INITIATIVE ON Agroecology

CGIAR

Agronomic Assessment of Agroecological technologies codesigned and experimented with the dairy farmers members of the Agroecological Living Landscape of Burkina Faso

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Contents

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1 Purpose

This framework aims to facilitate the collective assessment of results and lessons learned from the codesigned agroecological trials conducted in different Agroecological Living Landscapes (ALLs) participating in the CGIAR initiative on agroecology (AEI). The purpose of this assessment is to understand approaches and methods used for the design and evaluation of these trials (protocols, measurements performed, etc.) and contribute to the performance analysis of the agroecological technologies tested.

While each trial within the initiative may be unique due to the context-specific codesign process, the framework aims to analyze them in a generic and structured way to facilitate cross-comparisons. Although agronomic in nature, the framework's assessment integrates the productive, environmental, and socioeconomic dimensions of the trials to compare agroecological technologies with current practices in each ALL.

Additionally, the framework assesses contributions to the agroecological transition for each technology tested in the trials. This document serves as a guideline, to be enriched through interactions with country teams, with a final version potentially included as part of the codesign guidelines for the AE initiative.

1.1 Objectives

- ✓ Documenting codesigned agroecological technologies in the ALLs of the AE initiative.
- ✓ Facilitating the comparative performance analysis of AE technologies and “current” (non-AE) practices.
- ✓ Engaging with country teams to develop the comparative performance analysis and assess the codesigned agroecological technologies.

1.2 Considerations

- ✓ The process will be primarily based on the information already generated in trials conducted in the ALLs.
- ✓ The assessment could provide an opportunity for the local and global teams in the initiative to identify areas for further improvement and offer recommendations for the way forward.
- ✓ Authorship and data ownership belong to the country teams. The global team will only assist with data analysis if requested by the country team, and will only report summary statistics (not primary data) in its analysis after consent from the country teams has been provided.
- ✓ The scope of the assessment will be highly dependent on the implementation trajectories at each ALL. This generic framework includes aspects that may not always be relevant for the AE technologies tested in the trials.
- ✓ The framework is under construction. Consequently, interaction with local teams is expected to improve the framework, and shape it into the final operational version.

1.3 General structure of the assessment

The assessment will be made for each trial in the ALLs. It is structured in four main components. The first two components seek to gather information about the context of the trial and the agronomic performance of the technologies tested in the trial. The third component analyses the information collected to compare the performance of AE technologies against the current practice, focusing on the AE principles addressed by each innovation. Furthermore, a general assessment of AE transition is developed in this component. The last component will develop recommendations for improvements in the trials on different aspects.

1.3.1 Trial description

General description of the AE technologies and current practices being tested in the trial, as well as the context in which the trial is being developed. Besides, this section includes a brief description of the codesign process followed in the ALLs and the experimental setup (Figure 1).

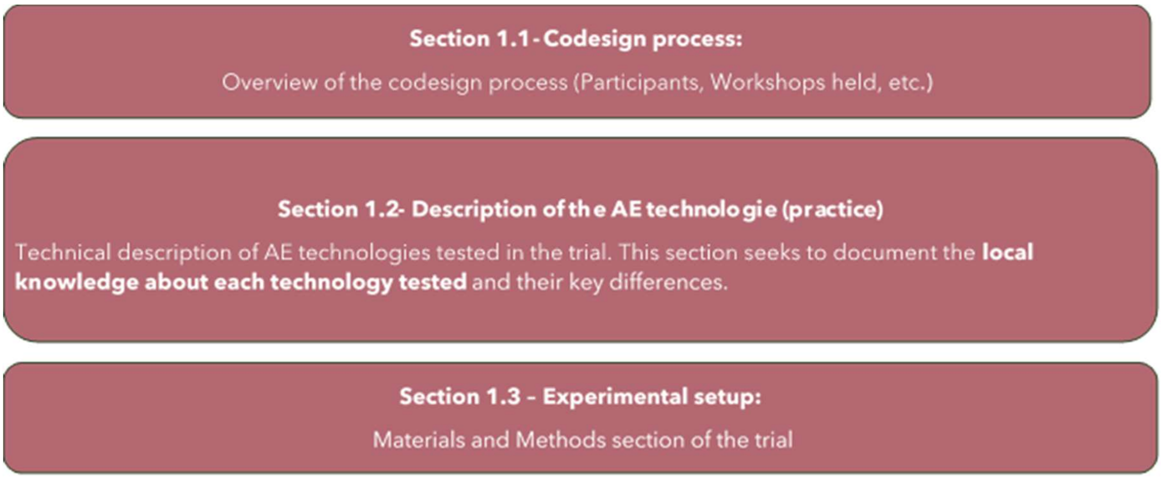

Figure 1: Sections included in the component about the trial description

1.3.2 Agronomic performance

The component on agronomic performance aims to compare the performance of AE technologies with current practices, as tested in the trial. While the framework attempts to identify common variables to document the performance in agroecosystems, some variables may not be relevant to all trials, and some pertinent variables may be excluded. In such cases, there is a section available to include relevant variables specific to the innovations tested in the trial (Figure 2).

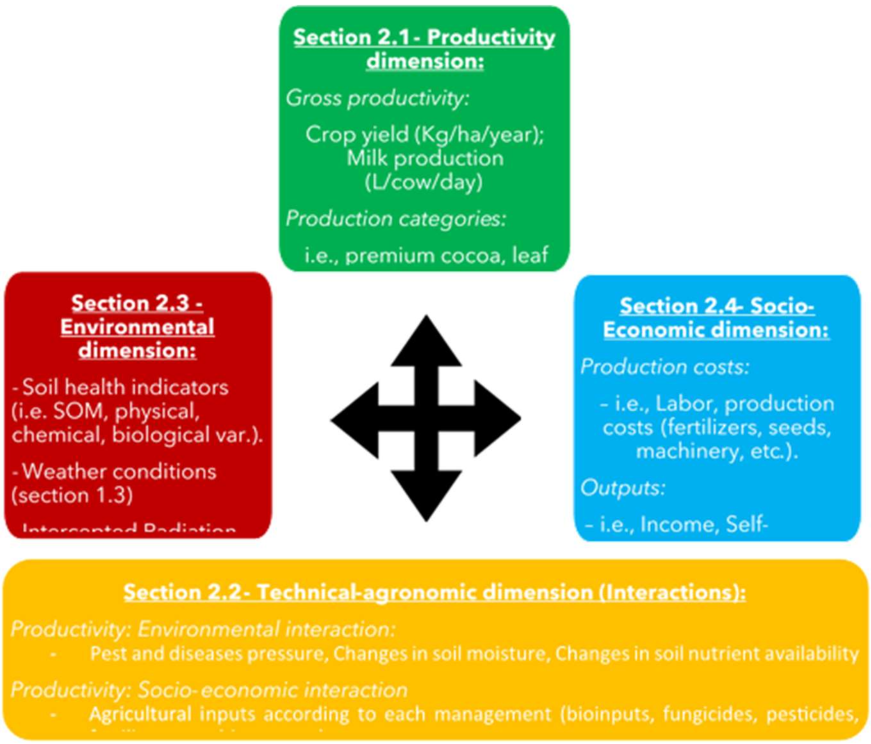

Figure 2: Sections included in the agronomic performance component of the trial

1.3.3 Agroecology assessment

This component includes two sections: A specific and a general assessment of the AE transition in each trial. In the specific assessment, based on information collected in previous components, an assessment of the AE principles addressed by each innovation is conducted. The specific assessment analyzes the effect of each AE technology against the current practices on the AE principle(s) addressed by each innovation (i.e., input reduction, soil health, economic diversification). In the general assessment, a characterization of the AE transition is done using a modification (simplification) of the TAPE protocol proposed by Mottet et al., (2020). These two assessments will contribute to the cross-analysis of results in the initiative.

1.3.3.1 Specific assessment

This section is highly dependent on the information available, and the AE principle(s) addressed by the innovations tested. An illustrative example of potential analyses in this component is presented in the following illustration box:

Agroecological technology tested: Spinach production using mulch.

