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Co-designing Technical Innovations in the Context of Agricultural Living Landscapes

A cross-country look at methodological approaches, progress and initial 2023 results

Authors:
Bernard **Triomphe** (CIRAD), Vimbayi **Chimonyo** (CIMMYT), Lisa **Fuchs** (CIFOR-ICRAF), Udo **Rudiger** (ICARDA), Eric **Vall** (CIRAD), Banna **Mbaye** (ISRA), José **Sánchez-Choy** (Alliance Bioversity-CIAT), Mark **Dubois** (IWMI)

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Peru:	M.C. Tristán
Laos:	S. Douangsavanh, M. Viossanges, V. Xaydala
Global WP1 team:	N. Bergamini, A. Navarrete

Executive summary

Work package 1 of the Agroecology Initiative is entitled "Transdisciplinary co-creation of innovations in Agroecological Living Landscapes (ALLs)". It started in 2023 by establishing functional ALLs in each of the seven countries of the Agroecology Initiative (AEI) at the time. Codesigning technical agroecological innovations is a major component and process that starts as soon as the ALL's membership is defined and the collective vision of where do stakeholders want to be in the future with respect to agroecology (see WP1 Vision-to-action consolidated report for 2023). While there are different types of innovations that can be codesigned, WP1 focuses on technical innovations related to production.

In a nutshell, codesigning technical innovations is a highly interactive, iterative process during which farmers, researchers and other relevant stakeholders (usually this mostly includes technicians from farmer organizations, NGOs or public institutions) come together to discuss their priority needs, identify existing practices and identify potentially suitable novel options (potential innovations) that may contribute to solving challenges they face and achieving their vision. Such options become the heart of participatory experimental set-ups negotiated with farmers to test, assess or at times simply demonstrate the behaviour and performance of these options in real on-farm conditions (such as farmer-led "simple" trials established in their field, or more controlled and complex set-ups which function as sources of more solid scientific evidence and of reference and inspiration for farmers and other stakeholders). Such a process may involve surveys, various meetings and workshops, training events, establishment and monitoring of experiments, field days. It finalizes with collective assessment of results and lessons and in most cases ushers in a renewed codesign cycle, until satisfactory results are obtained.

Codesign was a major focus of WP1 activities in the AEI countries during 2023. This report provides an overview of progress achieved in 2023 with respect to codesign of technological innovations in 7 countries (Zimbabwe, Kenya, Tunisia, Burkina Faso, Senegal, Peru, Laos). It highlights the commonalities, contrasts and originalities among them in terms of actual approaches, existing practices, types of technologies selected for experimentation, experimental set-ups and monitoring and evaluation protocols. Hardly any experimental results per se are presented, as most countries did not yet have time to process them.

The diversity observed among countries is both striking and yet was also to be expected. It stems from the specific context, the types of cropping and farming systems, the challenges farmers face in each country on one hand, and on the other hand, the prior trajectory of each country team with agroecology and related sustainable agriculture systems, as well as the profile and experience of the team members, among others. It also reflects the very nature of a true codesign process that has necessarily to be highly adapted to each situation and involves significant time investments and negotiations by and among the AEI teams and the ALL stakeholders. Finally, it reflects the highly decentralized mode of functioning o WP1, with no standard methodological approaches enforced upon countries.

The next steps in codesign process include a second iteration of experiments in most countries, analysis of results and identification of lessons and recommendations. Different products will also be developed to systematize and make sense of results across countries and to formalize and share the methodological learnings within and outside the AEI.

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1. Introduction

The Agroecology Initiative (AEI) has put at the very center of its work plan the establishment and functioning of **Agroecology Living Landscapes** (ALLs) (see a review of concepts related to Living labs and living landscapes in Navarrete et al. 2023). ALLs are spaces for multi-stakeholder engagement whose members are expected to develop and achieve a genuine, realistic, and context-specific agroecological transition aligned with the 13 agroecological principles identified by the HLPE (2019). ALLs operate across all Initiative work packages dealing with new agroecological production practices, value chain arrangements, business models, policy- and institutional-enabling environment, and behavioral change strategies. WP1 for its part focuses on the **codesign of technical agroecological innovations** in the production sphere. This involves identifying, codesigning, testing and eventually adopting an array of technical AE innovations responding to the specific context and conditions and to the needs / objectives of the farmers. In 2022, ALLs were established and started functioning in 7 countries. In 2023, most of the country teams were able to engage in 2 strategic activities under WP1: (1) developing a process eventually labelled "vision-to-action", allowing ALL stakeholders to identify a collective vision for a desirable future 10-15 years down the road and specify the contribution of Agroecology to this future, coupled with identifying transition pathways to go from the present state of the agriculture in the ALL to this future (see corresponding report) and (2) engaging in a process of codesign of desirable technical agroecological innovations from the view point of the users, typically following an assessment of existing practices and innovations.

This report presents the early progress obtained in 2023 with this on-going codesign process in seven of the eight country teams involved in the AEI in 2023 (i.e. all countries of the initiative except India, which only initiated activities in a new state toward the end of 2023 and hence did not yet have the opportunity to engage in the codesign process, which will start in 2024).

As was already the case for ALL establishment (see 2023 WP1 reports), it was clear from the onset that codesign, being as much a set of principles as a specific approach, could not be implemented following a standard centralized approach. Rather the different WP1 country teams went about codesign in a highly decentralized manner; allowing each of them to determine and implement what they considered the most suitable approaches to codesign. This is in keeping with the highly contrasting and specific situations and contexts each country faces. Such contrasts include, among other aspects, cropping calendar and farming / cropping systems (from cocoa-based systems in rainy Amazon to crop-livestock systems in semi-arid regions of North or West Africa), prior trajectories and advances each country had with agroecological practices and systems and related sustainable technologies - such as Conservation Agriculture for example - and also profile and experience of the country team staff with codesign and related participatory approaches. Another key reason for leaving great autonomy to the country teams comes from the fact that the codesign process is by nature partly designed and decided on the go, based on interactions and negotiations with national or local stakeholders in each ALL. As a result of the interplay among these various factors, some countries were fairly autonomous in making sense of the codesign principles and used in many cases original or novel approaches in one or several steps of the codesign process. On the other hand, other countries relied more on the initial and rather simple codesign guidelines developed and shared by WP1 leadership at their request. The following considerations illustrate such **diversity and differentiated progress among countries** with respect to the implementation of the codesign process.

- Zimbabwe started codesign as early as late 2022, in order to take advantage of the first full cropping cycle from November 22 to May 2023. The Zimbabwe teal was fairly autonomous as they had significant previous experience with codesign and sustainable / conservation agriculture.
- Kenya invested a lot of efforts in a systematic and participatory assessment of existing Agroecology practices before engaging in codesign of new practices. The Kenya team was also

especially careful to involve its main partners in each one of the two ALLs established (the so-called "host centers") in every step of the codesign process.
- Tunisia relied heavily in the codesign process on results and technological options developed in previous projects, while also attending a wide diversity of conditions and farming systems across the communities and farmers groups that are part of its ALL.
- More than any other country perhaps, Burkina Faso decided to tackle the whole farm scale for designing Agroecology practices and systems adapted to dairy farms.
- While Senegal only joined the AEI in early 2023, it was however able to build on activities and results obtained under the related EU-funded FAIR Sahel DESIRA project, which mobilizes approaches that are fairly original compared to what is being done within the context of the AEI or even the CGIAR in general.
- Peru is dealing with a perennial crop and hence experimentations are of a different nature compared to dealing with annual crops. Also, it had to adapt to the fact that one of main partners in the ALL, a farmer cooperative, had not actually "bought" the concept and approach of codesign by the time the AEI Peru team wanted to implement this approach.
- Laos consolidated a functional AEI team rather late during 2023. Most of the results obtained so far tend to focus on understanding / diagnosing the diversity of agricultural practices and systems at the watershed level, with little still in the way of experimentation of Agroecology practices. Also, the Lao team gave high priority to actions that attend the basic needs of very poor rural communities, such as access to groundwater.

To make sense of this diversity of experiences and still provide some overall sense to the progress achieved, this report is structured in the following manner:

- Following this introduction, the first section focuses on **methodological issues** by presenting generic aspects of a codesign approach as envisioned in the AEI and then looking at what different countries actually did. The section also includes some critical feedback about how the codesign approach was received and how it could be improved.
- The next section offers **four different zooms on specific approaches, methods and tools developed by some countries for selected steps of the codesign process** (namely, assessment of existing practices, codesign of cropping system ideotypes, looping and cascading experiments, and use of digital tools for participatory monitoring and evaluation of experiments). Such approaches may inspire other country team to imitate them by adapting their respective approaches in future steps and iterations of codesign.
- A third section **highlights similarities and contrasts in terms of key preliminary progress** achieved by end of 2023 with the codesign process across 7 countries. It particularly looks at the technologies selected, the design of experiments, the monitoring and evaluation systems put in place. Given the scarcity of actual results collected from the countries for this report; no attempt is made at doing a cross-analysis of results, but highlights are presented for Zimbabwe and Tunisia to give a sense of what type of insights can be gained from the codesigned experiments)
- A fourth very brief section outlines **the next steps** countries propose to follow with respect to codesign in 2024, as 2023 witness the first steps or initial cycle which are part of an iterative process that will continue in 2024 and beyond.
- The concluding section mentions a number of lessons and considerations from the viewpoint of WP1 leadership about **where the WP11 / the AEI is and can go with codesign**.

Note: *Unless stated otherwise, all information reported here has been extracted, synthesized and /or edited for clarity and conciseness from the seven country reports submitted to WP1 leadership on codesign for the year 2023, as listed at the end of this report. Any mistake or misinterpretation is entirely the responsibility of the first author.*

2. Methodology

2.1. The generic process followed for codesigning innovations

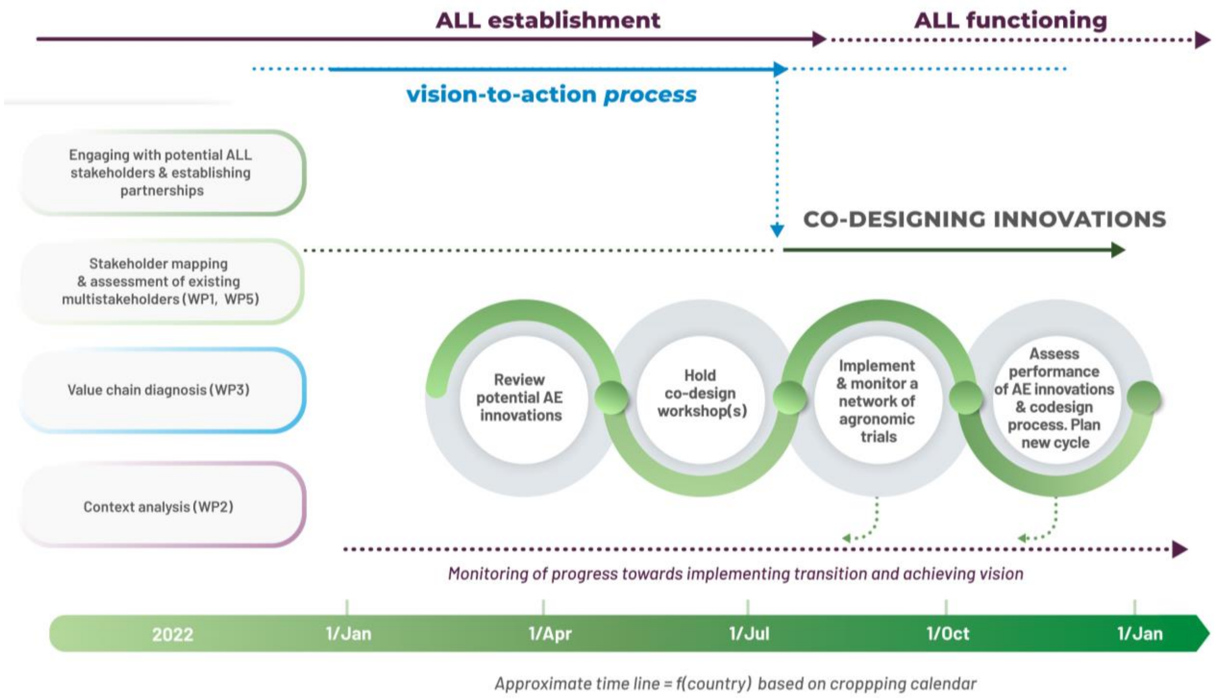
Generically speaking, codesigning innovations can be construed as an iterative, participatory process that involves several steps and mobilizes several types of stakeholders and information *(NB: the process presented below is not necessarily conducted within a short period of time nor in that particular sequence. It can also well be that some of the information indicated below is available as reference to a team engaging in codesign):*

1. It typically starts somehow by **identifying and assessing existing practices and existing (local) innovations** that may offer potential or even proven solutions to existing challenges with agricultural production, both **local ones** as developed by farmer innovators and **introduced ones** (e.g. developed or proposed by researchers and other stakeholders in the context of previous projects: case of Conservation Agriculture techniques in Zimbabwe or Tunisia for example).
2. It includes a step of **collective discussions and decision-making** among farmers, researchers and other relevant stakeholders **to identify priority issues and AE-focused innovations** (or packages of innovations for those taking a more systemic approach to agricultural practices) on which the collective wants to focus its efforts at experimenting / testing.
3. It includes a step during which **protocols and details of the experiments / trials to be established are fleshed out** among the main participants (usually at least farmers and researchers, but others may take part depending on the specific context and ALL configuration, such as technical advisors or representatives of farmers organizations).
   - *This includes experimental protocols, selection of participants in particular, as well as agreeing on how experiments are going to be monitored and assessed. Typically, this may involve measuring a number of collectively validated variables or indicators to know how the experiment is progressing and determine how the innovations is performing (from both a scientific and practitioner viewpoints), or holding field days allowing different stakeholders to observe and discuss the experiments and asses the various options.*
4. It then includes **a monitoring and evaluation phase** of whatever experiments have been established.
5. Finally, there is an analysis phase in which results are formalized along with any lessons related to the codesign and experimental process itself.
   - This last phase had part not been implemented yet in most countries by end of 2023 and hence is not being reported here

Note: *Steps 2 to 5 may be repeated during successive cropping cycles. Step 1 can be conducted, updated or refined at different moments over time, depending on resources available*

While codesign is generic and can be used to develop any types of innovations, in the context of the Agroecology Initiative, and throughout the various steps of the codesign process, it is also expected that **explicit efforts** will be made to assess or ensure **the compatibility** of the proposed innovations with **Agroecology principles**, as well as with the **vision** formulated by the collective for the future of the ALL / the territory of action of the ALL (see the Vision-to-action report).

Figure 1 highlights where codesign fits within the overall ALL establishment and consolidation process followed by the AEI countries since 2023.



Source: Authors

Figure 1: Various phases of the generic co-design process and where it fits in the ALL establishment and consolidation process followed in the AEI countries.

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Illustration 1: Group work during codesign of agroecological cropping systems in the commune of Ndiop, Senegal, August 2022

Specific methods and tools for conducting each step or even the whole process may vary according to the specific objectives and experience of the teams or stakeholders involved in the codesign, as outlined in the introduction. Typically, review of past experiences and documentation, surveys, focus group discussions, field days and workshops are all mobilized at one stage or another of the process. Other tools are being used (e. g. advisory tool at the whole farm level in Burkina Faso, digital monitoring of experiments in Zimbabwe: see section 3 on specific useful methods and tools developed and used by some countries.

