Agroecology Initiative

Technical Report

Synthesis of agronomic assessment for co-designed trials and recommendations

Global agronomy team- Work package 1

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Introduction

Foreword

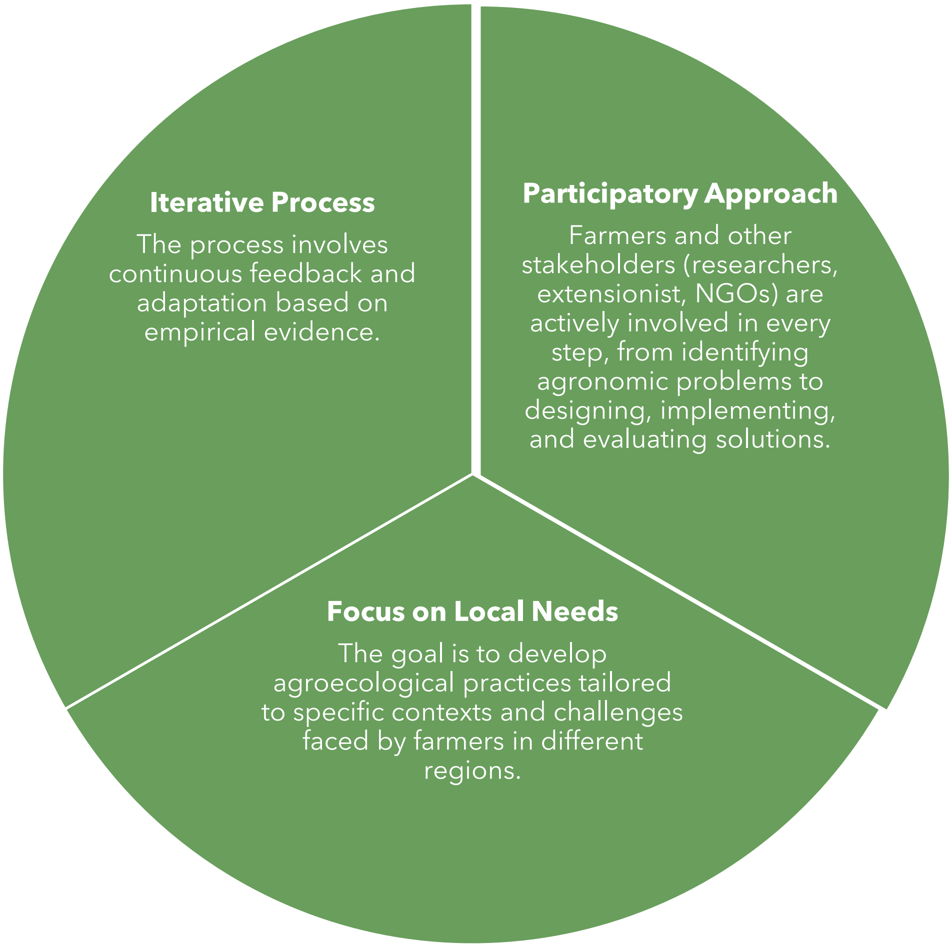
This document presents a consolidated cross-country analyses of agroecological innovations and trials based on the agronomic assessments developed in each country participating in the CGIAR Agroecology Initiative (AEI). The document consolidates two key outputs of the consultancy GH-2024-0573: a comprehensive draft report on the assessment of co-designed trials and results across the eight countries (Deliverable #3), providing a critical analysis of similarities, differences, and challenges, along with recommendations for the next phase of the AEI initiative; and refined suggestions for inclusion in two WP1 products – the co-design guidelines and the cross-analysis report (Deliverable #5). The present document is based on the information contained in the compilation of agronomic assessment reports from the different countries (Deliverable # 2).

The agronomic assessment of innovations was conducted between August and November 2024 by the global Work Package 1 (WP1) team of the CGIAR Agroecology Initiative (AEI). The assessment aimed at evaluating the agroecological trials codesigned across multiple Agroecological Living Landscapes (ALLs) within the initiative. Its primary objective was to analyze the performance of agroecological technologies compared to conventional practices by examining their productive, environmental, and socioeconomic dimensions. Through the documentation of protocols, methods, and results, the assessment aimed to facilitate cross-comparisons among innovations while respecting the context-specific dynamics of each ALL. Furthermore, the process fostered collaboration between global and country teams, identifying areas for improvement and offering actionable recommendations to enhance understanding of the agroecological transition and its potential impacts.

This document provides a synthesis of the agronomic assessment across the eight countries participating in the initiative. It analyzes agroecological innovations grouped into five thematic areas commonly addressed within the ALLs, compares the agroecological transition processes across ALLs, and offers recommendations for the next stages of the AEI, based on the country reports on agronomic assessments. Additionally, the document includes a concise overview of the innovations developed in each ALL for reference. It is important to note, however, that this document is based on the compilation of country reports. For more detailed information on any specific aspect covered here, readers are invited to consult the corresponding country compilation report.

Co-designing trials under an agroecological perspective

The co-design of trials within the CGIAR Agroecology Initiative across the eight participating countries is built around three key components (Figure 1). First, each co-design process emphasizes local needs and contexts, addressing specific agronomic challenges unique to each region. Despite the focus on local needs and differentiated level of maturity of each co-designed technology, a unifying factor across all eight countries is the shared objective of facilitating an agroecological transition – from conventional, non-agroecological practices to more sustainable, context-specific solutions. However, in some cases, such as in Kenya and Peru, the starting point of practices already included organic or permaculture agriculture. In these instances, the goal was to deepen the agroecological transition. Second, it follows a participatory approach, actively engaging multiple stakeholders, with farmers playing a central role throughout the process. Finally, it adopts an iterative methodology, characterized by continuous cycles of design, testing, evaluation, and re-design. This document aims at highlighting commonalities across the eight countries, offering both an evaluation of the co-design processes and a foundation for the next phases of the agroecology initiative.



Iterative Process

The process involves continuous feedback and adaptation based on empirical evidence.

Participatory Approach

Farmers and other stakeholders (researchers, extensionist, NGOs) are actively involved in every step, from identifying agronomic problems to designing, implementing, and evaluating solutions.

Focus on Local Needs

The goal is to develop agroecological practices tailored to specific contexts and challenges faced by farmers in different regions.

Figure 1- Main Components Identified for the co-design process of trials within the CGIAR Agroecology Initiative

Focus on local needs

Stakeholders in each Agroecological Living Landscapes (ALL) established specific agronomic goals during the co-design process tailored to local challenges and opportunities (Box 1). While diverse, these goals collectively aimed to foster agroecological transitions that enhance systems resilience and profitability.

Box 1. Agronomic Country-Specific Goals of the Co-design Process

Burkina Faso: Improve dairy livestock systems through fodder crop production (cereals and legumes), manure as fodder fertilizer, and optimized cattle diets.

India: Diversify the income and diet of smallholder tribal communities dedicated to paddy rice crop through the implementation of multilayer crop systems known as Agroecological Homestead Models (AHM).

Kenya: Enhance the resilience of crops like maize, beans, spinach, and cabbage through improved soil fertility, water management, and integrated pest management.

Laos: Improve food security and income through Integrated Rice-Fish Culture (IRFC), red rice production, and Vegetables during the dry season under the umbrella of a sustainable wetland management approach.

Peru: Improve the agronomic management in organic-certified cacao orchards organized in two local cooperatives, addressing the control of fruit diseases and the tree nutritional management.

Senegal: Enhance groundnut production through intercropping with cowpea and the use of manure as crops fertilizer.

Tunisia: Improve sheep fertility through forage mixtures (vetch, oat, and triticale) and enhance soil health in olive orchards, durum wheat fields and sulla forage plants.

Zimbabwe: Improve maize and sorghum production through agroecological practices like push-pull, mulching, and biochar, and promote the use of local landraces.

In Asia, country teams in India and Lao PDR are trying to diversify the traditional paddy rice monoculture. India's Agroecological Homestead Models (AHM) integrated multilayer cropping, introducing a variety of crops aiming to provide both dietary and income diversification for smallholder tribal communities. Similarly, the team in Lao PDR promotes Integrated Rice-Fish Culture (IRFC), red rice and dry season vegetables cropping within a sustainable wetland management framework, aiming to improve both food security and farm income by diversifying production systems beyond the white rice staple crop.

In Africa, the focus of the teams in Kenya and Zimbabwe is on enhancing the resilience of key staple food crops, such as maize, beans, and sorghum, as well as vegetables like lettuce and cabbage, through improved soil fertility, water management, and integrated pest management (IPM). Soil fertility is addressed using manure in Kenya and biochar in Zimbabwe. Water management practices include mulching in both countries and terraces in Kenya. IPM is implemented using bio-pesticides in Kenya and the push-and-pull system in Zimbabwe.

Also in Africa, livestock-crop integration is a key theme in the agronomic goals for teams in Burkina Faso, Tunisia, and Senegal. In Burkina Faso, the integration of fodder crops (cereals and legumes) with optimized cattle diets and manure use strengthens dairy livestock systems while enhancing soil fertility. Similarly, in Senegal, the use of horse manure to fertilize groundnut, combined with intercropping with an additional legume like cowpea (the "doubled-up legume" approach), aims to rejuvenate soils in traditional millet rotations. This approach benefits families by boosting grain production and providing increased biomass for livestock feed. The Tunisia team further supports livestock-crop integration by enhancing sheep fertility through forage mixtures of vetch, oat, and triticale. These strategies exemplify how mixed crop-livestock systems can enhance both crop and livestock productivity, promoting a sustainable transition to agroecological practices.

Two countries, Tunisia and Peru, set specific agronomic goals related to perennial crop systems, demonstrating the versatility of co-design approaches even in well-established fruit orchards. In Tunisia, the focus is on improving soil health in olive orchards through the use of olive mill wastewater, integrating circular economy principles into the co-designed agroecological practices. Meanwhile, in Peru, the emphasis is on refining the agronomic management of organic-certified cacao orchards. Efforts aim at controlling moniliasis – one of the primary cacao fruit diseases – and improving tree nutrition through the use of biofertilizers. Both cases highlight how co-design processes can effectively address critical agronomic challenges in perennial systems, fostering agroecological transitions even within established certified organic production systems, as seen in Peru.

Two transversal themes also emerged across several countries: the integration of legumes into cropping systems and the use of various types of animal manure. These practices, while not always directly tested, played crucial roles in supporting agroecological transitions. Legumes enhanced soil fertility and biomass production, while manure applications served multiple purposes depending on the specific interventions in each country. Typically, they improved soil health and fertility or strengthened key biochemical processes in bio-inputs. Although these strategies were sometimes implicit, they formed a foundational element for many teams, demonstrating their widespread applicability. A more detailed discussion of these practices and their impacts under the context of the agroecology initiative will be presented in the upcoming sections of this document.

Participatory approach of the co-design process

The participatory approach was a core element of the Agroecology Initiative across all countries. Overall, the participation of farmers and researchers was generalized during the co-design process, but the involvement of farmers varied among countries.

The active participation of farmers in the co-design process of agroecological trials was consistently observed in Burkina Faso, Kenya, Zimbabwe, and Senegal, where farmers played a central role throughout various phases. In these ALLs, the co-design included some level of adoption and upscaling of the agroecological innovations, as farmers voluntarily established trials in their fields or chose specific treatments to establish baby trials after a first cycle of mother or central trials. In Burkina Faso, farmers co-designed trials, established them in their fields, analyzed feed, and assessed biomass use, offering continuous feedback on manure pits and fodder crop performance to refine practices. In Kenya, they identified and prioritized agroecological practices, contributed to trial setup and monitoring, and proposed adjustments after the first cycle of trials. Similarly, in Zimbabwe, farmers participated throughout the process, establishing mother trials in their fields, taking part in seed fairs, and evaluating technologies during feedback workshops. Many farmers later contributed to upscaling interventions by establishing baby trials during the second year. In Senegal, pre-diagnosis workshops allowed farmers to identify constraints and propose solutions, which were later assessed in co-evaluation sessions and workshops, helping analyze agroecological innovations at a regional scale.

Four key lessons from countries with deeper farmer participation in co-design processes emerged, signaling further improvements for the participatory approach:

1. Senegal highlighted the need to assess the co-design process at the landscape level, recognizing that successful agroecological interventions require evaluating resource availability, such as seeds or manure, for effective upscaling. This finding reinforces the idea for the co-design processes to be landscape-aware.
2. Zimbabwe revealed challenges in the co-design process, particularly inconsistent representation of local private sector actors and development partners, which hindered knowledge-sharing. Moreover, community-identified challenges, including inadequate infrastructure, limited financial services, and market barriers, often surpassed the project's capacity, underscoring the importance of alignment between community needs and project scope.
3. In Zimbabwe, a differentiated rating of technologies by gender and age suggests that distinct social groups may value different performance domains. This highlights the potential for differentiated co-design processes offering an avenue for exploration in upcoming stages of the initiative.
4. In Burkina Faso, challenges emerged in applying decision-making tools to implement treatments, largely due to a lack of historical data on productivity and inputs. Implementing sensitization and training programs focused on these tools could empower farmers to utilize them effectively while also establishing routines for regularly collecting productivity data. This approach would support a transition to agroecology grounded in informed and strategic decision-making.

In countries like India, Lao PDR, Peru, and Tunisia the participation of growers was more moderate, characterized by limited involvement in decision-making in some stages but having a meaningful contribution in specific areas of implementation and feedback. In India, tribal communities engaged in the initial visioning and provided feedback after the initial AHM implementation that shaped design modifications. However, their primary role centered on implementing and adapting the AE innovation based on their experiences, with less influence on the initial co-design. Similarly, in Tunisia's forage trial, farmers actively selected animals, managed daily tasks, and provided feedback, yet researchers retained control over experimental design and data analysis. In Laos, farmers contributed during the visioning phase and chose fields for the IRFC trials. However, their role was largely implementation-focused, following technical advice from researchers and government agencies. In Peru, growers and technicians from cooperatives identified innovations and implemented trials. Nevertheless, the process was largely driven by cooperative technicians, with farmers playing a smaller role in design and analysis, constrained by the requirements of organic certifications. Finally, in Tunisia’s olive mill wastewater trial, farmers participated by applying treatments and offering feedback, while researchers led the experimental and analytical aspects. These examples highlight the varied roles farmers can play in co-design processes, from active contributors in feedback and adaptation to implementers of researcher-driven designs, often shaped by institutional and contextual constraints. A common feature across these countries is the necessity to adapt technologies to local contexts, which underscores the importance of initial experimentation under farmers' conditions. This foundational step is essential to enable farmers to engage meaningfully and contribute actively at each stage of the co-design process.

