefits, requiring further investigation into strategies that can improve the farm's economic performance, leading to a positive BCR. However, in practice, for many agricultural trials, a short-term BCR may be less than one because benefits are often dependent on time, i.e., they accumulate over the years,

while necessary fixed costs, such as digging and equipment, are one-time expenses. To achieve a more accurate long-term BCR, collecting performance data over an extended period is recommended. This longitudinal data would provide a more precise estimate of total benefits and compensate for the "high" initial total costs. Alternatively, for short-term evaluations, a separate analysis could exclude fixed costs to present a more "favorable", though incomplete, view of the operation's early economic returns. Therefore, the results presented in this report are interpreted with caution, as they are based only on data from the first year. Another growing season is underway, and we expect to collect additional data in the last quarter of 2025 to update these ratios.

Additionally, most farmers in Attapeu often operate a combination of these farming systems, i.e., IRFC, Rice-Only, and Loum Pa, which complicates the evaluation of performance data for each system individually. Despite using specially designed questionnaires for each system, farmers who manage multiple systems found it challenging to attribute specific outcomes, such as rice yield or household consumption, to a single farming system. For example, they couldn't distinguish between the part of their total rice production that came from the Loum Pa and the rice-only farm. Similarly, they couldn't clearly remember whether the amount of rice consumed came from their Loum Pa field, the Rice-Only farm, or the proportion of each system's production they consumed. Therefore, the collected data did not enable a clear independent separation of costs and benefits for each system within these combinations. To address this data limitation and better reflect farmers' operational realities, our analytical method was adjusted to evaluate costs and benefits across various scenarios presented in Table 1 below, which aligned with the observed farming combinations. Scenarios 1 and 4 have no data entries primarily because IRFC is an innovative farming practice that IWMI and partners are promoting.

Table 1. Possible combination of farming systems assessed

Scenarios	Farming systems combination	Number of farms
1	IRFC only	0
2	Loum Pa only	1
3	Rice-only	1
4	IRFC + Loum Pa	0
5	IRFC + Rice-only	2
6	Loum Pa + Rice-only	3
7	IRFC + Loum Pa + Rice-only	3

Fortunately, the performance monitoring data collected for the Red Rice trial did not encounter any of the aforementioned challenges. Additionally, none of the farmers in the Red Rice initiative participated in the IRFC, which explains why we do not observe any combinations involving the RR trial in Table 1.

3. Results and Discussion

3.1. Red Rice (RR) Trial

Table 2 presents the statistical results on the technical performance of the seven red rice farms surveyed, with their corresponding BCR estimates presented in Table 3 below. Table 2 shows that all respondents agreed to continue growing the red rice variety, indicating a stated adoption rate of 100%. The main reason supporting their decision to continue farming red rice is the reasonable price they receive, approximately 8,000 to 10,000 LAK ($0.37 to $0.46) per kilogram when selling their rice, compared to other local varieties priced at 5,000 LAK ($0.2). They also appreciate the market stability gained from being part of the red rice farming group, which offers preferential contractual prices.

The rice variety also has a short growing cycle, produces small plants, and yields more rice than local varieties. However, they also noted that pests easily attack red rice varieties, although none of them reported any pesticide costs. Some farmers also mentioned that consuming red rice is challenging for them because it requires longer cooking times, which may explain the low consumption rate of approximately 5-6%. Red rice is mainly produced for sale. All seven farmers also raise fish on the side, although only a small portion of their catch is sold.

Table 2. Summary of the farms' performance indicators

Variables	Farm 1	2	3	4	5	6	7
Total rice field (ha)	3	1	3.4	3	3	4	1.4
Red Rice Area (ha)	0.25	0.4	0.23	0.26	0.35	0.1	0.3
T. Fixed cost/ USD	261	488	185	491	275	199	395
T. Variable cost/USD	166	187	158	176	205	158	140
RR Harvest /Kg	275	1,125	720	900	1,260	675	810
RR yield Kg/ha	1,100	2,813	3,131	3,462	3,600	6,750	2,700
RR Sold/ Kg	240	900	460	890	800	675	720
Average % RR Sold	81.3%						
RR Avg. Price USD	0.43						
Average %RR Cons.	6.24%						
Avg. % RR_ Seed	3.6%						
RR Adoption Rate	100%						
Avg. Fish harvest/kg	8.5						
% Fish Cons. Rate	77.31%						
Avg. Fish price USD	2.31						

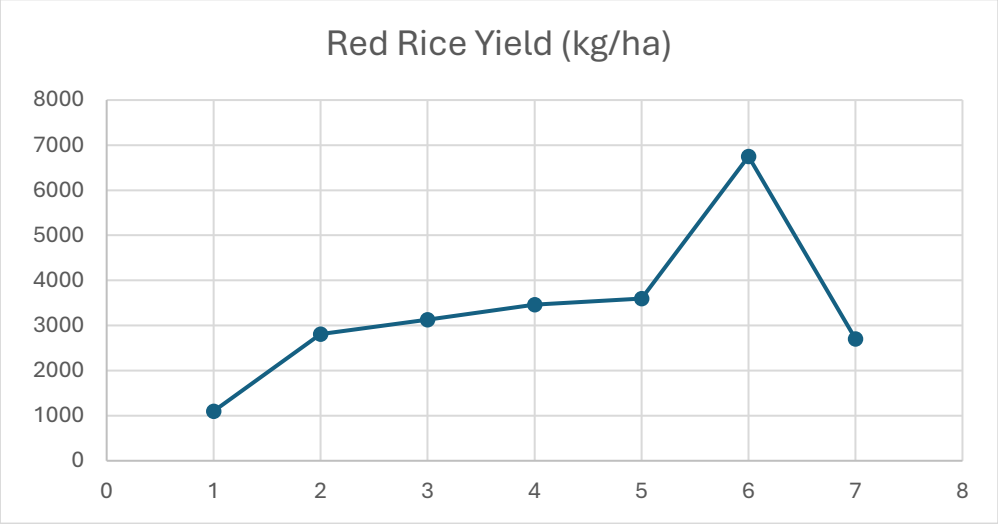
Table 3. Summary of the BCR for the Red Rice Trial

Farm	Yield (kg/ha)	Total Cost (USD/ha)	Rice Revenue (USD/ha)	Fish Revenue (USD)	Total Benefit (USD/ha)	BCR	BCR with No Fixed Cost
1	1,100	1,707	415	7	443	0.26	0.67
2	2,813	1,686	973	2.3	979	0.58	2.1
3	3,130	1,491	865.2	9.3	905	0.6	1.3
4	3,462	2,562	1,481	19	1,552	0.61	2.3
5	3,600	1,602	989	93	1,253	0.78	1.54
6	6,750	3,571	2,920	3.5	2,955	0.8	1.87
7	2,700	1,783	1,038	4.6	1,054	0.6	2.26

Although none of the farms achieved a BCR above 1, the highest observed BCR was 0.8, recorded by Farm 6. The relatively low BCR values across all farms are primarily due to high initial fixed investments, such as land preparation, digging, and the purchase of equipment and infrastructure, which represent significant long-term capital investments. In addition, these BCR calculations are based solely on a single production season of red rice and fish. As a result, the costs can easily be "overstated" relative to the short-term benefits of one growing season. These fixed costs will be spread over multiple years of production, e.g., three, five to ten years of operations, which may enhance the overall BCR in future seasons as we continue to monitor and collect new data on this trial. Hence, the BCR figures should be interpreted with caution. To approximate more realistic estimates, we also calculated "short-term" BCRs by considering only the farms' total variable costs and excluding their hefty, fixed costs. Based on these new estimates, all farms have a BCR above 1 except for Farm 1. This reinforces our initial argument that the fixed cost holds significant importance in the farm's profitability, especially in the short term.