2.2. An introduction to the guidelines provided by the WP1 leadership for the codesign of innovations

WP1 leadership provided simple guidelines to those teams that asked for them. Such guidelines, still formulated in draft form to this day, were shared relatively late in the course of 2023 (the first set of guidelines were circulated to the Tunisia team in June 2023). They focus rather narrowly on the **generic organization of one or several consecutive codesign workshops**, even though efforts were made to locate them within a broader sequence in the ALL establishment process and the codesign process (see Figure 1 above).

2.2.1. Place of a codesign workshop in the ALL establishment process?

Codesigning technical AE innovations is a core process and activity of the ALL. Hence it should ideally be addressed **only once the All establishment is sufficiently advanced. Concretely, this means**:

- **Key members** and especially farmers and their organizations, have been **confirmed**,
- **Key governance rules have been agreed** (especially decision-making) (see session on governance during Tunisia P&R workshop).
- **Efficient and neutral facilitation** is available for holding events.
- A significant part of the **vision-to-action process has been conducted**: not necessarily all the way to have an action plan, but at least a shared vision has been formulated, its relationship to Agroecology principles is clear and major changes needed to achieve the vision identified.

  While ideally, ALL members should also have identified and agreed on concrete transition pathway(s) and a work plan for 2023, this may not always be possible at these initial stages of ALL establishment, especially given the need to synchronize codesign with cropping calendars.

- Another requirement is to have identified and possibly pre-selected beforehand the potential AE innovations that research can offer for discussion to farmers and other relevant All stakeholder groups, based on previous experiences in the region or any agronomic assessment conducted up to the time of the co-design workshop.

2.2.2. Objectives of a codesign workshop

As a generic proposal that each country team will want adapt to its own context and needs, the codesign workshops should cover at least 3 objectives:

1. Identify and select with key concerned ALL stakeholders relevant (potential) AE innovations that can be tested as part of the ALL activities, whatever their source (research, farmers themselves)
2. Codesign a strategy and associated methods & protocols for assessing these innovations and comparing them to existing (non agroecological, or less agroecological) practices within a network of participatory on-farm trials
3. Agree on the responsibilities, activities and next steps to be implemented by concerned ALL members for operationalizing the strategy during the upcoming cropping cycle.

As with any participatory workshop, to what extent can such objectives be achieved will vary. Hence follow-up **activities, whether desk or field ones,** will usually be required until actual experiments can be implemented within the spirit of codesign and shared leadership, and with a fair probability of achieving desired learning and success, both from a technological viewpoint and from a process viewpoint.

2.2.3. Desirables participants in a codesign workshop

- Selected farmers and representatives from farmers organizations members of the ALL, based on a set of criteria (see below)
- Technicians from ALL member institutions involved in providing advisory services to farmers
- Local, national and international researchers who are partners of the Initiative and/or members of the ALL
- WP1 country team leads / coordinators and other relevant members from the Initiative country teams
- Local authorities (optional)
- External resource persons on specific technical issues related to the potential innovations (optional)
- External facilitators (highly desirable but optional)

2.2.4. The proposed generic structure of a codesign workshop

The guidelines suggest that a codesign workshop be organized around **the 4 following thematic sessions**:

- ***Session 1: But what are we looking to achieve today and how? Agroecology and codesign***
    - *This session is key to **framing the workshop** & **agreeing on what the workshop is all about**. This means clarifying **what kind of agroecological principles and criteria** should be considered and what codesigning means in practice.*
    - Also, part of this session is about inserting the codesign workshop into the sequence of activities carried out with ALL stakeholders up to this point, and particularly the vision-to-action process
- ***Session 2: Identifying potential AE innovations***
    - *This is perhaps the most strategic session as it should **allow to identify potential innovations originating both from research and from the farmers themselves** that respond to priority needs and desires of farmers*. While it could well be that farmers will readily be able to identify their own ideas and potential innovations, it could also be the case that this will be relatively novel and hence enough time should be dedicated to it, beyond the 2-3 h indicated here
    - *Another strategic issue in this session is **the selection of which AE innovations to test*** during this first cycle. This should be based on clear agreed-upon criteria.
        - Such criteria may include the maturity of the innovation (e.g. is it fairly new for farmers or is it already known by some?), how the innovation fits with AE technical or other principles such as equality, hybridization or knowledge), issues related to whole farm context (capital, labor, gender, etc.), its potential for scaling, the levels of risk applying the innovation entails (economic risk in particular), the need for support and capacity building to implement it (will the farmer need technical assistance, training?), etc. Important also is to come up with criteria regarding the experimentation process itself, and the learning aspects.
- ***Session 3: Developing a strategy & adequate protocols for assessing selected AE innovations***
    - This session might appear relatively familiar for those who have already developed participatory trials. It includes defining how many experiments, how many treatments (the simplest being 2: one control practice and one innovative one), the type of fields adequate for experimenting, the MEL of the experiments (what to measure / monitor, how and with whom, who to invite to field days and when, etc.), what will be the respective responsibilities and contributions of the various stakeholders, and in particular farmers, technicians and researchers

    - A major difference however, and challenge, with more conventional participatory approaches is to ensure protocols are actually codesigned, and that ownership of farmers over them is adequately fostered.
- ***Session 4: Planning Next steps***
    - This session delivers the follow-up steps. As it might be that previous sessions will not have produced a finalized output, it is critical to identify very concretely the remaining tasks and outputs which need to be developed so that the experimentation can be implemented and conducted with the required quality. Being concrete and realistic is paramount for this session to produce the desired "actionable" output.

2.3. Use and adaptation of the guidelines by country teams

As outlined in the introduction, the above guidelines were only requested by some countries, and even in such cases, were never meant as a straightjacket teams were asked to implement "as is". Rather they were meant as a source of inspiration and as a set of generic proposals requiring adaptation to each context and experience/ expertise of country teams. To this effect, bilateral virtual meetings were held with some country teams to make sense of the guidelines and adapt them to their context and needs. It is worth noting that WP1 leadership was not able to accompany country teams during the codesign process "in the field" in 2023, leaving it to the teams to do whatever they felt was best suited to their needs.

Several countries did not request or need guidelines from WP1 leadership, because they had pressing cropping calendar constraints (case of Zimbabwe, which started engaging in codesign as early as late 022) or also because they felt they had the required expertise in their midst to engage in codesign autonomously: that was particularly the case for Zimbabwe, Senegal and Burkina Faso.

2.4. Actual codesign process following in the countries of the AEI

The actual codesign process followed varied in each country, and might actually have included significant departure from the guidelines outlined above. Table 1 below summarizes the steps taken in the various countries with respect to the codesign process.

Table 1: Main features and outputs of the codesign process followed in the 8 countries

Country ➔	*Zimbabwe*	*Kenya*	*Tunisia*	*Burkina*	*Senegal (*)*	*Peru*	*Laos*
Was an inventory (Survey) of existing local AE innovations conducted as part of codesign process?	*Yes (600 farms)*	*Yes (80 farms)*	*Yes (592 farms)*	Prior to AEI	*Planned / on-going?*	*Interviews with FO staff*	*Yes*
Was an inventory of research or R&D designed AE technologies conducted?	*Yes*	*Yes*	*Yes*	Prior to AEI	*Yes (update on-going)*	*Yes*	*From secondary data/ongoing*
Were original approaches methods or tools developed / used by country team and for what purposes?	*Digital, participatory monitoring & evaluation of trials*	*Assessment of existing farmers practices*	*Developing sociotechnical packages around core technical innovation*	Cascading of experiments	*Codesigning ideotypes of Agroecology cropping systems*	*No (adaptation of WP1 guidelines)*	*Watershed approach*
Country team made use of the WP1 (draft) generic codesign guidelines?	*No*	*Yes*	*Yes*	No	*No*	*Yes*	*Yes*
How many codesign workshop(s) were organized (+)	*4 (1 per ALL)*	*2 (1 per ALL)*	*1*	1 (+ 9 FG)	*1*	*2*	*3 (Thematic workshops)*
Approx. duration of the codesign workshop(s)?	*1 day each*	*3 days*	*2 days*	1 day	*5 days*	*1 day*	*1 day each*
Who took part in the co-design workshop(s) and overall CD process, beside AEI-I team and Farmers?	*Extension staff, AGRITEX, EMA, Forestry Commission*	*ALL host centers, students, local government, technical experts, NGOs, extension agents*	*National research & extension staff*	Technicians (tbc)	*Diverse members of DyTAEL (the Senegal ALL)*	*F.O. technical staff*	*National research staff, Regional Agric. & forestry staff, National FO*
Were additional meetings & activities conducted to contribute to codesign?	*Seed Fair, mechanization service provider model*	*ALL host centre visits, meetings of farmers' groups*	*Stakeholder engagement workshop, workshop on socio-technical packages w/ NARES partners*	*9 focus groups w/ volunteers in milk collecting centers*	*Market gardening set-up by 5 farmers with support from Research?*	*Visits to farmers' plots*	*Farmer visits, Discussions w/ local authorities*

FO Farmer organization

(+) This number does not include preliminary workshops organized for assessing existing technologies for example
(*) most activities related to codesign in Senegal were conducted within the framework of the EU-funded Desira project "FairSahel" and have not been necessarily reported within the framework of the AEI. DyTAEL is the Senegal ALL in the framework of the AEI and is the multistakeholder structure coordinating and promoting Agroecology transition efforts in Fatick department.

From Table 1, one can observe the following main features:

- *There was a sizable variability in activities implemented across country, and in the corresponding approaches, some of them being quite original and even in some cases developed anew for the needs of the Initiative (see also Zoom section below for details)*
- *The (draft, incomplete) guidelines provided by WP1 leadership were used in some countries, but not in others, owing to their as yet incompleteness, their late availability and to varying degrees of experience with codesign approaches among country teams*
- *Codesign workshops involving, farmers, international and national researchers, technicians and other ALL stakeholders were often organized over at least 2 or 3 days, some times more (see critical reflection on this specific point below).*
- *Workshops were often complemented by other activities such as focus groups, visits to farmers' plots, which allowed to finalize several key details of the design of experiments*

Illustration 2: Consultation and co-design workshop for groundwater solar pump held in Laos

2.5. A critical cross-country look at the codesign process and methodologies used in the 7 AEI countries

Based on feedback received from the various country teams and reflections from the WP1 global team itself, below are a few lessons coming out of the implementation of the codesign processes by the various countries, in their diversity. We are looking successively at ideas related to (1) the positives and what worked well, (2) the challenges and what didn't work so well, as well as (3) refining the process and improving the guidance on such process that WP1 global team could provide in 2024 and beyond.

2.5.1. The positives / what worked well

A major positive across several countries is a recognition by both a diversity of project stakeholders in the ALL, and project staff themselves; that the intrinsically iterative codesign process (and at time step-by-step: see Burkina's experience) is crucial for increasing the likelihood that the resulting innovations are practical, sustainable, and respond to the needs and aspirations of the farming community. This is because farmers (as well as their knowledge, experiences and perspectives) are put at the center and participate in all key events and decision-making (such as for example agreeing on criteria for prioritizing innovations and jointly scoring potential innovations based on such criteria, as put forward by the Peru team). Using a multi-partner codesign approach fostered collaboration and synergies among stakeholders, and beyond, among projects and initiatives.

Consequently, engaging in codesign and providing training to farmers (as mentioned by the Zimbabwe team, particularly in the case of women) encourages participation and promotes a sense of shared ownership responsibility and empowerment among farmers. This way of proceeding is very different from the conventional way in which decisions about which innovations to develop, which experiment to implement start from outside, be it a researcher, a technical area: in such cases, frequently, farmers tend not to understand why and for what purpose the activity is being carried out.

At least 3 countries developed or propose to use digital tools to accompany and enrich the codesign process: Burkina Faso for providing advice to farmers through models allowing for scenario exploration between farmers and researchers, and Zimbabwe and Kenya (as inspired by Zimbabwe) for conducting participatory monitoring of experiments in an efficient and participatory manner (see- section Zoom).

2.5.2. The challenges / what didn't necessarily work very well

High time and resource requirements for implementing a codesign approach (in its various activities and steps, including its series of day(s)-long workshops and other meetings as well as its at time demanding participatory monitoring) compared to what is required in conventional approaches, is a major issue flagged by several country teams, both for farmers and project staff. This can be especially challenging for poor farmers having to prioritize meeting their basic needs on a daily basis. There is also the classical issue of conflict with fieldwork and farmer availability, which, to be avoided, requires careful alignment of codesign activities with local agricultural timelines.

Another challenge was, **how to ensure that innovations indeed meet agroecological criteria** and not stop at responding to farmers' personal needs as mentioned by Tunisia. Also, finding the right balance and bringing to bear enough technical and farmer knowledge about what is an innovation', and 'what is an agroecological innovation' was difficult as reported by Kenya: The Kenya team considers that the selected innovations were fairly basic, and were strongly inspired by what farmers already knew and/or were familiar with. Related to this is the issue of giving enough visibility and room to farmer-originated innovations at the moment of coming up with innovations to experiment with, something which, while very much aligned with basic AE principles (participation, co-creation of knowledge) may require more than an iteration until everybody, farmers and scientists included, understands, learns and is ready for engaging in the corresponding dynamics.

Aligning farmers and scientists' criteria and interest around **monitoring criteria and protocols** on and off-farm is another "inbuilt" challenge related to codesign approaches.

Mobilizing stakeholders in their diversity around codesign events is also a challenge several country teams faced: be it **women** who often have strong workloads or **youth** at the community level, poorly motivated by agriculture, but also **policy-makers** and representatives of **the private sector.** C**onsistency** (or lack of) of participating farmers across events which form part of the codesign process was also noted, which creates challenges with ensuring **continuity of the process.**

Clearly being able to adapt the theoretical /generic codesign process to the local context and situation remains a challenge: some times, unexpected barriers may pop up such as partnering with a Farmer organization whose leadership or technical staff that does not know or share the codesign principles for example as was the case in Peru. Or adapting to low availability of farmers to engage in events as was noted by the Lao team. While such inbuilt need for local adaptation of the approach was clearly flagged in the guidelines shared by WP1 leadership with country teams, how to do it concretely and whether one can properly anticipate all what needs to be adapted or the type of challenges that might emerge during implementation remains difficult.

One can also mention the specific challenge encountered by the Burkina team when applying a cascading approach to designing and implementing experiments on the farm (in which the results of one step feed into the next step) (see zoom **Error! Reference source not found.** below). In effect, such a pproach tends to generate losses of farmers along the way, as farmers who fail at step N have difficulty continuing work at step N+1. This may result in smallish sample sizes of farmers having successfully carried out the experiment from start to finish, which in turn may affect validity of the research results.

We can also mention the challenge of **capacity building around codesign approach**: this applies both to capacity building of the researchers in charge of piloting the approach, and that of the farmers and stakeholders invited to take part in the codesign process. While invaluable learning by doing is certainly happening in every case the approach is being used, a limited initial familiarity with and understanding of the approach, both conceptually and practically (e.g. capacity to facilitate meaningful discussions and hybridization of knowledge during a codesign workshop) can reduce the likelihood of success, or lead to sub-optimal outputs.