Iterative co-design process

While the co-design process within the Agroecology Initiative varied across countries to accommodate local contexts, several common or generic stages were followed in most cases. Notably, the Kenyan team has followed a more detailed and advanced procedure for this iterative co-design process (Box 2). The next section provides a summary of these generic stages, along with references to the specific countries that exemplified each step:

1. Initial Engagement and Problem Diagnosis:

Stakeholder Identification and Mobilization: This involved identifying key actors in the local food system, including farmers, researchers, extension workers, NGOs, and community leaders (Burkina Faso, Kenya, Senegal, Zimbabwe, Tunisia).

Participatory Workshops and Consultations: These were conducted to bring stakeholders together to discuss challenges, opportunities, and potential agroecological solutions (Burkina Faso, Kenya, India, Senegal, Zimbabwe, Tunisia).

Visioning Exercises: In some cases, communities engaged in visioning exercises to define their desired future for their food systems and landscapes (Kenya, Laos, Zimbabwe).

Baseline Assessments and Diagnostics: These activities helped to understand the current situation, including the agroecological status, socio-economic context, and existing practices (Kenya, Senegal, Zimbabwe, Tunisia).

2. Co-designing and Implementing Agroecological Innovations:

Identifying and Prioritizing Agroecological Practices: This often involved reviewing existing knowledge, farmer experimentation, and expert recommendations (Kenya, Peru).

Developing Experimental Designs and Protocols: Stakeholders collaborated to define the specific interventions to be tested, including crops, treatments, and monitoring protocols (Burkina Faso, Kenya, Peru, Senegal, Tunisia).

Establishing Trials and Demonstrations: This involved setting up on-farm experiments or demonstration plots to test the selected agroecological practices (Burkina Faso, Kenya, Senegal, Zimbabwe).

Capacity Building and Training: Farmers and other stakeholders received training on the implementation and monitoring of the chosen practices (Kenya, Laos).

3. Monitoring, Evaluation, and Adaptation:

Co-monitoring and Data Collection: Farmers and researchers worked together to collect data on the performance of the agroecological interventions (Kenya, Laos, Peru, Tunisia, Senegal, Zimbabwe).

Co-evaluation Workshops and Feedback: Stakeholders participated in workshops to share their observations, analyze results, and identify areas for improvement (Kenya, Senegal, Peru, Zimbabwe).

Iterative Adaptation and Refinement: Based on the feedback and evaluation, the interventions were adapted and re-designed to better suit the local context and address challenges (India, Kenya, Peru, Senegal, Zimbabwe).

Important Notes:

Farmer-to-Farmer Exchanges: farmer-to-farmer exchange visits played a crucial role in inspiring and informing the co-design process (India, Kenya, Peru, Zimbabwe).

Mother-Baby Trials: In Burkina Faso and Zimbabwe, mother-baby trials were used to adapt co-designed trials to farmers conditions, facilitating the dissemination of seeds and knowledge.

Focus on Specific Value Chains: In six countries, the co-design process focused on specific value chains, such as livestock-crop missed systems in Burkina Faso, and Senegal, cacao in Peru, staple food crops in Kenya and Zimbabwe, and vegetables in India.

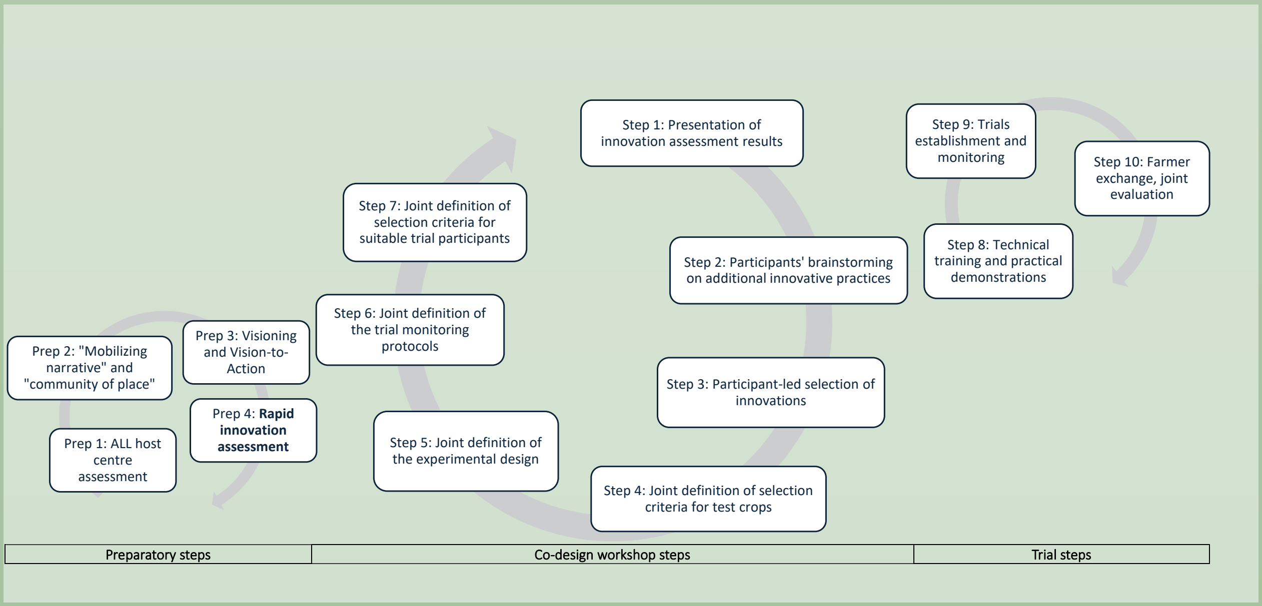
Focus on multiple Value chains in a Landscape: Two countries, Laos and Tunisia, adopted a landscape approach to address multiple systems. In Laos, co-design of trials focused on diversifying rice systems through integrated rice-fish culture, red rice, intercropped legumes, and dry-season vegetables, all under the umbrella of the integrated water management plans. In Tunisia, along the Kef-Siliana transect, co-designed trials targeted semi-arid agricultural systems, including mixed systems between sheep and fodder crops, the olive oil value chain, durum wheat, and the melliferous-fodder sulla plants.

Landscape approach: In Laos, the entry point for agroecological innovations has been integrated wetlands management, marking the first innovations explicitly co-designed within the framework of a landscape element. Other teams, such as those in Burkina Faso, incorporated exercises to assess the feasibility of upscaling successful interventions at the landscape level. Meanwhile, In Tunisia, the co-design of trials was developed on multiple value chains with some interactions between them, as the use of olive-derived biochar in durum wheat trials. Building on these experiences, a more deliberate and systematic inclusion of the landscape approach in future cycles of co-design could enhance the scalability and impact of agroecological innovations.

Box 2- Co-design procedure followed in the Kenya ALLs of Makueni and Kiambu Counties

The co-design procedure in Kenya followed three cyclic stages, as explained in detail by Kuria et al. (2024):

- The preparatory steps: This stage involved identifying stakeholders, conducting a rapid innovation assessment, and preparing for the co-design workshops.
- Co-design Workshop Steps: During these workshops, stakeholders reviewed identified innovations, engaged in brainstorming exercises, selected innovations, defined experimental designs, and established monitoring protocols.
- Trial Steps: In this final stage, trials were established, monitored, and farmers exchanged experiences, setting a starting point for a new cycle of co-design.



Stepwise proceeding followed in the on-farm innovation co-design at the Kiambu and Makueki ALLs of Kenya ***Source: Kuria et al., (2024)***.

For further details about the procedures followed during the co-design of trials in Kenya, including the steps followed during the process and monitoring protocols, please refer to the following publications:

- Kuria, A.W.; Bolo, P.; Adoyo, B.; Korir, H.; Sakha, M.; Gumo, P.; Mbelwa, M.; Orero, L.; Ntinyari, W.; Syano, N.; Kagai, E.; Fuchs, L.E., Understanding farmer options, context and preferences leads to the co-design of locally relevant agroecological practices for soil, water and integrated pest management: A case from Kiambu and Makueni agroecology living landscapes, Kenya. *Frontiers in Sustainable Food Systems* 8, 2024, https://doi.org/10.3389/fsufs.2024.1456620
- Korir, H.; Sakha, M.; Gumo, P.; Bolo, P.O.; Adoyo, B.; Mbelwa, M.; Kuria, A.; Mihindo, N.; Kiruthi, E.; Syano, N.; Kihoro, N.; Baijukya, F.; Fuchs, L.E. (2024) Protocols for innovative agroecological soil, water and integrated pest management practices: Management techniques, trials establishment and monitoring. 48 p. https://hdl.handle.net/10568/152216
- Fuchs, L.E., Adoyo, B., Orero, L., Korir, H., Sakha, M., Anyango, E., Ongus, E., van Dien, C., Kipkorir, L., Apondi, V., Ntinyari, W., Bolo, P., Mong'ina, D. Transition pathways and vision-to-action in the Agroecological Living Landscapes (ALLs) in Kenya. 2023a. https://hdl.handle.net/10568/138753
- Fuchs, L.E., Korir, H., Adoyo, B., Bolo, P., Kuria, A., Sakha, M., Gumo, P., Mbelwa, M., Syano, N., Kiruthi, E., Orero, L., Ntinyari, W. Co-designing on-farm innovations in the Agroecological Living Landscapes (ALLs) in Kenya, 2023b. https://hdl.handle.net/10568/138714
- Kuria, A., Bolo, P., Ntinyari, W., Orero, L., Adoyo, B., Korir, H., Syano, N., Kagai, E., Fuchs, L.E. Assessment of Existing and Preferred Agroecological Soil, Water, and Integrated Pest Management Practices in the Makueni and Kiambu Agroecological Living Landscapes, Kenya, 2023. https://hdl.handle.net/10568/137726

Agroecological innovations

Table 1- Main technologies tested, by topic, country and commodity (Table developed by the technical/scientific coordinator of the agronomic assessment as a guideline for the final product 3 and 5 of this consultancy)

TOPICS	COUNTRIES	COMMODITIES	SPECIFIC TECHNOLOGIES	TRIALED[†]
Crop-livestock integration	Burkina Faso	Livestock (Cattle)	Fodder crops (cereals and legumes) and Manure	Yes[‡]
	Senegal	Groundnut/Millet	Horse manure and Cowpea intercropping	Yes
	Tunisia	Livestock (Sheep)	Fodder crops (Vetch-Oat-Triticale)	Yes
	Kenya	Maize/Bean	Farmyard manure	Yes
	India	Vegetables	Farmyard manure and poultry manure	No
	Peru	Cacao	Manure use to produce bio-inputs	No
	Lao	Rice	Integrated Rice-Fish Culture	Yes
Bioinputs	Kenya	Maize/Bean	Neem-based biopesticide	Yes
	Kenya	Cabage	Chili-based biopesticide	Yes
	Zimbabwe	Maize, Sorghum	*Lantana*, *Maerua*, chili (biopesticides)	Yes[‡]
	Zimbabwe	Maize, Sorghum	Biochar	Yes[‡]
	Peru	Cocoa	Organic compatible fungicides to control	Yes
	Peru	Cocoa	Foliar biofertilizers	Yes
	Tunisia	Olive	Wastewater valorization as soil amendment	Yes
	Tunisia	Sulla, Wheat	Rhizobium	Yes
	Tunisia	Wheat	Biochar	Yes
	India	Vegetables	Mixtures (based on cow urine, neem, etc)	No
Diversification	India	Rice	Agroecological homestead models (AHM)	Yes[‡]
	Lao	Rice	Red Rice	Yes[‡]
	Lao	Rice	Dry season vegetables	No
	Lao	Rice	Integrated Rice-Fish Culture	Yes[‡]
	Burkina Faso	Livestock (Cattle)	Fodder crops (cereals and legumes) and Manure	Yes[‡]
	Senegal	Groundnut/Millet	Horse manure and Cowpea intercropping	Yes
	Tunisia	Livestock (Sheep)	Fodder crops (Vetch-Oat-Triticale)	Yes
	Zimbabwe	Maize and	Landraces cropping	Yes[‡]
Soil-water conservation	Kenya	Maize/bean	Terraces	Yes
	Kenya	Spinach	Mulching	Yes
	Zimbabwe	Maize, sorghum	Dead and live mulch	Yes[‡]
Crop associations	Zimbabwe	Maize, sorghum	Push-pull (cowpea and *Brachiaria*) with Sorghum in Mbire or with Maize in Murehwa	Yes[‡]
	Zimbabwe	Maize, sorghum	Mucuna used as a live mulch for sorghum in Mbire or for Maize in Murehwa	Yes[‡]
	Senegal	Groundnut	Groundnut-cowpea intercropping	Yes
	Lao	Rice	Rice-legume intercroping	No
	India	Vegetables	Agroecological homestead models (AHM)	Yes[‡]

[†] TRIALED: Yes- the technology is being actively tested in at least one experimental treatment. No- The technology is being utilized as part of an agroecological (AE) innovation, but its specific effects are not being tested yet.

[‡] Technology trialed but results not reported yet or data aggregation do not help to draw conclusions on their effects.

Table 1 categorizes the various agroecological innovations co-designed within the AEI into five key topics: crop-livestock integration, bioinputs, diversification, soil-water conservation, and crop associations. These categories reflect the diverse approaches being implemented to promote a transition into agroecology under diverse ALLs. In the following sections, each topic will be analyzed based on the information available in the agronomic assessments of the eight countries participating:

Crop-livestock integration

The integration between crops and livestock systems was commonly used as a strategy to facilitate the agroecological transition in the ALLs of the AEI. Among the most widely tested or implemented practices were the use of livestock manure and the production of fodder crops, including fodder cereals and fodder legumes. Manure use and fodder crops were tested in an integrated manner in Burkina Faso and Senegal, looking for a full crop-livestock integration with benefits for both the crop and livestock sub-systems at farm level.

In Burkina Faso, cattle manure (unreported rate) was used to fertilize fodder crops such as cereals (maize and sorghum) and legumes (cowpea and mucuna) in demonstration plots under farmer conditions at the Bobo Dioulasso ALL, then cattle's diet was planned based on those fodder crops (only cereals, legumes, or both) against the traditional free grazing and concentrate feeding diet. Although the main result expected at farm level – improved milk yield with reduced reliance on concentrate feeds – has yet to be reported, the use of cattle manure generated a notable increase in biomass production, ranging from 1 to 5 tons per hectare. This additional biomass produced in manure-fertilized fodder crops, compared to the biomass from free-grazing cattle reliant on straw without manure application, offers significant potential to reduce farmers' dependence on concentrate feeds under the conditions of Bobo Dioulasso.