***Agroecological principle(s) addressed*:** Soil Health (main), Economic diversification.

Comparative performance analysis (against production of spinach without mulch):

- Soil moisture content during the productive cycle
- Yield components at harvest, such as plant height, number of leaves per plant, leaves size.
- Differential prices of spinach according to their sizes.

Hypothesis tested:

- Spinach produced using mulch increased the soil moisture during the entire productive cycle.
- Spinach produced using mulch significantly increased the number and size of leaves, thus increasing grower income through higher prices for larger leaves in the local market.

1.3.3.2 General assessment

This component will be developed by applying scores to selected indices of Characterization of AE transition (CAET) according to the methodology proposed by Mottet et al., (2020). The scoring can be conducted in each ALL by the local staff in charge of the trial, based on the knowledge gained during the trial development. CAET indices proposed by Mottet et al. (2020) cover the ten elements of agroecology according to FAO: diversity, synergies, efficiency, recycling, resilience, culture and food traditions, co-creation of knowledge, human and social values, circular and solidarity economy, and responsible governance. This framework proposes to assess four elements of the transition—diversity, synergies, efficiency, and recycling—as they are directly related to practices developed at the field level in the trials.

1.4 Recommendations

This component is developed in close coordination with country teams about different aspects in the trials: i.e., protocols, co-design process, analysis of results, etc. This section provides an opportunity for the country and global teams in the initiative to identify areas for further improvement and offer recommendations for the way forward.

2 Foreword

In the Agricultural living landscape of Bobo-Dioulasso in Burkina Faso, a systemic approach at farm scale, and even landscape scale including grazing land, has been adopted in the AEI. By focusing on the milk sector, and therefore on dairy cattle, it was indeed necessary to consider the plot scale with the biomass produced on farm, but it was also important to consider the farm scale to assess the fodder self-sufficiency (using *CoProdScope* tool) of farmers and distinct cattle feed ration (using J*abnde* tool). In this context, this agronomic assessment presents the specificity to consider two levels of analysis. At plot scale, the conventional practice (crop residue used as fodder for dairy cows) will be compared to 2 alternative technologies (Legume fodder crop and cereal fodder crop, both with high manure use). At farm scale, the conventional technology of feeding cows with crop residue and grazing land is compared to ration with addition of legume fodder, cereal fodder, and reduced access to concentrate feed, while maintaining access of the cows to grazing land.

2.1 Trial description

2.1.1 Codesign process

The co-design process of the Agroecology Initiative in Burkina Faso has started in march 2023 during a workshop gathering all stakeholders involved in the local milk sector around bobo-Dioulasso (Sib et al., 2023). Actually, the work to identify the relevant stakeholders and starts interacting with them around co-built problematic in the milk sector started 3 years before during the Africa-Milk project (French Development Agency; AFD). This project conceived a Dairy Innovation Platform (DIP, PIL in french) and gather dairy farmers, milk collectors, dairy processors units, and private and public supply services. The initial objective of the DIP was to reach 18,000 liters of milk per day to provide the city of bobo-Dioulasso and its surroundings. With this Agroecology Initiative, the team improved this co-design framework and built a second version called the On-farm Experimental Design for Agroecology (OnEDA, or Dispositif Experimental Agroécologique en Milieu Paysan in French).

2.1.1.1 Participant: Who was involved in the process?

As explained above, different stakeholders are part of the OnEDA, at different stages of the value chains. Nonetheless, in this first phase of the Initiative, the team has focused on farmers as key actors of the sector. 57 farmers have been selected to implement agronomic trials on fodder crop (fodders demo-plots). Concerning the assessment of biomass use in the farm with CoProdScope tool, a sub-sample of 10 farmers have been chosen. Regarding the analysis of cattle alimentation with Jabnde, a first selection of 30 dairy farmers were made on a basis of fodders demo-plots participation and potential biomass stored, and a final selection of 20 farmers regarding other constraints. Among the 57 farmers selected for fodder demo plot, 54 were volunteers to build manure pits and received all requested materials to do so.

2.1.1.2 Workshops and Activities: What workshops and activities were held?

The co-design framework implemented relies on 4 types of activities, all complementary at far farm scale, which emphasizes the systemic dimension of the activities in this Agricultural Living Landscape. They are all synthetized in the Figure 3.

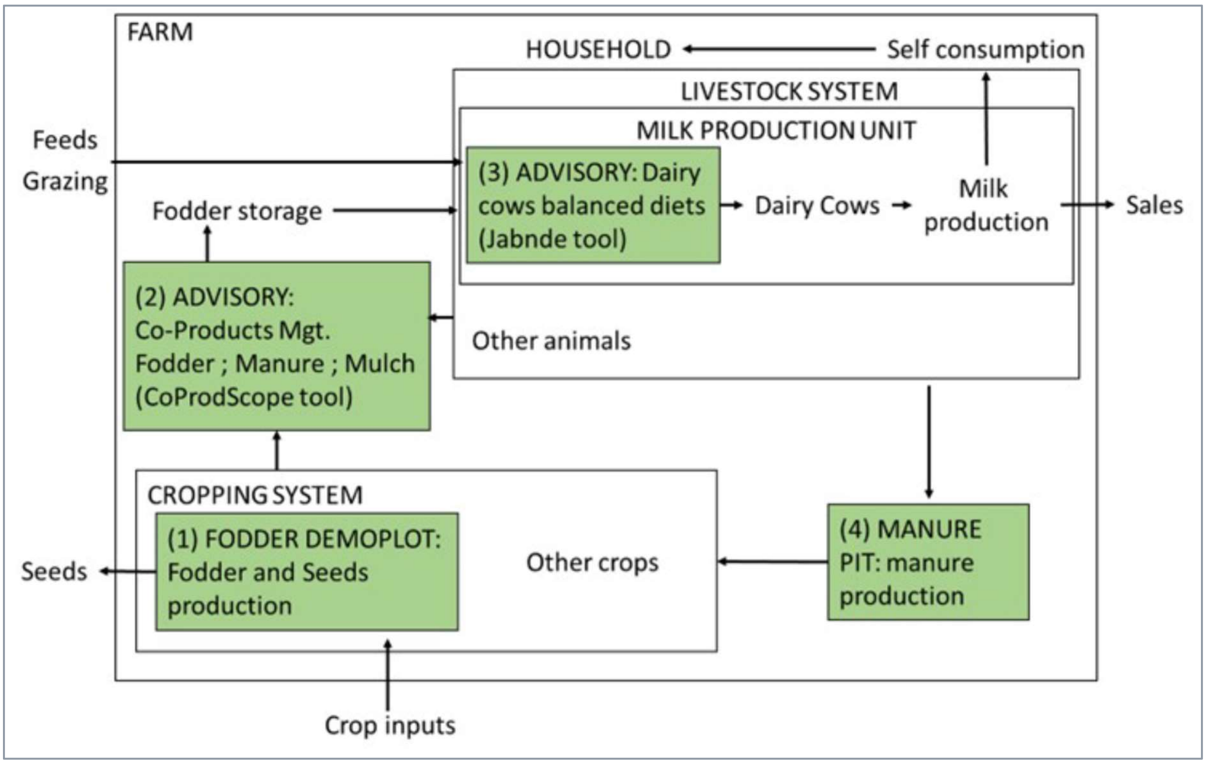

Figure 3: Presentation of the co-design approach in Burkina Faso ALL (On-farm Experimental Design for Agroecology) for an agroecological transition of the dairy livestock system

As described in Figure 3, 4 main types of workshop and activities are part of the co-design process:

- ✓ **Fodder Demo-plot**: their objective is to test on-farm, i.e. in real conditions (soil, labor constraints, weeds pressure, etc.) the potential of fodder crops to increase biomass production and thus improve alimentation self-sufficiency to feed the dairy herd throughout the year especially in the dry season. A framework based on mother-baby trials allowed not only to demonstrate agronomic performances of these fodder crops, but, in the meantime, to disseminate seeds at other farmers, releasing a key constraint in the region (seed access).
- ✓ **Managing coproducts at farm scale**: *CoProdScope* tool was used in an interview with farmers to assess their self-sufficiency in biomass at farm scale. Indeed, the tool allows to calculate balance on crop residues produced by the cropping systems and the crop residue needed to feed the cattle. Also, the tool allows calculation of manure needed to increase soil fertility and calculate if manure produced by the herd is enough to do so.
- ✓ **Co-design dairy cattle diets with *Jabnde tool***: Jabnde tool was used to formulate balanced and economically acceptable dairy cow diets, using the farm's animal feed resources (spontaneous rangelands, fodder and livestock feed) to reach the farmer milk production objective.
- ✓ **Co-designing manure pit**: A manure pit were established in each volunteer farm, in order to increase the use of manure of the cultivated plots of the farm. A monthly survey has been implemented to evaluate farmers use of the manure pits (biomass added, collected), along with chemical analysis of the compost in the manure pit to analyses its content in MO, C, N, P, K, etc.