2.5.3. Recommendations for future WP1 guidelines on the co-design process

It is still relatively early in the codesign process in the AEI (most country teams have not yet implemented all the steps for their first codesign cycle, including analysis of results and planning of a subsequent cycle based on the lessons and result of the initial cycle). Still, a few ideas and lessons seem already relevant to consider for providing appropriate guidance in the future about codesign to country teams (and others interested in applying such approaches):

- Developing concise, simple and user-friendly guidelines and tools for co-design, making them suitable not only for researchers but also for farmers, and other non-researchers (This may require adaptation on a case-by-case manner).
- Ensure that the codesign process pays sufficient attention and proposes ways of identifying and assessing traditional (local) technologies and innovations, including disappearing ones (due to "modernized agriculture") or ones with the potential to be improved. This would enhance the probability that "farmer-originating agroecological technologies" will eventually be selected.
- Emphasize the need for the codesign process to be inclusive by associating, beyond farmers themselves (in their diversity of profiles, gender, age, etc.), actors like farmer unions, media, financial institutions, input suppliers, etc. (which specific actors need to be included will obviously depend on the local context. Also address the issue of how to motivate such a diversity of stakeholders to participate.
- Addressing codesign of technologies beyond the field / farm level, such as those that might be relevant at the landscape level.
- Similarly, address the need for codesign to not only focus on individual technologies but also on bundles of related innovations or whole systems (cf. Senegal experience with ideotypes), and by linking innovations with market access considerations (as suggested by Kenya)
- Emphasize and propose capacity-building modalities on codesign approach and principles and specific steps (such as innovation assessment, participatory monitoring for example) for different stakeholders, including researchers and farmers.
- Include guidance on how to design and digitize farmer-friendly or even farmer-centered data monitoring protocols and methods.

3. Zoom on specific useful methods and tools developed and used by some countries

The following section consists of four different zooms or highlights on specific approaches implemented in Kenya, Senegal, Burkina and Zimbabwe respectively. The various zooms were provided upon request from WP1 leadership and authored by the corresponding teams: they are mere snapshots of approaches and tools being documented and sometimes published autonomously from this report by those same teams.

The four zooms included in this report are as follows:

1. A method for assessing existing innovative practices, by the Kenya team. It is up to now the most meticulous and systematic approach used in the AEI to look at existing practices before engaging in codesign, something frequently overlooked as scientists tend to focus more on external technologies or on diagnosing problems and constraints.
2. A method for codesigning ideotypes of agroecological cropping systems, by the Senegal team. Key in this approach is a focus on cropping systems rather than individual practices. Also, participants in the codesign are asked to explore creatively new horizons and new solutions without limiting themselves to what they already know, something hardly done in typical approaches which favor the known rather than creativity.
3. A method for cascading experiments, by the Burkina Faso team. It relies on the fact that at the farming system level, one innovation may only be possible if other ones are already in place. This is particularly true in diary systems in which interactions and synergies between crop and livestock are critical to the functioning of the farm.
4. Use of digital participatory tools for monitoring experiments, by the Zimbabwe team. This is very useful to facilitate what can be a very tedious and error-prone task, it also accelerates the interval between data collection and data use / return to farmers and scientists, which in more manual monitoring systems can be quite delayed.

3.1. Assessing existing innovative practices in Kenya

Authors:
Lisa E. Fuchs,[1] Anne Kuria,[1] Peter Bolo,[2] Winnie Ntinyari,[3] Levi Orero,[1] Beatrice Adoyo,[1] Hezekiah Korir[3]

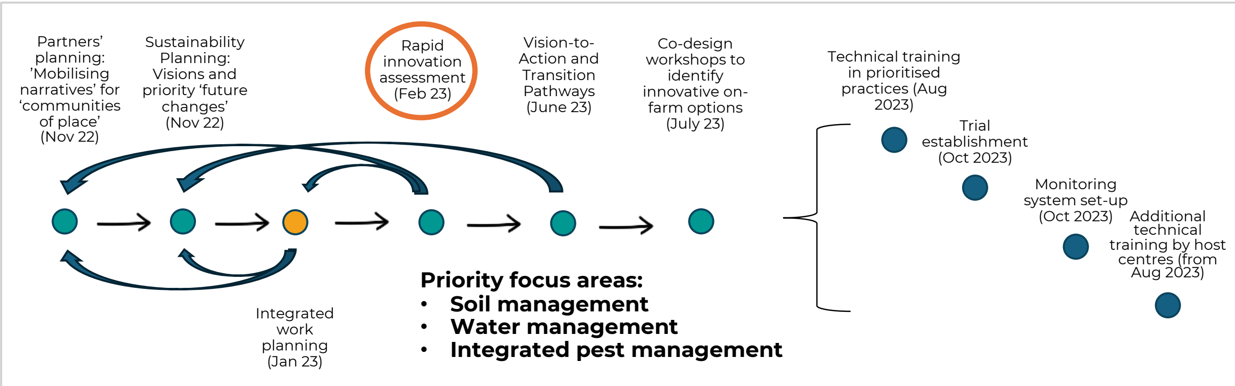
[1]World Agroforestry Centre (CIFOR-ICRAF) ; [2]Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT); [3]International Institute of Tropical Agriculture (IITA)

Background

Agroecology is about co-creation and co-design. Both typically emphasise iteration cycles, which allow different individuals and groups of people to come together, present their views and perspectives, interact with each other's understandings and insights, and create new knowledge through these interactions. In the context of the CGIAR Agroecology Initiative (AE-I), and its objective to contribute to improving the sustainability and resilience of agroecological on-farm practices in the ALLs, the Kenya project team developed an innovative method to gain sufficient context-specific insights into the practices that already existed in each of the ALLs before engaging in further co-learning cycles.

The team was also interested in understanding more about farmers' experience with, and their evaluation of, these practices - and ultimate which practices they liked and were likely to be interested in adopting. The team considered this information vital to developing an evidence-based 'opinion' that would allow making informed recommendations for practices that could potentially be interesting to be subjected to farmer trials.

Drawing on the 'options by context' (o x c) approach formulated by Sinclair and Coe (2019) and widely used at CIFOR-ICRAF and beyond, the Kenya team developed and applied an original method to assess existing innovative practices in its two ALLs in preparation of the planned co-design workshops. The rapid innovation assessment approach was also informed by previous engagement steps, including the partners' planning workshop through which the partners identified a 'mobilising narrative' around which the 'communities of place' in their respective ALLs could be mobilised (see step 1 of the Sustainability Planning method, Fuchs et al. 2021). It further built on the initial engagement workshops (see steps 2-5 of the Sustainability Planning method), as well as the integrated 2023 work plans that the AE-I Kenya team and partners developed and that operationalised the AE-I logical framework while being *responsive* to priorities identified through previous engagements (see Figure 2).



Source: Authors

Figure 2: Innovation assessment context, iterations, and timelines in the Kenya ALLs

***Notes**. The orange circle on the timeline signifies that this was primarily an inclusive and reflexive team-led planning activity, while the five others were interactive and participatory workshops.*

The method

Planning to interview and survey the farms of a sample of farmers in the ALLs, both those who had previously been trained and interacted with the ALL host centres and those who had not, the survey – or rather conversation guide entailing several closed- and many more open-ended questions - included three sections:

- Section 1: Socio-economic farm and household characterisation
- Section 2: Assessment of individual practices
- Section 3: Future aspirations and preferences

The first section focused on the central socioeconomic characteristics of the respondents, alongside the dominant farming system, perceptions of soil quality and their indicators, as well as perceptions of the effects of climate change.

To identify relevant existing innovative on-farm practices, the second section then focused on precise farm and practice characterisations, alongside subjective performance evaluations. After naming and classifying existing 'options' in terms of the existing soil, water, IPM practices on farm, as well as the crop(s) on which the practice is implemented, their evaluation and performance in that specific 'context' was addressed in six sections:

- General characterisation: Implemented since when; Practice known/learned from where
- Materials and mechanisms: Use of locally available materials; Reduction or substitution of synthetic inputs; Interaction with other organic or inorganic treatments; Awareness of the scientific mechanisms behind the practice
- Cost and viability: Financial cost; Labour intensity; Gender roles in labour
- Data collection and methods: Previous data collection about the practice

- Evaluation and context: Effectiveness of the practice; Contextual factors determining effectiveness; Sensitivity to climate change
- Additional observations: Strengths; Challenges; Recommendation of wide application

The last section then asked respondents more specifically about their aspirations in terms of future 'preferences', their main interests in terms of soil, water, and IPM, as well as their potential interest in participating in the trials, and expected benefits from doing so.

Implementation

With the help of the ALL host centres, a total of 80 farms and their households were sampled for the rapid assessment across the two ALLs in Kenya (40 farms per ALL).

Because of the diversity and heterogeneous nature of the study areas, stratified random sampling was applied in each ALL. The sampling approach involved multiple stages to derive a sample that is representative of the biophysical and socioeconomic context and characteristics of the respective ALL populations. Five key factors were considered: (1) whether or not they had previously been trained by the ALL host centres), (2) in which village they lived, (3) their gender, (4) their age, and (5) their land size.

The assessment was then conducted, and data collected in February 2023 using semi-structured questionnaires that entailed both open- and closed-ended questions. Section 1 mostly entailed close-ended questions, while Section 2 combined closed- and open-ended, and Section 3 almost exclusively open-ended questions. Prior to data collection, training and pre-testing were conducted at the ALL host centres. The data was collected by the members of the WP1 team comprising researchers from CIFOR-ICRAF, the Alliance of Bioversity and CIAT, and IITA, as well as staff of the ALL host centres.

Results

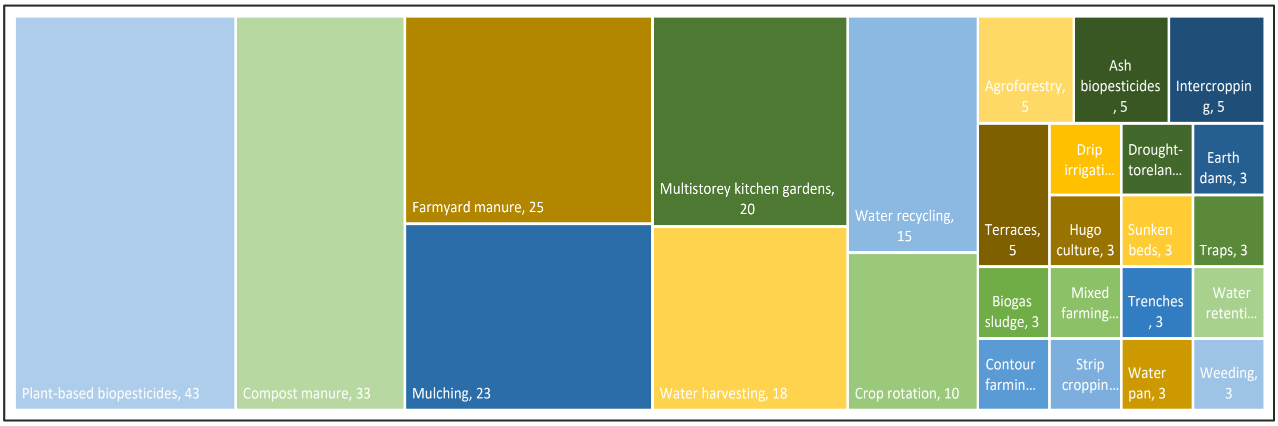
The data analysis report (Kuria et al. 2023) focuses on the core themes targeted by the rapid assessment, namely:

- Existing practices ('options')
- Performance and evaluation ('context')
- Future aspirations ('preferences')

Some core highlights of the assessment include the identification of 27 unique 'options' (see Figure 3), including 26 different practices identified in the Kiambu, and 13 in the Makueni ALL, respectively. In Kiambu, the five most commonly found 'options' were plant-based biopesticides (43% of Kiambu ALL respondents), compost manure (33%), farmyard (animal) manure (25%), mulching (23%), and multistorey kitchen gardens (20%). In Makueni, the most common ones included farmyard (animal) manure (50% of Makueni ALL respondents), terraces (35%), compost manure (28%), plant-based biopesticides (25%), water harvesting (20%), but also agroforestry (18%).

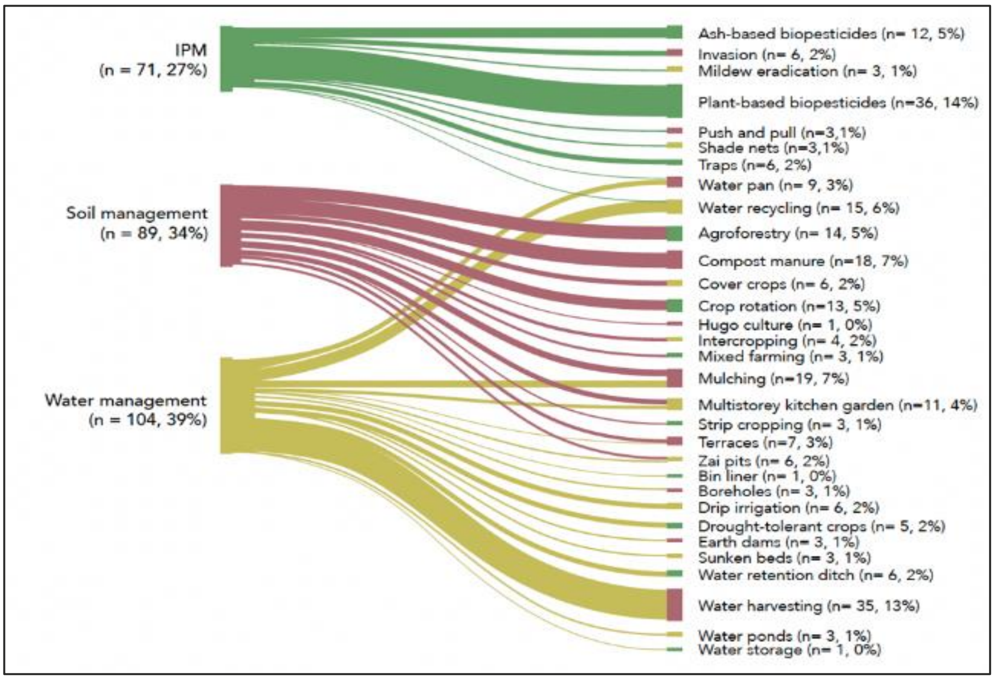
Looking at the preferences expressed in the Kiambu ALL, several interesting results emerged (see Figure 4). Of the practices that were mentioned as 'preferred' independently from whether or not they were currently implemented, the top priorities included: plant-based biopesticide (14% of all responses given by Kiambu ALL respondents), followed by water harvesting (13%), multistorey gardens (12%), compost manure (7%), mulching (7%), water recycling (6%), agroforestry (5%), crop rotation (5%), and ash-based biopesticides (4%). While three-quarters of these practices were listed under a single priority area, about one-quarter were listed under two focus areas. The practices that were mentioned as addressing multiple functions included:

- Soil and IPM: Plant-based biopesticides
- Soil and water: Terraces, mulching, multistorey gardens, zai pits
- Water and IPM: Water recycling, water pans



Source: Fuchs et al. 2023

Figure 3: Existing innovative practices ('options') identified in the two Kenya ALLs.



Source: Kuria et al. 2023

Figure 4. Preferred practices and their multiple functions identified in the Kiambu ALL, Kenya.

(Note: results from Makueni are not presented here but can be found in Kuria et al. 2023)

As indicated, while the 'context' section entailed initial nominal (yes/no) questions, each of these questions entailed a qualitative follow-up question. The data analysis hence focused predominantly on identifying themes and patterns in the qualitative data – which are reported in detail in the data analysis report (Kuria et al. 2023), as well as the summary co-design report (Fuchs et al. 2023).

Why assessing existing innovation practices matters

Agroecology is commonly defined by a set of elements or principles – in the AE-I specifically by the 13 CFS HLPE (2019) principles – rather than a fixed list of on-farm (and off-farm) practices. While arguably not restricted to, more than half of these principles are explicitly applicable to the agroecosystem, and hence to various on-farm system components. These include principles 1-7, namely recycling, input reduction, soil health, animal health, biodiversity, synergy, and economic diversification (see, for instance, Wezel et al. 2020).