Figure 1 below visually shows the relationship between a farm's red rice yield and its BCR. It is also worth noting that Farm 6 achieved the highest red rice yield, demonstrating a strong relationship between technical and economic performance. Therefore, while BCR provides insight into short-term economic performance, it should be complemented with measures of technical productivity, such as yield per hectare, to assess a farm's overall performance and long-term sustainability thoroughly.

An additional way to improve the BCR could be through a preferential price and institutional contracts, as total revenues and benefits are based on the reported average price. As the RR group is projecting to increase its rice production, higher prices via contracts could potentially further enhance the BCR (Sokchea A., and Culas R., 2025), along with technical performance at low operational cost (Tran Quoc Nhan, 2019). Alongside the economic performance, this analysis highlights other positive aspects of the farming systems, such as fish consumption at nearly 75% and rice consumption at 5-6%.



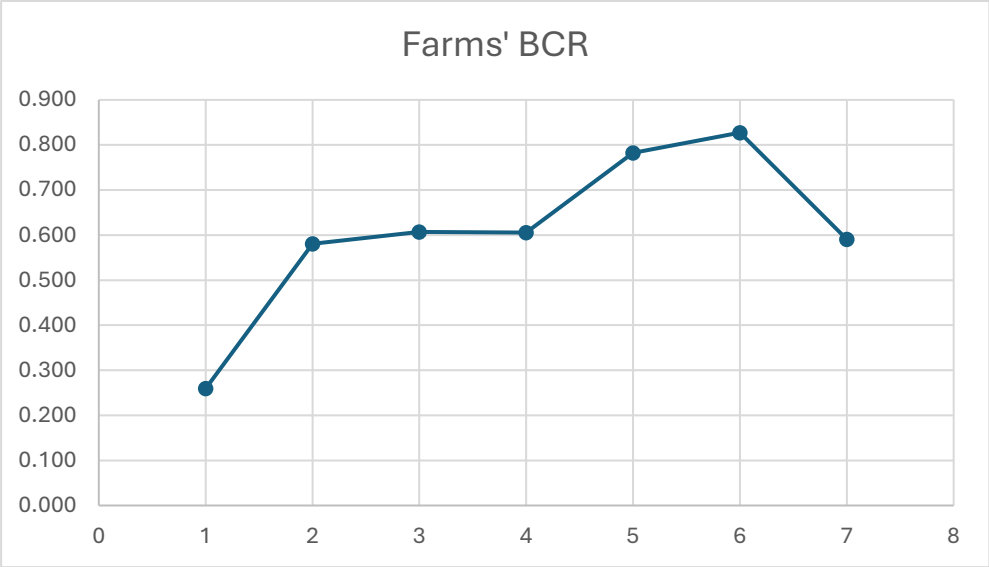


Figure 1. Farms' red rice yield and BCR (*Source:* authors' creation)

3.2. Integrated Rice Fish Culture (IRFC), Loum Pa, and Rice-Only Farm

This trial's assessment is conducted using scenario approaches. Below, in Table 4, we present the results for scenarios 2 and 3, focusing on single farming types with their corresponding BCR estimates in Table 5. The outcomes for scenarios 5, 6, and 7 are displayed in Tables 6, 8, and 10, respectively, with their corresponding BCR estimates presented in Tables 7, 9, and 11.

Scenarios 2 and 3: Rice-Only and Loum Pa farms

Table 4. Loum Pa and Rice-only farm within a single farming system

Variables	Scenario 2: Rice Only	Scenario 3: Loum Pa
Farm area (ha)	0.9	1.7
Fixed cost/ USD	192	521
Variable cost/USD	30	1,552
Rice Harvested/Kg	1,820	1,575
Rice Yield Kg/ha	2,022	927
Rice sold/ Kg	0	0
Average % rice consumed	1,750 Kg or 96%	1,260 Kg or 80%
Average % rice for seed	70 kg or 4%	270 Kg or 17%
Average selling price/ USD	-	0.4
Average fish harvest in Kg	-	15
Average % of fish consumed	-	100%
Average % of fish sold	-	-
Average selling price/ USD	-	-
Top reasons in favor of the IRFC	Have enough food for household consumption	Fish availability for consumption Vegetables and snails are available
Top reasons against the IRFC farm		People can steal fish from the pond.

Table 5 below presents the BRC estimates for the rice-only and Loum Pa systems, with and without fixed costs.

Table 5. Summary of the BCR for the Rice-Only farm and the Loum Pa farm

System	Yield (kg/ha)	Total Cost (USD/ha)	Rice Revenue (USD/ha)	Fish Revenue (USD)	Total Benefit (USD/ha)	BCR	BCR with no fixed cost
Rice-only	2,022	222	673	-	673	3	22.4
Loum Pa	927	1,220	343	7	347	0.3	0.4

The BCR of the rice-only farm is 3, which is higher than 1 and even higher when considering the BCR without fixed costs, indicating a potentially economically viable farming operation compared to the Loum Pa system, which has both BCR estimates of less than 1, as evidenced in Figure 2 below. The major comparison points between the two farm operations are their plot sizes and total operational costs.

The Loum Pa plot is approximately 50% larger than the rice-only farm, which could be attributed to the fishpond area required to accommodate the fish and the additional costs incurred from setting up and maintaining the ponds. The primary driver of the high total cost is the labor wage of approximately 28 million LAK ($927), accounting for approximately 60% of the total cost. However, the rice-only farm also exhibits a strong technical performance of more than 2,000 kg/ha, compared to the Loum Pa farm's performance of less than 1,000 kg/ha.

Figure 2 below visually illustrates the link between farm technical and economic performance. When a farm has a higher technical productivity, it is typically reflected in improved economic

performance. Therefore, while BCR provides insight into short-term economic viability, it should be complemented by technical productivity indicators, such as yield per hectare, to thoroughly assess the farm's overall performance and long-term sustainability. An additional avenue to improving the Loum Pa BCR could be through institutional contracts, as seen in the red rice case, where total revenues and benefits are generated based on the reported average price. Higher and less volatile prices through contracts can enhance the BCR through farm total benefits.

