



SCALING DIVERSIFICATION OPTIONS IN RICE-BASED SYSTEMS: INSIGHTS AND LESSONS LEARNED FROM 2022 TO 2025



Training Workshop Report

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Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture. It is led by the Alliance of Bioversity International and CIAT and supported by a grant from the International Development Association (IDA) of the World Bank. Explore our work at aiccra.cgiar.org

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Titles in this series aim to disseminate interim research on the scaling of climate services and climate-smart agriculture in Africa, in order to stimulate feedback from the scientific community.

Photos

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Abstract

Diversification in rice-based systems has emerged as a critical strategy to enhance climate resilience, improve farm profitability, and strengthen food and nutrition security in Mali. As climate change intensifies rainfall variability, seasonal unpredictability, pest pressure, and soil degradation, rice monoculture alone no longer provides a stable production system. Between 2022 and 2025, the AICCRA Mali program supported the scaling of diversified farming practices, including rice–legume systems, rice–fish integration, vegetable rotations, agroforestry options, and by-product valorization, all aimed at helping farmers reduce climate risks, restore or maintain soil health, and increase income. A key diversification intervention promoted by the AICCRA project is the provision of solar-powered irrigation pumps, enabling farmers to engage in off-season vegetable production through the Pay-as-you-go (PAYG) scheme. Under this initiative, over 4,483 farmers (60% of whom are women) have benefited from the solar-powered irrigation scheme, supporting dry-season cultivation of important crops. Moreover, over 3658 farmers are engaged in rice-fish farming, of whom about 3% are women.

A workshop held on 21 November 2025 in Bamako brought together researchers, extension agents, and lead farmers to review progress made, share field experiences, strengthen capacity, and identify lessons learned in scaling diversified rice production systems. Through detailed presentations, demonstrations, and interactive discussions, participants gained practical knowledge on diversification principles, benefits, and implementation challenges. Insights from the workshop show that diversification significantly enhances soil fertility, improves household nutrition, expands income streams, particularly for women, and mitigates climate-induced risks. However, constraints such as high input costs, limited access to quality seeds, labor bottlenecks, and insufficient extension support hinder full adoption. The lessons drawn from 2022–2025 underline the need for strengthened farmer support systems, improved agroecological integration, and better financing and infrastructure for sustainable scaling.

Keywords: Climate resilience; Diversification; Adoption; Scaling; Mali



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1. Introduction

Rice production in Mali is highly vulnerable to climate-related stresses, including unpredictable rainfall, water shortages, seasonal droughts, flooding, and a higher incidence of pests and diseases (World Bank, 2023). These challenges have increased the fragility of rice monoculture systems, which rely heavily on consistent water supply and fertile soils. As climate impacts grow, farmers face greater production risks, declining soil health, and increased dependence on inputs, trends that threaten national food and nutrition security.

Food and nutrition insecurity remains a pressing concern in Mali, with recurring shocks, climatic and economic factors jointly limiting stable access to sufficient and nutritious food (WFP, 2023). While rice remains a central staple in Mali, sole reliance on rice production exposes households to both environmental and market risks. Diversification within rice-based systems, therefore, provides an essential adaptation pathway. Integrating legumes, vegetables, trees, off-season production, fish farming, and value addition not only enhances resilience but also improves nutrition, income stability, and year-round food supply for farm households. Legume-based systems contribute to biological nitrogen fixation, improving soil fertility, rice-fish systems provide animal-source protein, and vegetable systems increase micronutrient availability in households' diets, particularly for women and children (FAO, 2022).

Between 2022 and 2025, AICCRA Mali promoted the dissemination of different diversification innovations (rice-legume, rice-vegetables, rice-fish, rice-agroforestry) across targeted rice-growing zones. Moreover, farming communities and cooperatives were provided with access to solar-powered irrigation pumps, using a pay-as-you-go business model to support the production of off-season vegetables. This innovation is important, particularly at a time when the fuel crisis in Mali is becoming prominent. Given the fuel crisis in Mali, which became severe in October and November 2025, disrupting economic activities, transportation, and farming, there is a need to promote renewable energy innovations in the agricultural sector to limit farmers' reliance on fuel for irrigation systems. These



solar-powered irrigation innovations align with climate-smart agriculture (CSA) principles by promoting improved resource-use efficiency, environmental sustainability, and enhanced farmer resilience. Unlike technological packages focused solely on yield, diversification offers multifunctional benefits that strengthen both ecosystem and livelihood stability.