Since there is no comprehensive list of what constitutes an agroecological practice in general, and existing lists focusing on Kenya focus on a small number of practices – see, for instance, PELUM's 2021 publication called '12 best agroecological practices for Kenya' (Kibui 2021), it was important to first foster conversation among the team about what might indeed qualify as. The learning led to the identification of a complementary classification of numerous soil, water, and integrated pest management practices that are relevant for the Kenyan context, including both those that can be defined as agroecological and those that might not (see Table 1 in Kuria et al. 2023).

These conversation about existing on-farm practices, their degree of agroecological integration, as well as their classification also involved the staff of ALL host centre, as the farmers interviewed with whom existing practices were jointly identified during farm visits, and contributed to further co-learning.

Beyond looking at the existence of and the extend of engagement in specific practices, and their scenically justified classification, the co-identification of practices alongside the farmers, and learning about farmers' experiences and views led to tremendous additional learning. This learning extended to important aspects such as:

Practices' multiple functionalities - initially by seeing how people classified them across the three focus areas (water, soil, IPM)

Their application 'context' – specifically through questions that were phrased in a way that addressed common agroecological principles, as well as the agroecological benefits targeted, alongside, which allowed the team to 'measure what matters' beyond yield and other common indicators that often provide a limited perspective on their performance (Geck et al. 2023), with an assessment framework that is echoed in the One Million Voices of Agroecology citizen science platform as well (Henry 2023).

Preferences not always equating existing practice – and that what people do is one thing, but what they aspire to might be different.

These and other learnings provided important insights and entry points to developing recommendations or suggestions for what practices might be suitable that considered multiple aspects at the intersection of ecological, historical, cultural and perspectival relevance in view of different people's identities, interests and preferences. Practically, the team composed simple single practice-focused posters for the most common and most preferred practices that were used during the co-design workshops (see Appendix 1: Sample information poster developed from the innovation assessment data in the Kenya ALL). These posters fed the discussion during the highly structured co-design workshops, and contributed to selecting the final practices that were subjected to farmer trials (see more details in Fuchs et al. 2023).

While the team's initial recommendations erred on the side of caution (see details in Fuchs et al. 2023) – and hence emphasized practices that farmers tended to be more familiar with and that aligned more clearly with local and sometimes traditional knowledge – the gap between current 'options' and 'preferences' also allowed glimpses into potential 'opportunity spaces' in view of farmers' contextual suitability and performance evaluations. The rapid innovation assessment will hence help the in the continuation of the farmer trial cycles, and will allow making recommendations about how trials might become even more 'innovative' while remaining rooted in local practice and preferences.

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3.2. Designing ideotypes of agroecological cropping systems in Senegal

Authors:
Raphael Belmin (CIRAD), Banna Mbaye (ISRA) and Bernard Triomphe (CIRAD).

In 2022, Senegal applied an approach to co-design "ideotypes" of agroecological cropping systems (see useful definitions in Box 1 at the end of this section), mobilizing a number of local stakeholders and representatives from Fatick's ALL (the DyTAEL) for a 5-day mission. The overall process workshop was organized in three stages: a preparatory meeting, a three-day workshop and a field day. Here are a few highlights of the corresponding approach, based on the workshop report (Belmin et al 2022).

Box 1: A few useful definitions used in the codesign of ideotypes of agroecological cropping system (Belmin et al. 2022)

- Ideotype *= Theoretical (i.e. 'ideal') cropping system that seems coherent from an agronomic and socio-technical point of view. An ideotype responds to a set of identified constraints, and is based on knowledge of the diversity of cropping systems and farms in a given area. The ideotype is therefore a result in itself, and has intrinsic value (i.e. it can be published) even if it has not yet been tested in the field.*

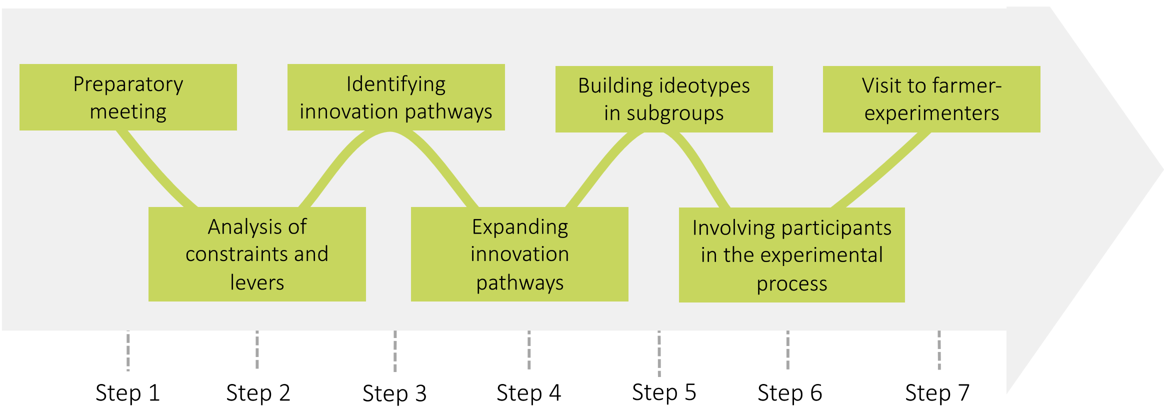
- Ideotyping *= Co-construction of one or more cropping system ideotypes in a multi-stakeholder workshop.*

- Prototype *= Real (and therefore sometimes incomplete) cropping system implemented by researchers (experimentation in semi-controlled conditions) or growers with the aim of testing an ideotype. There can be a variety of prototypes around an ideotype.*

- Prototyping *= In situ or ex situ testing of a range of cropping systems that are as close as possible to one or more ideotypes.To do this, we prefer to select growers' plots that already match certain characteristics of the target ideotypes. The prototypes cannot always 'match' the ideotypes, because growers cannot change their practices quickly and radically in just one year. On the other hand, ideotypes can be used as compasses to guide farmers through step-by-step changes to their production systems. Prototyping produces knowledge that can lead researchers to develop their ideotypes in an iterative approach.*

Overall approach

Figure 5 below summarizes the 7-step approach used in this workshop. Each step is described briefly below.



Source: Authors based on Belmin et al 2022

Figure 5. General approach to constructing ideotypes and embedding farmer-experimenters as used in Senegal.

- ***Step 1 - Holding a preparatory meeting of the project team***

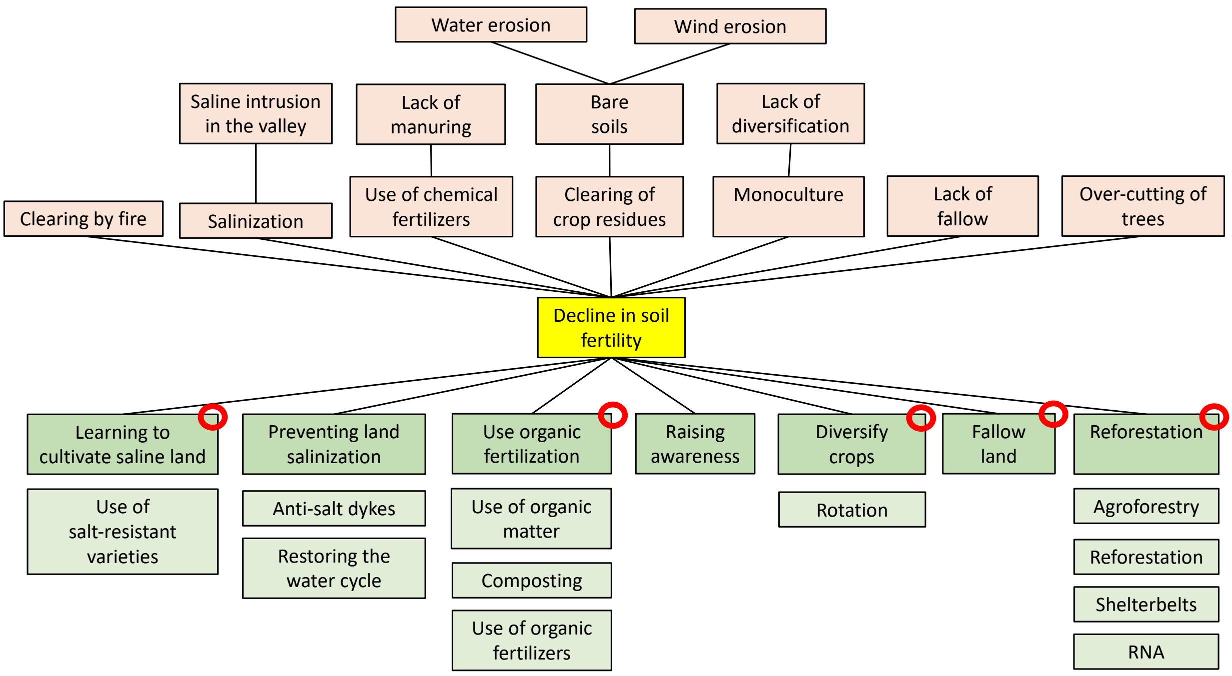
The day before the start of the workshop, the project team met for a briefing session. Goal was to discuss how the workshop would be run, identify the role of each team member and agree on the agenda.

- ***Step 2 - Analysis of constraints and levers for ecological intensification***

The workshop began with group work with two objectives: (1) to identify the underlying causes of the agronomic constraints in the area (pre-identified via a rapid diagnosis in 2021) and (2) to propose technical or organisational levers that could potentially remove these constraints and sub-constraints. The participants were divided into 4 working groups. All the groups worked on all the pre-identified constraints.

- ***Step 3 - Assembling levers into innovation pathways***

The project team constructed summary figures (see Figure 6 below for an example) bringing together, for each constraint, the underlying causes (orange) and the levers (light green) identified by the 4 groups. Innovation pathways (dark green column headings) have been constructed by grouping together several levers based on the same logic for transforming cropping systems. The innovation paths that directly concern farmers were selected (red circles) for the rest of the workshop. In all, 10 and 12 avenues of innovation were identified for market gardening systems and bush fields respectively.



Source: Authors based on Belmin et al 2022

Figure 6. Example of a diagram summarising the results of the group work for the "Decline in soil fertility " constraint, codesign workshop, Ndiop, Senegal, August 2022.

- ***Step 4 – "Expanding" innovation pathways***

On the second day of the workshop, group work enabled a broader exploration of the avenues for innovation identified the previous day. The participants were divided into 4 working groups (3 bush fields + 1 market garden). For each avenue of innovation, they had to (i) put forward at least 4 concrete options, (ii) describe the options selected in detail and (iii) not limit themselves to what is currently being done in the area. The integration of 4 options for all innovation pathways (8 to 12 pathways depending on the group) resulted in the construction of an "innovation boxes" which served as resources the following day, for the ideotype construction stage (see below).

- ***Step 5 - Construction of cropping system ideotypes***

On the third day, group work enabled to construct ideotypes. Building ideotypes involves selecting, assembling and matching technical and organizational levers from innovation boxes. Participants were asked to explain the relationships between each of the levers making up the ideotype.

- ***Step 6 & 7 - Selecting and visiting farmers-experimenter***

At the end of the workshop, the project team asked participants to indicate their interest in trying out 1 of the 4 ideotypes that had been constructed. The following day, the project team visited several potential farmer-experimenters to assess the conditions and feasibility of such experiments.

Conclusions and perspectives

The ideotypes thus created have intrinsic value because they are the result of a collective thought experiment. Thanks to an appropriate methodological framework, the participants were able to construct - at least in their minds - radically new forms of agriculture for their commune, based solely on their own knowledge. But if these ideotypes are to become resources for effective transformation, they need to be appropriated and put to good use by the development players. They can serve as a compass to guide technical support for agricultural projects or policies. The activity was also intended to provide input for the Fatick DyTAEL by defining the territorial changes needed to facilitate the adoption of the cropping system ideotypes. However, the ideotyping process took longer than expected, and it will be the task of a future workshop to tackle the regional scale.

The ideotyping approach presented above was carried out in 2022 in the Fatick department, as part of a project to co-design cropping systems. In 2023, work on other projects enabled the ideotyping approach to be tested at production system (Belmin 2023) and food system (Belmin 2024) scales. In 2024, new ideotyping work will be undertaken with the Fatick DyTAEL, to imagine how the area could effectively combat land salinization. The ideotyping will be followed by backcasting work (Robinson et al 2011) to consider the concrete conditions for change. The problem of salinization of agricultural land has been identified by members of the DyTAEL technical committee as a priority.

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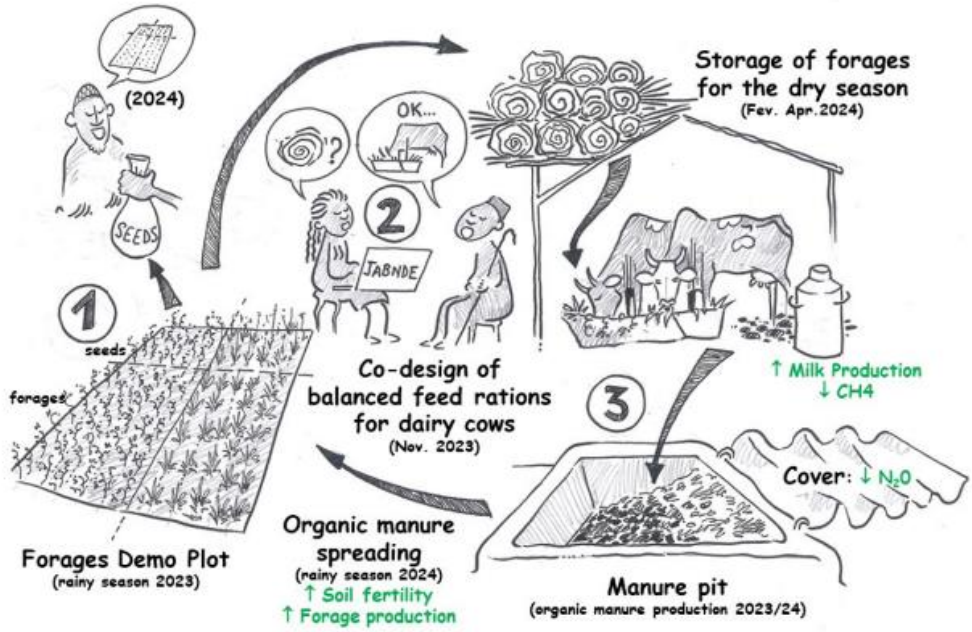
3.3. Loops and cascade approach used for co-designing and experimenting more agroecological dairy farming systems in Burkina Faso

Authors:
Ouattara S. D. [(1)], Sib O. [(1)], Sanogo S. [(2)], Sodré E. [(3)], and E. Vall [(1)]
(1) Cirad, (2) Cirdes, (3) INERA

In agro-sylvo-pastoral systems of Burkina Faso, and in particular in farming systems oriented in milk production, biodiversification of the fodder system, crop-livestock interactions and co-products recycling are key factors of agroecology (Sib et *al.*, 2017, Vall et *al*., 2021, Sodre et al., 2022, Vall et *al.*, 2023).

These principles refer to agricultural practices that concern the different components of the farm (cropping system, livestock systems, co-products management system) and which follow one another over time (production of crop biomass => management strategy for this biomass => feeding animals with this biomass and use it by farmers => recycling of livestock and crop co-products into manure => application of manure to fields, etc.). It is therefore a succession of cascading actions that loop over a year.