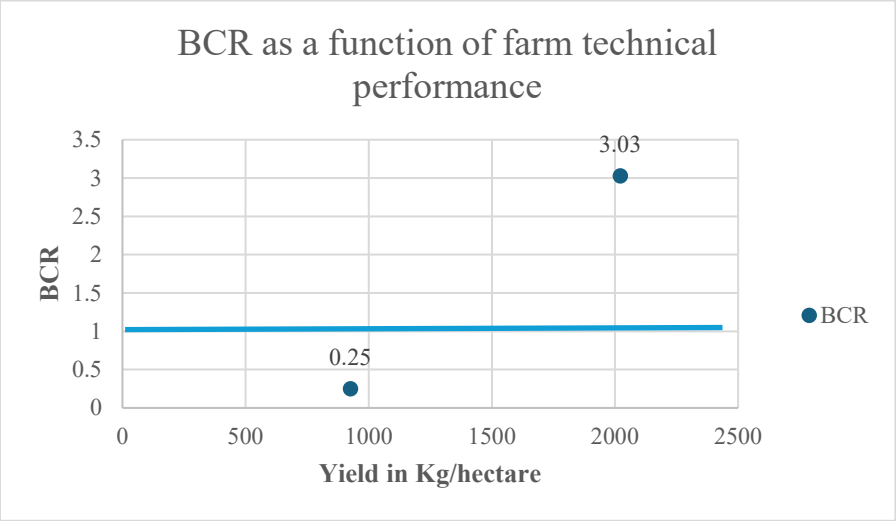


Figure 2. Rice Only and Loum Pa BCR as a function of their yields.

Scenario 5: IRFC and Rice Only

Table 6. Summary of performance indicators of scenario five farms: IRFC and Rice Only in a joint farming system

Variables	Farm 1	Farm 2
Total rice field (ha)	2	2.6
IRFC area (ha)	0.19	0.09
Fixed cost/ USD	1,309	408
Variable cost/USD	401	272
IRFC rice Harvested/Kg	400	200
IRFC rice Yield Kg/ha	2,106	2,222
IRFC rice sold/ Kg	400	200
Weighted rice average yield in Kg/hectare	2,142.86	
Average % rice sold	100%	
Average % rice consumed	0%	
Average % rice for seed	32%	
Average selling price in USD	0.254	
Average fish harvested in Kg	52	
Average % of fish consumed	64%	
Average % of fish sold	36%	

Average selling price in USD	23.33	
Top reasons in favor of the IRFC	Food availability and cultural agricultural practice Additional fish consumption and an income source Improved rice yield without chemical fertilizer	
Top reasons against the IRFC farm	Water is insufficient, especially in the dry season. High cost of digging channels for fishponds Challenge accessing hatcheries	
Rice Only area (ha)	1.8	1.9
Fixed cost/ USD	728	280
Variable cost/USD	1,458.07	29
Rice Only Harvested/Kg	3,000	3,825
Rice Only Yield Kg/ha	1,667	2,013
Rice Only sold/ Kg	1,400	1,500
Weighted rice average yield in Kg/hectare	1,845	
Average % rice sold	42%	
Average % rice consumed	55%	
Average % rice for seed	3%	
Average selling price in USD	0.3	
Top reasons in favor of the rice-only farm	Cultural farming practice Enough food and income for the household	
Top reasons against the rice-only farm	Water insecurity issues are especially prevalent in the dry season.	

Additionally, Table 7 below presents the BRC estimates for the joint (IRFC and Rice Only farm) farming system, with and without fixed costs.

Table 7. Summary of the BCR for the (IRFC and Rice Only farm) farming system

Farm	Yield (kg/ha)	Total Cost (USD/ha)	Rice Revenue (USD/ha)	Fish Revenue (USD)	Total Benefit (USD/ha)	BCR	BCR No fixed cost
1	1,709	1,958	434	120	495	0.25	0.53
2	2023	496	514	120	575	1.2	3.8

The BCR of Farm 2 is slightly above 1 and more than 3 when estimated solely based on its total variable costs, indicating a potentially economically viable operation compared to Farm 1, which has both BCR estimates below 1. Both farms are almost exactly 2 hectares in size and generate similar fish revenue. Although their technical performance is comparable, the main difference is in their operating costs. Farm 1's total cost is four times higher than that of the second farm, resulting in a significantly lower overall BCR.

Scenario 6: Loum Pa and Rice only

Table 8. Loum Pa and Rice only farms in a joint farming system

Variables	Farm 1	Farm 2	Farm 3
Total rice field (ha)	2.7	0.25	2

Loum Pa area (ha)	1	0.12	0.2
Fixed cost/ USD	928	354	880
Variable cost/USD	278	2.31	809
Loum Pa rice Harvested/Kg	1,000	1,200	4,050
Loum Pa rice Yield Kg/ha	1,000	10,000	19,286
Loum Pa rice sold/ Kg	1,950	0	3150
Weighted average rice yield Kg/hectare	4,699		
Quantity of rice consumed in kg	1,500	3,096	3,015
***Quantity of* rice kept for seed**	250	40	270
Average selling price in Lak	8,250		
***Quantity of* fish harvested in Kg**	60	5	55
***Quantity* of fish consumed**	45	5	45
Average selling price in USD	-		
Top reasons in favor of the Loum Pa	Enough food and fish for household consumption, save money that would have been spent on fish, and improve food security during lean seasons.		
Top reasons against the Loum Pa farm	Maintaining a clean fishpond requires regular cleaning, typically done once a year.		
Rice Only area (ha)	1.7	0	0.04
Fixed cost/ USD	0	0	79
Variable cost/USD	43	0	143
Rice Only Harvested/Kg	1,950	0	2,700
Rice Only Yield Kg/ha	1,147		67,500
Rice Only sold/ Kg	450	-	-
Average % rice sold	-		
Average quantity of rice consumed	1,500		
Average quantity of rice for seed			
Average selling price in USD	0.3		
Top reasons in favor of the Rice-only farm	Having enough rice for household consumption, earning income for selling excess production, and saving money for other household needs.		
Top reasons against the Rice-only farm	Pest and snail in the rice field. Rice diseases.		

In addition, Table 9 below shows the BRC estimates for the joint farming system (Loum Pa and Rice Only farm), both including and excluding their respective fixed costs.

Table 9. Summary of the BCR for the (Loum Pa and Rice Only farm) farming system

Farm	Yield (kg/ha)	Total Cost (USD/ha)	Rice Revenue (USD/ha)	Fish Revenue (USD)	Total Benefit (USD/ha)	BCR	BCR No fixed cost
1	1,093	447	606	166	668	1.5	6.5
2	10,000	2,973	3,051	19	3,205	1.1	166
3	27,000	6,755	7,801	140	8,361	1.24	2.58

All three farms under this scenario have both BCR estimates above 1, indicating all are potentially economically viable operations. The primary difference lies in their technical performance. Farm 3 has the highest yield with 27,000 kg per hectare, unlike the other two farms. However, Farm 3 also has the highest cost among all three, which was compensated for by its highest total benefit. Meanwhile, Farm 2 has the strongest BCR estimate without fixed costs, as its reported total variable cost per hectare is just below $20 on a 0.12 hectare, but a hefty total fixed cost per hectare of $2,953.

Scenario 7: All three farming systems, i.e., IRFC, Loum Pa, and Rice Only.