2.1.1.3 Outcomes and Challenges: What were the main outcomes and challenges?

The major outcome is the overall satisfaction of all farmers involved in the co-design process, and the arrival of "baby" farmers which received seeds from "mother" farmers, increasing the number of farmers who beneficiate from the Initiative Agroecology. Regarding CoProdScope and biomass management at farm scale, the main challenges were the lack of information tracking in the farm. Indeed, it was not easy to collect all data needed on biomass use (manure and crop residue) to calculate balances, without any written information. For dairy cattle ration, the main difficulty was to isolate the cattle concerned with alternative rations.

All the information about the co-design process and the preliminary findings coming from 2023/24 OnEDA campaign are presented in Ouattara et al (2023).

2.2 Description of AE technologies experimented

2.2.1.1 At plot scale: Fodders Demo-Plots

Control Treatment: Conventional non-fodder crops (maize, sorghum, cowpea) + Low use of organic manure

Description: The control treatment is not part of the trial here, but reflects the current main practice in the region to feed the herd in a highly constrained environment. Most farmers grow conventional non-fodder crops such as maize, sorghum or cowpea and use low organic manure. If these plants do produce biomass in addition of the grain production, they are not selected to optimize this biomass production, in contradiction to fodder crop. Alternative technology at plot scale are therefore varieties of crops (legume and cereals) selected to optimize the biomass production, the key objective for cattle owners under biomass constraints.

Agroecological technology 1: Cereal fodder crops (maize, sorghum) + high manure input

Description: This technology, as the second one on legume fodder crops has been implemented on-farm according to farmers' condition and access to mechanization, mineral fertilizer, labor, pesticide use, etc. Cereal fodder crops are a very promising technology in the region because it has a high capacity to generate biomass if sufficient inputs are provided, which also explain why the technology is tested with increased use of manure. The only condition was to grow the cereal fodder crop on at least 0.125 ha. Variety for maize was "Maïs Espoir" and for sorghum the variety was "Grinkan". 3 kg and 1.5 Kg of seed, for maize and sorghum respectively, was provided to the farmers. Cereal fodder crops tested in the co-design framework of the ALL in Burkina is illustrated in Figure 4. For each plot with cereal fodder crops, 2/3 of the land was dedicated to fodder production and the remaining 1/3 to the seed production. This seed production was then divided in 3 : (i) one third to replicate the demo-plot next year, the two remaining third for new farmers (baby farmers) to implement the trials next year. Agronomic performances were measured with 4 sample of 4 m2 (quadrant method). Two quantities of biomass were measured, one actually produced in the trials based on these 4 samples, and one when biomass was collected by the farmers to assess the biomass really available for cattle (considering biomass storage constraint of the farmers).

Agroecological technology 2: Legume fodder crops (maize, sorghum) + high manure input

Description: Exactly as in Agroecological technology 1, these trials were led on-farm under farmers' constraints. The minimum land size was 0.125 ha for each legume fodder crop (for a total for cereal and legume crops of 0.5 ha). Legume fodder crop has tested because they allow both to increase biomass production and increase soil nitrogen due to symbiotic fixation. The protocol for this second agroecological technology is the same as in the first one.

For both alternative technologies, a sum of 202 trials have been implemented and all results are available for both agricultural practices and grain and biomass yield.

Figure 4: Illustration of the 4 types of fodder crop tested in the ALL of Burkina Faso

2.2.1.2 At farm scale: Dry-season feeding practices for dairy cows

The fodder crop tested in the previous section at plot scale are only one type of aliment to feed the dairy cattle. To be sure of the added value of these fodder crops, and the extra biomass they provide, it was necessary to embrace a more systemic approach at farm scale (and even landscape scale considering grazing land outside the village) and test distinct feed ration including, or not, these fodder crop.

Control Treatment: High use of natural pasture use of non-fodder crops and High use of concentrates

Description: The control treatment in this case is the current feed ration of cattle in the region of Bobo-Dioulasso. Cattel mainly rely on grazing land when available; crop residue stored by the farmers or grazed in other farmers' field (free grazing is the rule in the region and cattle are authorized to graze on field after harvest period); and finally concentrate fed such as cotton seedcake when no more fodder is available. This cattle ration constitutes the T0 control treatment at farm scale.

Based on this statement, 3 agroecological technologies, i.e. alternative feeding strategies were tested to optimize the biomass production of fodder crops and decreased the dependency on grazing land and concentrate feed.

Agroecological technology 1: Low grazing land use, crop residue, cereal fodder crop and low concentrate feed use

Description: This agroecological technology assumes that the extra biomass produced by the cereal fodder crop will allow the farmers to reduce its expenses in concentrate feed (highly expensive feed) and its dependency on grazing land. Indeed, due to expansion of agricultural land, grazing land are less accessible and more herders concentrates on them. Depending on grazing land is thus a non-resilient strategy that should be overcome with on-farm biomass production. In addition, if cows stay close to the farm with accessible biomass, the manure produced will be more easily optimize in the cropland, in contrary to the manure deposited in grazing land, considered as lost for the farmers (but useful to sustain soil fertility of these grazing land though).

Agroecological technology 2: Low grazing land use, crop residue, legume fodder crop and low concentrate feed use

Description: Added value of this agroecological technology is based on the same assumption as the T1 described below (reduced use of concentrate feed and reduce access to grazing land). In addition to these added values, this agroecological technology suggest to use legume, instead of cereals to produce biomass. By doing so, this technology will not only increase biomass production, but also increase soil nitrogen through symbiotic fixation. In this environment where access to mineral fertilizer is very limited, legume can help to sustain soil fertility, in addition of significant inputs of organic matter. Finally, Legume fodder crop is highly nutrient fodder complementary to cereal fodder crop richer in fiber.

Agroecological technology 3: crop residue, cereal and legume fodder crop and low concentrate feed use

Description: In this agroecological technology, both type of fodder are grown (cereals and legumes), in addition of low use of concentrate feed and crop residue. The amount of biomass produced is sufficient to avoid grazing land, which allows the farmers to optimize manure collection and therefore improve its soil fertility management. In order to be completely self-sufficient in biomass, it will important to have enough land size to grow both cereals and legume fodder crop.

2.2.2 Experimental setup

If the trial were developed in different location in the ALL, please provide the information about the most representative locations.