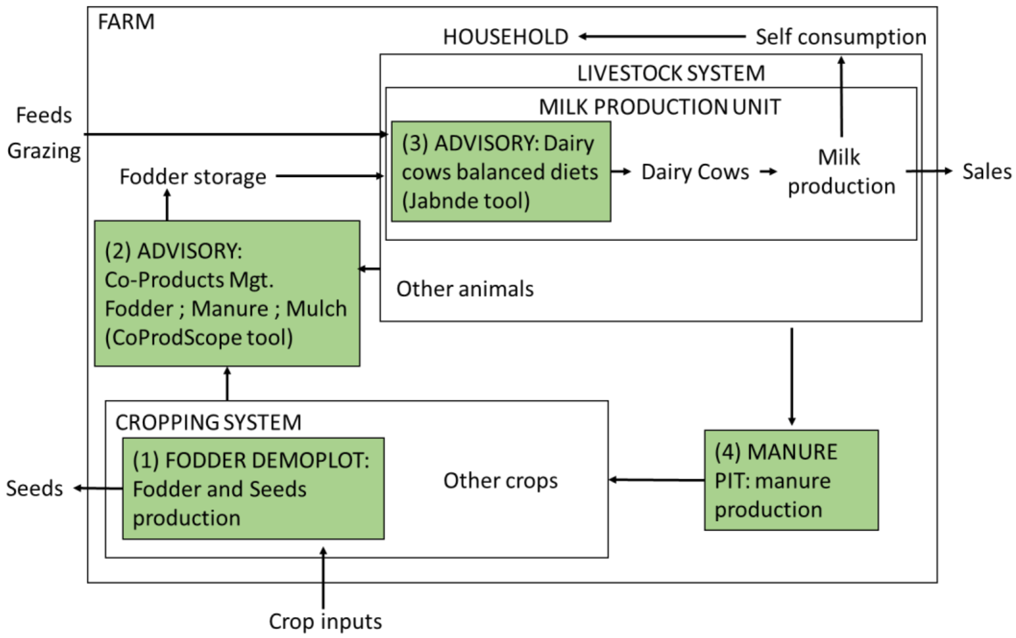
However, these practices can be improved to increase biodiversification, interactions and recycling and in particular to better valorize farm co-products (Zoungrana et *al.*, 2023). It' is why we have proposed to test some of these practices in an experimental system on farms involving loops and cascades of actions aimed at intensifying production by agroecological means, imitating what actually happens on a farm. The results of one action feed into the next action as shown in Figure 7, following the principle of "step by step" co-design and experimenting changes (in which the novelty is built at the same time as we learn to control it; Meynard et *al.*, 2023).



Source: Authors

Figure 7. Simplified representation of the loops and cascade approach used with dairy farmers in Burkina Fao

At the beginning, during a co-design workshop an "agroecological package" was proposed to the stakeholders of the Agroecological Living Landscape (ALL) who amended it and suggested adjustments to meet their needs and constraints. This package, validated by the actors, is based on three components: 1) a fodder demo-plot (~0,5 ha of Mucuna, Cowpea, Maize and Sorghum); 2) a covered cemented manure pit (~9 m^3); 3) the use of two tools: CoProdScope (Zoungrana et al., 2023) for co-designing with the farmer smart strategies of co-products management, and *Jabnde* to co-design balanced diets for dairy cows based on fodder and other feed resources available (rangeland, local feeds). These three components are engaged into a cascading and looping process represented in Figure 8. Then, the attendants gave feedback on the process to the volunteer dairy farmers for experimenting with the Ae package. Local workshops were organized with the volunteers committed to participate to a training session on the looping and cascading approach and management of innovations (demo-plot, manure pit).



Source: Authors

Figure 8. Theoretical representation of the experimentation of the agroecological package in a farm following the loops and cascade approach as used in Burkina Faso

In this looping and cascading participatory experimentation, we work at the farm scale and we consider the household and its resources, the cropping system, the livestock system, and the co-products recycling system. However, we focus on specific elements: 1) the fodder demo-plot; 2) the advisory on co-product management; 3) the advisory on dairy cow feed management; 3) and the production of organic manure. Data is collected on the entire farm by a survey to fully understand its general functioning. However, detailed data collection is made: 1) firstly on fodder demo-plots and manure pits during monthly monitoring, 2) and secondly during the advisory activity on the management of crop and livestock co-products in fodder and manure (with CoProdScope tool) and during the advisory activity on the management of cow diets (with Jabnde tool). Farm survey, on-farm experimentation monitoring, and elaborating advisory take a lot of time (i.e. ~15 days/farm/year 1 day per survey, 12 days for monitoring, 2 days for advisory). That's why we cannot measure everything in this type of looping experiment.

In 2023, this AE package was implemented with around 55 volunteers by a junior researcher assisted by a technician. Demo-plots were set up by almost all the volunteers (a few got together to set up a collective demo-plot). A part of the fodder seeds produced on the demo-plot will be shared with two new volunteers in 2024 (theoretically, one mother DP in year 1 will give three babies DP in year 2, and then 3^N babies in year N. We know that such speed of progress will never be achieved. But this seed sharing action will make it possible to concretely put into action principle No. 8 of agroecology (Co-creation of knowledge). It will allow to assess if disseminating changes can be partly achieved without relying on the market). A manure pit was set up and started with approximately 30 volunteers. Co-product management advice was carried out with 10 volunteer farmers (there wasn't enough time to do more). Cow feeding management advice will be carried out with 34 volunteers. These figures show that it is difficult to implement all the package for everyone as this type of on-farm experimentation is time-consuming. In this cascading and looping on-farm experiment approach there is also a risk of volunteer's losses online. Farmers who fail at step N have difficulty continuing work at step N+1. Such losses, break the expected looping effect of novelties, which could convince the farmers to change their current practices. This is at the end, a risk for the research which may end up with a small sample of farmers having successfully carried out the experiment from start to finish.

However, despite these risks and constraints, this loops and cascade approach of on-farm experimentations allows to learn from the successes (outcomes) but also from failures (causes of failures). This approach allows to understand why the principles of agroecology are not always so easily implemented by farmers in reality. It's allows volunteers to adjust the protocol to their situation. This flexibility should make it possible to obtain results more adapted to the needs of farmers, which can then be more easily adopted by the farmer community. It therefore allows to better understand the levers and barriers that act on the transformation of agricultural systems.

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3.4. Integrating Digital Tools for Agroecology in Zimbabwe

Authors:
Vimbayi Chimonyo, Dorcas Matangi and Telma Sibanda,
CIMMYT-Zimbabwe

The agroecology initiative in Zimbabwe integrates digital tools for monitoring, analyzing, and visualizing both qualitative and quantitative data derived from trials and engagements. Utilizing R statistics software and a variety of packages, the team processes datasets gathered through surveys and monitoring activities conducted with the KoBo Toolbox. The KoBo Toolbox serves as a practical digital tool for data collection, installed on mobile devices to facilitate offline data collection in areas with connectivity challenges. The team has designed forms in KoboCollect for diverse purposes, such as recording management aspects within demonstration plots like planting date, frequency of weeding and fertilize application; collecting data on pests and diseases incident and severity; tracking harvesting activities; and obtaining stakeholder perceptions on technologies through rating and ranking exercises.

R contributes to precision and accuracy in data collection through the development of QR codes, ensuring precise capture, especially in cases of repeated measures. Each demo plot holder and farmer with assessed technology receives a unique QR code, simplifying host identification during data collection. QR codes are also assigned to signages for different treatments within the trials, enhancing data reliability (Illustration 3).

Illustration 3. Signage with QR Code also showing Farmer name and technology being tested in Zimbabwe

Simultaneously, R aids in creating visuals like graphs and charts, facilitating a clear presentation of research outcomes. R's versatility extends to developing applications like the Shiny app, promoting citizen science engagement. Playing a pivotal role in the initiative, R offers a multifaceted approach to data analysis, visualization, and dashboard creation, ensuring comprehensive insights into agroecology within Zimbabwe (Figure 9). Its statistical rigor in data analysis, coupled with customizable visualizations, enhances clarity for diverse audiences, while interactive dashboards foster real-time engagement with stakeholders, making complex data accessible and promoting inclusive communication with policymakers, funders, and the general public.

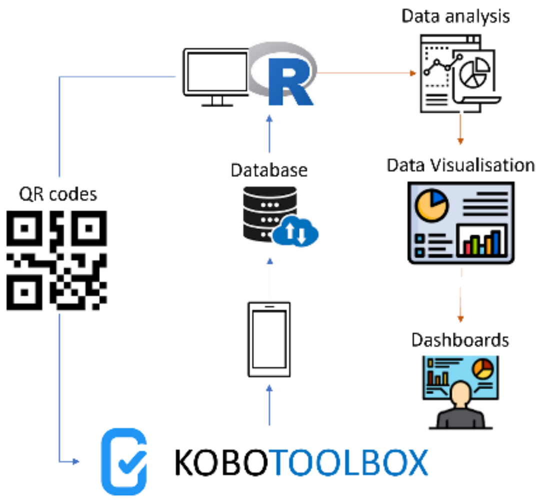

Figure 9. Data management workflow used by the Zimbabwe country team of the AEI

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4. Key results obtained in 2023

4.1. Key Results of inventory and assessment of existing practices

The following section illustrates approaches and some results obtained by two country teams using very different approaches, Kenya and Senegal. Other countries proceeded differently, or included this identification as part of the codesign workshops they held.

4.1.1. Kenya

The methodological approach used in Kenya was already highlighted in section 3.1, and will only be briefly summarized here.

In preparation of the planned co-design workshops, and building on the Sustainability Planning workshops, and the integrated 2023 work planning (details reported in the vision-to-action country report), the Kenya WP1 team with support from the ALL host centres engaged three days of fieldwork in each ALL to assess existing innovative practices across the jointly identified priority focus areas – namely soil management, water management, and integrated pest management. These three priority areas had already been identified during the identification of the respective 'mobilising narratives', and confirmed during subsequent engagements.

To identify relevant existing innovative practices, the team developed a **survey format** that includes precise farm and practice characterisations, alongside subjective evaluations, and future aspirations were assessed. Specifically, survey entailed three sections to investigate the core priorities for rapid assessment, including:

1) Existing practices ('options')
2) Performance and evaluation ('context')
3) Future aspirations ('preferences')

The total sample size was 80 farms across both ALLs, with 40 farms being analysed per ALL. Because of the diversity and heterogeneous nature of the study areas, **stratified random sampling** was applied in order to arrive at a sample that is representative of the biophysical and socioeconomic context and characteristics of the entire population. Stratified random sampling was carried out with the help of the ALL host centres using a multi-stage approach using the following five key factors: program and non-program farmers (referring to whether or not they had previously been trained by the ALL host centres), geography (villages), gender, age, and land size.

- In the Kiambu ALL, 27 farmers who had previously been trained by Community Sustainable Agriculture and Healthy Environment (CSHEP) and 13 non-CSHEP farmers were interviewed. In the Makueni ALL, 10 non-DNRC (Drylands Natural Resources Centre) farmers were selected, whereas 30 were affiliated with DNRC.

Furthermore, the practices being implemented in the host organizations for the respective ALLs, namely, CSHEP in the Kiambu ALL and DNRC in the Makueni ALL, were evaluated.

For an illustration of the results obtained through the survey, see Figure 3 and Figure 4 section 3.1. See also Kenya codesign reports and specific outputs related to this activity.

4.1.2. Senegal

The approach used in Senegal is intimately linked to the-foresight exercise conducted with DYTAEL members in Fatick (see vision-to-action report).

A literature review was the main tool used for identifying innovations. It mostly yielded innovations promoted by projects, local authorities through projects and local NGOs (Table 2).

Table 2. List of agroecological innovations identified in the department of Fatick, Senegal

Specific technology	**Domain (e.g. soil fertility, IPM, mechanization, systemic)**	**Origin**
Composting	Soil fertility management	FAIR, ENDA PRONAT, ANCAR
Triple bagging for harvesting	Seed conservation	AGRISUD
ZAï	Soil fertility management	Town halls of Ndiob, ENDA PRONAT, ANCAR
Food processing unit	Transformation	Women transformers of Ndiob
Environmental education and awareness	Education	Ndiob town halls, World Vision
Tolou Kër	Biodiversity	Ndiob town halls; Great Green Wall reforestation agency
Inoculation of symbiotic microorganisms in the field	Soil fertility management	IRD, ISRA, ANCAR, ECLOSIO, Ndiob town councils
Crop association	Biodiversity	FAIR SAHEL, ENDA PRONAT, AGRISUD
Saving the mangroves	Reforestation	CAREM, APIL, NEBEDAY
Local agreement on the management of natural resources		Local authorities, ENDA PRONAT, Water and forestry
Assisted natural regeneration	Reforestation	ENDA PRONAT, World vision, UICN, IED Afrique, ISRA (CNRF), ANCAR
Intercommunal network	Networking	Municipalities in Senegal
Multi-stakeholder coalition	Networking	ENDA PRONAT, ANCAR, AGRISUD, CAREM, Caritas
Champ Ecole Paysan	Sharing knowledge	ENDA PRONAT
Soap production unit	Transformation	Ndiob town halls, associations of French-speaking mayors, SOS faim, RECAP
Availability of biofertilisers	Grant	Senegal States
Supporting the development of renewable energies		Departmental Council, NGO ID
Seed coating	Seed conservation	AGRISUD

Group work during a follow-up workshop with DyTAEL members (the Senegal ALL) used a 'serious game' aimed at producing innovation maps, which are technical sheets focusing on AE innovations, (roughly equivalent to the posters developed in Kenya, see Appendix 1 for an example, but using a very different methodology and emphasizing the territorial dimensions of the innovation). In addition to the maps, a territorial mapping by actors and the scenarios designed as part of the territorialisation process (see Vision to Action report) made it possible to assess the resilience of innovations according to the different scenarios for the futures in the Fatick department as well as their applicability (more details can be found in the Senegal report).

Given the number of players who have joined DYTAEL, a new literature review will be carried out in 2024 to update the catalogue of innovations. A field mission will then be organised to conduct close interviews with the project leaders in order to understand the operating logic and added value of the innovations. These close-up interviews will also take place in the various localities in the area to identify initiatives led by innovative farmers, livestock breeders or fishermen. The aim will be to identify the type of stakeholder behind the innovation, the innovation itself and the reasons (economic, social, environmental, etc.) that explain the (potential) appropriation of the innovation and the difficulties encountered. The results will then be transcribed in the form of an innovation map and a workshop will be organised to validate and assess the innovations. During this workshop, the so-called "operational" innovations will also be identified with the participants, and then in a second phase, a reflection on the strategies and conditions for scaling up will be undertaken with the stakeholders in the process.

See Senegal report and specific outputs related to this activity.

4.2. Overall number of technologies and types of design

Country teams selected a number of technologies and supported farmers in establishing experiments of various levels of complexity, as illustrated by Table 3.