The capacity-building workshop held on 21 November 2025 was convened to consolidate evidence and lessons learned from four years of implementing diversification activities in rice-based systems in Mali. Capacity-building workshops such as this are essential for equipping rice actors, including service providers, researchers, extension agents, and lead farmers, with the skills and knowledge required to manage diversified and resilient production systems. Strengthening human capacity is a critical step toward ensuring that innovations are not just introduced but effectively scaled to support Mali's long-term goals of climate resilience and rice self-sufficiency.

2. Objectives

The objective of the workshop include:

- Present and discuss diversification options in rice-based systems introduced under AICCRA from 2022–2025.
- Strengthen participants' technical knowledge on crop rotation, varietal diversification, integrated rice–fish systems, agroforestry, off-season vegetable production, and by-product valorization.
- Facilitate sharing of experience among farmers, extension agents, and researchers to identify practical challenges and enablers to scaling diversification.
- Review lessons learned and developed recommendations for guiding future scaling initiative



3. Methods

3.1 Participants and organizations

The training workshop held on the 21th of November 2025 at Bamako, Mali, was attended by 25 participants (researchers, extension agents, NARES, service providers, lead farmers) from the Niger Office, Institute for Rural Economy (IER), the National Meteorological Agency (Mali-Météo), Collective Actions for Sustainable Agriculture in Mali (ACAD-Mali), Malian Association for Support and Advice to Community Initiatives (AMACIC), Selingue Rural Development Office (ODRS), lead farmer representatives from cooperatives, and other local NGOs who are actively engaged in rice-value chain activities. Among the 25 participants, 35% of the participants were female. Participants came from three of the major rice-producing regions of Segou, Sikasso, and Koulikoro.

The workshop utilized a participatory and knowledge-sharing approach, featuring:

- Technical presentations with real field photos and data from AICCRA intervention sites (Office du Niger, M'Bewani, Sélingué).
- Interactive discussions for inclusive participation.
- Knowledge-sharing between extension agents, lead farmers, and other participants engaging in or promoting diversification approaches (e.g., rice-fish farmers).
- Group reflection sessions to identify constraints and opportunities for scaling.
- Question-and-answer segments allowing participants to raise practical implementation concerns.

4. Summary of key outcomes from the workshop

The workshop highlighted crop diversification as a central climate-smart strategy for strengthening the resilience, productivity, and profitability of rice-based systems in Mali. Presentations and experience-sharing sessions demonstrated that diversification does not replace rice as a staple crop, but rather complements rice production by spreading climatic and economic risks, improving soil health, and enhancing better household nutrition. Evidence shared from AICCRA intervention



sites between 2022 and 2025 confirmed that diversified rice systems contribute to improved land and water use efficiency, increased income stability, and reduced vulnerability to climate shocks.

4.1 Rice–legume diversification systems

The trainer began the presentation with the Rice–legume diversification system, explaining that it emerged as a widely adopted, technically sound option, particularly in inland valleys and irrigated farmlands. Furthermore, the trainer explained that leguminous crops such as cowpea and groundnut can be introduced either in rotation with rice or during the dry season. This system improved soil fertility through biological nitrogen fixation, reduced dependency on mineral fertilizers, and contributed to pest and disease suppression. Participants reported improved rice yields following legume integration, alongside enhanced household diverse nutrient intake. The approach was noted as low-cost and well-suited for smallholder farmers with limited access to inputs.

4.2 Rice–vegetable diversification systems

Rice–vegetable systems were presented as one of the most economically attractive diversification options, especially for women and youth. Off-season vegetable production (tomato, onion, pepper, leafy vegetables) is possible in rice-production systems in Mali mainly due to the residual soil moisture, shallow groundwater access, and, in some cases, solar-powered irrigation. With the introduction of solar-powered irrigation pumps, farmers can benefit from these services during the off-season through pay-as-you-go (PAYG) schemes, enabling them to produce vegetables and generate additional income. Moreover, the trainer explained the importance of solar irrigation pumps for sustainability, including lower energy requirements and reduced environmental pollution.

This diversification pathway significantly increased household income and improved dietary diversity through access to fresh vegetables. Workshop discussions emphasized that vegetable diversification strengthened resilience by providing income during periods when rice production was not possible. However, the system



requires careful pest management and access to high-quality seeds and water-control infrastructure.

4.3 Integrated rice–fish systems

The integrated rice–fish system was showcased as an upcoming innovation combining rice cultivation with fish farming in the same plot. Demonstrations from AICCRA sites in Office du Niger, Sélingué, and M'Bewani illustrated how trenches and refuge ponds allow fish to coexist with rice. Participants highlighted multiple benefits, including improved nutrient recycling, reduced insect pressure, enhanced water productivity, and increased availability of animal protein at the household level. Fish production from pilot sites reached significant levels, demonstrating the potential of this system to contribute simultaneously to income generation and nutrition security.