In Senegal, horse manure and the "doubled-up legume" innovation (intercropping groundnut with cowpea) were tested in plots traditionally used for groundnut-millet rotations in the Fatick ALL. In the first year of the trial (2021), the application of horse manure (4 tons/ha/year) did not significantly impact the grain, or biomass yields of the legume crops at Ndiourbel Sine Village (data not shown). However, by 2022, millet yields showed a positive trend in plots that had previously incorporated horse manure or cowpea (trend not statistically significant by the 2022 season, P>0.05), particularly those combining horse manure and the groundnut/cowpea intercropping system (Figure 2). Millet yields in the treatment integrating horse manure and the intercropped legumes (G+C+HM+M) increased grain production up to 30-fold and biomass yield fourfold compared to plots where only groundnut was grown in the previous season (G+M). Although data on the further effects of these practices on legume performance in 2023 or livestock production outcomes have not yet been reported, the observed results by 2022 underline the potential of these innovations diversifying the fodder crop production to enhance productivity and resilience in integrated crop-livestock systems.

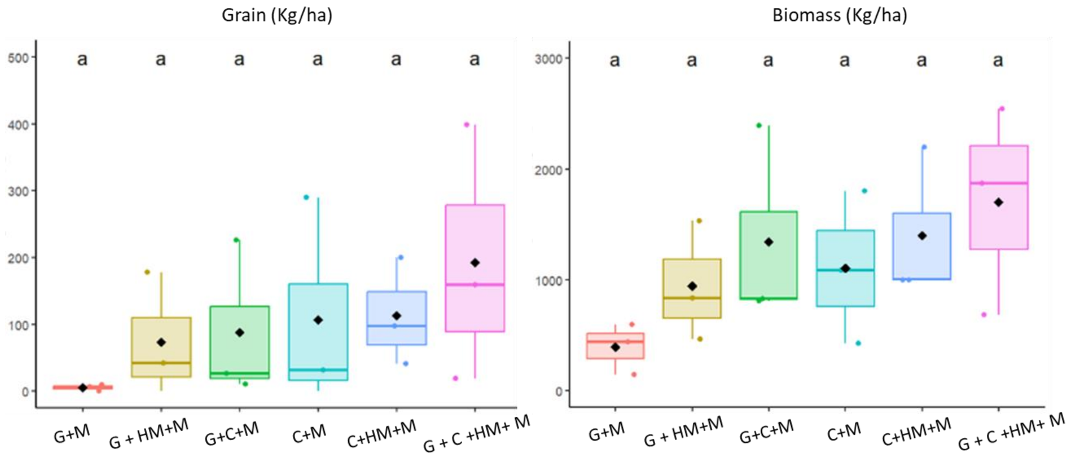


Figure 2 - Millet grain and biomass yield during the 2022 cropping season in the trial at the Ndiorbel Sine Village (G: Groundnut; C: Cowpea; HM: Horse manure; M: Millet). Source: Agronomic assessment in Senegal.

Furthermore, in Tunisia, at the Kef-Siliana transect ALL, ewes grazing on the intercropped mix of vetch, oat, and triticale (VOT) demonstrated synchronized mating periods and increased flock fertility compared to traditional fallow-based dispersed grazing supplemented with purchased grains and hormones. Approximately 90% of ewes grazing the VOT mix became pregnant during the first month of a trial involving three selected flocks in the region – a 20% increase compared to those on traditional diets. By the end of the three-month VOT grazing period, 100% of the ewes were pregnant, compared to 90% for those on the traditional diet. This outcome ensured a shorter lambing period, enhancing flock resilience under the semi-arid conditions of the Kef-Siliana ALL. Additionally, farms employing the VOT mix in the transect showed significantly higher soil microbial activity compared to those practicing monocropping of fodder crops. Farms with the VOT mix recorded 880 mg C/kg of soil, compared to 400–560 mg C/kg in monocropped soils. These results, like the reports for the inclusion of cowpea in Senegal, confirmed the benefits of diversifying the crop component in mixed crop-livestock systems, improving also soil health.

In Kenya, at the Makueni ALL, the use of composted farmyard manure (5 tons/ha the first year and 10 tons/ha the second year) significantly increased the overall two-season yield of maize and beans in an intercropping system. Maize yields increased by 18%, and bean yields by 25%, reaching 4.7 tons/ha and 0.5 tons/ha, respectively, when fertilized with farmyard manure compared to the control plots without manure. However, at the Kiambu ALL, applying 4 tons/ha of farmyard manure did not significantly increase the overall yield of spinach. These results underscore the importance of understanding the composition of farmyard manure, their cumulative effect on soil fertility, and determining the appropriate rate required for each crop and context to achieve a meaningful impact.

In other countries, while livestock manure was used as part of the agroecological practices, its effects were not always monitored or tested. In India, cow manure was employed as a physical soil conditioner for perennial crops within the microsite improvement innovation. Additionally, cow dung and urine were key ingredients in the preparation of bio-inputs (Brahmastra, Neemastra, Agniastra) used in the AHM multilayer cropping system at the Mandla ALL. Similarly, in Peru, cacao cooperatives in Pucallpa utilized farmyard manure to produce bio-inputs, including foliar biofertilizers and compost.

Finally, in Lao PDR, the integrated rice-fish culture (IRFC) system incorporates a triple integration of crop, livestock, and fish production. At the Attapeu ALL, cow and buffalo manure were the sole inputs used by paddy rice growers, applied in both the IRFC system and the traditional paddy rice control. However, the application rates relied on manure availability. A distinguishing feature of the IRFC is the inclusion of fish trenches surrounding the rice fields. While the integration is expected to yield positive effects, the results from the first cycle are still being analysed at the time of this assessment.

Key messages from the crop-livestock integration

- Crop-livestock integration is primarily driven by livestock manure use and the production of fodder crops.
- Livestock manure is used in seven out of the eight countries of the AEI. Given the multiple and significant roles of livestock manure, several key questions arise regarding the upscaling of these innovations at the landscape level, particularly those relying on manure use:
    - Manure availability: As highlighted by the Senegal team, addressing manure availability at the landscape level is critical for successful upscaling. In Laos, limited manure availability is a constraint for paddy rice growers, as it is for farmers in India. This challenge suggests that the availability and distribution of manure should be a key consideration in scaling efforts.
    - Manure quality and management: The Senegal team also emphasized the need for in-depth analyses of manure quality, composition, and best practices for handling and storing. In this regard, the Burkina Faso team is monitoring the composition and use of cattle manure based on their manure pits innovation, but the results have not been reported yet. However, beyond compositional aspects, understanding the influence of manure on soil biochemical and microbiological processes is equally essential to maximize its benefits and effectiveness.
    - Cattle diet and residue management: As noted by the Peru team, cooperatives avoid using manure from cattle grazed on herbicide-treated pastures due to potential residual effects that could jeopardize the organic certification of cacao. This underscores the importance of considering livestock diets in the broader context of manure use.
    - Environmental impacts: Environmental considerations must be integrated into the upscaling of livestock manure use in crop-livestock systems. Best practices for manure management to mitigate greenhouse gas emissions (Petersen et al., 2013) and prevent nitrogen leaching into subsoil (Wang et al., 2023) should be identified and implemented. Furthermore, evaluating manure's effects on soil nitrogen mineralization and other soil microbiological processes is essential for sustainable and environmentally sound practices (Eghball et al., 2002).
- The innovations involving fodder crop production offer a sustainable alternative for increasing biomass production for livestock feed.
- Across three countries testing the effect of fodder crop innovation on the performance of the crop-livestock systems, innovations included legumes such as groundnut and cowpea in Senegal, mucuna and cowpea in Burkina Faso, and vetch in Tunisia. The inclusion of these legumes had positive effects on biomass productivity. Further analyses are needed to quantify their impacts on soil health and productivity of both sub-systems (crops and livestock), tailored to the specific conditions of each ALL in the initiative.
- The production of fodder crops in Tunisia demonstrated an improvement in soil microbial activity, supporting the soil heath because of an agroecological innovation.
- Additional results may provide further insights and enable more comprehensive comparative analyses. However, some experimental outcomes are still in progress, or the country teams have yet to report them.

Bioinputs

The agroecological innovations implemented in five countries involved the utilization of bio-inputs to address specific agronomic challenges, including pests, diseases, and nutrient management.

Use of biopesticides

In Kenya, an integrated pest management (IPM) approach was trialed using neem-based biopesticides to control Fall Armyworm (FAW) (*Spodoptera frugiperda*) in maize and Bean Aphids (*Aphis fabae)* in beans (Figure 3). The biopesticides were applied as soon as the pests were observed in the crops. Ten intercropped maize-bean systems were established under farmer conditions at the Makueni ALL. The neem bio-fungicide significantly reduced the two-year average FAW incidence in maize by 5.2% compared to the control plot, which experienced an 8.1% attack. Neem also decreased aphid incidence in beans by 22% compared to the control plot's 39% incidence. Similarly, at the Kiambu ALL, chili-based biopesticides reduced the incidence of Brassica aphids - *Brevicoryne brassicae*- in cabbage by 5% compared to the control plot's 16% incidence. While these differences were statistically significant in the three trials using the IPM in Kenya, further testing need to be done, especially during years of meaningful incidences of pests in the ALL conditions, as pest incidences, particularly for FAW in maize and aphids in cabbage, appeared relatively low during the experimental period compared to typical Kenyan conditions. Moreover, neither neem nor chili biopesticides significantly impacted yield compared to the control treatment. Kumela et al. (2019) reported FAW incidences in maize averaging around 47% in Kenya, leading to yield reductions of 0.8 to 1 ton/ha due to those incidences under growers' conditions. Other factors, such as climate variability, may have influenced the overall performance and pest incidence, particularly during the trial in 2024, as precipitation doubled the monthly average in April and May. However, the aggregated data reported in Kenya across both years of trials does not permit a detailed assessment of these effects or the effectiveness of IPM under extreme weather conditions, such as those experienced in 2024.

In Zimbabwe, biopesticides based on Lantana, Maerua, or Chili were tested, similarly to Kenya, to control FAW in maize at the Murewa ALL and in wheat at the Mbire ALL, both in mother and baby trials. While these biopesticides were applied to a treatment using landraces in mother trials and in various baby trials, specific results were not reported. In India, biopesticides derived from various plants, including neem (Brahmastra and Neemastra) and chili (Agniastra), as well as cow urine and dung, were utilized in multilayer agroecological homestead models (AHM) to manage prevalent pests such as aphids. However, the effectiveness of these biopesticides has not yet been tested. Thus, while the IPM approach demonstrated some level of pest control—particularly for aphids in beans at the Makueni ALL in Kenya—the lack of detailed, disaggregated results and incomplete data collection prevents drawing definitive conclusions about the efficacy of these bioproducts within the AEI framework. Furthermore, the aggregated data from Kenya and Zimbabwe likely makes it difficult to understand the influence of critical co-factors, such as climate variability, which may influence pest dynamics and the performance of bioinputs. Comprehensive and systematic data collection is essential to validate the effectiveness of these practices across diverse contexts.

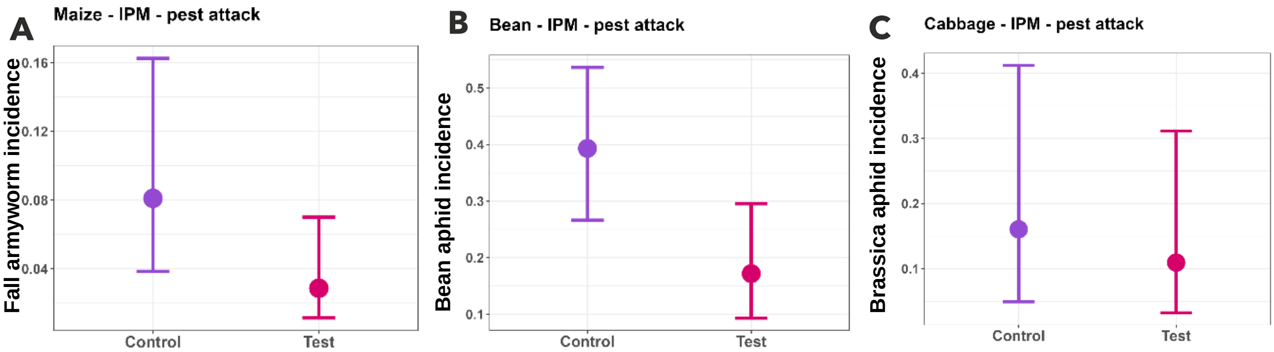


Figure 3- Predicted pest incidences for mother trials at the Makueni ALL for maize (A) and bean (B), and at the Kiambu ALL for cabbage (C). Test treatments at the Makueni ALL involved the use of neem-based biopesticides, while at the Kiambu ALL, chili-based biopesticides were used. The control treatment represents conventional pest management practices at each ALL. Points indicate predicted means derived from mixed model outputs pooled across two observation seasons, with whiskers representing the 95% confidence intervals. A treatment's predicted value differs significantly from the control when the corresponding dot and whiskers are colored pink; no significant difference is indicated by purple coloring. (Source: Agronomic assessment in Kenya)

Use of biofungicides

In Peru, at the Pucallpa ALL, several organic-compatible biofungicides were tested to control fruit diseases in cacao orchards managed by two cooperatives. The Colpa de Loros cooperative, which exports fine-flavor local cacao cultivars, co-designed trials in four orchards using treatments that increased the frequency of foliar sprays, resulting in 2 to 6 applications of for a mix of bioinputs[1] during the fruiting season. Meanwhile, the Banaqui-Curimana cooperative, focused on higher-yielding but less fine-flavor cacao varieties, tested four different organic-compatible products (lime-sulfur mixture, Bordeaux mixture, Visosa mixture, or ozonated oil) applied three times during the season. In both trials, the four co-designed treatments were compared against traditional moniliasis management practices. By the end of the main harvest period in October 2024, no statistical differences or discernible trends were observed among treatments in controlling fruit diseases. Disease incidence remained low, with moniliasis – the prevalent fruit disease in the area, affecting up to 80% of fruits in previous seasons- affecting less than 10% of fruits at the Colpa de Loros cooperative and less than 5% at Banaqui-Curimana. These results were largely attributed to unusually dry and warm weather during the 2024 fruiting season (Figure 4). Monthly precipitation in Curimana decreased by 13% to 73% compared to the 1991–2020 average, with rainfall reductions intensifying from a 17% decrease in February to a 76% decrease by June. Additionally, average temperatures throughout the year were approximately 2 °C higher than normal. The unusually dry and warm conditions during the 2024 fruiting season in Curimana significantly reduced the prevalence of moniliasis, masking potential differences among the treatments. Furthermore, the co-design of treatments in Colpa de Loros was reassessed by technicians and the research team after the first cycle, as the mix used combined contradictory agronomic principles, such as blending biological fungi with fungicide mixtures. Although fruit disease incidences were generally low across treatments and orchards, one orchard that deviated from the general recommendation of regularly harvesting diseased fruits experienced increased fruit disease incidence regardless of the treatment applied. These results underscore the importance of evaluating the agronomic principles underlying treatments and assessing the role of cultural practices in fruit disease control, while also considering the environmental conditions during the experimental period.