Table 10. Summary of performance indicators of farms with IRFC, Loum Pa, and Rice Only in a joint system

Variables	Farm 1	Farm 2	Farm 3
Total rice field (ha)	2	1	0.62
Loum Pa area (ha)	0.2	0.52	0.25
Fixed cost/ USD	551	851	520
Variable cost/USD	25.89	104	6.9
Loum Pa rice Harvested/Kg	400	2,120	770
Loum Pa rice Yield Kg/ha	2,000	4,077	3,080
Loum Pa rice sold/ Kg	-	200	700
Weighted Avg. rice yield Kg/hectare	5,350		
Average % rice sold			
Quantity of rice consumed in kg	3,000	2,880	1,200
***Quantity of* rice kept for seed**			
Average selling price in Lak	3	-	150
***Quantity of* fish harvested in Kg**	3	14	4
***Quantity* of fish consumed**	3	28	4
Average % of fish sold	-	-	-
Average selling price in USD	2.9		
Top reasons in favor of the Loum Pa	No cost in fingerlings, no additional cost of fish food, enough food and fish for household consumption		
Top reasons against Loum Pa farms	High cost of setting up Loum Pa systems.		
IRFC area (ha)	0.20	0.06	0.06
Fixed cost/ USD	584	785	47
Variable cost/USD	351	414	213
IRFC rice Harvested/Kg	440	220	200
IRFC rice Yield Kg/ha	2,200	3,667	3,333
IRFC rice sold/ Kg	0	0	0
Weighted average rice yield in Kg/ha	2,688		
Quantity of rice sold in kg	-	-	-
Average % rice consumed	3,000	2,880	1,200
Average quantity kept for seed in kg	200	200	-
Average fish harvested in Kg	62	50	36

Average % of fish consumed	48	50	36
Average % of fish sold	13	-	-
Average selling price in USD	2.3		
Top reasons in favor of the IRFC	Consume fish from the field, natural grass, and pest control, and an additional source of income		
Top reasons against the IRFC farm	High digging costs, rice disease, difficulties in accessing fingerlings, and water insufficiency.		
Rice Only area (ha)	1.60	0.42	0.31
Fixed cost/ USD	2,650	326	241
Variable cost/USD	74	99	95
Rice Only Harvested/Kg	3,200	2,320	1,050
Rice Only Yield Kg/ha	2,000	5,524	3,387
Rice Only sold/ Kg	-	200	700
Weighted avg. Rice yield in Kg/hectare	2,820		
Average % rice sold			
Average quantity of rice consumed	3,000	2,880	1,200
Average quantity of rice for seed	200	-	-
Average selling price in USD	0.23	0.28	0.23
Top reasons in favor of the Rice-only farm	Having enough rice for household consumption, earning income for selling excess production, and saving money for other household needs.		
Top reasons against the rice-only farm	Pest and snail in the rice field. Rice diseases.		

Table 11 presents BRC estimates for the combined systems (IRFC, Loum Pa, and Rice Only), showing results for all three systems, both with and without fixed costs.

Table 11. Summary of the BCR for the (IRFC, Loum Pa, and Rice Only) farming system

Farm	Yield (kg/ha)	Total Cost (USD/ha)	Rice Revenue (USD/ha)	Fish Revenue (USD)	Total Benefit (USD/ha)	BCR	BCR No fixed cost
1	2,020	2,118	467	152	543	0.26	2.4
2	4,660	2,579	1,282	167	1,450	0.56	2.5
3	3,258	1,809	753	93	902	0.5	1.8

All three farms under this scenario have a BCR less than one, as shown in Figure 3 below, indicating none is yet economically viable. However, their BCR without fixed cost yield estimates are above 1. The primary difference lies in their technical performance.

Farm 2 also has the highest yield among the three and the highest BCRs despite its high total cost per hectare, indicating how both technical and economic factors interact with each other. Similarly, Farm 3 has the lowest total cost per hectare, but with higher BCR estimates due to its higher yield compared to Farm 1.

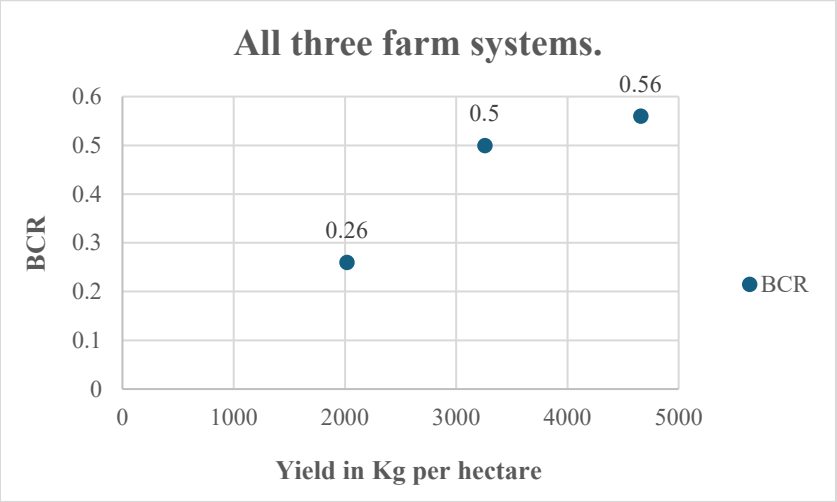


Figure 3. Scenario 7 (all three farming systems): BCR as a function of their respective yields.

3.3. Discussion

Overall, among the different combinations and scenarios examined:

- Scenario 2, which features a Rice-Only farm, has the highest BCR of 3 across all scenarios.
- Scenario 6, which includes Loum Pa and Rice-Only jointly, seems to produce one of the best integrated systems in terms of both technical and economic performance. All three farms under this scenario have a BCR of 1 or above.
- The lowest BCR of 0.25 was achieved under scenario 5, which includes a joint IRFC and Rice-Only farm, although scenario 7 with all three systems also has one farm with a 0.26 BCR.

These initial findings suggest that the familiarity and commonality of traditional farming systems like monoculture and Loum Pa, with accumulated experience over the years, may have contributed to their overall performance, both technical and economic, compared to those in new systems such as the IRFC. Most farms within the IRFC showed lower productivity and inefficiency due to various technical and financial reasons. Farmers often fail to protect their open-field fishponds from fish theft; as a result, they lack the motivation and incentive to invest in making fish production more efficient and profitable through proper monitoring, management, and especially feeding practices. This leads to premature harvesting, preventing fish from reaching their full market value and simply being consumed. With the long tradition of the Loum Pa system, where farmers don't have to invest in fingerlings, fish feeds, or other inputs to catch indigenous or native fish species in their rice fields. Hence, there is a tendency to believe that fish in the IRFC can also feed themselves independently. This is more evident for farmers whose dwellings are not located near their fields. Consequently, the IRFC appears to be costly and less beneficial.

However, implementing IRFC can also be expensive for farmers with limited resources. Knowledge and practice in farming are essential for understanding fishery or aquaculture

production and for ensuring the system runs efficiently for both rice and fish/aquaculture products. For example, rice seed selection should have a lifecycle suitable for fish farming. Access to water should be reliable, and farmers should not rely solely on rainfall for support in rice and fish cultivation. In addition, access to fingerling distributions, feeds, and extension services should be ensured, unlike farmers' reported experience. Although most farmers in Attapeu are familiar with fisheries, they resist adopting the integrated system because they do not want to lose land used for digging channels in the paddy rice fields for fish production, which they consider larger than the fishpond within their Loum Pa.

While the rice-only system consistently has the highest BCR, an integrated scenario featuring the Loum Pa and Rice-Only farms shows strong overall technical and economic results. Most farms in this integrated system achieve a BCR of 1.0 or higher, indicating potential benefits of multi-cropping over monoculture. This result also signals that the traditional Loum Pa system could be a potential pathway to introduce integrated systems like IRFC. Building on these cumulative experiences with Loum Pa could serve as a basis to build upon local knowledge to co-design suitable trenches that could accommodate fish. Also, although farmers have received technical training on data monitoring and record keeping, they still struggle to provide information on their farm production, especially when they operate in more than one farming system like the IRFC and Loum Pa jointly. Detailed and disaggregated data, such as self-consumption, seeds, gifts, and post-harvest losses data, are missing as farmers couldn't recall or didn't keep their records, which represents another layer of the study's limitation.