Location: Provide the geographic location of the trial in the WGS84 system, or indicate the geographic coordinate system in which the coordinate is provided

Latitude: 11.165044112452302

Longitude: -4.306279876777938

Geographic coordinate system: WGS84, decimal degree

Climatic and weather conditions: Figure 5

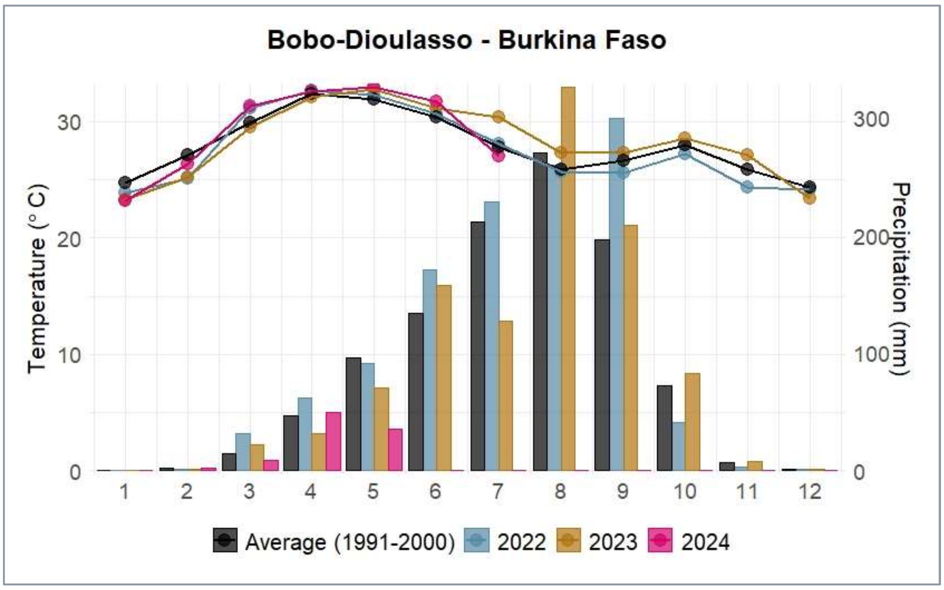

Figure 5: Climate graph developed for Bobo-Dioulasso (Burkina-Faso; Graph produced using the ClimateCharts.net platform)

Landscape description (Select the appropriate option)

Land slope: flat (0-2%) to gentle (3-5%)

Slope shape: Linear

Soil texture class: sandy clay

Soil classification : Several types of soil are found in the region, but the most important are sesquioxide soils, which are rich in iron oxide or manganese and result from the decomposition of tropical ferruginous soils (Kouakou et al. 2023).

Trial setup: Experimental design: (Indicate key features of the experimental design used in the trial., i.e., number of reps, plots, average area of each experimental unit)

As explained above, the agronomic trials led in this first phase of the Initiative Agroecology in the ALL of Burkina Faso was implemented on-farm, under farmers' condition. Therefore, no common protocols was used for the agronomic trials of fodder crop (legume and cereals). The only common protocol was to implement the 4 fodders crop under a minimum of 0.125 ha to reach a global surface of 0.5ha. In addition, one third of the seed produced was saved by the farmer to reproduce the trial the coming year, and other seed was given to other farmers (mother baby approach). The Figure 6 illustrates this experimental design.

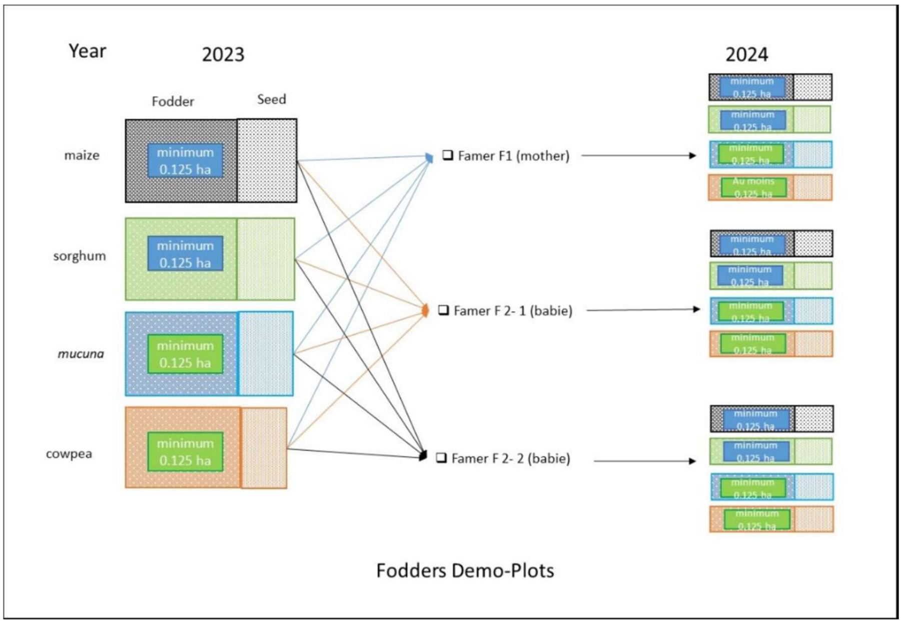

Figure 6: Graphical synthesis of the experimental design for fodder demo plots of the ALL of Burkina Faso

Date of trial establishment: Start of the rainy season (June and July 2023)

Planned date for ending measurements: Start of the dry season (November and December 2023)

If the global recommendation was to implement the trial for each crop on at least 0.125 ha, Figure 7 demonstrated that it has not been possible for many farmers, certainly due to land constraint on their farm. At the opposite, is it also important to knot that in all villages, some farmers implemented the trials on more land than recommended, demonstrating their high interest in this agroecological technology. A cooperative of 7 volunteer growers have installed a large Fodder Demo-Plot at in Kouakoualé. Table 1 present the measurements developed during the trial.

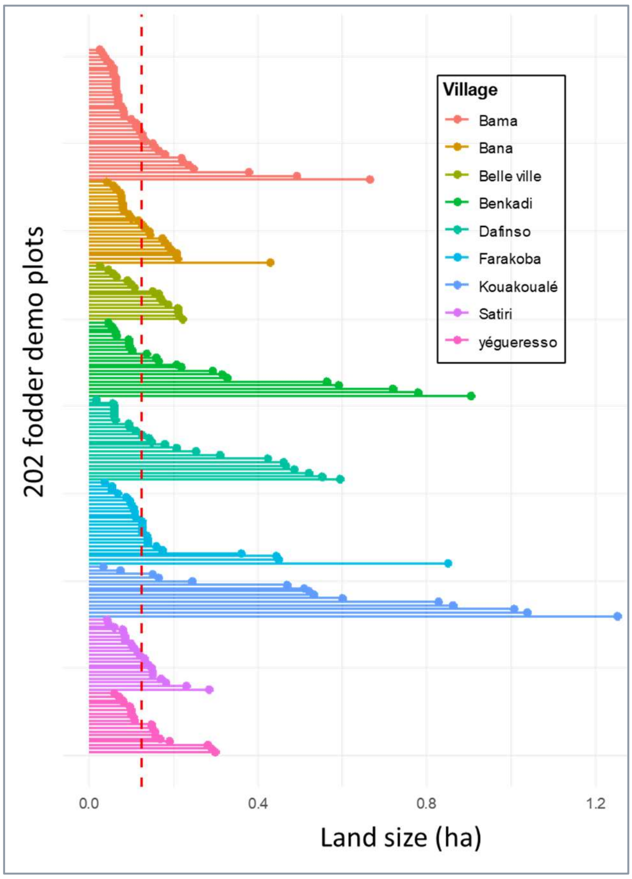

Figure 7: Land allocated to every 202 fodder demo plots in the ALL of Burkina Faso (9 villages). The vertical dashed lines represent the recommenced land size by the local team (0.125 ha)

Table 1: Measurements developed during the trial

Variable	Units	Methodology	Frequency	Responsible
Seed_emergence_rate	%	observation	1	Farmers and local team
Nb_Plant	unit	observation	1	Farmers and local team
Quantity_NPK_(kg)	Kg NPK	Farmers' declaration	1	Farmers and local team
Quantity_urea_total	Kg	Farmers' declaration	1	Farmers and local team
Number of weeding	Occurence	Farmers' declaration	1	Farmers and local team
Insecticide use	Yes/no	Farmers' declaration	1	Farmers and local team
Seed harvested	Kg	Based on quadrat method	1	Farmers and local team
Biomass harvested	Kg	Based on quadrat method	1	Farmers and local team

2.3 Agronomic performance

2.3.1 Productivity dimension

The cereals produced a median value of 2,500 kg/ha and legume around 1,500 kg/ha (Figure 8). Regarding the high constraint on biomass in the region, this quantity of biomass is non negligible to help farmers coping with the feed scarcity in the dry season, if they can store it properly. Also Figure 8 shows a significant grain production for both cereals and legumes, which is a key result in the co-design process as seed access and dissemination is crucial for fodder plots. Lastly, Figure 8 displays boxplots with high variability which reflects the high variability of farmers' condition to lead these on-farm trials. Indeed, in-depth analysis of practices revealed that significantly different levels of inputs, pest management, weeding, were used in the trials and it affected the biomass and grain yield.