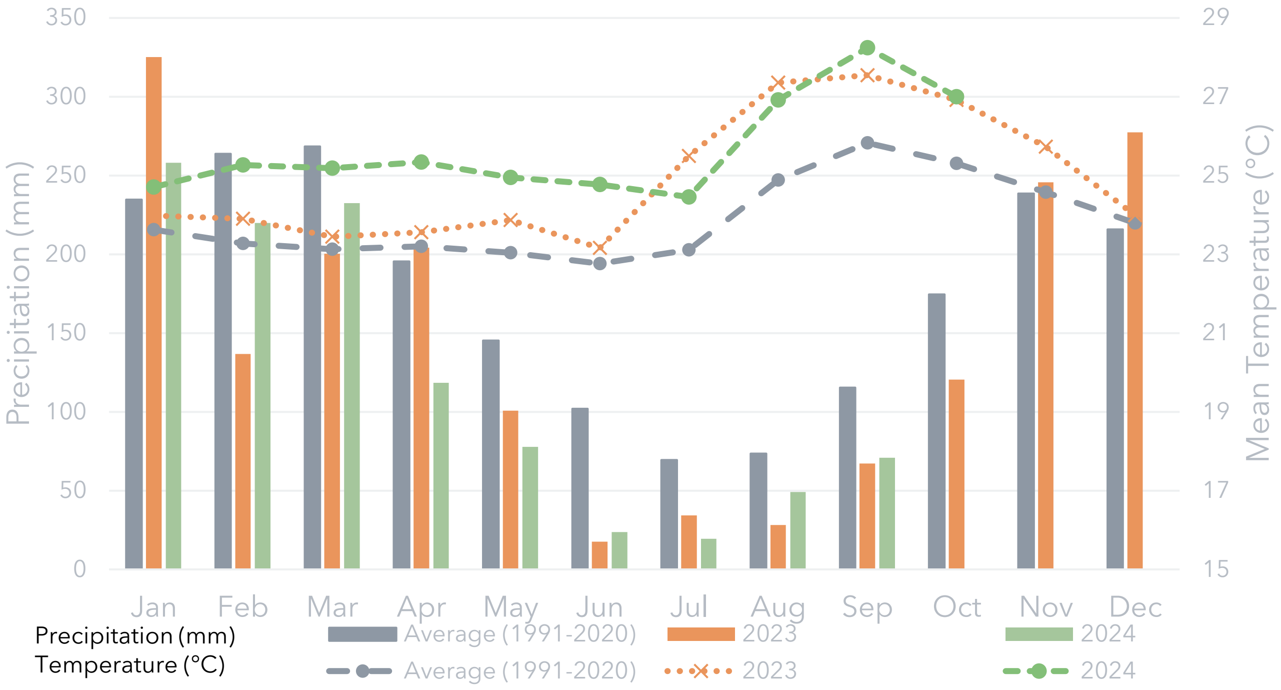


Figure 4- Average monthly precipitation (bars) and average temperature (lines) for the Curimana district in Pucallpa, Peru. Long term averages between 1991 and 2020 (Black bars and lines) and weather monthly conditions for 2023 and 2024 years (Blue bars and lines). (Data extracted from https://app.climateengine.org/climateEngine: Precipitation data is based on CHIRPS and temperature on CFS) (Source: Agronomic assessment in Peru)

Enhancing crop nutrition with bioinputs

Nutritional management using bioinputs such as biochar, rhizobium, foliar biofertilizers, and organic soil amendments emerged as one of the most promising innovations within the AEI. These bioinputs were applied in Tunisia, Paru and Zimbabwe, complementing the use of livestock manure as a biofertilizer and soil conditioner, which was already highlighted in the crop-livestock integration section.

In Tunisia, biochar and plant growth-promoting rhizobacteria (PGPR) were tested alongside chemical fertilizers, such as diammonium phosphate (DAP) and ammonium nitrate (NH4NO3), in durum wheat trials (Figure 5). Results showed that biochar

[1] lime-sulphur mixture, Visosa mixture (Bourdelex mixture added with micronutrients), the fungus Thrichoderma spp., and a local prepared biofertilizer or biol

combined with either 100% or 50% DAP significantly increased grain yield, nearly doubling production compared to other treatments, including the control (no amendment) and the treatment with full mineral fertilizer. Although specific fertilizer rates were not reported, this innovation represents a promising strategy to optimize grain production of durum wheat in the El Kef-Siliana transect ALL. In addition, PGPR application alone doubled biomass production compared to the control without affecting grain yield. This result positions durum wheat biomass as a valuable fodder crop due to its high fiber and protein content, potentially enhancing sheep fertility, as previously discussed for the VOT mix. Another notable innovation in Tunisia involved rhizobium inoculation on sulla plants, a legume used for both melliferous and fodder purposes. The inoculation significantly increased plant height and stem thickness compared to non-inoculated or chemically fertilized plants. Inoculated plants achieved a more than twofold increase in height, surpassing 60 cm, while biomass production exceeded 7.5 tons/ha. This contrasted sharply with control plots, where plant height averaged 30 cm and biomass reached only 3.8 tons/ha. Overall, rhizobium inoculation uses significantly boosted plant biomass in sulla and durum wheat plants, while biochar optimized the mineral fertilizer use, doubling grain production in Tunisia's semi-arid conditions.

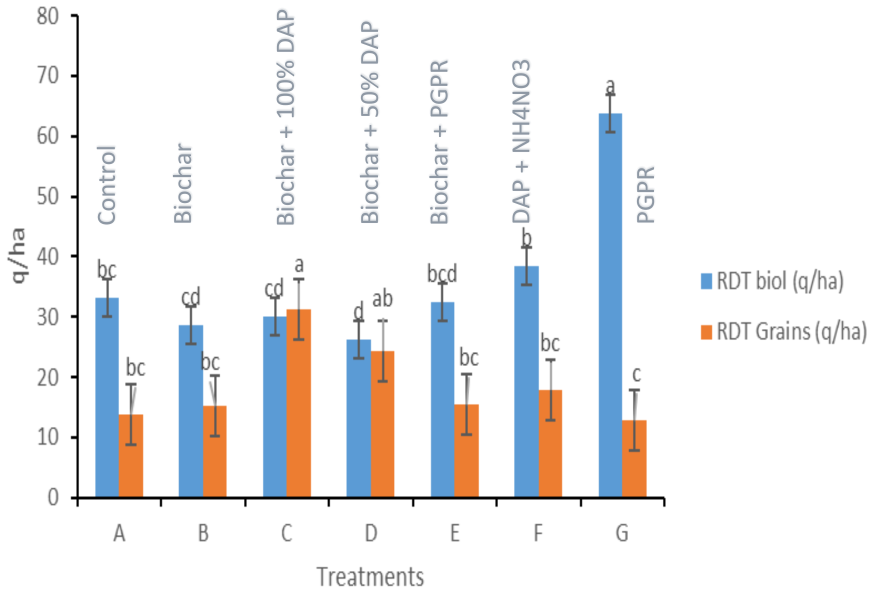


Figure 5- Biological (Blue) and grain (Orange) yield of durum wheat crop after different soil amendments. A: unamended soil, B: soil amended with olive-derived biochar (10ton/ha); C: soil amended with olive-derived biochar combined with 100% DAP, D: soil amended with olive-derived biochar combined with 50% DAP; E: soil amended with biochar combined with biofertilizer (PGPR); F: soil fertilized with 100% DAP and ammonium nitrate; G: soil amended with biofertilizer (plant growth-promoting rhizobacteria- PGPR). The letters represent the significant differences from one-way ANOVA analysis (n=3) at the 5% significance level. (Source: Agronomic assessment in Tunisia)

Bioinputs were also trialed in two perennial crops to enhance their nutritional status. In Peru, a mix of foliar biofertilizers was tested in cacao across five orchards, while in Tunisia, olive mill wastewater (Margines) was applied as a soil amendment in one olive orchard. In Peru, although yield differences were not statistically significant during the main harvest season, there was a clear trend of increased yield with more frequent biofertilizer applications. Specifically, cacao yield rose by 25%, from the control treatment (T0) to the treatment receiving monthly biofertilizer applications. Observations during orchard visits suggested that this effect may strengthen after the secondary harvest season concludes in March 2025, supported by the substantial fruitlet load observed in October 2024. This justifies further analysis in the coming months to confirm these initial results. In Tunisia, the application of Margines improved olive production significantly, with fruit yield per tree increasing by 37%, from 12.2 kg/tree in untreated plots to higher yields in treated plots. While Margines offer promising results, their application has been regulated in Tunisia due to potential environmental risks, such as groundwater contamination. Nevertheless, this by-product of olive oil extraction could be a viable option for orchards with access to it, particularly where nutrient enrichment is needed. These trials demonstrate the potential of bioinputs to improve the nutritional aspects of perennial fruit crops. Their application offers innovative agroecological solutions for increasing productivity in cacao and olive orchards. Continued research is essential to fully understand their long-term impacts, optimize application strategies, and address potential environmental concerns at landscape level, paving the way for broader adoption in diverse agroecological systems.

Finally, in the Peruvian trial using foliar biofertilizers, the incidence of moniliasis was monitored to evaluate whether improved nutritional status might indirectly influence disease prevalence. However, due to the overall low incidence of moniliasis during the study period, this effect could not be confirmed. Nevertheless, a clear trend emerged: orchards that did not consistently remove diseased fruits showed higher disease incidence, underscoring the critical role of this cultural practice. This instrumental effect was also observed in orchards participating in trials directly testing biofungicides for disease control (see Box 3).

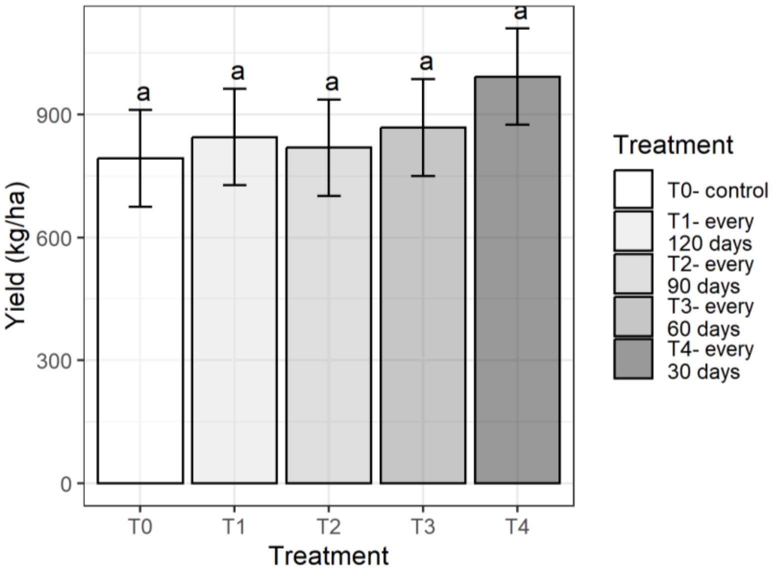
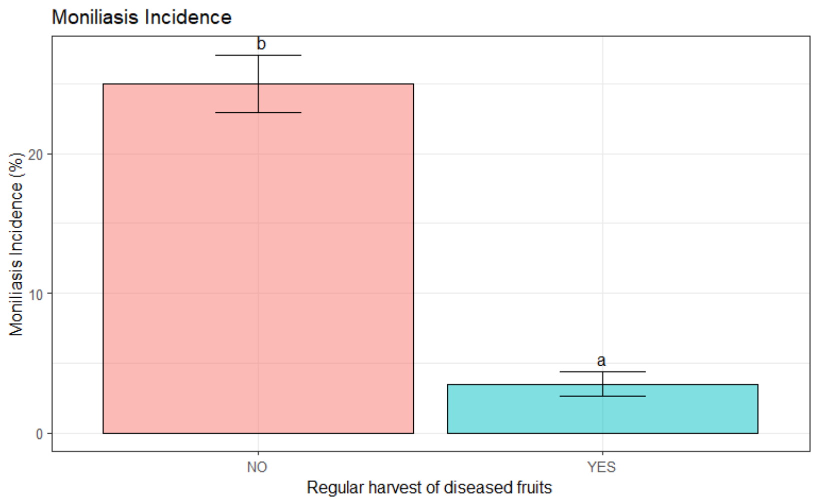


Figure 6- Cacao yield in kg/ha aggregated by biofertilizer treatment in Pucallpa, Peru, during the main harvest season 2024 (Source: Agronomic assessment in Peru)

Box 3. The Relevance of Cultural Practices in Agroecology

A standout recommendation from the Pucallpa ALL trials was the regular harvesting of diseased cacao fruits—a simple yet highly effective cultural practice for controlling moniliasis. While some growers struggled to implement it due to labor or financial limitations, the practice proved to be the most successful strategy during the 2024 main harvest season in Ucayali. Orchards where growers consistently removed diseased fruits maintained moniliasis incidences below 5%, whereas orchards neglecting this practice experienced incidences nearly five times higher, regardless of whether bio-fungicides were used or not.



Source: Agronomic assessment in Peru

This practice exemplifies agroecological and organic principles by reducing disease pressure without relying on external inputs. By addressing the source of infection, regular harvesting minimizes the risk of moniliasis outbreaks, safeguarding production even during seasons with low disease incidence. However, the lack of adoption among some growers underscores the need for targeted support and awareness campaigns, emphasizing the long-term benefits.

As demonstrated in the 2024 trials, this practice not only aligns with sustainable and organic farming systems but also holds economic promise. Increased yields in orchards practicing regular harvesting could serve as a compelling incentive for broader adoption, turning this simple measure into a cornerstone of integrated disease management in cacao agroecosystems.