The RR trial BCRs are only above 1 for the estimates without fixed cost, although all farmers reported that they were willing to continue farming the new rice variety and even allocate more land to it, mainly because of the stable and preferential market price and its farmer-led governance framework. These promising preliminary results, along with a notable increase in farmer interest in these trials, the Red Rice group, which is set to expand to more farmers in 2026, suggest that red rice has strong potential for large-scale adoption and long-term benefits to farmers' livelihoods. However, with a less than 5% consumption rate, red rice is primarily a cash crop whose value chain is managed by the LFN under contract farming and sold mostly overseas. These also suggest that the red rice variety may not currently have a local market in Attapeu, and farmers may become potentially vulnerable if any unexpected change in production size or price occurs under their contract.

Across both trials, i.e., RR and IRFC, as well as the Loum Pa, farmers reported various non-monetary or other benefits linked to their rice production, i.e., aquaculture production, such as fish, shrimps, algae, and frogs, which contributed to enhancing their food and nutrition security through more diversified and protein-rich diets.

Conclusion and Recommendations

In this report, we use a benefit-cost ratio (BCR) approach to evaluate the economic performance of mainly two agroecological trials that the International Water Management Institute (IWMI) and its local partners have introduced, including red rice (RR) and the Integrated Rice Fish Culture (IRFC), as well as local farming systems such as Loum Pa and Rice-only farms conducted under the CGIAR MFL initiative project activities in Attapeu province, Laos. The main takeaway from the preliminary results of the first year's data shows that no single farming system provides a universal solution for economic viability under a fragile landscape. While the rice-only system yields the highest short-term economic returns with a high BCR, its benefits are limited to monetary gains and do not necessarily include nutritional benefits or agricultural diversification and biodiversity restoration. The integrated rice-fish culture (IRFC) and Loum Pa systems, despite their potential, face significant technical, financial, and management challenges that seem to hinder their profitability.

One of their most frequently reported problems is the theft risk associated with open-field fishponds, which discourages farmers from investing in proper management and feeding practices for their IRFC. This often results in a reliance on natural fish feeds, a common practice in the traditional Loum Pa system, where indigenous fish are not purposely stocked. Consequently, fish are often harvested early, preventing them from reaching their full market value. However, the red rice trial shows potential for scale, even though BCRs are relatively low; farmers are willing to keep growing and adopting this crop because it provides a stable market, higher prices, and better yields compared to traditional varieties. This could create a significant opportunity for crop diversification through organic farming practices, with positive impacts on livelihoods. It is also important to note that these results are based on data from a single year of production, even though they pertain to capital-intensive systems like IRFC farming. The high initial fixed costs obscure the long-term profitability and non-monetary or other benefits of these systems. Therefore, for a thorough assessment, BCR should be supplemented with additional years of production data and information on their technical performance, such as yield per acre, as well as other benefits, including improved food and nutrition security. This integrated approach provides a clearer view of a farming system's actual value and its potential for long-term sustainability. Below, we have listed a few recommendations to strengthen the transition to more sustainable farming practices, aligning with the landscape-driven perspectives.

- To provide support to cover upfront capital investment for high-potential systems: Policymakers should recognize that high initial costs in systems like IRFC and even RR are investments for the future. Funding and support programs should help farmers cover these upfront costs, enabling them to reap the long-term benefits of increased profitability and agroecological sustainability.
- To invest in extension services and tailored training, especially on aquaculture: To improve the efficiency of the IRFC and Loum Pa systems, policies should focus on providing technical training and extension services in fishery and aquaculture development. These programs should address key challenges such as fishpond

management, disease control, proper feeding practices, and the importance of allowing fish to reach maturity before harvesting.

- To strengthen value chains and market access: The analysis indicates that both red rice and IRFC systems have the potential to become economically viable and to scale. Policies should promote, whenever relevant, the creation of institutional contracts, market linkages, and consumer preference studies for red rice and fish, reduce the risk of price volatility, and secure a consistent income for farmers. This is especially vital for red rice, where farmers may become vulnerable if any unexpected change to their contract occurs.
- Promote integrated systems based on local knowledge, e.g., Loum Pa: While the rice-only system seems economically efficient, policy should build upon the local knowledge on Loum Pa to introduce and support the adoption of integrated systems, like IRFC, by emphasizing their benefits beyond just monetary gains, including food security, income diversification, resilience to climate shocks, and biodiversity restoration.

These recommendations should be tailored to local needs and gain support from farmers, so they understand the reasons behind these policies. They should also address specific obstacles faced by farmers, such as land-use challenges and risks of theft.

References

Chanthalath A., Dubois M., Kotchofa P., Xaydala V. (2025). Could red rice be the key to a better future for farmers in Lao PDR? (https://www.iwmi.org/blogs/could-red-rice-be-the-key-to-a-better-future-for-farmers-in-lao-pdr/).

Clayton, T.; Douangsavanh, S.; Sinavong, P.; Phimmachanh, P.; Nhuong, T.; Kosal, M.; Dyna, E.; Viossanges, M.; Dubois, M. (2023) Context Assessment: Analysis of the biophysical, sociopolitical, economic and agroecological context in Attapeu Province, Lao PDR. 52 p. (https://hdl.handle.net/10568/138357)

Douangsavanh, S.; Pavelic, P.; Kotchofa, P.; Dubois, M. 2025. Performance and cost-benefit evaluation of farmer-managed solar-powered groundwater irrigation in Attapeu Province, Lao PDR: interim results from the first year of operation of four pilot systems. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Multifunctional Landscapes Program. 32p.

Sokchea, A., Culas, R. (2015). Impact of Contract Farming with Farmer Organizations on Farmers' Income: A Case Study of Reasmey Stung Sen Agricultural Development Cooperative in Cambodia. Australasian Agribusiness Review. https://doi.org/10.22004/ag.econ.262469

Tran Quoc Nhan (2019). Effect of private-led contract farming on rice growers' yield, cost, selling price, and return: evidence from Vietnam's central Mekong Delta. IFAMA Review olume 22 Issue 5, 2019; DOI: 10.22434/IFAMR2018.0093

Annex. Data Collection Tools

SURVEY QUESTIONNAIRE ON THE COST-BENEFIT ANALYSIS OF RICE FARMING SYSTEM TRIALS.

Date:
Name of enumerator:
Province:
Village:

Goal of the survey: This survey is designed to evaluate the performance of three rice farming systems: Loum Pa (traditional Rice Fish Farming), Integrated Rice and Fish Culture (IRFC), and Rice-Only farming with Good Agricultural Practices (GAP). We will gather information on the costs and benefits of the activity.

Consent of participation: Do you agree to participate in this brief survey questionnaire? *(Circle the respondent's answer.)* Yes: No:

Name of the respondent:……..