4.4 Rice–agroforestry systems

The trainer also made a presentation on rice–agroforestry systems, which comprises integrating tree species such as *Gliricidia sepium* as a long-term sustainability strategy. The trainer also highlighted the importance of trees in improving soil organic matter, controlling erosion, and regulating microclimate. Participants acknowledged that although benefits accrue gradually, agroforestry improves long-term land productivity and resilience to climate extremes. This system was recognized as particularly relevant in degraded lowlands, where declining soil fertility constrains rice productivity.

4.5 Varietal diversification in rice systems

Varietal diversification, which involves combining local, improved, drought-tolerant, and flood-tolerant rice varieties, was identified as a critical adaptation strategy. The trainer emphasized that farmers adopting multiple varieties reduced production risk associated with erratic rainfall, flooding, and pest outbreaks. The workshop emphasized that varietal diversification complements agronomic



diversification by stabilizing yields and improving adaptation to increasingly unpredictable climatic conditions.

4.6 Diversification through rice by-product valorization

The trainer also emphasized the economic benefits of value addition and processing of rice byproducts, such as broken rice, rice bran, rice husk, and rice straw. Diversification can be achieved through value addition to rice by-products, including straw for compost, livestock feed, and mushroom production, as well as parboiling and improved rice packaging. This approach can create employment opportunities, particularly for women, and strengthen local rice value chains. Participants noted that by-product valorization enhances overall system efficiency and reduces post-harvest losses.

4.7 Gains from diversified systems (2022–2025)

The trainer also highlighted key gains farmers have realized from engaging in diversified rice production systems in Mali, under the ACCRA interventions.

- Increased rice yields and farmer income through off-season diversification ($\approx 500 - 1,953$ kg/ha yield gain).
- Improved nutrition via vegetable and fish integration.
- Enhanced soil fertility through legumes and agroforestry (*Gliricidia sepium*).
- Strengthened resilience against climatic shocks.
- Reduction in soil degradation and erosion.
- Higher profitability for women's processing groups using GEM parboiling.

4.8 Constraints, insights, and lessons learned (2022 – 2025)

Key constraints reported by farmers and extension agents were highlighted at the end of the presentations. They include:

- Limited access to quality seeds for legumes, vegetables, and improved rice varieties
- High pest and disease prevalence in vegetable systems
- Inadequate irrigation and drainage infrastructure for dry-season diversification



- Limited access to credit and finance, particularly for women and youth
- Labor constraints during peak agricultural periods
- Weak market linkages and price volatility for diversified products
- Limited technical capacity for integrated systems such as rice–fish and rice–agroforestry

The key lessons to learn from the 4-year scaling was also a topic of discussion among participants and the trainers. The following key lessons and insights were noted:

- Off-season vegetable production is the most profitable diversification option.
- Rice–fish systems effectively enhance dietary protein and income.
- Agroforestry systems require significant early maintenance but improve long-term soil health.
- Diversification must be planned carefully to avoid crop-family conflicts and resource strain.
- Women and youth require better access to land and resources for equitable scaling.

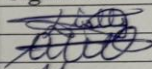
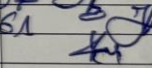
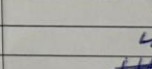
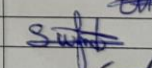
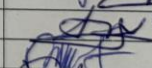
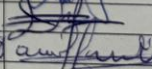
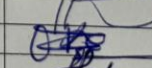
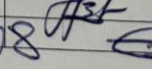
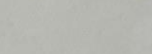
5. Conclusion

The workshop demonstrated that diversification in rice-based systems is a powerful lever for climate resilience, soil restoration, income diversification, and improved nutrition in Mali. Lessons from 2022–2025 show clear benefits but also expose persistent challenges that require attention for the continuous strengthening of scaling initiatives. Strengthened extension support, targeted financial mechanisms, improved access to quality inputs, and gender-responsive strategies were identified as critical to sustainably scaling diversification systems. Investing in diversified rice systems means investing in the long-term stability, productivity, and resilience of Mali’s rural rice communities.



6. Appendix

Appendix Section 1: Attendance list

 AfricaRice		 AICCRA			
Training workshop on climate-smart agriculture innovations and climate information services in rice-based systems in Bamako, Mali					
Bamako, le 21/11/2025					
Liste de Presence					
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26					
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Bamako le...../...../2025

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