Key messages from the bioinputs use

- The IPM approach using biopesticides represents a promising agroecological strategy. However, further experimentation under diverse environmental conditions is necessary, especially considering the increasing impacts of climate change and extreme weather events. Additionally, data aggregation in country reports and the status of experimentation limited a deeper understanding of the effects of plant-based bioinputs such as neem and chili extracts.
- The use of organic-compatible fungicides in Peru during the main cacao harvest season of 2024 did not significantly reduce the incidence of fruit diseases. Dry and warm weather conditions likely minimized the prevalence of pathogens, such as those causing Moniliasis. These findings emphasize the importance of considering environmental conditions during experiments and adopting an IPM approach that integrates cultural practices with bioinput applications.
- Observations from cacao trials highlighted the critical role of cultural practices, such as regular removal of diseased fruits. This agroecological-compatible practice proved effective in reducing pathogen incidences, even under conditions unfavorable for disease expression. Although this practice is a standard recommendation across farming systems, the results support its broader promotion to enhance disease management.
- The use of bioinputs for improving plant nutrition yielded the most promising results of bioinputs use across different countries. These bioinputs not only enhanced biomass and yields in various crops but also improved soil nutrient status and increased the efficiency of mineral fertilizers. Notably, rhizobium demonstrated the ability to optimize mineral fertilizer use in durum wheat, underscoring its role in transitioning toward more sustainable cropping systems.
- The application of olive mill wastewater (Margines) offered a promising circular economy solution aligned with agroecological principles. However, a landscape-scale approach is needed to assess its broader environmental impacts and risks, including nitrogen leaching and the effects of bioinputs on water resources. Such considerations should extend to other bioinputs, including livestock manure, as previously discussed in the crop-livestock integration section.

Diversification and crop associations

The agroecological innovations focused on diversifications were primarily associated with the paddy rice crop in Asian countries (India and Lao PDR) or the fodder crops in the integrated crop-livestock systems in Burkina Faso, Senegal, and Tunisia. Besides, local landraces in Zimbabwe were trialed for sorghum at the Mbire ALL and for maize at the Murehwa ALL.

In India, at the Mandla ALL, twenty multilayer crop systems were established in mid-2024 with tribal communities to complement traditional paddy rice cultivation and address the malnutrition and economic instability faced by families reliant solely on paddy rice cultivation. These systems, known as Agroecology Homestead Models (AHM), cover less than 1000 m² per homestead and integrate up to 15 crops, including root vegetables, leafy greens, shrubs, and climbers (Figure 7). AHM aims to enhance food security, to provide year-round income, and to reduce dependence on rice monoculture while promoting agroecological practices such as sustainable pest control, nutrient management, and dry-season irrigation. Preliminary results, just 3 to 4 months after AHM implementation, indicate that most families already engaged in production have surpassed the income typically projected for rice cultivation. Additionally, the initiative has supported family nutrition, as produce not sold is consumed internally by the households. The crops planted in each AHM were co-designed with the families based on their preferences and the local availability of seedlings or seeds. While the team has inquired about the origin of the germplasm used, this information has not yet been reported, leaving it unclear whether the seeds or seedlings are native or introduced. Despite being in its early stages, this initiative stands out as a significant agroecological innovation, not only aiming to diversify the income and diets of tribal communities but also holding considerable potential to preserve local germplasm.

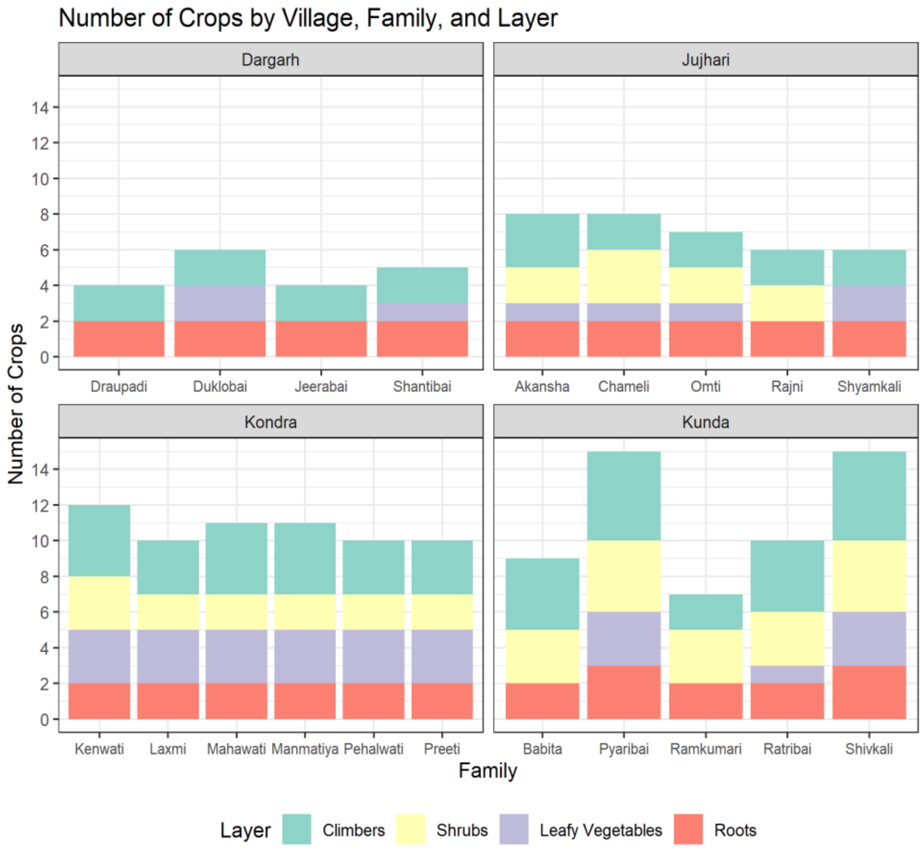


Figure 7- Number of crops by village, family and layer at the multilayer Agroecological Homestead Models (AHM) in the Mandla ALL, India. (Source: Agronomic assessment in India)

In Lao PDR, under the umbrella of integrated wetlands management, the Attapeu ALL is implementing agroecological innovations to diversify traditional sticky rice systems. These include Integrated Rice-Fish Culture (IRFC), which combines rice cultivation with fish farming to improve land-use efficiency and income; organic red rice production, offering shorter growth cycles, pest resistance, and access to stable markets; and dry-season vegetable cultivation in paddy fields, led by women's groups using solar-groundwater-powered irrigation to provide fresh produce for local schools and markets. As of the agronomic assessment in October 2024, the innovations were still in progress and thus were not included in this report. However, several agronomic challenges were identified that need to be addressed in upcoming seasons, along with key data collection efforts necessary to fully document the impact of these innovations under the AEI framework. Additionally, the potential for establishing seed banks was recognized, particularly for the red rice initiative, to enhance growers' access to germplasm and ensure its conservation.

The agroecological innovations in crop-livestock integration also contribute to system diversification by introducing new species into the cropping sub-system, introducing different crop associations. In Burkina Faso, Mucuna legume was introduced alongside traditional monoculture crops like cowpea, maize, and sorghum. In Senegal, cowpea was incorporated into the rotation of traditional fodder crops, groundnut, and millet. In Tunisia, a mixture of vetch, triticale, and oat was introduced. Improved crop varieties were used in the trials in Burkina Faso and Senegal, including *Maïs Espoir* for maize and *Grinkan* for sorghum in Burkina Faso, and *Baye Ngagne* for cowpea and 55-437 for groundnut in Senegal. However, in Tunisia, the origin of the varieties used was not reported. Overall, diversification in these systems was achieved through the introduction of new species rather than by increasing germplasm diversity. The specific results for those interventions were reported before in the crop-livestock integration section.

In Zimbabwe, one of the five treatments co-designed in the mother trials incorporated the use of landraces as an agroecological alternative for comparing with improved crop varieties. This included testing a local sorghum landrace in Mbire and a local maize landrace in Murewa. However, as detailed in the bio-inputs section, the results from Zimbabwe were aggregated across species and ALL. Thus, the agronomic assessment reported a lower cereal grain yield of the local landraces (0.6 tons/ha) against the 0.8 tons/ha of the conventional yield. Similarly, the stover yield was 3 tons/ha for the conventional practice and 2.2 tons/ha for the landraces. However, the aggregation of data, developed by the country team to avoid conflicts with publications under preparation, did not allow to know which landrace (sorghum in Mbire or maize in Murewa) was performing best under local conditions.

Key messages from the diversification innovations

- In Asia, diversification innovations were co-designed to diversify the traditional paddy rice crop. However, these innovations are still in the very early stages of implementation, limiting the scope of analysis thus far.
- Despite the early stage of implementation of diversification innovations in both countries, these innovations show potential for preserving local germplasm. Additionally, field visits highlighted the need for careful attention to agronomic practices and data management aspects of the intervention.
- The inclusion of different species of fodder crops was identified as an innovative approach with promising results for crop-livestock integration technologies. The germplasm used was generally improved crop varieties.
- Data aggregation in Zimbabwe limited the scope of this analysis. This aggregation was justified by the local team to avoid conflicts with ongoing publications.

Soil-water conservation

Mulching, conservation agriculture (combination of mulching and minimum tillage), and terracing were the three agroecological innovations related to soil-water conservation co-designed in Kenya and Zimbabwe. In Kenya, two seasons of experimentation reported no statistically significant differences in maize yield in Makueni using terraces with napier grass (*Pennisetum purpureum*) on the edges or in spinach yield in Kiambu using mulching. However, the aggregated results hindered a proper analysis of the implications, particularly given the drastically different weather conditions across the two seasons (Figure 8). In 2023, monthly precipitation ranged between 70% and 80% of the 30-year average, whereas in 2024, precipitation during April and May was two to three times higher than the historical monthly averages. These contrasting weather conditions altered the soil water balance between the two cycles, potentially influencing productivity outcomes—particularly in interventions designed to reduce soil erosion and improve water retention during dry periods. Given the experimentation is being developed under the current conditions of climate change and variability, it is recommended to measure the soil moisture dynamics to assess the effects of these technologies on soil water balances and yield.

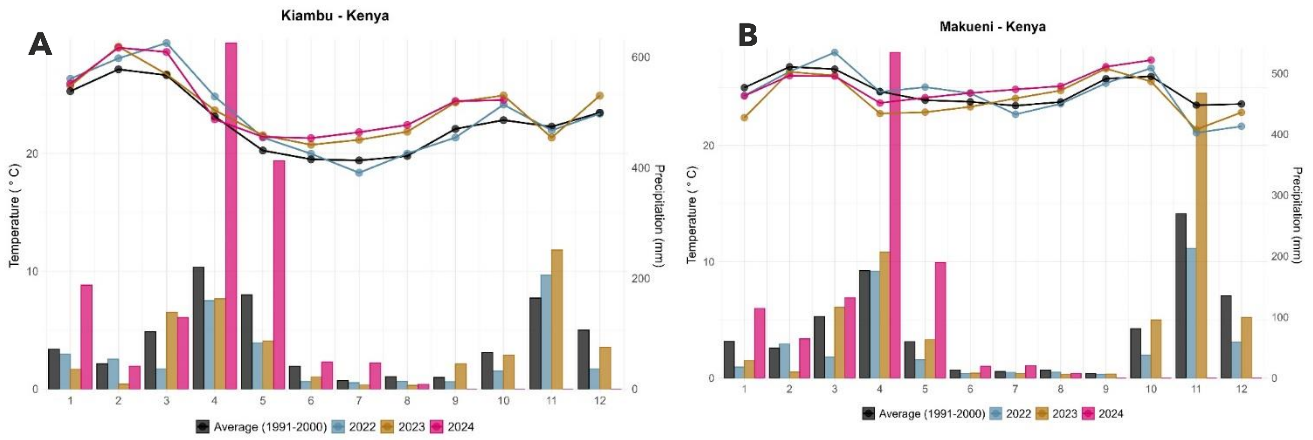


Figure 8- Average monthly precipitation and temperature for the Kiambu (A) and Makueni (B) ALLs in Kenya. Comparison between the average value for the 30-year period 1991 to 2020, and data from 2022, 2023, and 2024 (Data extracted from https://app.climateengine.org/climateEngine: Precipitation data is based on CHIRPS and temperature on CFS). (Source: Agronomic assessment in Kenya)

In Zimbabwe, two treatments—one with dead mulch from grass and one with live mulch using *Mucuna* plants—were co-designed and included in trials with sorghum in Mbire and maize in Murehwa. Similar to the Kenyan case, data aggregation in the report, which combined productivity results for maize and sorghum, constrained the depth of this assessment.

Key messages from the soil-water conservation innovations

- Mulching and terracing were the two innovations co-designed in this regard. Data reported did not revealed a productivity advantage, however, the data aggregation limited the scope of this assessment.
- It is recommended to monitor the soil moisture dynamics to assess the effects of these technologies on soil water balances and yield.

Characterization of the agroecological transition (CAET)

The Tool for Agroecology Performance Evaluation (TAPE) was developed by an international consultation led by FAO (Mottet et al., 2020), to assess the effectiveness of agroecological practices, aiming to develop a robust evaluation framework. TAPE provides a standardized method for evaluating the extent to which agricultural systems embody agroecological principles and contribute to sustainable development goals. The framework is composed by three stages, the Characterization of Agroecological Transitions (CAET), based on the 10 elements of agroecology adopted by FAO (diversity, synergies, efficiency, recycling, resilience, culture & food traditions, co-creation & sharing of knowledge, human and social values, circular & solidarity economy, responsible governance), the core criteria performance, and the validation of results from previous stages.

In the current agronomic assessment, country teams were involved in constructing the CAET assessment by comparing the ratings of different elements for the control (or current non-agroecological practice) against the co-designed agroecological practices. These comparisons were based on their ongoing experiences with trial implementations. Seven country teams completed the assessment (Tunisia did not). Two countries, Burkina Faso and Senegal, developed assessments only for the four primary elements, which are typically evaluated at the plot or farm level. Peru conducted the assessment on nine elements, excluding *Culture & Food Traditions*, while India, Kenya, Laos, and Zimbabwe completed assessments for all ten elements.

A full agroecological transition in an element (or 100% on the axes in Figure 9 to 11) is achieved when all sub-elements receive a score of 4. Sub-element scores range from 0, indicating no agroecological transition, to 4, indicating a full transition.