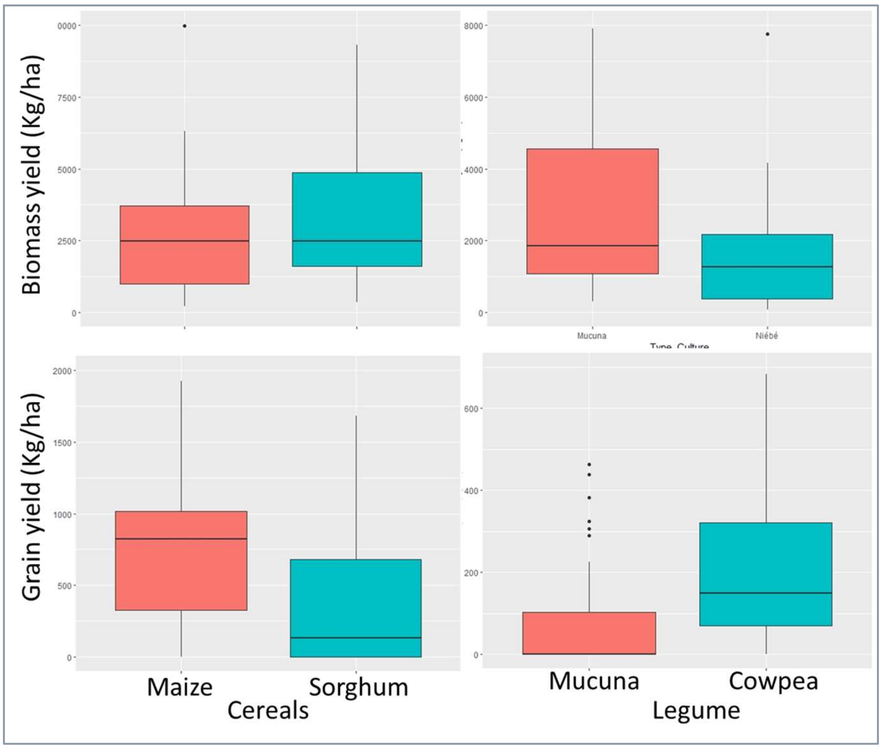

Figure 8: Main agronomic performances (grain and biomass production) of cereal fodder crops and legume fodder crops tested on-farm in the ALL of Burkina Faso

2.3.2 Technical-agronomic dimension

2.3.2.1 Pest and diseases pressure

Almost three quarters of all plots were led without pesticide use (Figure 9). The main reason declared by farmers for using pesticide was the observation of pest attacks in the field, or because it was recommended to use pesticide with this plant. Figure 9 also shows that pesticide was mainly used on cowpea, a plant locally known to attract pests.

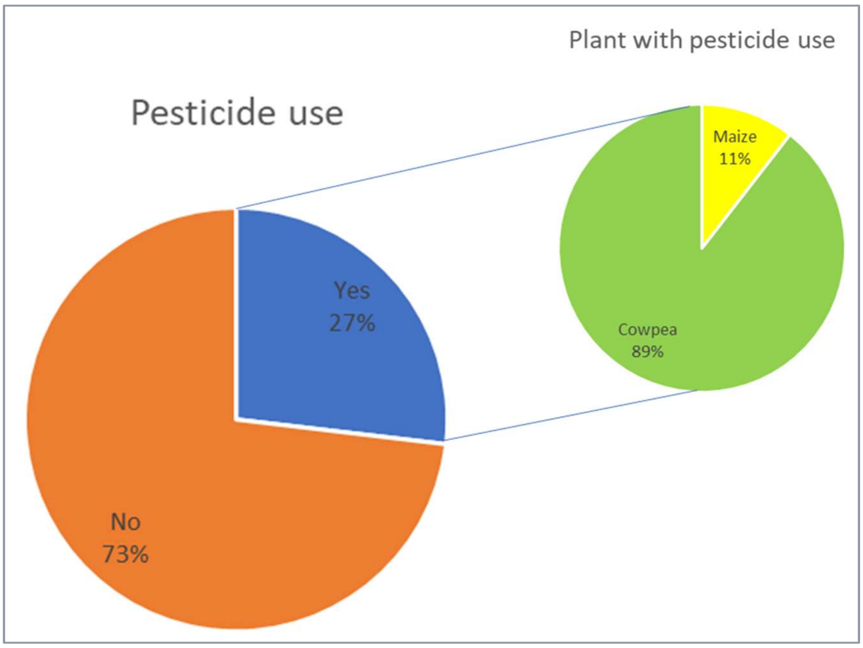

Figure 9: Pesticide use for the 202 fodder demo plots in the ALL of Burkina Faso and plants concerned for pesticide users

Table 2 presents the monitoring program for pests and diseases

Table 2: Pest or disease monitoring program

Pest or disease	Monitoring program	Method
Pests	Farmers' observation during the trial	observation

2.3.2.2 Soil Characteristics

Table 3 presents the soil characteristics and monitoring method.

Table 3: Soil characteristics and monitoring (source: Data from HOLPA survey, Bobo-Dioulasso, 2023-2024)

Soil feature	Values	Monitoring program	Method[1]	Unit[2]
Organic carbon	0.89 ± 0.36	Samples were taken from growers' fields in a single pass	Laboratory analysis	%
Organic matter	1.53 ± 0.62	Samples were taken from growers' fields in a single pass	Laboratory analysis	%

[1] Describe the analytical method. [2] Unit (%, mg/kg, meq/100g, pH)

2.3.2.3 Agricultural inputs

Most of the fodder demo-plots did not received mineral fertilizer (148 out of 202) as the objective of the trials was to optimize manure use. Figure 10 below shows the level of mineral fertilizer use and the plant concerned for the 54 farmers that declared using mineral fertilizer. Figure 10 shows that high doses of mineral fertilizer mainly concerned the two cereal crops that indeed needs significant nutrient inputs. Interestingly, regarding the low doses, we observe on Figure 8 that cowpea is concerned while it is a legume that fix nitrogen through symbiotic fixation.

For specific data used in each of the 202 fodder demo-plots, please refer to the document "Agronomic_data_Burkina_English".

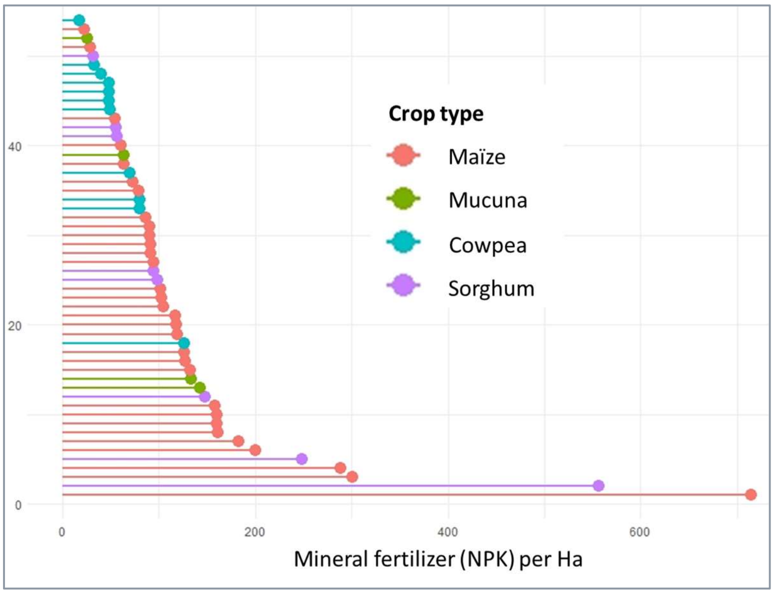

Figure 10: Mineral fertilizer use on the 54 fodder demo plots of the ALL of Burkina Faso. All other fodder demo plots did not received any mineral fertilizer

2.3.3 Environmental dimension

The first phase of the Initiative has not focused on the environmental dimension and the local team will further explore this dimension in the next phase. For instance, the use of Jabnde tool (to establish balanced dairy cow diets) has allowed to estimate the methane emission from different cattle feed ration, and this type of analysis will be pursued in the next phase.