Table 3: Selected outputs of the codesign process followed in 7 countries of the AEI

Country ➔	*Zimbabwe (*)*	*Kenya*	*Tunisia (+)*	*Burkina*	*Senegal*	*Peru*	*Laos*
Approx. number of AE technologies being experimented with	*6*	*5*	*13*	*3*	*5*	*3*	*4*
Number of on-farm experiments installed in 2023	*20*	*63 on farms + 6 on host centres*	*40*	*55*	*17*	*13*	*30*
Types of on-farm experiments 2023 (1)	*Demos / Composite / Statistical*	*Simple / Composite*	*Simple / Composite-statistical*	*Simple*	*Simple / Statistical / System?*	*Composite*	*Demos / Simple*
Importance of training of farmers and others as part of the codesign process	*high*	*high*	*high*	*high*	*high*	*high*	*high*

Notes:
(*) Experiments installed in Nov-2022 and continued with modification for a second cycle in Nov-2023.
(+) Experiments installed in late 2022, greatly affected by a generalized drought. Re-established or continued with modification for a second cycle in late 2023.
*(1) **Types**: **Demos** (no side-by-side control, just applying a technology) **Simple** (1 Check vs 1 treatment); **Composite** (several treatments), **Statistical** (with design such as RCBD or other), **System** (comparing "packages" of innovations of different nature or different alternative cropping systems)*

From Table 3, we can see that**:**

- There is a fairly variable number of technologies and experiments being experimented with in each country, with some having relatively few (case of Laos, probably because they started the codesign process late and focused on farmers' demands, factors and scales beyond the plot level, case of Peru dealing with a perennial crop not easily experimented with) and some relatively large numbers (case of Tunisia)
- There was usually a mix of types of experiments established in a given country and across countries, with a predominance of fairly simple trials (1 treatment vs 1 check) established over a number of farms / plots. More composite or even systemic trials and trials with statistical design are not uncommon however.
- Training of farmers (and other stakeholders, such as technicians. Researchers were not explicitly mentioned, but most certainly many of them also got trained!) held a significant place and role as an integral and necessary part of the codesign process. This aligns well with one of the key engagement principles of ALL establishment identified in 2023, which is to build the capacity of ALL stakeholders as a step towards future sustainability and empowerment. It was however not possible at this stage to analyze in-depth the content of the training, and particularly how much of it was pure technical training related to the innovations themselves (e.g. knowing how to prepare compost or a biopesticide), or also tackled the codesign and experimentation process itself, with of view of building the corresponding capacities.

4.3. Types of technologies

Table 4 below presents selected key features of the technologies being experimented with in the 7 countries, as well as the overall corresponding experimental set-ups. For their part, illustrations 4 to 11 below the table provide a concrete sense for how some of the corresponding activities were implemented "in the field".

From Table 4, we can see that:

- Across the 7 countries, there is a large array of technologies relating to various technical domains, as one would expect from a compilation over such a diverse set of agroclimatic and socioeconomic contexts across 7 countries. Note that some technologies are not production practices but rather tools (case of Burkina which is using an advisory tool at the whole farm level) or infrastructure / equipment (case of Laos with sola pumps or specially designed ponds for rice-fish farming).
- Some countries and stakeholder alliances have selected large numbers of technologies on their own to respond to diverse local contexts: case of Tunisia (with its six "sub-ALLs" being located in different agroecological regions).
- For the most part however, countries have tended to select fairly simple technologies (practices) linked to recycling or input reduction (e.g. compost, farmyard manure, use of bioinputs). Less frequently dealt with are more complex "systemic" ones aiming at crop-livestock integration or at fostering various types of synergies (case of Zimbabwe, Burkina, Senegal, Tunisia or Laos). A good example is the formulation of sociotechnical AE packages around key technical innovations in Tunisia. This is a great way (among others) of tackling the systemic nature of what innovating and AE transition actually entail, which goes way beyond coming up with a technology in isolation of the cropping systems and the "enabling" environment.
- A majority of technologies tested within the framework of the Initiative have strong links to previous research or R&D conducted in the various countries (often times by some of the very same people and partners involved in the AEI). There are also technologies coming from empirical technical knowledge of ALL stakeholders (case of Peru). Interestingly, there are only a few "farmer innovations". And obviously, many technologies were codesigned, which allows to combine to varying degrees research, technical and farmers contributions (choice of technologies, of test crop, design of the treatment or the M&E protocol, etc.).
- Experimental set-ups vary across country: most favoured were fairly simple comparisons (1 innovation or treatment vs. 1 control = farmer practice), repeated multiple times within and across localities. Still, in several cases, experiments with a handful of treatments were established. In some cases, researcher-controlled (and relatively more complex) statistical trials were established (case of Senegal, Tunisia for example), which will help provide statistical robustness and validity to the results, something researchers are very keen about, but constitutes just one way of validating and potentially extrapolating results: others being farmers' perceptions during field days.

Note: For most countries, actual end-of-experiment results have not yet been obtained or reported for the 2023 cycle (with the notable exception of Zimbabwe, see section 4.5.1below).

Table 4: Key features of technologies and experiments that were considered in the codesign process in the 7 countries of the AEI

COUNTRY	Specific technology	Domain (1)	Key underlying AE principle(s) (2)	Origin of technology (3)	Number of farmers / Experimental design / protocol
Zimbabwe Illustration 4	Push-Pull (PP) Years 2022/23 and 2023/24	IPM	Input reduction, biodiversity, soil health, animal health	Research	4 sites: 2 in Mbire and 2 in Murehwa , 20 farmers in total. Between 2 (2022/23) to 5 (2023/24) **treatments** (plus control), no Reps • **Treatment PP**: Sorghum-cowpea in Mbire and Maize-bean in Murehwa under strip-cropping,. • **Treatment CA with biomass mulch**: Sorghum or Maize with mulch under no-tillage. • **Treatment Biochar: tbc** • **Treatments CA w/live mulch**: Sorghum or Maize in Murehwa NT intercropped with velvet bean under strip-cropping (Live Mulch). • **Treatment Traditional bioinsecticides**: Maize or Sorghum landraces under conventional tillage with bioinsecticide **Control** = Sorghum or maize under conventional tillage (with *Brachiaria* as a border crop tbc)
	Conservation Agriculture (CA) (Biomass mulch) Years 2022/23 and 2023/24	Systemic (water management, productivity)	Recycling, soil health, synergies	Codesign	
	Biochar Year 2023/24	Soil fertility/amendments	Input reduction, soil health	Research	
	CA (Live mulch) Year 2023/24	Water management, productivity, livestock production	Synergies, animal health	Codesign	
	Traditional bioinsecticides as alternatives to Push-Pull and CA (Year 2023/24)	IPM, productivity	Social values and diets	Local practice, Codesign	
	Hay making, Feed formulation, mechanization	Livestock production, mechanization	Animal feed / health, economic diversity	Farmer innovation	Not experiments per se, but processing technologies or implements being "demonstrated" as learning experience and to increase awareness among farmers about their utility. **Seed fairs** are a key arena for exchanges among farmers on such technologies and about experimental treatments in general
Kenya Illustration 5	Compost	Soil fertility	Recycling Input reduction	Codesign	10 farmers in Kiambu, 2 treatments: with compost vs. control, test crop: Spinach
	Mulching	Water management	Soil Health	Codesign	10 farmers in Kiambu, 2 treatments: with mulch vs. w/o mulch, Test crop: Spinach
	Plant-based biopesticides	Integrated pest management	Input reduction Soil Health	Codesign	20 farmers (10 each in Kiambu and Makueni), 2 treatments: Biopesticide (neem or chili-based) vs. farmer control (chemical control and/or other biopesticides), Test crop: Cabbage (Kiambu), Maize & beans (Makueni)
	Animal manure (farmyard)	Soil management	Recycling Soil health	Codesign	10 farmers in Makueni, 2 treatments: pure manure vs. combination of manure & fertilizer. Test crops: maize and beans
	Water terraces (farm ponds)	Water management	Soil Health (?)	Codesign	10 farmers in Makueni. **2 treatments**: terraces with various crops on the edges vs. with bare edges. Test crops: maize and beans
Tunisia Illustration 6	**Forage mixture**	seed production Soil fertility, livestock feed	Animal Health, biodiversity	Prior international R&D	4 sites: Rhahla, Chouarnia, Sers, Elle Per site: 5 farmers, each w/ 1 plot of Forage mixture *Vetch-Oat-Triticale (VOT)* + 1-3 monocrops (V, O, T)
	Biofertilization w/ Sulla	Soil fertility, livestock feed, beekeeping	Biodiversity, economic diversification, animal health	Prior international R&D	**3 sites**: Kesra, Seres, Rhahla **Per site**: 3-6 demo plots, in Kesra only: **Controlled experiment** with 3 treatments and 3 reps CBRD -**T1:** Non-inoculated sulla plants -**T2:** Inoculated sulla plants -**T3**: Control (natural fallow)

COUNTRY	Specific technology	Domain (1)	Key underlying AE principle(s) (2)	Origin of technology (3)	Number of farmers / Experimental design / protocol
	Valorization of olive by-products	Recycling of by-products	Recycling, input reduction	National research	2 sites: Hamam Biadha, Elles Per site: 1-2 demo plots with 4 treatments applied in band **-T1:** Control **-T2:** Compost or Soil amendment **-T3:** Biochar **-T4:** Compost + Biochar (50%/50%) or intercropping 30 kg of Fertilizer applied at foot of the olive trees (tbc: 3 reps part of the protocol for these demo plots)
	Composting units	bioinputs	Recycling, input reduction	National research + local practice	2 sites: Hamam Biadha, Sers Per site: 1-2 demo plots with 3 treatments arranged in windrows • *Windrows 1*: OM 60%, OP 30%, PW 10% • *Windrows 2*: CM 60%, OP 30%, PW 10% • *Windrows 3*: OM 30%, CM 30%, OP 30%, PW 10% *Ovine manure = OM* *Olive pomace = OP* *Pruning wood = PW* *Cattle manure = CM*
Burkina Faso *Illustration 7*	production of forage of several species (cowpeas, mucuna, maize, sorghum)	Animal feeding Soil fertility (pulses)	Biodiversity, animal health, synergies, recycling, participation	Research	55 forage demo-plots installed throughout the outskirts of Bobo-Dioulasso *Note: sharing of seed among farmers is being promoted*
	Covered manure pits	Soil fertility	Recycling, efficiency	Research	43 pits by end of 2023
	Advisory tool "CoProdScopfore" for management of farm co-products to produce forages, manure and mulch	Animal feeding Soil fertility	Recycling, synergies, efficiency	Research	10 dairy farmers (end of 2023)
	Advisory tool "Jabnde" for the diets of the dairy cows using pasture + forages + feeds	Animal feeding Milk production	Efficiency	Research	34 dairy farmers (end of 2023)
Senegal *Illustration 8* *Illustration 9*	Multiple alternatives responding to local farmers' needs and challenges	(systemic)	Biodiversity, soil health, synergies,	Research / Codesign	3 controlled "central plots" with multiple treatments (from 2021)
	Conservation Agriculture	Soil fertility	Soil health, synergies	Codesign	"simple" multi-site trials with farmers (from 2022) Treatments: Peanut with millet residue or without residue; peanut with Guiera senegalensis leaves (selected from the central plot)
	Legume intercropping	Soil fertility	Biodiversity, synergies	Codesign	multisite "simple" farmer trials (2022 onward) **Treatments Ndiop:** groundnuts w/ different cowpeas (niebe) varieties in three spatial arrangements (strips, mixtures, mixed), millet residues effects on peanuts. **Treatments Diouroup & Tataguine**:.peanuts-beans or millet-beans w/ several fertilization methods
Peru *Illustration 10*	Frequency of use of mixture of bioinputs produced by FO to control moniliasis in cacao	IPM / Bioinputs	Recycling, input reduction,	Technical knowledge	4 farmers from one FO, 5 treatments (various frequencies of application of the FO's recommendations), RCBD with 2 reps / farmers. <u>Test crop</u>: Cacao,
	Comparing various types of inputs to control moniliasis in cacao	IPM / Bioinputs	Input reduction	Technical knowledge + farmer experience	4 farmers from one FO, 5 treatments (type of inputs used), RCBD with 2 reps / farmers, <u>Test crop</u>: Cacao

COUNTRY	Specific technology	Domain (1)	Key underlying AE principle(s) (2)	Origin of technology (3)	Number of farmers / Experimental design / protocol
	Frequency of use of mixture of bioinputs produced by FO to improve cocoa yield	IPM / bioinputs	Recycling, Input reduction	Technical knowledge + farmer experience	5 farmers from one FO, 5 treatments (various frequencies of application of the FO's recommendations), RCBD with 2 reps / farmers, Test crop: Cacao
Laos *Illustration 11*	Solar pumping of groundwater for farming, domestic and school consumption	Renewable energy, water management, dry season crops / productivity	Input reduction, economic diversification	Codesign	*Not an actual experiment*, but solar pump specifications were codesigned and provided to private providers + survey conducted, implementation underway
	Rice-fish system	Integration crop-animal, resource efficiency, production, nutrition, soil fertility	Economic diversity, input reduction, biodiversity, diets	Co-design	*Experiments designed, composite – statistical design, implementation underway.*
	Organic Red rice growing	Productivity, soil health	Economic diversity, input reduction, diets	Co-design	30 demo plots (10.16 ha each) of red rice managed with organic manure and no chemical inputs. No design per se at this initial stage.
	(Wetlands management)	*Natural resource management*	*(Participation)*	*Not applicable*	*No experiment yet. Diagnosis survey: drone mapping + truth-grounding of wetlands, landscape/habitat connectivity; Monitoring of water abstraction underway*

Notes

*(1) **Domain**: Soil fertility, Integrated Pest Management, bioinputs, water management, mechanization, biodiversity, "systemic"; integration crop-livestock, etc.*

*(2) **Agroecology principles** (whether HLPE or FAO): Recycling / Input reduction/ Soil health / Animal health / Biodiversity / Economic Diversification / Synergies / Efficiency (NB: Co-creation of Knowledge and participation are AE principles applied systematically as part of the codesign process and hence are not mentioned in the table)*

*(3) **Origin of the technology: Research** = previous research; **R&D** Previous Research and Development as developed in previous or related R&D projects, **Technical Knowledge** = (Empirical) Technical Knowledge owned and recommended or used by local stakeholders such as farmers organizations or farmers; **Local innovation** = Innovation originating from the farmers themselves, **Codesign** = mostly result of codesign process itself in its various phases*

Innovation co-design workshop in Murehwa

Signage with QR Code also showing farmer name and technology being experimented with

Farmers pegging and planting demo plot in Mbire, November 2023

Farmers showcasing diverse seed varieties during the Mbire Seed Fair

Illustration 4: Various aspects of the codesign process implemented in Zimbabwe

 Learning about terraces during technical training, Makueni, August 2023. © B. Adoyo,	 Learning about mulching during technical training in Kiambu ALL, August 2023. © B. Adoyo.
 Farmer monitoring the growth of her intercropped beans in her experiment, Makueni © H. Korir	 Spinach harvest in a farmer mulching test plot, Kiambu, December 2023. © H. Korir

Illustration 5: Various aspects of the codesign process implemented in Kenya

Co-design workshop held in June 2023 with different national and ALL stakeholders

Researchers from the Olive institute discussing with farmer the co-experiment / protocol for growing forages between olive trees

Illustration 6: Various aspects of the codesign of experiments implemented in Tunisia

On-going construction of manure pit in Dafinso

Training session on practices for demo-plots with dairy farmers from a Milk collecting center

Using Coprodscope advisory tool with a dairy farmer from a Milk Collecting Center

During the co-design workshop for the Agroecology innovation package in May 2023

Photos: © D. Ouattara

Illustration 7. Various aspects of the codesign process implemented in Burkina Faso

Photos: © R. Belmin

Illustration 8: Group work during the workshop on codesign of ideotypes of agroecological cropping systems, Ndiop, held in Senegal, August 2022

Visit to an experimental plot in Koussanar, testing cropping association / organic fertilization as part of the Fair Sahel Project.