What is the TOTAL Size of the respondent's Rice field? …….. *(Ha or Sq. Meters)*

Which rice farming system(s) do the respondents use? *(Please circle the respondent's answer.)*

a) Loum Pa (traditional Rice fishing);
b) Integrated Rice and Fish Culture (IRFC);
c) Rice-Only farm with good agricultural practices

I. LOUM PA (TRADITIONAL RICE AND FISHING SYSTEM)

1.1. What is the size of the Loum Pa Rice field? …….. *(Ha or Sq. Meters)*

1.2. What are the crops farmed on your Loum Pa field? *(Circle the respondent's answer.)*

a) Rice only
b) Rice with fish
c) Rice with others to be listed: ……

A. Field preparation and equipment used for the Loum Pa:

1.3. How much did you spend on land preparation or digging for the Loum Pa? ……

1.4. How much did you spend on plowing land for the Loum Pa? ……

1.5. How much did you spend on your farm equipment? *Please indicate if these are shared costs across multiple farming systems*……..……..

1.6. How much did you spend on your farm machinery used in this field *(please indicate if these are shared costs across multiple farming systems)*? ……..……..

1.7. How much did you spend on fuel on this farm? *Please indicate if these are shared costs across multiple farming systems*……..……..……

1.8. How much did you spend on transportation to and from your farm? *Please indicate if these are shared costs across multiple farming systems*. ……..……

1.9. How much did you spend on energy? Please indicate if these are shared costs across multiple farming systems. ……..……..

1.10. How much did you spend on regular or contracted labor to maintain the farm? *If the answer is zero and this work is done by yourself or a family member, please indicate how much you would have to pay someone else to do this task if no family member were available. Additionally, please specify if these costs are shared across multiple farming systems.*
……..……

B. Operation costs for the Loum Pa farming system

1.11. How many rice seed varieties are planted on your Loum Pa field? ……..…

1.12. Please list all the rice seed varieties planted in your Loum Pa field. ……

1.13. How much did you spend on all the rice seeds? ……..……

1.14. How much did you spend on rice nursery? ……..……

1.15. What is your total labor cost for rice planting? *If the cost is zero because it's done by you or a family member, please ask how much you would need to pay someone else to do this task if no family member were available.*
……..……..……

1.16. How much did you spend on chemical fertilizers? ……..……

1.17. How much did you spend on manure or organic fertilizer?
……..……

1.18. How much did you spend on pesticides? ……..……

1.19. How many species of fish are in your field? ……..……

1.20. Please list all the fish species in your field. ……..……

1.21. How much did you spend on fingerlings for your rice field? ……..……

1.22. How much do you spend on fish food to feed the fishes in your rice field?

1.23. What is your total labor cost for harvesting your rice? If the cost is zero because it's done by you or a family member, *please ask how much you would need to pay someone else to do this task if no family member were available.* ……..……

1.24. What is your total labor cost for harvesting your fish? If the cost is zero because it's done by you or a family member, *please ask how much you would need to pay someone else to do this task if no family member were available.* ……..……

1.25. How much did you spend on water for your rice field? *(Please indicate the periodicity of the payment.)* ……..……..……

1.26. Are there any other costs not listed here? If yes, please list them separately with their relative amounts. ……..……..……

C. Benefits of the Loum Pa (traditional Rice fishing)

1.27. How many bags of rice have you harvested from your Loum Pa Rice field?……..

1.28. How many bags (kg or tons) of rice did you sell from your Loum Pa Rice field?……

1.29. What is the average price at which you sell your rice?……..……

1.30. What quantity did you gift as donations?……..……

1.31. What quantity did you keep for seed?……..……

1.32. What quantity of rice did you consume at home with your family?……..……

1.33. Do you often exchange rice to get another good of your choice? Yes or No:
If yes, what quantity of rice did you exchange from your harvest? ……..……

1.34. What quantity (kg) of fish did you harvest from your plot? ……..……

1.35. What quantity (kg) of fish did you sell for income? ……..……

1.36. What is the **average price** at which you sell your fish? ……..……

1.37. What quantity of fish did you gift as donations? ……..……

1.38. What quantity of fish did you consume at home with your family? ……..……

1.39. Do you often exchange FISH to get another good of your choice? If yes, what quantity of fish did you exchange from your harvest? ……..……

1.40. Do you sell other products besides rice and fish to earn money from your Loum Pa **rice field**? If yes, please list them separately and indicate how much you sell them for.……..

1.41. Please tell us three things that you like about your Loumpa field.
- a- ……..……..……..……
- b- ……..……..……..……
- c- ……..……..……..……

1.42. Please tell us three things you dislike and wish to improve in your Loumpa field.
- a. ……..……..……..……
- b. ……..……..……..……
- c. ……..……..……..……

II. IRFC SYSTEM

2.1. What is the size of your IRFC field? …….. (Ha or Sq. Meters)

2.2. What are the crops farmed on your IRFC field? *(Circle the respondent's answer.)*

d) Rice only
e) Rice with fish
f) Rice with others to be listed: ……

D. Field preparation and equipment used for the IRFC

2.3. How much did you spend on land preparation or digging for the IRFC? ……

2.4. How much did you spend on plowing land for the IRFC? ……

2.5. How much did you spend on your farm equipment? *Please indicate if these are shared costs across multiple farming systems*……..……..

2.6. How much did you spend on your farm machinery used in this field *(please indicate if these are shared costs across multiple farming systems)*?
……..……..

2.7. How much did you spend on fuel on this farm? *Please indicate if these are shared costs across multiple farming systems*……..……..……

2.8. How much did you spend on transportation to and from your farm? *Please indicate if these are shared costs across multiple farming systems*. ……..……

2.9. How much did you spend on energy? Please indicate if these are shared costs across multiple farming systems. ……..……..

2.10. How much did you spend on regular or contracted labor to maintain the farm? *If the answer is zero and this work is done by yourself or a family member, please indicate how much you would have to pay someone else to do this task if no family member were available. Additionally, please specify if these costs are shared across multiple farming systems.*
……..…

E. Operation costs for the IRFC system selected above

2.11. How many rice seed varieties are planted on your IRFC field? ……..…

2.12. Please list all the rice seed varieties planted in your IRFC field. ……
2.13. How much did you spend on ALL rice seeds? ……..……

2.14. How much did you spend on rice nursery? ……..……

2.15. What is your total labor cost for rice planting? *If the cost is zero and it's done by a family member, how much would you need to pay someone else to do this task if no family member were available?* ……

2.16. How much did you spend on chemical fertilizers? ……..……

2.17. How much did you spend on manure or organic fertilizer?
……..……

2.18. How much did you spend on pesticides? ……..……

2.19. How many species of fish are in your field? ……..……

2.20. Please list all the fish species in your field. ……..……

2.21. How much did you spend on fingerlings for your rice field? ……..……

2.22. How much do you spend on fish food to feed the fishes in your rice field?

2.23. What is your total labor cost for harvesting your rice? If the cost is zero because it's done by you or a family member, *If the cost is zero and it's done by a family member, how much would you need to pay someone else to do this task if no family member were available?* ……

2.24. What is your total labor cost for harvesting your fish? If the cost is zero because it's done by you or a family member, *please ask how much you would need to pay someone else to do this task if no family member were available.*
……..……

2.25. How much did you spend on water for your rice field? *(Please indicate the periodicity of the payment.)*
……..……..……

2.26. Are there any other costs not listed here? If yes, please list them separately with their relative amounts. ……..……..……