2.3.4 Socioeconomic dimension

As shown in Figure 11 expenditure on cereal production (maize and sorghum) is much higher than on legumes (cowpea and mucuna). This is due to the fact that cereals are very demanding in terms of fertilizers, particularly maize, which in general accounts for the bulk of expenditure. This is why it makes sense to improve and increase organic manure production on a dairy farm scale. In the next phase, the local team and the farmer will work to further reduce production costs for the different crops.

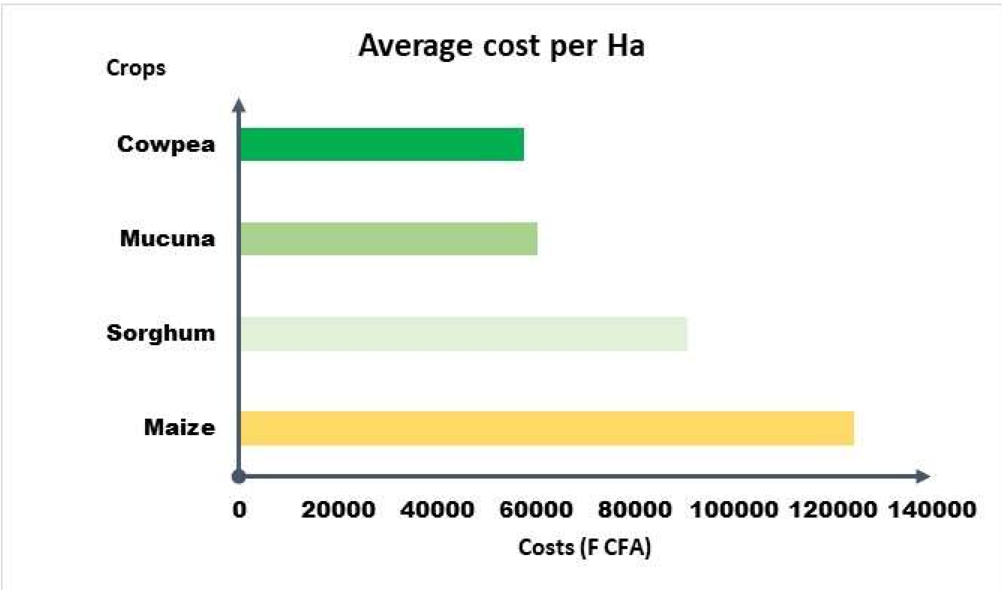

Figure 11: Average cost of cropping cowpea, mucuna, sorghum and maize in Bobo-Dioulasso area (source: monitoring of Fodders Demo-Plots, 2023)

2.4 Agroecology assessment

2.4.1 Specific assessment

Agroecological innovations tested: Cereals and legume fodder crops to increase biomass production for cattle feed ration

Agroecological principles tested: synergy, diversity, recycling

Comparative performance analysis (compared to conventional ration):

- Production of additional biomass to feed cattle, specially during the dry season
- Production of quality feed to compensate low quality feed on grazing area
- Production of biomass that can be stored to be used during the dry season

Hypothesis tested:

- Legume and cereal fodder crops can be grown under farmers' condition and generate enough biomass to feed dairy cattle during the dry season
- Legume and cereal fodder crops are quality fodder that allows to increase dairy production without increasing production cost (in comparison to conventional approach based on grazing area and concentrate feed)

2.4.2 General assessment

The agroecological technologies tested in the ALL of Burkina Faso with farmers involved in the co-design framework were assessed during participative workshops (Figure 12).

Figure 12: Participatory assessment of agroecological technologies tested in the ALL of Burkina Faso with farmers involved in the co-design framework

2.4.3 Assessment at plot scale level (fodder crops)

The results of the participatory assessment at plot scale level reveals very positive evaluation by farmers of the two alternative AE technologies under study (Table 4). Indeed, the conventional practice is mostly ranked under the average value, due to low biomass available if crop grown are not specifically fodder crop. Indeed, most current varieties focused on grain production, to the detriment of the biomass available for the alimentation of the cattle. The introduction of the cereal fodders increases this biomass production and then get higher score on all dimensions assessed (Figure 13 and 14). This cereal crop offers both biomass optimization and grain production to contribute to household food security. The highest rank technology is the legume fodder, as it increases the diversity of crop grown and also provide a very qualitative fodder to feed the dairy cows. Legume also offers the capacity to fix nitrogen in the soil, a crucial advantage in this region where farmers have very low access to mineral fertilizer.

Table 4: Results of the participatory assessment of conventional practices versus agroecological technologies at plot scale level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition: Diversity, Synergies, Efficiency, Recycling

Treatment	Element	Index[1]				Element Score[2]	Rating[3]
		I	II	III	IV		
T0: Conventional cereal crop + low manure	Diversity	2	1	2	1	6	37,5
T1: Cereal fodder crop + high manure		3	2	3	2	10	62,5
T2: Legume fodder crop + high manure		4	3	4	2	13	81,25
T0: Conventional cereal crop + low manure	Synergies	1	1	1	1	4	25
T1: Cereal fodder crop + high manure		2	2	2	2	8	50
T2: Legume fodder crop + high manure		3	1	3	3	10	62,5
T0: Conventional cereal crop + low manure	Efficiency	1	1	2	1	5	31,25
T1: Cereal fodder crop + high manure		2	2	1	2	7	43,75
T2: Legume fodder crop + high manure		3	3	1	3	10	62,5
T0: Conventional cereal crop + low manure	Recycling	1	1	3	1	6	37,5
T1: Cereal fodder crop + high manure		3	2	2	2	9	56,25
T2: Legume fodder crop + high manure		4	2	3	2	11	68,75

Keys: Index[1]: Scoring from 0 to 4 for each index (I = Crops ; II = Animals (including fish and insects) ; III = Trees (and other perennials) ; IV = Diversity of activities, products and services) ; Element Score[2]: Sum of Index scores, ranging between 0 to 16 ; Rating[3]: (Element score/16) * 100