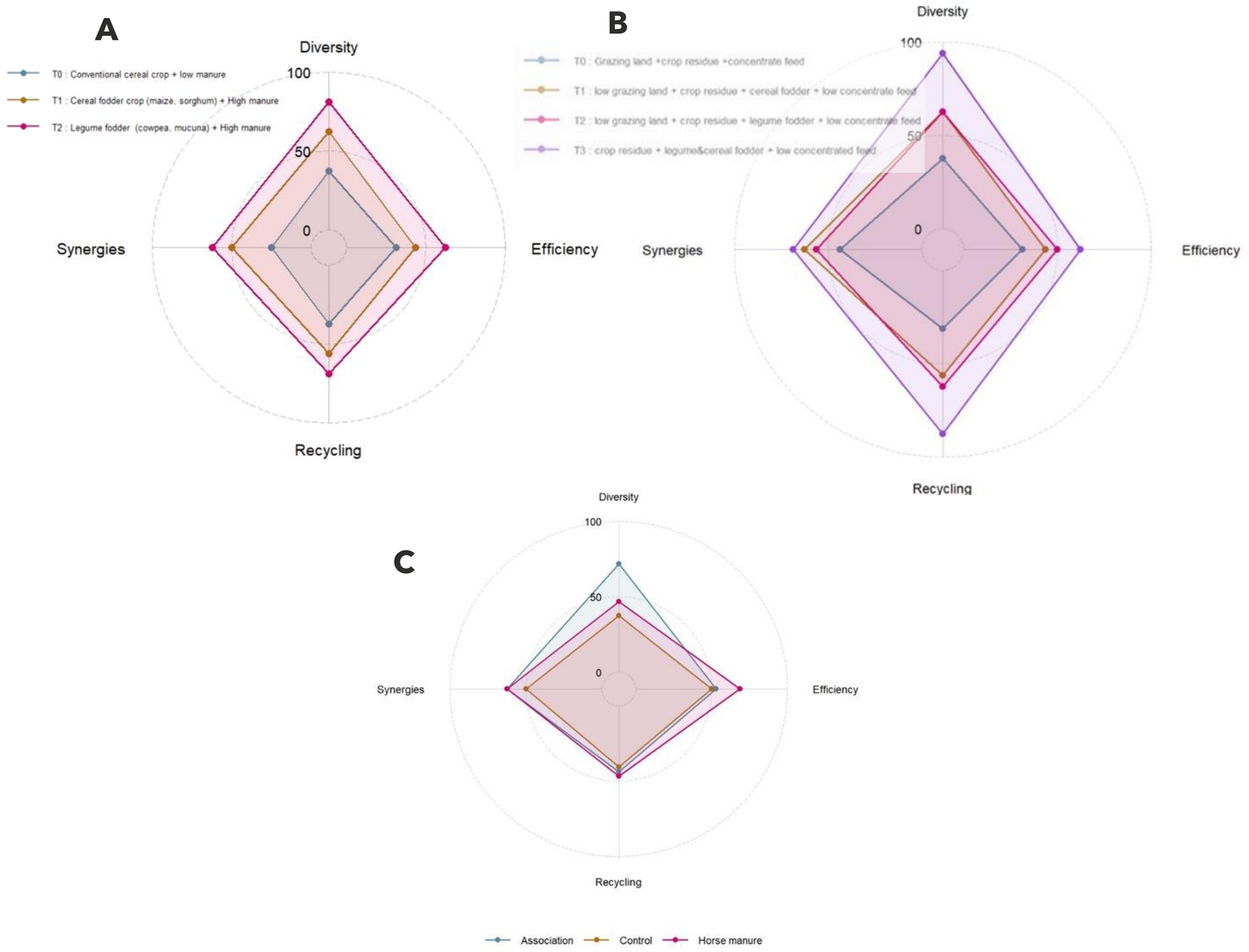


Figure 9- CAET assessment for mixed crop-livestock systems in Burkina Faso (A and B) and Senegal (C). The four elements—Diversity, Efficiency, Recycling, and Synergies—represent activities developed at the plot or farm level. In Burkina Faso, plot A shows the rating of technologies for producing fodder crops, while plot B focused on the formulated cattle diets based on these fodder crops. In Senegal, the technologies evaluated were those used to produce fodder crops, the association Cowpea/groundnut, and the same association plus horse manure (C).

For mixed crop-livestock systems in Burkina Faso and Senegal (Figure 9), the CAET assessment, performed by farmers and technicians at the Bobo Dioulasso and Fatick ALLs, demonstrated significant progress in agroecological transitions, particularly in the diversity element. Diversity scores were notably high – exceeding 80% – across all indicators of agroecological innovations, especially those focused on plot-level practices or fodder crop production (Figure 9A and 9C). The highest ratings were achieved with innovations involving legumes in both countries. This highlights the strong perception of the benefits of legumes in mixed crop-livestock systems. Moreover, the integration of manure and legumes into fodder crop systems consistently received the highest scores for the efficiency and recycling elements in both Burkina Faso and Senegal, particularly in the Senegal assessment. These findings align with the results and trends presented in earlier sections of this report, reinforcing the significant potential of these combined innovations to drive sustainable management of mixed crop-livestock systems. The positive perceptions of farmers and technicians align closely with the promising outcomes observed in field trials, underscoring the value of these practices in accelerating agroecological transitions.

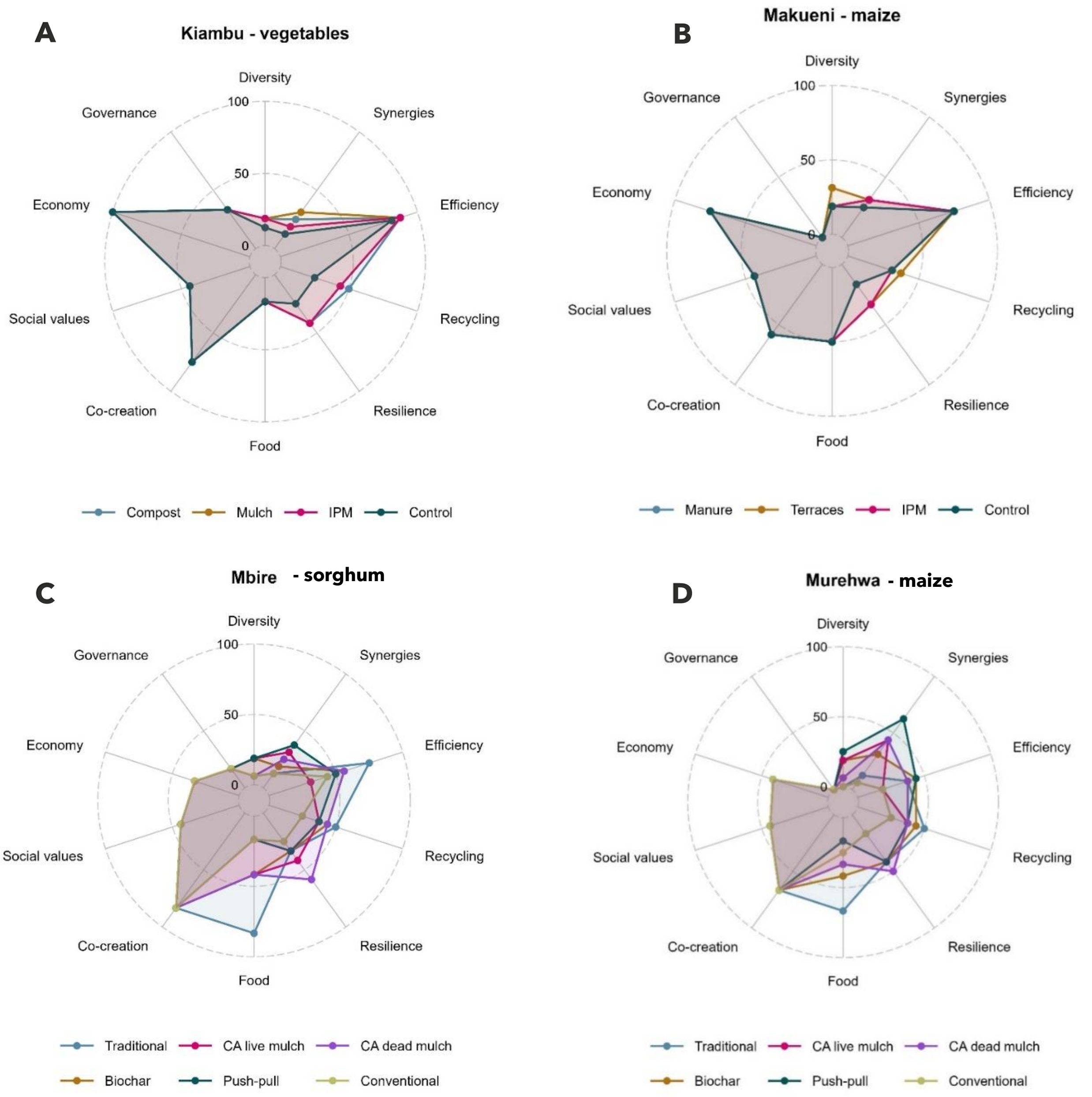


Figure 10- CAET assessment for agroecological innovations in Kenya (A and B) and Zimbabwe (C and D). (A) innovations on vegetables at Kiambu ALL, (B) innovations on Maize at Makueni ALL, (C) innovations on Sorghum at Mbire ALL, (D) innovations on Maize at Murehwa.

For the CAET assessments in Kenya and Zimbabwe (Figure 10), agroecological transitions showed similar results across treatments for most elements. Differences were observed in the plot-level elements along with the elements of recycling, resilience, and food culture & traditions. In Kenya, similarities between the control and agroecological treatments were largely due to the organic or permaculture nature of the control crop, while Zimbabwe exhibited more pronounced differences between the control and the co-designed treatments. Pest management innovations, such as integrated pest management (IPM) in Kenya and push-pull technology in Zimbabwe, rated higher than the control for the resilience element across all four ALLs, with greater differences in Kenya. In Zimbabwe, synergies were also rated higher, reflecting enhanced crop interactions for the push- pull system. Water management innovations, like mulching and terracing, scored higher for resilience, emphasizing their role in improving water balance, while soil fertility innovations, including compost, manure, and biochar, rated higher in the recycling element, except for manure in Makueni, reflecting efforts to reduce dependency on synthetic fertilizers across ALLs. These findings highlight a clear focus on enhancing resilience for staple food crops and vegetables through IPM and water management practices, while recycling scores emphasize the value of nutrient cycling from applied compost or manure. However, farmers did not perceive any differences in farm-level and landscape-level elements, such as social values, economy, and governance, presenting a challenge for integrating a landscape-scale approach into agroecological transitions. Addressing this gap will be critical for advancing the agroecological transitions in the AEI for those ALLs in future stages.

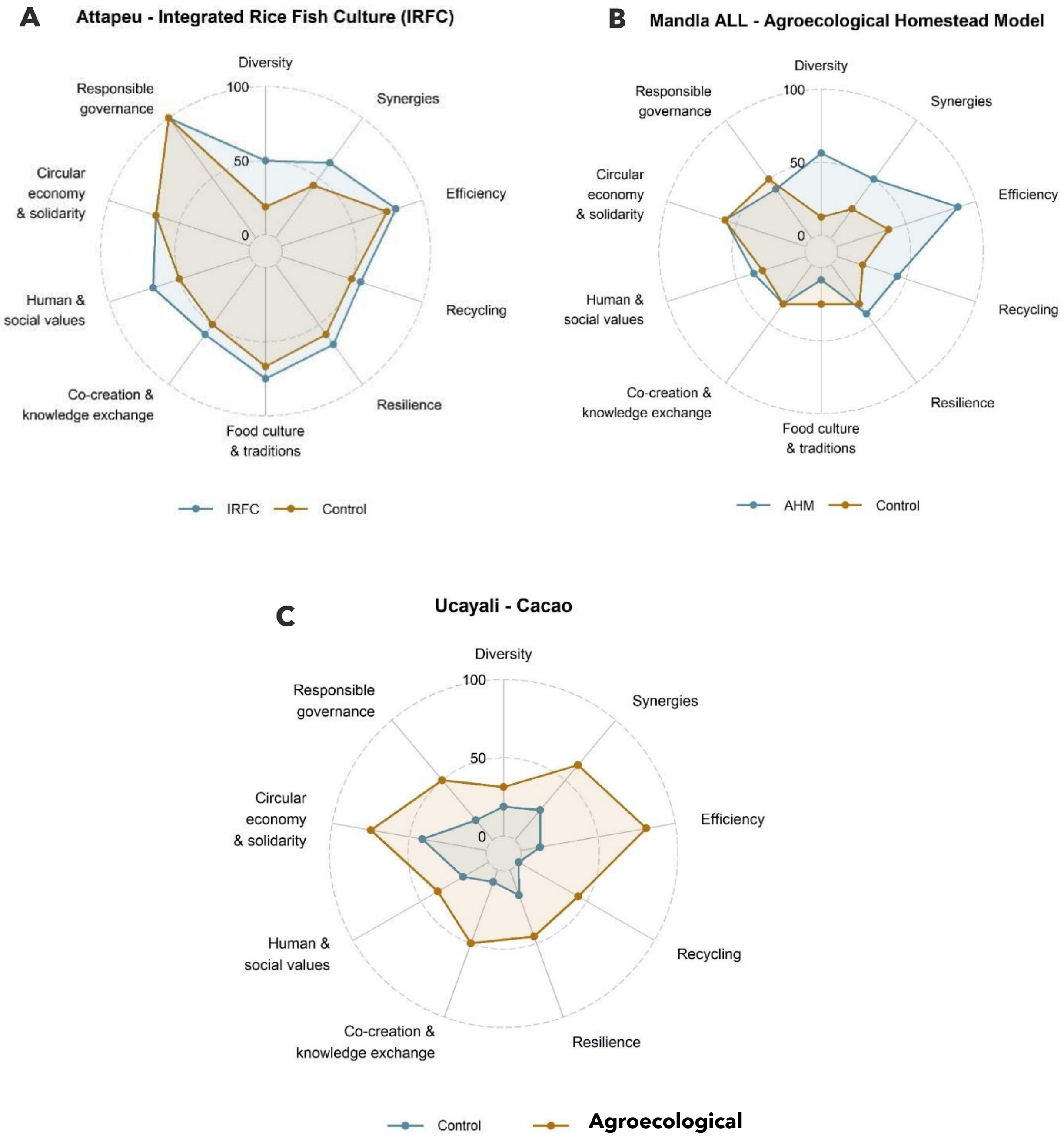


Figure 11- CAET assessment for agroecological innovations in Lao PDR (A), India (B) and Peru (C)

For the CAET assessment in Lao PDR and India (Figure 11A and B), the most significant differences between the control and the agroecological innovations were observed in the diversity element, reflecting efforts to diversify the traditional paddy rice systems in Asia. Additionally, the AHM in India achieved notable results in the efficiency element, further highlighting the intention to develop new sustainable alternatives to the current dependency on only one staple food crop.