F. Benefits of the IRFC system

2.27. How many bags (kg or tons) of rice have you harvested from your IRFC Rice field?……..…

2.28. How many bags (kg or tons) of rice did you sell from your IRFC Rice field?……

2.29. What is the average price at which you sell your rice?……..……

2.30. What quantity did you gift as donations?……..……

2.31. What quantity did you keep for seed?……..……

2.32. What quantity of rice did you consume at home with your family?……..…

2.33. Do you often exchange rice to get another good of your choice? Yes or No:
If yes, what quantity of rice did you exchange from your harvest? ……..……

2.34. What quantity (kg) of fish did you harvest from your plot? ……..……

2.35. What quantity (kg) of fish did you sell for income? ……..……

2.36. What is the **average price** at which you sell your fish? ……..……

2.37. What quantity of fish did you gift as donations? ……..……

2.38. What quantity of fish did you consume at home with your family?
……..……

2.39. Do you often exchange FISH to get another good of your choice? If yes, what quantity of fish did you exchange from your harvest? ……..……

2.40. Do you sell other products besides rice and fish to earn money from your **rice field**? If yes, please list them separately and indicate how much you sell them for.……..……

2.41. Please tell us three things that you like about your IRCF Rice field.
- d- ……..……..……..……
- e- ……..……..……..……
- f- ……..……..……..……

2.42. Please share three things you dislike and wish to improve about your IRFC field.
- d. ……..……..……..……
- e. ……..……..……..……
- f. ……..……..……..……

III. RICE-ONLY FARM WITH GAP FARMING SYSTEM

3.1. What is the size of your Rice-Only field? …….. (Ha or Sq. Meters)

3.2. What are the crops farmed on your Rice-Only field? *(Circle the respondent's answer.)*
- g) Rice only
- h) Rice with others to be listed: ……

G. Field preparation and equipment used for the Rice-Only selected above:

3.3. How much did you spend on land preparation or digging for the Rice-Only? ……

3.4. How much did you spend on plowing land for the Rice-Only? ……

3.5. How much did you spend on your farm equipment? *Please indicate if these are shared costs across multiple farming systems*……..……..

3.6. How much did you spend on your farm machinery used in this field *(please indicate if these are shared costs across multiple farming systems)*?……..……..

3.7. How much did you spend on fuel on this farm? *Please indicate if these are shared costs across multiple farming systems*……..……..……

3.8. How much did you spend on transportation to and from your farm? *Please indicate if these are shared costs across multiple farming systems*. ……..……

3.9. How much did you spend on energy? Please indicate if these are shared costs across multiple farming systems. ……..……..

3.10. How much did you spend on regular or contracted labor to maintain the farm? *If the cost is zero as it's done by a family member, how much would you need to pay someone else to do this task if no family member were available? Also, specify if these costs are shared across multiple farming*……...

H. Operation costs for the Rice-Only system

3.11. How many rice seed varieties are planted on your Rice-Only field? ……..…

3.12. Please list all the rice seed varieties planted in your Rice-Only field. ……

3.13. How much did you spend on ALL rice seeds? ……..……
3.14. How much did you spend on rice nursery? ……..……

3.15. What is your total labor cost for rice planting? *If the cost is zero, as it's done by a family member, how much would you need to pay someone else to do this task if no family member were available?* ……

3.16. How much did you spend on chemical fertilizers? ……..……

3.17. How much did you spend on manure or organic fertilizer?
……..……

3.18. How much did you spend on pesticides? ……..……

3.19. What is your total labor cost for harvesting your rice? *If the cost is zero as it's done by a family member, how much would you need to pay someone else to do this task if no family member were available?* ……..……

3.20. How much did you spend on water for your rice field? *(Please indicate the periodicity of the payment.)*
……..……..……

3.21. Are there any other costs not listed here? If yes, please list them separately with their relative amounts. ……..……..……

I. Benefits of the Rice-Only System

3.22. How many bags (kg or tons) of rice have you harvested from your Rice-Only field? ……

3.23. How many bags (kg or tons) of rice did you sell from your Rice-Only field? …….

3.24. What is the average price at which you sell your rice? ……..…

3.25. What quantity/bags of rice (kg or tons) did you gift as donations? ……

3.26. What quantity/bags of rice (kg or tons) did you keep for seed? ……..…

3.27. What quantity/bags of rice (kg or tons) did you consume at home with your family?...

3.28. Do you often exchange rice to get another good of your choice? Yes or No:
If yes, what quantity/bags of rice (kg or tons) did you exchange from your harvest?……

3.29. Do you sell other products besides rice to earn money from your **rice field**? If yes, please list them separately and indicate how much you sell them for.……

3.30. Please tell us three things that you like about your Rice-Only field.
g- ……..……..……..……
h- ……..……..……..……
i- ……..……..……..……

3.31. Please share three things you dislike and wish to improve about your Rice-Only field.
g. ……..……..……..……
h. ……..……..……..……
i. ……..……..……..……

SURVEY QUESTIONNAIRE ON THE COST-BENEFIT ANALYSIS OF THE RED RICE TRIALS.

Date:
Name of enumerator:
Province:
Village:

The survey aims to evaluate the performance of the red rice farming systems. We will collect information on farming practices and their costs and benefits.

Consent to Participate: Do you agree to participate in this brief survey? (Circle your answer.) Yes: No:

Name of the respondent:……..

List all the varieties of rice planted by the respondents. *(If the red rice variety is listed, proceed with the rest of the questionnaire.)*

- **…….**
- **…….**
- **…….**
- **…….**

IV. RED RICE FARMING SYSTEM

What is the TOTAL Size of the respondent's rice field? …… *(ha or sq. meters)*

4.1. What is your RED Rice field size? …….. *(Ha or Sq. Meters)*
4.2. What are the crops farmed on your RED Rice field? *(Circle the respondent's answer.)*
   i) Rice only
   j) Rice with fish
   k) Rice with others to be listed: ……

J. Field preparation and equipment used for the Loum Pa:

4.3. How much did you spend on land preparation or digging for the red rice field? ……

4.4. How much did you spend on plowing land for the red rice field? ……

4.5. How much did you spend on your farm equipment? *Please indicate if these are shared costs across multiple farming systems*……..……..

4.6. How much did you spend on your farm machinery used in this field *(please indicate if these are shared costs across multiple farming systems)*?
……..……..

4.7. How much did you spend on fuel on this farm? *Please indicate if these are shared costs across multiple farming systems*……..……..……

4.8. How much did you spend on transportation to and from your farm? *Please indicate if these are shared costs across multiple farming systems*. ……..……

4.9. How much did you spend on energy? Please indicate if these are shared costs across multiple farming systems. ……..……..