An experimental plot combining groundnuts and cowpeas

Photos: © R. Belmin

Illustration 9: Codesigned experimental work on agroecology implemented in Senegal

Identifying challenges and common interests during a visit to a cacao plot, September 2023

A farmer applying biol in his cacao experimental plot, November 2023,

Photos: © J. Sanchez

Illustration 10: Various aspects of the codesign process implemented in Peru

Field visit to assess potential site for rice-fish culture

Co-design workshop on infrastructure for rice-fish culture

Illustration 11: Various aspects of the codesign process implemented in Laos

4.4. Approaches to monitoring and evaluation

Protocols for monitoring and assessment vary across countries but usually include a number of fairly conventional technical variables (such as yields, soil sampling, plant samples, pest incidence, cost/benefit analysis) as well as more empirical ones that farmers can more easily relate to and follow (plant vigour, animal appearance). Field days have been conducted or are being planned to assess innovation progress and performance and share perceptions and observations among multiple stakeholders.

Below is selected information corresponding to the M&E as agreed or implemented in Zimbabwe, Kenya, Tunisia, and Peru, as a way to illustrate the diversity. As could be expected, many specificities have to do with the type of experiment, and the kind of stakeholder set-up and participation in each ALL. Previous experience of AEI staff and partners with such issues is also a differentiating factor among countries.

4.4.1. Zimbabwe

Note: Additional details about the digital tools used for monitoring are provided in section 3.4.

Participatory monitoring

The objective was to solicit farmers' views, obtain a rating and ranking exercise and assess the initial uptake or adoption of the tested technologies for the 2022/23 farming season. To this end, a participatory approach to understanding farmer perceptions and choices was used. The rating and ranking exercise was embedded in field day activities in both districts. A field tour was conducted first, with the host farmer explaining the activities carried out in each plot. The objective of the tour exercise was to give other farmers/actors a concise understanding of the practices, activities, challenges, and benefits encountered in each practice. Farmers were divided into four groups to evaluate the performance plot: young males/females (18 years – 35 years) and old males/females (36 years and above). Discussions were done with enumerators using a designed tool in KoboCollect (see a. Farmers ranked and rated the three implemented technologies against the following indicators: increase in yield, increase in biomass yield, inputs use efficiency, labour efficiency, crop pests and diseases management, coping with climate change, and soil conservation. To support the focus group discussion, we conducted supplementary interviews with local leaders, government stakeholders and farmer groups to solicit the farmers' perceptions of the implemented technologies.

Pest and Disease Monitoring

The objective of this monitoring was to assess the effectiveness of push-pull (PP) compared to other treatments (Conservation Agriculture CA and Conventional Practice CP). To this end, assessments were done during the vegetative and flowering stages for armoured cricket, maize stalk borer, fall armyworm for cereals and locusts, beetles, aphids, and bean stem maggot for legumes. Treatments were assessed for severity and prevalence scores. Five points per treatment were sampled (W method); and ten plants were sampled for each point. facilitators collected the data using KoBo collect in collaboration with demo plot holders. Farmers were also asked to rank and rate the implemented technologies against the following indicators: increase in yield, increase in biomass yield, inputs use efficiency, labour efficiency, crop pests and diseases management, coping with climate change, and soil conservation. Comprehensive data on crop management practices, rainfall data and grain and yield data are collected on all demo sites. Grain and biomass yield is compared across all three treatments to assess the performance of the treatments.

For the 2023/24 farming season, the assessments are again being done to assess the effectiveness of push-pull compared to CA and CP and also to compare the push-pull method to identified traditional pest control measures.

4.4.2. Kenya

The M&E to be implemented on the experiments was discussed and developed for each ALL based on its own set of innovations and test crops (vegetables in Kiamu, maize and beans in Makueni). Interestingly, Kenya interacted with the Zimbabwe team and developed its own set of digital tools to ease the monitoring.

In Kiambu, monitoring parameters include both quantifiable variables (i.e., leafy vegetable yields at two-week intervals, growth rates, leaf surface area, plant nutrient content, shelf life, harvest duration of leafy vegetables), and **observable parameters** (i.e., plant colour, plant vigour, weed density), as well as additional factors to be considered at the moment of analysis which comprised production costs, marketability, and weed count on the farm.

Similarly, in Makueni, a large number of measurable and observable criteria was suggested for the monitoring protocols, including soil-fertility, moisture, growth rate, production in terms of yield (grain; stover), size of grains, presence of pests and diseases, time of pest infestation and re-infestation, crops' succulence, maturity period, vigour, frequency of pesticide application, rainfall details-frequency, timing, and intensity, taste, labour, cost of implementation, active elements of biopesticides, and application.

In both ALLs, data collection takes place in two stages:

- **baseline data collection**, encompassing actions like soil sampling before land preparation and an overview of historical farm management,
- **trial data collection**, which involves measuring the pre-identified parameters.

Three types of participants are involved in data collection and monitoring: farmers, ALL host centre staff, and AE-I researchers.

4.4.3. Tunisia

For M&E, the Tunisia team proposed to hire enumerators in charge of collecting data from experiments on the farm level using ODK and tablets (in link with WP2).

Based on the previous plots monitoring survey developed by ICARDA staff under SWC@scale project, in collaboration with NARES partner (INRAT), a new updated survey was developed, currently available on e-version compatible with ODK and Kobocollect. This tool has been uploaded on MEL platform in its XML form which can be used to monitor on-farm trials related to crop experiments.

In parallel, the Tunisia team developed the below questionnaire for rapid appraisal and follow-up of the of the co-design experimental process and results.

a. General information

- Name of agroecological innovation
- Brief description of the proposed agroecological innovation (species/varieties; associated cropping/breeding practices; proposed equipment)
- Site where the trial will take place (GPS points if possible)
- Structure responsible for co-designing the innovation
- Name(s) of FO(s) involved
- Collaborating organizations/structures
- Name and contact of the researcher responsible for co-designing the innovation
- Name and contact of FO farmer(s) involved in co-design

b. Specific information on the co-designed agroecological innovation

- Participatory research questions
  - What were the additions/modifications proposed by the farmers or OPAs in the proposed innovation at the time of design?

    - What were the additions/modifications proposed by farmers or OPAs in the proposed innovation at the time of implementation of the experiments?
    - What adjustments were co-designed during implementation?
  - Indicators to be measured
  - Participatory trial protocol:
  - Procedure/mechanisms to involve farmers in the participatory trial:
  - Schedule / Planning
  - Trial results
    - technical results (in line with indicators proposed by stakeholders)
    - changes in farmers' behavior (how the innovation has modified old practices, changed the way work is organized, or revised the farming system).
    - Feedback from farmers (quotes, narratives, collected expressions)
    - some photos

4.4.4. Peru

In Peru, the Monitoring and evaluation plan includes periodic data collection in each experiment in sync with the practices being implemented. The main focus for observations is a sample of cacao trees in each treatment. Measurements will be carried out using an information collection matrix, which will include the producer code, treatment, number of trees evaluated, harvest number, harvest date, total number of ears, total healthy ears, total bad ears, degrees of moniliasis attack, presence of witch's broom, presence of Phytophora, presence of carmenta and weight of wet almond.

Data collection is carried out by the AE initiative team, with the participation of farmers and the collaboration of local technicians from the 2 farmers' organizations belonging to the ALL.

4.5. Preliminary findings from experiments in Zimbabwe and Tunisia

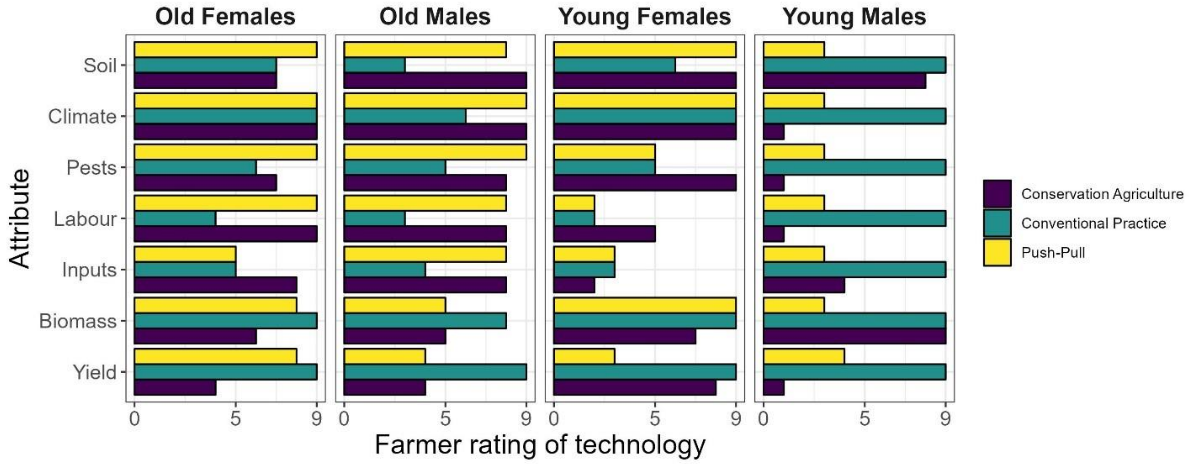
For most countries, results of experiments have not yet been reported. The (preliminary) results presented below are meant as an illustration of what country teams who have already engaged in processing data from the experiments have been doing and in doing so illustrate the diversity and richness of results obtained. The 2 examples are from **Zimbabwe** (the team most advanced in this respect) and **Tunisia** (which has only so far shared a very preliminary analysis for a small experiment with silage as feed).

4.5.1. Zimbabwe

Zimbabwe has already been able to engage in an in-depth analysis of the results of the codesigned experiments established since the 2022/2023 cropping cycle, which focused on comparing Push-Pull (PP), conservation agriculture (CA) and Conventional practice (CP) in its two ALLs (see Table 3, Section Approach to Monitoring and also Zoom Zimbabwe for a few details about the digital monitoring system used among others to rate and rank innovations in this report, as well as the related Zimbabwe reports and knowledge products for more complete details).

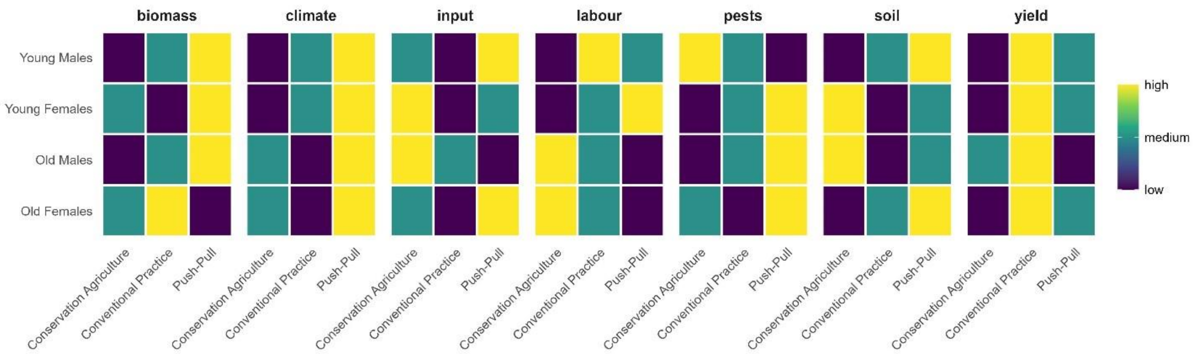
- ***<u>Farmer rating and ranking of technologies</u>***

Both men and women in the ALLs had similar perceptions of the performance of the 3 tested technologies across the various attributes related to AE (See Figure 10 and Figure 11 below for Mbire ALL). Young males in the Mbire district perceived the conventional practice (CP) plot highly across all indicators, whilst both older male and female farmers perceived push-pull (PP) plots as the best. Both male groups in Mbire indicated that "the intercropping presented by the push-pull treatment is good for nitrogen fixation; it increases yield and helps with soil conservation". The Local leadership in Mbire indicated that "the AE practices you implemented help in input efficiency and push-pull is relevant for the district. From the observations, we can see that a small piece of land can produce a high yield." Different farmers have different perceptions of the impact of PP, CA and CP on all attributes except yield and biomass on PP and CP plots, where the CP plot is ranked top. Young farmers rated the CA plot low in easing labour, pests, and input use efficiency, whilst older farmers perceived CA to have performed better than the CP plot on climate, pests, and labour attributes



Source: Zimbabwe report

Figure 10: Farmer rating of technologies by groups of farmers of different age and gender across attributes related to agroecology in Mbire, Zimbabwe.

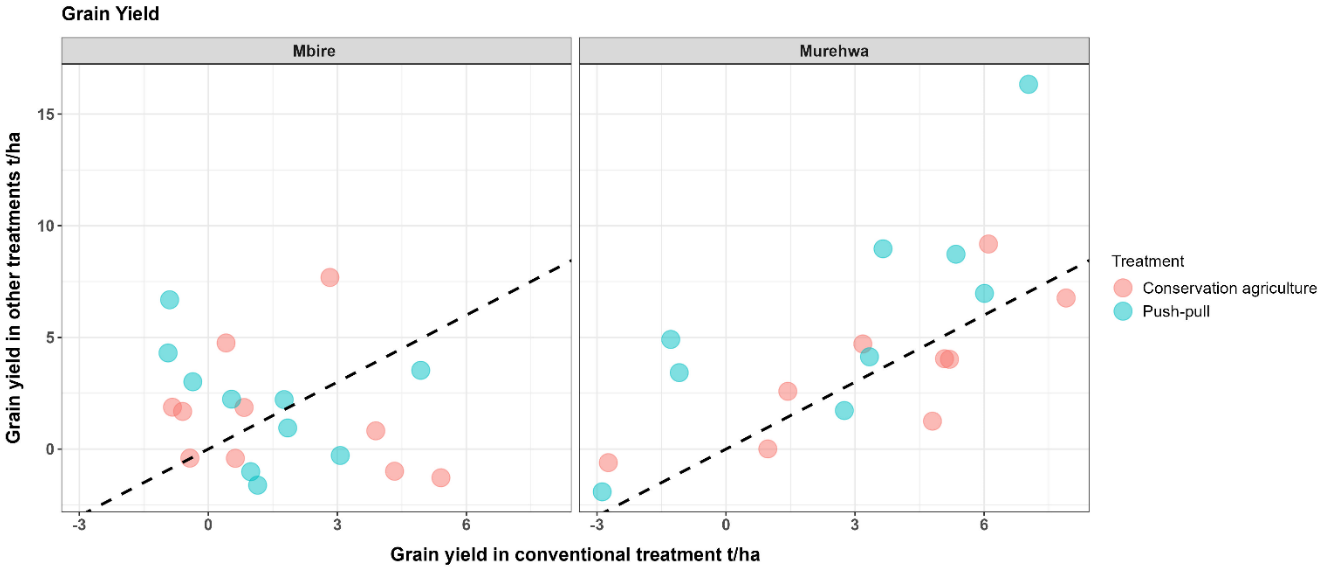


Source: Zimbabwe report

Figure 11: Farmer ranking of technologies by groups of farmers of different age and gender across attributes related to agroecology in Mbire, Zimbabwe

- ***Cereal yield***

Figure 12 shows sorghum and maize yields obtained under push-pull and conservation agriculture. The yields obtained under PP, CA or CP were fairly similar. In Murehwa, PP and CA had higher yields compared to CP. The monitoring data allowed to understand the reasons for lower or higher yields among plots. For example, the higher yields in Mbire seem due to farmers using indigenous knowledge to control pests and good management practices. In Murehwa, good or on the contrary sub-optimal management (e.g. delayed weeding) or type of soils all had an influence on yields.