In Peru (Figure 11C), the assessment compared an ideal agroecological cacao production system with a traditional non-organic cacao orchard, where crops were sold individually rather than through a cooperative. This comparison revealed a clear overall advantage for the co-designed agroecological innovation. However, it is important to emphasize the need for greater focus on improving the diversity element in the upcoming phases of the AEI. The limited differences observed in this element suggest an opportunity to better integrate a landscape-scale approach, particularly given the proximity of cacao production to the Amazon rainforest.

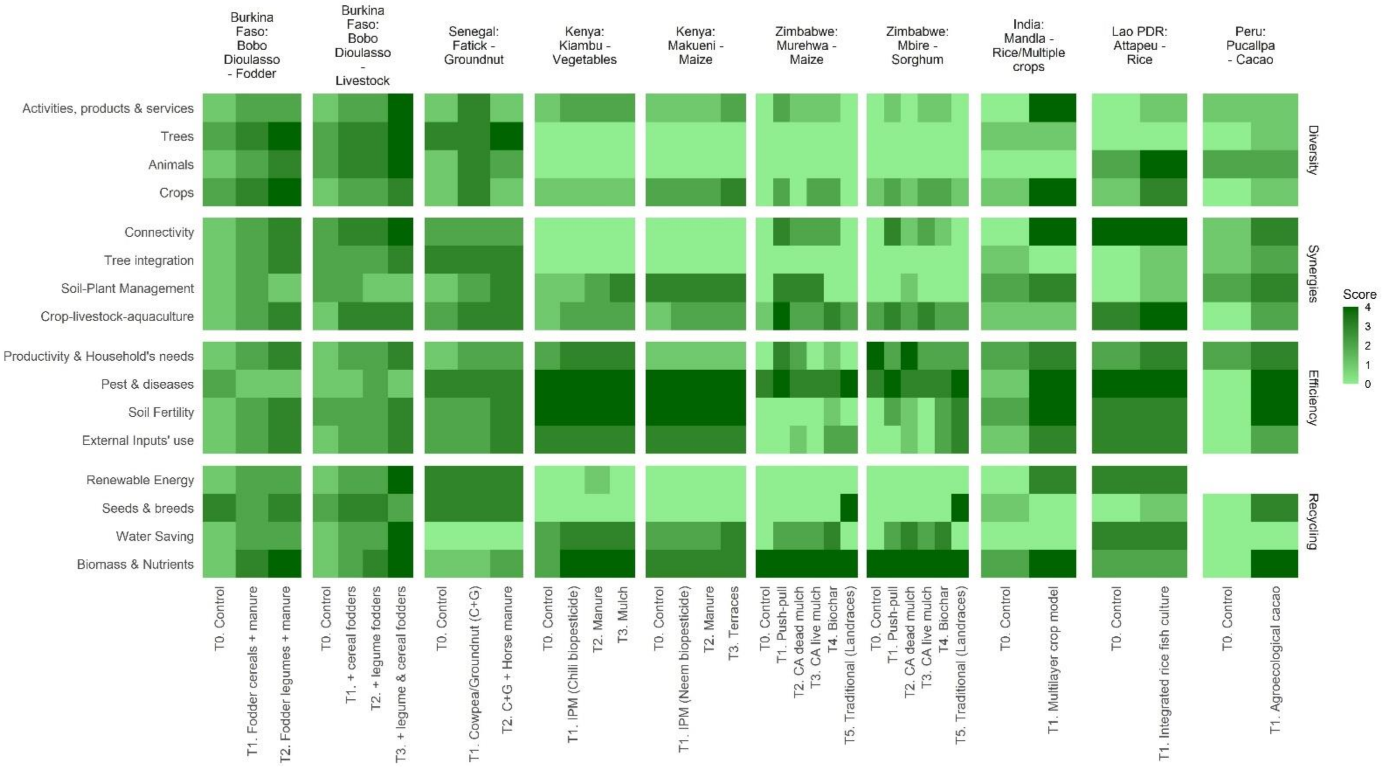


Figure 12 – Heatmap of scores for each sub-element of the first four elements (Diversity, Synergies, Efficiency, and Recycling) in the CAET assessment across seven countries participating in the Agroecology Initiative. Each assessment compares the T0 (control) treatment or current non-agroecological practice with the co-designed innovations tested in each ALL. Ratings range from 0 (no agroecological transition) to 4 (full agroecological transition). A 100% transition in an element is achieved when all scores for that element are rated at 4.

Finally, Figure 12 provides a graphical summary of the sub-elements within the first four elements rated in the CAET assessment across the seven countries. The results ranged from the most contrasting ratings, observed in the Diversity element within ALLs focused on crop-livestock integration (upper-left boxes in the first three ALLs), to the more uniform ratings, represented by consistent horizontal colors, seen in the ALLs in Kenya and Zimbabwe.

Recommendations

This section presents a synthesis of recommendations developed by the global and country teams during the agronomic assessments of co-designed trials in the eight countries participating in the AEI. The recommendations are organized into four key themes identified across assessments in the different countries: improving the process of co-design of trials, addressing agronomic aspects, enhancing data management and evidence generation, and promoting landscape integration. Together, they offer a framework for evaluating the current stage of implementation within the initiative and identifying actionable steps for future development. While the recommendations are broadly framed to accommodate diverse contexts, their relevance may vary depending on the specific progress and unique characteristics of each intervention.

Codesign of trials process

✓ Strengthen farmers leadership roles in co-design cycles:

To strengthen farmers' participation, it is crucial to encourage new co-design cycles driven by the analysis of data and experiences after completing at least one trial cycle. For example, improvements to the Agroecological Homestead Models (AHMs) in India, the Integrated Rice-Fish Culture (IRFC) in Laos, or cacao disease management in Peru should be based on farmers' current experiences and performance data from the first trial cycle.

In the new co-design cycles, farmers should play an active role not only in implementing innovations but also in discussing results with researchers. These feedback loops, including raising awareness about the importance of detailed monitoring, can enhance data collection.

Furthermore, involving farmers in result discussions can empower them and improve decision-making. For instance, farmers in Burkina Faso could better adopt tools for cattle diets if they have access to performance data, while in Tunisia, sharing results from the green fertility trial and its economic impact on lambing could boost farmer engagement. Moreover, in Peru, sharing concrete data about the impact of harvesting diseased fruits on moniliasis incidences could increase the adoption of this cultural practice in orchards with low level of implementation.

By strengthening farmers' leadership in stages where they are already involved in the AEI, their participation, engagement, and future adoption of agroecological innovations can be significantly enhanced.

✓ Broadening stakeholders' representation

A broader range of stakeholders should be engaged in the next cycle of co-design of trials (or adjustments in the co-designed trials), building on the lessons learned and overcoming the obstacles identified during the first cycle. For example, the initial co-design cycle was time-consuming, as farmers and researchers faced challenges in prioritizing agronomic problems and identifying suitable solutions, particularly in Kenya, Zimbabwe, Peru, and Tunisia. The current cycle could address these challenges, improving the active involvement of underrepresented groups such as women, youth, and local private sector actors. Additionally, the Zimbabwe team suggested targeted consultations and differentiated co-design processes for trials between different genders and age groups, which could also be explored to facilitate the co-design of trials.

This more efficient and streamlined process could also strengthen partnerships with local development organizations, governments, the private sector, financial institutions, input providers, and market representatives. These collaborations would ensure that agroecological innovations align with broader community needs.

Furthermore, the use of participatory mapping techniques, as recommended by Tunisia for the next stages and implemented by teams in Kenya, Zimbabwe, and Laos, could help identify relevant stakeholders in sectors such as agriculture, forestry, water management, policy, and commodity value chains. This approach would facilitate dialogue among diverse stakeholders.

While the first cycle served as an entry point for promoting agroecological transitions with a limited group of stakeholders, the next phase should aim for broader participation with specific goals, building on the results from the first cycle of co-design.

✓ Technical refinements of the co-designed treatments

During the agronomic assessment, several specific technical issues were identified in both co-designed and control treatments. Addressing these issues is essential for generating robust evidence on the impact of agroecological innovations.

Key issues identified

Timely implementation of treatments: Delays in the initiation of treatment applications hindered their proper development. This challenge was observed in several countries such as in Laos (late arrival of red rice seeds and fish fingerlings for the Integrated Rice-Fish Culture-IRFC); in Peru (delayed delivery of bio-inputs); and in Tunisia (Late start in the green fertility trial).

Ensuring a timely start to treatments is critical for improving the validity and reliability of experimental outcomes.

Establishment of non-agroecological control treatments: Properly establishing and monitoring control treatments remains a challenge in several countries, such as in Kenya, where it is necessary to include traditionally managed crops, as many are currently managed using organic or permaculture principles. In Laos, proper control plots need to be established for red rice and vegetable production during the dry season. In India, traditional paddy rice fields must be established and monitored for comparison with Agroecological Homestead Models. In Peru, although it is unlikely to include traditional non-organic controls in certified orchards, monitoring neighboring conventional orchards could be an alternative. In Burkina Faso, monitoring biomass in nearby plots could help quantify the benefits of fodder crop implementation. Addressing these gaps in control treatments will improve the comparability and robustness of findings.

Evidence-based recommendations during the second cycle of co-designing treatments: Evidence-based recommendations during the co-design phase of treatments could significantly enhance the quality of data and the ability to gather evidence on the impacts of transitioning to agroecology. Including research-based guidance in the process could lead to fewer demonstration plots or farmer-managed trials, but with more detailed monitoring of specific variables, as recommended for the inclusion of in-depth variables in Kenya, Zimbabwe, and Peru. Besides, monitoring of changes in manure composition over time, as recommended in Senegal, or soil health indicators should be included for better understanding of innovations' impacts in the ALL. It could also enable better treatment selection based on agronomic principles and prior evidence, as highlighted in Peru. This approach would strengthen the overall experimental design and ensure that the generated evidence supports informed decision-making and scaling of agroecological innovations.

Evidence generation and monitoring: As recommended in India at the Mandla ALL for the Agroecological Homestead Models (AHM), but applicable to all ALLs, greater emphasis should be placed on generating evidence of the agronomic and environmental impacts of interventions, alongside economic assessments. For example, monitoring pest and disease incidence in AHMs can provide valuable insights for this multi-crop system in India. Additionally, the inclusion of critical measurements in monitoring protocols—such as soil moisture dynamics can strengthen evidence generation in agroecological interventions aimed at improving soil water balance, as recommended in Kenya and Zimbabwe.

A significant gap across many innovations, particularly those involving legumes and manure applications to soil (identified in seven out of eight countries), is the monitoring of soil health indicators. Except for Tunisia, which reported microbial activity in two of the four trials conducted at the Kef-Siliana ALL, other trials did not report data on soil health—a fundamental pillar of the agroecological transition. Addressing this gap is essential to ensure a holistic understanding of AE innovation impacts, or at least in ALLs where soil health has been identified as a critical issue.

Agronomic aspects

An increased emphasis on agronomic aspects during the implementation and monitoring of agroecological innovations and trials was identified as a critical need across the ALLs in countries participating in the Agroecological Initiative.

In Asian countries, the importance of improving agronomic packages in different systems was highlighted: In Laos, the Integrated Rice-Fish Culture (IRFC) and production of vegetables during the dry season require support for pest management and soil fertility management to enhance its outcomes. In India, an improvements of soil fertility management in the microsite improvement intervention were identified. While the Agroecological Homestead Model (AHM) appears agronomically sound, monitoring pests and diseases under local conditions could facilitate its wider adoption by identifying agronomic challenges. In both Asian countries, monitoring phenological stages of multiple crops and varieties under local conditions could provide insights for improving agroecological management of soil fertility, integrated pest and disease management, and cultural practices. Additionally, these interventions, as well as the production of red rice in Laos, have the potential to support the conservation of local germplasm. However, basic agronomic characterization is crucial to establish effective seed and germplasm systems.

In Africa, innovations focusing on mixed cropping systems demonstrated potential to increase biomass production and improve livestock feed. However, several agronomic challenges emerged. In Burkina Faso and Tunisia, for example, challenges in fodder plot management were identified, including labor constraints during harvesting and issues with storage and handling. Also in Burkina Faso, developing adequate livestock diets tailored to specific productive goals was a focus. However, while Tunisia reported improved fodder availability for livestock through enhanced sheep fertility, there were no reports on improvements in livestock product quality in Burkina Faso or Senegal. Finally, the need to assess manure availability at the landscape level, as well as its composition and quality changes, was highlighted.

In Kenya and Zimbabwe, as previously noted, more detailed monitoring of agronomic aspects like water balance at the plot level could enhance outcomes for soil-water conservation innovations. Moreover, while some quality indicators, such as leaf color in spinach, were monitored, other yield components (e.g., number of leaves or other productivity measures) have yet to be fully evaluated in vegetables and staple food systems (maize, sorghum, beans).

In Peru, a thorough review of the agronomic logic of co-designed treatments was conducted during the agronomic assessment phase, leading to refinements in the monitoring plan and co-design in one cooperative. Negotiations with cooperatives, informed by gathered evidence and data from prior work, served as a baseline for discussions and improvements.

Emerging agronomic challenges: Several additional agronomic challenges were noted:

- The establishment of adequate fertilizer rates to combine with biochar in wheat was identified in Tunisia and Zimbabwe. In Tunisia, the management of margins (Olive mill Wastewater) in olive orchards, including equipment improvements for applications and composting options to reduce environmental risks were also identified.
- For mixed crop systems, addressing questions about the availability, quality, and management of manure, as well as its environmental impacts and impacts on soil health indicators, such as microbial activity, nutrient mineralization, pH status, and other parameters, remains a critical knowledge gap.
- While legumes improved biomass productivity in mixed systems, further analyses are needed to quantify their impacts on soil health and productivity for both crop and livestock sub-systems.
- Results in Peru highlighted the critical role of cultural practices in agroecology, particularly in reducing dependency on external inputs, including bio-products. Revisiting and integrating these practices into the co-design process is strongly encouraged to ensure that agroecological innovations align with local knowledge, traditions, and sustainability goals.
- Tailored agronomic packages, informed by agroclimatic forecasts, should be integrated into the agronomic support for trials under the AEI. This is particularly important given the widespread impacts of extreme weather conditions reported across trials.