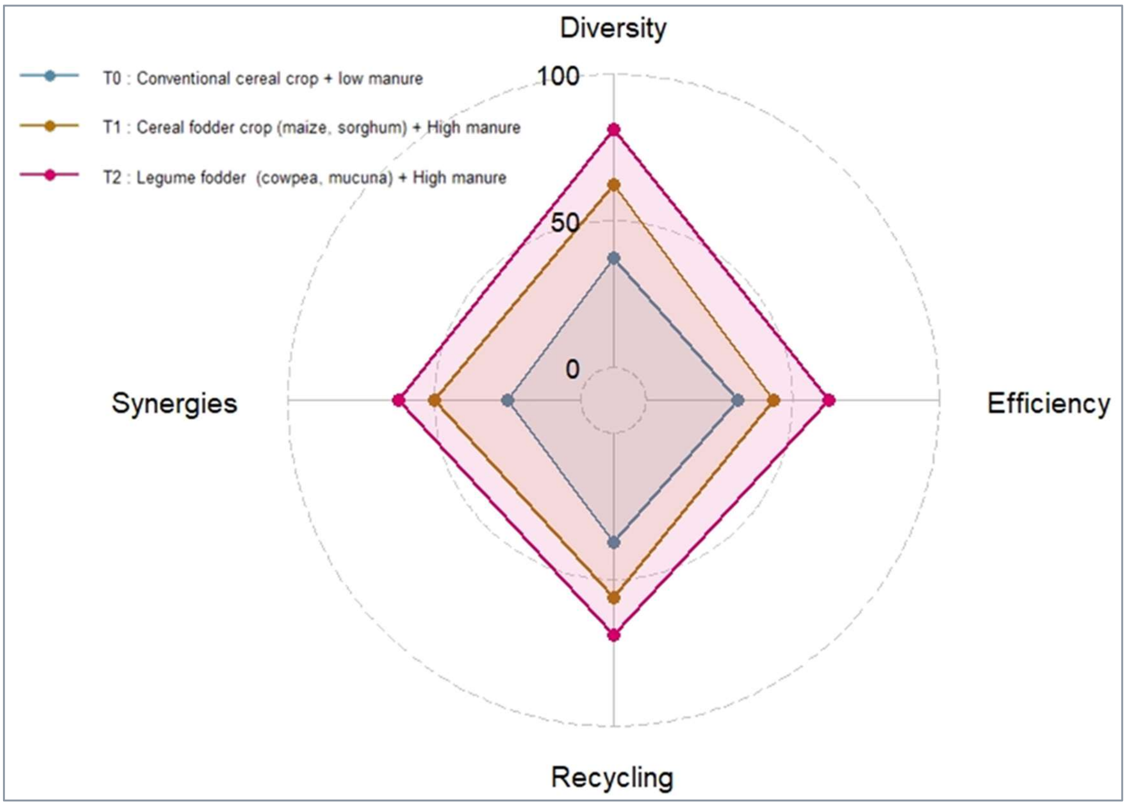

Figure 13: Results of the participatory assessment of conventional practice versus agroecological technologies at plot scale in Burkina Faso ALL level for 4 dimensions of the Characterization of Agroecological Transition (diversity, synergies, efficiency, recycling)

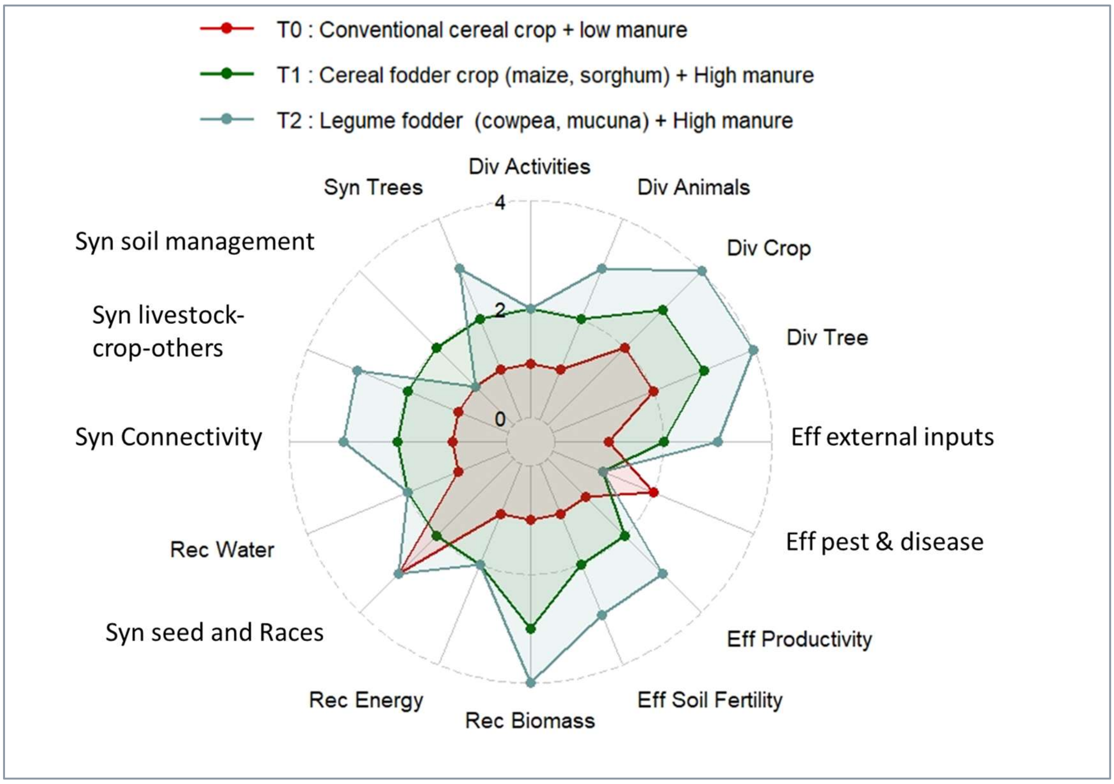

Figure 14: Results of the participatory assessment of conventional practices and agroecological technologies at plot scale level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition and its sub-categories (diversity, synergies, efficiency, recycling)

2.4.4 Assessment at landscape scale: livestock feeding strategies

Results of this participatory assessment of technologies at landscape level offers a clear hierarchization from the lower rank (conventional practice) to the higher rank (crop residue and mixture of crop and cereal fodder with low concentrate feed), with average value for solely one type of fodder (legume or cereal) in addition of crop residue and low concentrate feed (Table 5 and Table 6). Figure 15 and 16 below shows that T1 and T2 have a same raking on most dimension, always better than the conventional practice. The combination of these 2 types of fodder, represented in T4, clearly display the highest rank, as it combines (i) the capacity of legume to fix nitrogen and produce biomass and (ii) the capacity of cereal crops to produce grain for the household food security and produce biomass. These results, at systemic scale, demonstrate that expectation from agroecological technologies are not focused on a single dimension but they are expected to achieve high performance on various aspects of the farming system.

Table 5: Results of the participatory assessment of conventional practices versus agroecological technologies at landscape scale level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition, Part 1: Diversity, Synergies

Treatment	Element	Index[1]				Element Score[2]	Rating[3]
		I	II	III	IV		
T0: Grazing land, crop residue, concentrate feed	Diversity	1	2	2	1	6	37,5
T1: Low grazing land, crop residue, cereal fodder, low concentrate feed		2	3	3	2	10	62,5
T2: Low grazing land, crop residue, legume fodder, low concentrate feed		2	3	3	2	10	62,5
T3: crop residue, legume & cereal fodder, low concentrated feed		3	4	4	4	15	93,75
T0: Grazing land, crop residue, concentrate feed	Synergies	1	2	2	2	7	43,75
T1: Low grazing land, crop residue, cereal fodder, low concentrate feed		3	2	2	3	10	62,5
T2: Low grazing land, crop residue, legume fodder, low concentrate feed		3	1	2	3	9	56,25
T3: crop residue, legume & cereal fodder, low concentrated feed		3	1	3	4	11	68,75

Keys: Index[1]: Scoring from 0 to 4 for each index (I = Crops; II = Animals (including fish and insects); III = Trees (and other perennials); IV = Diversity of activities, products and services); Element Score[2]: Sum of Index scores, ranging between 0 to 16; Rating[3]: (Element score/16) * 100

Table 6: Results of the participatory assessment of conventional practices versus agroecological technologies at landscape level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition, Part 2: Efficiency, Recycling

Treatment	Element	Index[1]				Element Score[2]	Rating[3]
		I	II	III	IV		
T0: Grazing land, crop residue, concentrate feed	Efficiency	1	2	1	1	5	31,25
T1: Low grazing land, crop residue, cereal fodder, low concentrate feed	Efficiency	2	2	1	2	7	43,75
T2: Low grazing land, crop residue, legume fodder, low concentrate feed	Efficiency	2	2	2	2	8	50
T3: crop residue, legume & cereal fodder, low concentrated feed	Efficiency	3	3	1	3	10	62,5
T0: Grazing land, crop residue, concentrate feed	Recycling	1	1	2	1	5	31,25
T1: Low grazing land, crop residue, cereal fodder, low concentrate feed	Recycling	2	2	3	2	9	56,25
T2: Low grazing land, crop residue, legume fodder, low concentrate feed	Recycling	3	2	3	2	10	62,5
T3: crop residue, legume & cereal fodder, low concentrated feed	Recycling	4	4	2	4	14	87,5