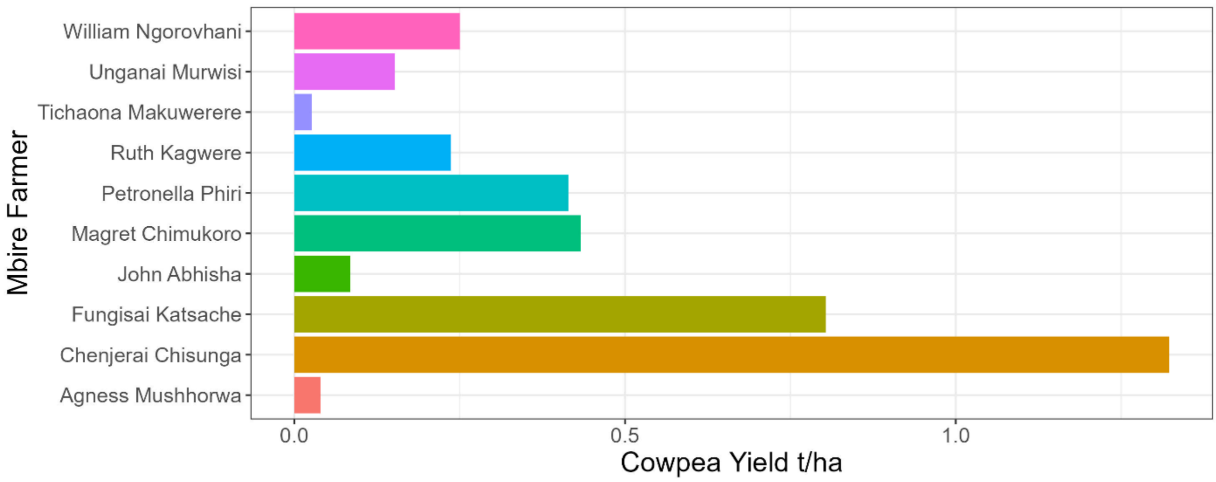


Source: Zimbabwe report

Figure 12: Mbire sorghum and Murehwa maize yield in t/ha under Conservation Agriculture and Push-Pull, Zimbabwe.

Notes: Points for push-pull (PP) and conservation agriculture (CA) above the regression line suggest treatment performed better and below the conventional practice (CP)

With respect to cowpea, 60% of the demonstration plot holders achieved cowpea yields below 0.5 tons (Figure 13). Cowpea was attacked by different insects and pests, which affected the crop's productivity. The higher yields obtained in some plots can be attributed to farmers having implemented practices such the use of chili sprays to protect their crop from various pests.



Source: Zimbabwe report

Figure 13: Cowpea yield (t/ha) from the push-pull (PP) treatment in Mbire, Zimbabwe.

(Note: More complete results and discussions are available in the Zimbabwe report).

4.5.2. Tunisia

Tunisia for its part reported preliminary results for the maize silage feeding experiment (Table 5).

Table 5: Results of the silage feeding experiment, Tunisia

Treatment / Variable	Treatment 1 w/ Silage	Treatment 2 w/ Silage	Control – no silage
Milk production (l/day/cow)	29	26	19
Return of milk (TND/day/cow)	37.7	33.8	24.7
Feed costs (TND/day/cow)	33.9	29.1	23.1
Net benefit (TND/day/cow)	3.8	4.7	1.6

(TND Tunisian Dinar - 1 TND = 0.326 USD on 31/12/2023)

Since only 2 farmers took part in this experiment due to limited availability of both maize silage and suitable dairy cows, the scientific validity of these results is limited and extrapolation not possible. Nevertheless, farmers could see the potential of feeding cows with silage. After three weeks, the two participating farmers observed that their cows were in better shape (much shinier hide, more rumination taking place). Milk production for its part increased by 7-10 l /cow /day after seven weeks of feeding silage, translating into a net benefit increase of 2-3 TND / dairy cow / day. These results have been shared with the other members of the women's dairy farmer group. Five of them have already purchased some silage in bags. The bags are collected to be sold and recycled (another key AE principle) in a factory nearby, allowing farmers to get another small additional income (1 TND / kg of plastic bag).

5. Next steps in the codesign process

Table 6 presents an overview of how the various countries of the AEI plan to continue engaging in the codesign process and corresponding activities in 2024 (the table includes India in addition to the 7 countries covered in this report, as codesign will be fully implemented in in Madya Pradesh in 2024 after a late start of AEI activities there in 2023, mostly focusing on ALL establishment and the vision-to-action process: see vision-to-action report).

As expected, and in keeping with what was implemented in 2023, calendars and specific activities vary markedly from one country to the next. Some countries will undergo a second or perhaps even a third cycle of experimentation and codesign, while others will start their first cycle (India), and others will continue experiments started in 2023 on perennial crops, which take longer to run (case of Peru with cacao, and Tunisia with olive trees).

Also, emphasis on and the actual possibility of getting results analysed in 2024 will depend on cropping calendars: some countries will carry the analysis in the early months of 2025.

At the global WP1 level, methodological support will be provided to each country depending on its specific needs. WP1 also proposes to develop and share more comprehensive guidelines (see section 2.5.3). Also, systematization of experiences, approaches, processes followed and whenever available results as well as identification of generic lessons will be pursued by and across countries, using cross-analysis as a major tool.

Table 6: Next steps in the implementation of the codesign process in 2024 in the 8 countries of the AEI

Country	Participatory M&E of experiments established in 2023 (incl. Field days)	Analysis of 2023 experimental results	Planning of 2024 cycle	Main changes introduced or expected compared to the 2023 cycle	Implemen-tation of 2024 cycle	Analysis of 2024 results	Other key activities related to codesign to be implemented in 2024
Zimbabwe	Until March 2024	Mostly done	(done)	Establishment of baby trials based on results of District Choice Experiments	On-going	Summer 2024	Seed fair
Kenya	January 2024	On-going	1st trimester 2024	TBD	TBD	TBD	TBD
Tunisia (*)	Jan- Autumn 2024 (depending on innovation package & crop)	March 2024 for 2022/23 cycle	(done for 2023/2024 cycle)	Forage mixture trials (comparison with 2023); new socio-technical packages: biofertilization, valorization of Olive by products, establishment of 2 composting units, developing participatory M&E process	On going	Autumn 2024 for 2023/24 cycle	(information not received)
Burkina	(over)	Jan 2024	March 24	Same as 2023+ Baby fodder demo plots + adding more volunteers for testing the AE package	Jun-Dec 24	Early 2025	Expand advisory services
Senegal	(over)	pending	Feb-May 24	TBD	June-Sept 24	Oct-Dec 24	Tracking of local AE innovations; co-design of an integrated salinity management strategy for the Fatick department
Peru	April-June 2024 August- Sept	July – Nov 2024	NA	No changes expected, as experiments deal with a perennial crop (cocoa) and will run over many months	NA	NA	Socialization of results
Laos	Until March 2024	March 2024	Feb-March 24	New experiments and treatments to be codesigned in 2024	2 successive cycles (dry & wet seasons).	Nov-Dec 2024	Implement Sala Phoum style farmer-led research activities across trials
India	January- Oct - 24	NA	(Done)	Implementation of field pilots of 6 identified technologies	March – Oct 24	Oct- Dec 24	Developing knowledge base on agroecological practices

<u>Notes</u>:

TBD To be determined once formal 2024 planning is finalized and agreed upon with national and local partners

NA Not applicable

(*) Tunisia cropping & experimental cycle runs approx. from. from October of year N to June of Year N+1 for annual crops

6. Concluding remarks

As this consolidated report has amply demonstrated and illustrated, codesign is on-going in all seven countries at a faster or slower pace, depending on circumstances. At this stage, most countries are yet to have obtained their first harvest of experimental results, much less analysed them. This reflects specificities of cropping calendars in different countries and other implementation issues. But more importantly, it is a direct consequence of the significant and at time challenging time investment it requires from a given ALL and its supporting AEI team to be in a position to truly and knowingly negotiate with and agree among ALL concerned stakeholders on the content and form of what a desirable set of experiments should be about (such as type of technologies / innovations, experimental set-ups, monitoring and assessment criteria and methods, etc.). This by itself provides a clear and indeed welcome contrast with more conventional researcher-controlled approaches to experimental design, which tend to take less time, but have also less potential for answering farmers needs and, in our specific case, farmers' and other stakeholders' vision with respect to where they want to go with agroecology. Codesign also offers a host of associated benefits, such as contributing to strengthening the capacities of local stakeholders in developing innovations, creating a sense of ownership and more generally, reshaping the interactions and hierarchies among actors.

This report also illustrates the diversity of approaches that countries implemented in going about codesign, which is a tribute to the AEI teams' creativity, resourcefulness and enthusiasm in engaging into and learning by doing what codesign and "doing research differently" entails and how it allows to consider farmers' needs, experience and knowledge and attempts to give them a real voice as co-researchers in what is being researched / experimented / proposed. Indeed, in doing so, several teams have gone beyond what WP1 leadership had envisioned initially or was able to provide concrete methodological guidance and support for. This diversity hence constitutes a great source of richness and future learning across the initiative, something which WP1 will strive to capitalize on in 2024.

Perspectives at the end of 2023 are many-fold:

- First, all countries will continue with the codesign process they started or conducted in 2023, including by finalizing the on-going cycle of experimentation and assessing the corresponding results and lessons, planning and implementing new cycles if possible.
- In doing so, country teams will also need to put codesign results in perspective, by assessing how they contribute to transition pathways and to the vision ALL's stakeholders have identified for a desirable future and for agroecological transition in particular. .
- Another major investment will be to systematize the approaches, experiences and results across countries, and identify lessons of different kinds (be it with respect to technologies, codesign process, approaches, methods and tools, multistakeholder collaboration, etc.) that can be taken forward in phase 2 of the Initiative or shared with the relevant research, R&D and practitioners' communities and networks at the local, national and international level. The International network of ALLs that WP1 plans to establish and facilitate in 2024 constitutes one of the arenas for doing this. Developing a more comprehensive and user-friendly methodological guide that covers from the assessment of existing innovations to participatory monitoring and evaluation all the way to result analysis, and goes hopefully beyond the plot or even farm the scale will be one way of transmitting our lessons and experiences, along with more classical academic papers.

As one can see from these perspectives, codesign started in earnest in 2023 in most countries of the initiative, and the road to be travelled is still long, and hopefully will take AEI teams and their national or local partners much beyond 2024, reflecting the fact that AE transition is a long-term change process

7. Country reports used for this consolidated report

Country	Title (as given to report by each team)	Authors
Zimbabwe	A report on co-design of innovations for Zimbabwe	Chimonyo V., Sibanda T., Matangi D.
Kenya	Individual report on co-design of innovations in Kenya	Fuchs L., H. Korir, B. Adoyo, P. Bolo, M. Sakha, P. Gumo, M. Mbelwa, N. Syano, E. Kiruthi, A. Kuria, L. Orero
Tunisia	Codesign of innovations in the Tunisian living landscape. 2023 report	Rudiger U., El Sheikh H., Mannai A, Tebourbi O., Alary V., Frija A., Zaiem A., Cherni H., Hidri Y.
Burkina	Co-Design of Innovation in Burkina Faso	Vall E, Sib O, Ouédraogo S, et Sanogo S.
Senegal	Report on Codesign of innovations in Senegal	Mbaye B., Belmin, R., Piraux M.
Peru	Individual report on codesign of innovation for Peru	Sánchez J. and Tristán M.C.
Laos	Co-design of innovations in Lao PDR. Report 2023	Dubois M., Douangsavanh S., Viossanges M., Xaydala V.

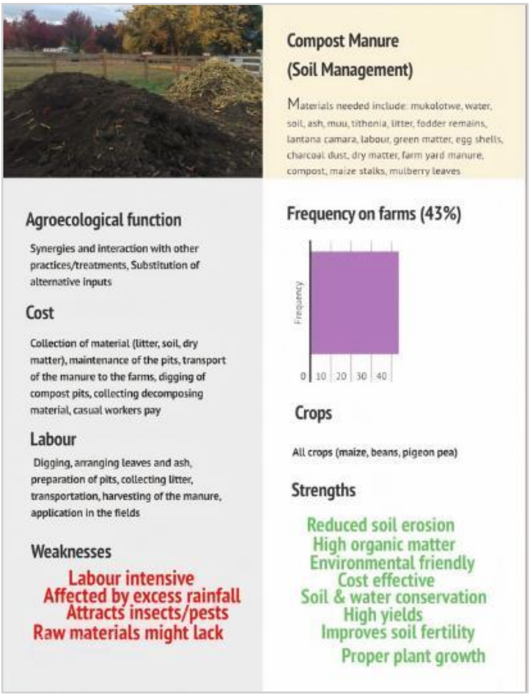
Note 1: At the time this report was prepared, no report had yet been received from India, but some early stages of codesign had indeed taken place

Note 2: Interested readers can find more details about what has been reported and synthesized in this report in the individual country reports and products available on CGSpace and increasingly through country-specific publications.

Appendix

Appendix 1: Sample information poster developed from the innovation assessment data in the Kenya ALL

Case of compost manure in Makueni



Source: Own composition.

Appendix 2: Format for Rating and Ranking of technology demos, Zimbabwe

Example of the comparison between Conservation agriculture or push-Pull vs. conventional practice)

Age and sex group

○ Young Males ○ Young Females ○ Old Males ○ Old Females

Rating Technologies

Select one technology

○ Conservation Agriculture ○ Conventional Practice ○ Push-Pull

On a scale of 1-9 to what extent do you think this technology helps in increasing grain yield?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology helps in increases biomass yield?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology helps in easing the use of inputs (fertilizer, herbicides)?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology reduces labour input?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology reduces crop pests and diseases?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology helps copying with climate change?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

On a scale of 1-9 to what extent do you think this technology helps in conserving soil ?

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

Ranking: Preferred technology that helps in increasing grain yield

1st choice

◯ Conservation Agriculture ◯ Conventional Practice ◯ Push-Pull

2nd choice

◯ Conservation Agriculture ◯ Conventional Practice ◯ Push-Pull

3rd choice

◯ Conservation Agriculture ◯ Conventional Practice ◯ Push-Pull

Ranking: Preferred technology that helps in increasing biomass yield

(Similar: 1st choice / 2nd Choice, 3rd choice)

Ranking: Preferred technology that helps in easing the use of inputs

(Similar: 1st choice / 2nd Choice, 3rd choice)

Ranking: Preferred technology that helps in reducing labour use

(Similar: 1st choice / 2nd Choice, 3rd choice)

Ranking: Preferred technology that helps in reducing crop pests and diseases

(Similar: 1st choice / 2nd Choice, 3rd choice)

Ranking: Preferred technology that helps copying with climate change

(Similar: 1st choice / 2nd Choice, 3rd choice)

Ranking: Preferred technology that helps in conserving soil

(Similar: 1st choice / 2nd Choice, 3rd choice)

Bernard Triomphe, CIRAD. bernard.triomphe@cirad.fr

Vimbayi Chimonyo, CIMMYT. V.CHIMONYO@cgiar.org

Lisa Fuchs, CIFOR-ICRAF. L.Fuchs@cifor-icraf.org

Udo Rudiger, ICARDA. U.Rudiger@cgiar.org

Eric Vall, CIRAD. eric.vall@cirad.fr

Banna Mbaye, ISRA. bannambaye@yahoo.fr

José Sánchez-Choy, Alliance Bioversity-CIAT: J.G.Sanchez@cgiar.org

Mark Dubois, IWMI. M.Dubois@cgiar.org

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