By addressing these agronomic challenges and increasing the agronomic focus within the AEI, the initiative has the potential to achieve outstanding outcomes, both in terms of evidence generation and the successful implementation of agroecological innovations.

Data management and reporting

Several challenges were identified regarding data management within the initiative. Recommendations for improvement include refining existing digital tools, such as the *KoBo Toolbox* developed in Kenya, to streamline the flow of information and enable more straightforward analyses. Furthermore, the development of new tools for data collection in Peru was recommended and is currently being implemented. In Burkina Faso, the identified challenges related to historical data about productivity and livestock feed, being addressed by the local team with secondary information. However, a continuous improvement of data management (repository, documentation, etc) across countries is encouraged.

Challenges were also observed in the reporting of information. In some cases, ongoing trials limited the ability to provide complete datasets, while in others, country teams expressed constraints due to pending publication processes of their results. Besides, some teams openly expressed the requirement of support for streamline data analyses and reporting.

To address these challenges, an early and continuous support from the global WP1 team should be encouraged. This support could integrate the development of standardized digital tools, such as refined *KoBo Toolbox* forms and R workflows, while incorporating flexible timelines to accommodate ongoing trials and publication processes. Additionally, clear guidelines for data sharing and reporting could enhance collaboration and ensure that interim results are effectively utilized to inform decision-making across the initiative.

Landscape integration

During the current stage of implementation, most agroecological innovations under the AEI have been developed at plot or farm scales, focusing on transitioning activities within specific production systems. However, suggestions from teams such as Senegal and Tunisia underscore the critical importance of adopting a landscape approach to ensure the scalability, sustainability, and long-term impact of these innovations. The following are some actionable recommendations for integrating the landscape scale in the co-design of trials and AE innovations.

Required landscape integration into co-design of innovations and treatments

To fully leverage the potential of agroecological innovations, a landscape-scale perspective should be integrated into the co-design of innovations and treatments process. This integration can involve:

- **Assessing inputs and resources availability**: Evaluate flows of inputs used in the agroecological innovations such as livestock manure, or natural resources such as water and local seeds across the landscape to ensure equitable and sustainable access.
- **Addressing environmental impacts**: Monitor the broader implications of agroecological practices, including soil health, biodiversity, water balances at plot and landscape levels, and nutrient cycles. Moreover, addressing the assessment of this impacts could lead also to identify risks and benefits of AE innovations in key processes such as nitrogen leaching, or soil N mineralization.

- **Strengthening natural resource governance**: This inclusion represents an opportunity for sustainably upscaling agroecological interventions. In this regard, the promotion of collective management of key resources like water and germplasm through participatory approaches could support the upscaling processes. Offering also an opportunity for promoting agroecological business models at regional level.

- **Foster a cross-sectoral collaboration:** By integrating multiple stakeholders at landscape level, the required cross-sectoral collaboration could be achieved.

Learning from the current stage of the AEI initiative

Several AEI innovations offer valuable insights into integrating a landscape approach:

- **Integrated wetlands management in Laos**: This entry point highlights how agroecological innovations can be co-designed around a key landscape element, addressing both ecological and productive goals.
- **Multi-value chain Integration in Tunisia**: The Tunisia team co-designed multiple innovations from systems in the same Kef-Siliana transect ALL. Some of them included come interactions between them. For example, the use of olive-derived biochar in durum wheat or using Sulla plants inoculated with Rhizobium for both melliferous and fodders purposes. The last being another alternative to increase feed availability and sheep fertility in the future. Both integrations demonstrated the potential for linking diverse systems within a landscape framework.
- **Leveraging circular economy opportunities in Tunisia:** Innovations like the application of olive mill wastewater (*margines*) in Tunisia highlight the potential of circular economy approaches aligned with agroecological principles. However, scaling such practices requires landscape-level assessments to identify broader environmental risks and mitigate potential negative impacts, such as nutrient runoff or contamination of water sources. Similar assessments should extend to other bio-inputs, including livestock manure, as emphasized in crop-livestock integration discussions.

Thus, a deliberate and systematic inclusion of the landscape approach in future cycles of co-design will enhance the scalability and impact of agroecological innovations. By addressing resource availability, environmental impacts, and governance at the landscape level, the AEI can build more resilient, inclusive, and sustainable innovations.

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Overview of the agronomic assessment of co-designed trials by country

Since this document was prepared based in the information by country in the agronomic assessment of trials, the following sections provide a brief overview of the agronomic assessment in each country:

Burkina Faso (Bobo-Dioulasso ALL) – Fodder & Livestock

The co-design process focused on identifying stakeholders, primarily farmers, and selecting participants for agroecological trials. Activities included modeling fodder crop production, managing cattle diets using specific tools, and transitioning dairy cattle farming to agroecological practices. Workshops were held to assess and simulate farm systems, including biomass production and manure management. Demonstration plots were established with 51 families across 9 villages.

The technologies tested at each demonstration plot were:

At plot level:

T0-Control: Cereals with low manure; cereals grown for grain and straw used as feed. (Practice not included in the demonstrations plots but commonly used in the zone)

T1 - Cereal fodder (maize, sorghum) + high manure input.

T2-: Legume fodder (Mucuna, Cowpea) + high manure input.

At farm scale:

T0-Control: Free grazing and concentrate feeding.

T1- Low grazing, crop residue, cereal fodder crop, and low concentrate use.

T2- Low grazing, crop residue, legume fodder crop, and low concentrate use.

T3- Crop residue, cereal, and legume fodder crop, with low concentrate feed use.

Results reported: Biomass production of fodder crops using high manure (Technology tested at plot level). No data about the farm level trial included in the report.

India (Mandla ALL) – Rice/Agroecological Homestead Models (AHM)

The co-design process included identifying women self-help groups, selecting interested families, and collaboratively choosing plots and crops for implementing AHM. Capacity-building needs were identified, and adjustments are being dynamically proposed by families according to their experiences. A total of 20 AHM were implemented in 4 villages in the homestead area, traditionally cropped with paddy rice.

The technologies tested were:

T0-Control: Traditional Paddy Rice Crop

T1- Agroecological Homestead Model: Multilayer crop system

Results Reported: The number of crops sown in each AHM and the income generated up to October 2024 from AHMs (Paddy rice and AHMs still ongoing).

Kenya (Kiambu ALL – Vegetables & Makueni ALL- Maize/Bean intercropping)

The co-design process included multiples workshops and engagement with local communities and stakeholders. The process is very structured and organized. The co-design workshops involved 45 stakeholders across multiple phases, including preparation, workshops, and trials. The workshops addressed common agricultural interests and practices such as soil management, water management, and integrated pest management (IPM). Challenges arose from diverse stakeholder interests, but common solutions were identified through prioritization exercises and decision-making on crop and practice combinations for trials. Three trials, each corresponding to a domain identified during the co-design process, were established at each ALL. Across the six trials (three in Kiambu and three in Makueni), approximately 10 growers per trial set up paired plots comparing local practices with the proposed agroecological innovations.

The technologies tested at each treatment were:

In the Kiambu ALL- *Crop* Vegetables (spinach for soil and water management and cfabage for IPM)

Soil Management:

T0-Control: Manure + Fertilizer.

T1: Compost (4 tons/ha).

Water Management (Kiambu):

T0-Control: No Mulch.

T1: Mulch (variable thickness).

Integrated Pest Management:

T0-Control: Standard pesticides.

T1: Chilli-based biopesticides.

In the Makueni ALL- *Crop intercropping Maize\Beans*

Soil Management:

T0-Control: Manure + Fertilizer.

T1: Farmyard manure (5–10 t/ha).

Water Management:

T0-Control: Terraces with bare edges.

T1: Terraces with planted edges.

IPM:

T0-Control: Chemical pesticides.

T1: Neem-based biopesticides.

Results Reported: Yield and pest incidence aggregated across both trial seasons. Although the GAT staff accessed and analyzed the data, more detailed information was not included in the assessment report. It was due to potential conflicts with publications, and these are under development by the local team.

Lao PDR (Attapeu ALL) – Rice

The Integrated Rice-Fish Culture (IRFC) trials were co-designed following consultations with local communities. Key components included the introduction of fish farming alongside rice production, the selection of participating farmers, and the identification of service providers to construct fish trenches. A strategy for co-monitoring and implementation was developed. Seven plots were established in two villages on growers' fields. The plots were organized in pairs: one with the IRFC (including the fishpond) and the other using the traditional paddy rice crop.

The technologies tested were:

T0-Control: Traditional Paddy Rice

T1- Integrated Rice-Fish Culture (IRFC) plots

Results Reported: No results have been reported, as the harvest season was still ongoing as of November 2024.

Peru (Pucallpa ALL) – Cacao

Two cooperatives and research institutions collaborated in defining problems to address under an agroecological perspective, protocols and selecting orchards for testing. The two main aspects to address were the control of fruit diseases as moniliasis (Freeze pot rot disease) and improving the tree nutrition. Trials were conducted in organic-certified orchards for one harvest season. At the end of the first cycle, adjustments were made based on the first harvest, particularly with one cooperative. Technicians played a significant role in finalizing trial co-designs. Trials were established in one hectare of orchards under production, 4 orchards for each trial working to control moniliasis and 5 for the trial using bio-fertilizers to improve the tree nutrition.

The technologies tested in each trial were:

For moniliasis control (Frosty pod disease)

Colpa de Loros Cooperative

T0-Control: Grower practice.

T1: Mixture of bio-inputs every 110 days.

T2: Mixture of bio-inputs every 60 days.

T3: Mixture of bio-inputs every 50 days.

T4: Mixture of bio-inputs every 40 days.

Banaqui-Curimana Cooperative

T0-Control: Grower practice.

T1: Use of lime-sulfur.

T2: Use of Bordeaux mixture.

T3: Use of Visosa mixture.

T4: Use of ozonated oil.

For improving tree nutrition with bio-fertilizers

T0-Control: Grower practice.

T1: Mixture of bio-fertilizers every 120 days.

T2: Mixture of bio-fertilizers every 90 days.

T3: Mixture of bio-fertilizers every 60 days.

T4: Mixture of bio-fertilizers every 30 days.

Results Reported: Yield and Moniliasis incidence results from the three trials are available for the main harvest season, which is the only season completed so far. The GAT staff analyzed the raw data with unrestricted access to the datasets. While some trends have been observed, the differences are not statistically significant at this stage of experimentation.

Senegal (Fatick ALL) – Groundnut

The co-design process involved several phases: pre-diagnosis, trial implementation, and co-evaluation. Workshops focused on innovating at a regional scale, addressing challenges like seed and manure availability and farm equipment. Collaborations with national research institutions and communities were central to the co-design process. Trials in two sites were established to test the co-designed treatments. Additionally, 9 satellite trials were established under grower's conditions.

The technologies tested were:

T0-Control: Groundnut-millet rotation, standard sowing practices

T1: Cowpea sole cropping with horse manure (4 t/ha).

T2: Cowpea + Groundnut intercropping.

T3: Cowpea sole cropping.

T4: Cowpea + Groundnut intercropping + horse manure.

T5: Groundnut sole cropping + horse manure.

T6: Cowpea + Groundnut + compost mix (multiple manures).

Results Reported: Results from 2021 and 2022 at two sites on the yield of groundnut, cowpea, and millet show no statistically significant differences among treatments. However, as recommended by the GAT team, the use of mixed models or other statistical procedures could provide a clearer understanding of the treatment effects. No data about satellite trials were reported.

Tunisia (El Kef-Siliana transect ALL)- Multiple farming systems in a semi-arid area

Several agroecological innovations were tested and co-designed with six groups of farmers in the El Kef-Siliana transect ALL.

The technologies tested in the different farming systems were:

Forages intercrops

Survey study in 74 farms of the area using the Vetch-Triticale-Oat intercrop and the same fodder crops as monocrop.

Rhizobia bio-fertilizer for sulla plant (fodder and Melliferous pruposes) (30 farmers as replicates)

T0- Control: Conventional non-inoculated Sulla plant

T1: Sulla plant fertilized

T2: Sulla plant bio-inoculated with Rhizobia

Green fertility trial for sheep livestock (3 flocks of around 20 sheeps, half of them in each treatment)

T0- Control: Conventional feed based on grains, concentrate and hormones to prepare ewes for mating

T1: Green feed of vetch, triticale, and oat

Olive Biochar and Rhizobia for optimization durum wheat fertilization (One farm with trial of 3 replicates)

T0- Control: Unamended soil

T1: Biochar application

T2: Biochar and 100% DAP

T3: Biochar and 50% DAP

T4: Biochar and plant growth promoting Rhizobacteria (PGPR)

T5: DAP and NH_4NO_3

T6: PGPR

Olive mill wastewater (Margines) agricultural valorization in olive orchards (One farm with trial of 3 replicates)

T0 – Control: plot without Margines application

T1: Margines application to plot in olive orchard

Results Reported: One cycle of assessment for each trial described. The details for some treatments like the fertilizer rates were not reported. The characterization of the agroecological transition (CAET) was not reported in any of the trials.

Zimbabwe (Mbire ALL- Sorghum & Murehwa ALL-Maize)

The process involved engaging stakeholders, including farmers and the private sector, through multiple activities such as site identification, participatory mapping, and monitoring interventions. The process was iterative, but challenges included inconsistent representation of local partners and communication barriers, as well as issues like climate variability and infrastructure limitations. Trials were developed at two levels under grower conditions, with 10 mother trials each ALL for two years and 83 baby trials the second year.

The technologies tested in mother trials were:

T0-Control: Conventional monocropping (maize or sorghum) with fertilizer. No pest control.

T1: Push-Pull system (pest control with intercropping).

T2: Conservation Agriculture with dead mulch.

T3: Live mulch for improved water management.

T4: Biochar application for nutrient management.

T5: Traditional landraces crop Maize and Wheat.

The technologies tested in baby trials were:

Minimum two technologies from mother trials selected by growers in each 83 baby trials.

Results Reported: The yield of cereals (maize and wheat combined) and the severity of pest attacks in mother trials have been aggregated across both ALL. Similarly, yield and pest severity data from baby trials during the second year of implementation (maize and wheat combined) were reported. Although the GAT staff accessed and analyzed the data, more detailed information was not included in the assessment report. It was due to potential conflicts with publications and theses under development by the local team.

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