4.10. How much did you spend on regular or contracted labor to maintain the farm? *If the answer is zero and this work is done by yourself or a family member, please indicate how much you*

would have to pay someone else to do this task if no family member were available. Additionally, please specify if these costs are shared across multiple farming systems.
……..……

K. Operation costs for the red rice field farming

4.11. How much did you spend on the red rice seeds? ……..……

4.12. How much did you spend on all the other rice seeds? ……..……

4.13. How much did you spend on the rice nursery for the red rice?
……..……

4.14. What is your total labor cost for rice planting? *If the cost is zero because it's done by you or a family member, please ask how much you would need to pay someone else to do this task if no family member were available.*
……..……..……

4.15. How much did you spend on chemical fertilizers? ……..……

4.16. How much did you spend on manure or organic fertilizer?
……..……

4.17. How much did you spend on pesticides? ……..……

4.18. How many species of fish are in your red rice field?
……..……

4.19. Please list all the fish species in your field. ……..……

4.20. How much did you spend on fingerlings for your red rice field?
……..……

4.21. How much do you spend on fish food to feed the fish in your red rice field?

4.22. What is your total labor cost for harvesting your red rice? If the cost is zero because it's done by you or a family member, *please ask how much you would need to pay someone else to do this task if no family member were available.*
……..……

4.23. What is your total labor cost for harvesting your fish? If the cost is zero because it's done by you or a family member, *please ask how much you would need to pay someone else to do this task if no family member were available.*
……..……

4.24. How much did you spend on water for your red rice field? *(Please indicate the periodicity of the payment.)*
……..……..……

4.25. Did you inquire other costs not listed here for your red rice field? If yes, please list them separately with their relative amounts. ……..……

L. Benefits of the Red Rice

4.26. How many times do you cultivate/harvest the red rice per year?
……..……

4.27. How many bags of red rice have you harvested from your rice field? ……..

4.28. How many bags (kg or tons) of red rice did you sell from your Rice field?……

4.29. What is the average price at which you sell your red rice?……..……

4.30. What quantity did you gift as donations?……..……

4.31. What quantity did you keep for seed, if any?……..……

4.32. What quantity of red rice did you consume at home with your family?……..……

4.33. Do you often exchange red rice to get another good of your choice? Yes or No:
If yes, what quantity of rice did you exchange from your harvest?
……..……

4.34. What quantity (kg) of fish did you harvest from your red rice plot?
……..……

4.35. What quantity (kg) of fish did you sell for income? ……..……

4.36. What is the **average price** at which you sell your fish? ……..……

4.37. What quantity of fish did you gift as donations? ……..……

4.38. What quantity of fish did you consume at home with your family?
……..……

4.39. Do you often exchange FISH to get another good of your choice? If yes, what quantity of fish did you exchange from your harvest? ……..……

4.40. Do you sell other products besides rice and fish to earn money from your **red rice** field? If yes, please list them separately and indicate how much you sell them for.……

4.41. Please tell us three things that you like about your Red Rice field.
j- ……..……..……..……
k- ……..……..……..……
l- ……..……..……..……

4.42. Please share three things you dislike and wish to improve about your Red Rice field.
j. ……..……..……..……
k. ……..……..……..……
l. ……..……..……..……

4.43. Would you adopt (continue to farm) the red rice? *(Circle the respondent's answer.)*
m- Yes ……..……..……..……
n- No ……..……..……..……

SURVEY QUESTIONNAIRE ON THE COST-BENEFIT ANALYSIS OF THE COMMUNITY-MANAGED SOLAR GROUNDWATER TRIALS.

Date:
Name of enumerator:
Province:
Village:
Site: 1, 2, 3, 4, 5 *(Circle your answer.)*

The survey aims to evaluate the performance of the community-managed **solar groundwater**. We will collect information on farming practices and their costs and benefits.

Consent to Participate: Do you agree to participate in this brief survey? *(Circle your answer.)* Yes: No:

Name of the respondent:……..

M. Cost elements:

5.1. What is the <u>total amount paid</u> to set up the solar groundwater system? ……..…. (Lak)

5.2. Besides the facilities provided by the project, what other contributions, materials, or finances have you provided for this trial (e.g., wooden fence, etc.)? What was the estimated cost?.....(kips)

5.3. How often do you <u>monitor and record data</u> about the groundwater system?

5.4. What is the unit cost (or total) for each monitoring activity *(please indicate if this is the unit total cost)*

5.5. Is access to the groundwater system subject to a membership fee? *(Circle your answer.)*
- Yes: No:
- If yes, how much do you pay periodically? ……..……..……..……..…. (Lak)

5.6. Did you receive some vegetable seeds as part of your membership fee or for your access to the groundwater? *(Circle your answer.)*
- Yes: No:
- If yes, please list the varieties and the cost per vegetable seeds. ……..…. (Lak)

Please fill in the table below.

Vegetable seeds (provided by the project)	Providers	Lao Kips	Check if farmers grow these vegetables
Chilli	project	90,000	
Coriander herb (1kg)	Project	120,000	
Morning glory (1kg)	Project	80,000	
Asian spinach	project	90,000	

Chinese mustard greens	project	90,000	
Bok choy	project	90,000	
Watermelon	farmer	850,000	
Long green bean	farmer		

N. Benefits

5.7. What is the total quantity of water that you use to extract per day BEFORE they set up the solar groundwater irrigation system?……
…….(mm3).

5.8. For farming households, what were your total areas cultivated BEFORE they set up the solar groundwater irrigation system?…….(hectare).

5.9. What is the total quantity of water you can extract daily WITH the solar groundwater irrigation system? …….(mm3).
We know this number from the project 17-23 m3

5.10. What is the total number of households with access to the groundwater system *(including home consumption and irrigation)?* ……
…… ……

5.11. What is the ratio of water used for domestic purposes compared to farming (irrigation) activities (e.g., how many litters or containers of water are used for household vs. farming purposes per day)?

5.12. For farming households, <u>list all crops farmed</u> using the groundwater water from the pump.
…… ……For questions 5.12 to 5.16, refer to the table below as a guide.

5.13. What is the total area cultivated for each crop (vegetables) listed above?

5.14. What is the total quantity of crop harvested (kg or tons) for each cultivated area, plot, or Crop?

5.15. What is the <u>average price</u> at which you sell each crop
?……..……

5.16. What quantity of each crop did you <u>consume at home</u> with your family?…… ……..……

Vegetable seeds (provided by the project)	Providers	Cost for seeds (kips)	Total yield (kg)	Total sales (kg)	Total sales (kip)	Household consumption (kg)	Area or plots
Chili	project	90,000					
Coriander herb (1kg)	Project	120,000					

Morning glory (1kg)	Project	80,000					
Asian spinach	project	90,000					
Chinese mustard greens	project	90,000					
Bok choy	project	90,000					
Watermelon	farmer	850,000					
long green bean	farmer						
	farmer						

O. Gender aspects:

5.17. Have solar groundwater systems led to greater crop irrigation during the dry season, and what impact has this had on women's involvement in agriculture and their income?
……..……..…….

5.18. How has the quality of life for women and their families improved due to the availability of solar-powered groundwater? (e.g., women and young girls collecting water, time saved, distance covered) ……..……..……

5.19. Have there been any changes in gender roles or responsibilities in the community since adopting solar groundwater systems? ……..……

5.20. What training or support do women need to effectively manage and utilize solar groundwater systems? ……..……..……

5.21. What are women's primary challenges in operating and maintaining solar groundwater systems? ……..……

P. Nutrition and perceptions:

5.22. What do you think about the quality of the water extracted from the pump for your household use?
……..……..……

5.23. Could you describe any improvements in dietary diversity and food security for you and your household resulting from using solar groundwater systems for irrigation?
……..……..……..

5.24. What do you appreciate about this solar groundwater pumping for your family and community?
……..……..……

5.25. What would you have done differently to improve the management of the groundwater system? ……..……

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IWMI International Water Management Institute