Keys: Index[1]: Scoring from 0 to 4 for each index (I = Crops; II = Animals (including fish and insects); III = Trees (and other perennials); IV = Diversity of activities, products and services); Element Score[2]: Sum of Index scores, ranging between 0 to 16; Rating[3]: (Element score/16) * 100

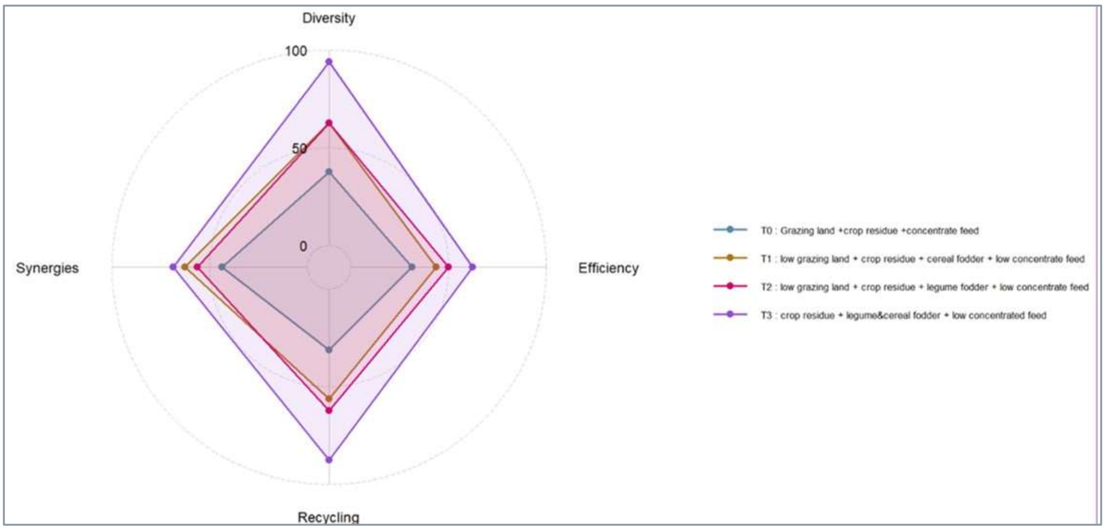

Figure 15: Results of the participatory assessment of conventional practices versus agroecological technologies at landscape level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition (diversity, synergies, efficiency, recycling)

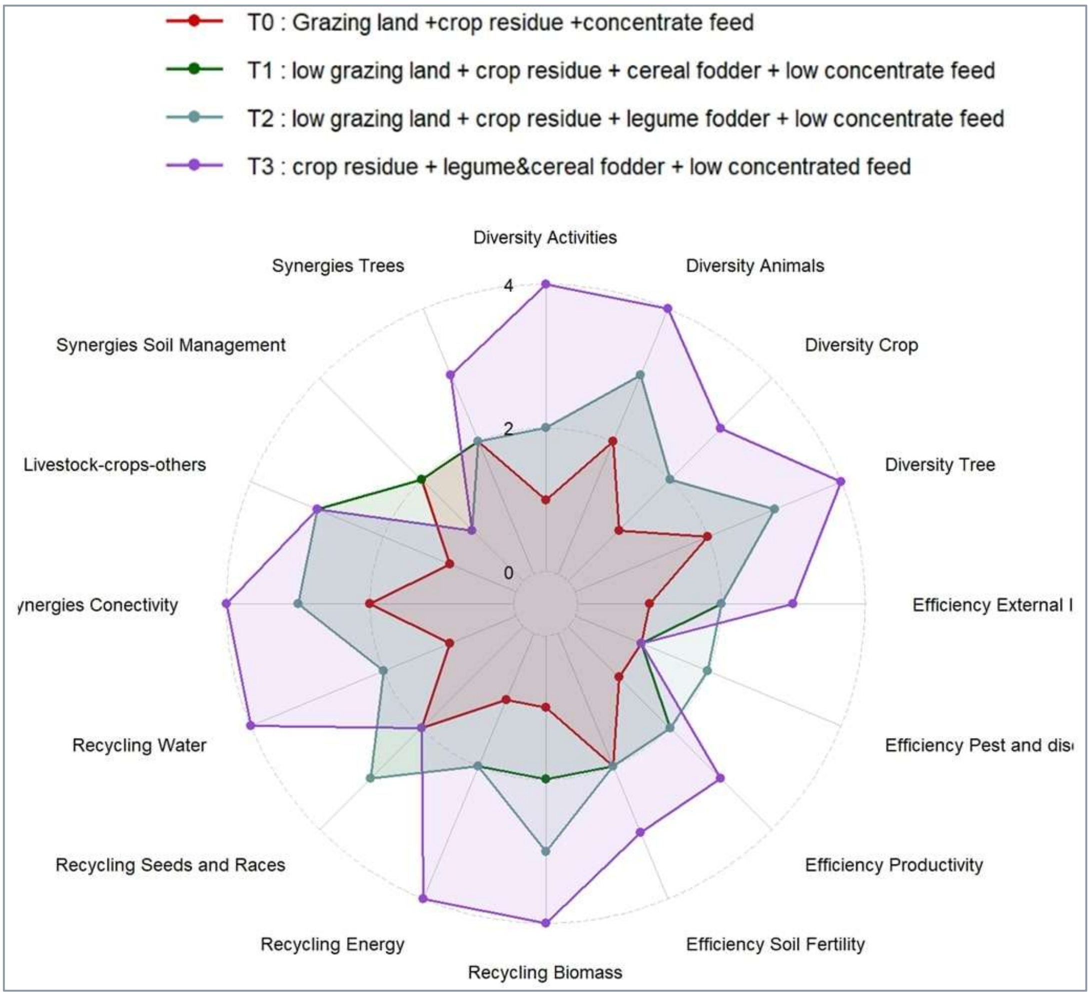

Figure 16: Results of the participatory assessment of conventional practices versus agroecological technologies at landscape level in Burkina Faso ALL for 4 dimensions of the Characterization of Agroecological Transition and its sub-categories (diversity, synergies, efficiency, recycling)

3 Conclusion

The two levels of participatory evaluation of the Characterization of Agroecological Transition carried out (farmers' cropping systems and dry-season dairy cows feeding practices) revealed that the introduction of dual-purpose forage crops improved the production systems of dairy farms. Conventional cultivation and cow-feeding practices were mostly ranked below the technologies tested, according to the agroecological dimensions of diversity, synergy, efficiency and recycling. The availability of forage resources enabled animals to be fed during the dry season, helping to reduce the use of natural pasture. Thus, animals fed on the farm increase the availability of organic manure, which is then used to improve field fertility.

Recommendations

To dairy farmers:

- ✓ Improve the management of fodder demo plot (protect the fodder plots against livestock intrusion, Raise awareness of farmers on the importance of good forage storage and conservations practices);
- ✓ Improve the use and the management of their co-product in order to increase fodder storage, manure production and maintaining mulch;
- ✓ Improve dairy cow diets at an affordable cost by using the resources available at farm level (grazing of spontaneous rangeland; forage crops residues; cultivated forages; and reasonable use of feed concentrates by on the market);
- ✓ Keep abreast of weather warnings to know the best time to sow.

Technical services for breeding and meteorology:

- ✓ Training dairy farmers in the production and conservation of forage and forage seed;
- ✓ Advising dairy farmers with CoProdScope tool for smart management of their farm co-products in order to optimize fodder storage, manure production and maintaining mulch
- ✓ Advising dairy farmers with Jabnde tool for smart management of the diet of their dairy cows in order to reach their objective of milk production at an affordable cost;
- ✓ Encourage milk producers to expand their fodder crop areas (through rental or acquisition of land)
- ✓ Set up an early weather warning system to keep dairy farmers informed.

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