Working Document

WORK PACKAGE 2

Preliminary results of the agroecological performance assessment of milk-producing farms in the Bobo-Dioulasso production basin using the HOLPA tool

English version

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The CGIAR Initiative Transformational Agroecology across Food, Land, and Water Systems develops and scales agroecological innovations with small-scale farmers and other food system actors in seven low- and middle-income countries. It is one of 32 initiatives of CGIAR, a global research partnership for a food-secure future, dedicated to transforming food, land, and water systems in a climate crisis.
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Contents

1 Introduction

Agroecology is an approach to achieving sustainable farming and food systems, rooted in a set of principles (recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, co-creation of knowledge, social values and diets, equity, connectivity, governance of land and natural resources, and participation) that emphasize the need to work with nature rather than against it. It aims to achieve social justice by co-creating knowledge, increasing the participation of farmers and multiple stakeholders in decision-making, while strengthening the connection between producers and consumers.

It is in this context that the CGIAR Initiative on Agroecology project, through one of its specific objectives, aims to produce scientific evidence on the performance of agroecological farming systems, in order to promote their large-scale development in local areas. Achieving this objective requires collecting data and evidence on the performance of agroecological farming systems.

In order to produce locally relevant and globally comparable data on the performance of agroecological farming systems, Work Package 2 of the CGIAR Initiative on Agroecology has developed the HOLPA (Holistic Localized Performance Assessment for Agroecology) tool. But before applying this tool at farm level, the following steps are essential: (i) drawing up a context document taking into account the current situation of the targeted farming systems of the producers described using technical, economic, environmental and social criteria as well as the 13 principles of agroecology, (ii) getting to grips with the HOLPA tool and (iii) identifying local indicators specific to the milk value chain in the Agroecological Living Landscape (ALL).

As a reminder, in Burkina Faso, activities under this CGIAR Initiative on Agroecology project focus on the dairy value chain, with an ALL based on the Bobo-Dioulasso multi-stakeholder dairy innovation platform established in 2020 and other partner members affiliated to it. In 2023, the dairy innovation platform (DIP) was consolidated into an ALL with the incorporation of new members and partners as part of the said project.

To achieve this, the implementation of these activities involved researchers and the participation of several cooperatives of milk producers, processors, representatives of the public sector (Regional Directorate of Agriculture, Animal Resources, and Fisheries, Town Hall), Technical and Financial Partners, NGOs and professional organizations. All these stakeholders were involved, each in their own right, in drawing up the context document, identifying local indicators, familiarizing themselves with the HOLPA tool and collecting quantitative and qualitative data.

This report summarizes all the activities carried out in 2023 to assess the performance of agroecological farming systems based on evidence gathered in the Bobo-Dioulasso dairy basin.

2 Drawing up a context document

The context document prepared as part of the CGIAR Initiative on Agroecology project presents agriculture and its agroecological characteristics in the Hauts Bassins region, which is the implementation area for the Agroecological Living Landscape project in Burkina Faso.

Agriculture in this region is based on agro-sylvo-pastoral systems in which cotton production plays a predominant role, with a greater or lesser presence of livestock on the farms, particularly cattle exploited for their milk. In the first part, the document presents a brief review of the main elements making up the physical, administrative, social, economic and political context of the Hauts Bassins region. It then presents the main characteristics of the region's production systems:

- The characteristics and evolution of the agro-sylvo-pastoral system, the main form of agriculture in the region;
- The dairy production systems that will be the focus of our work as part of the CGIAR Initiative on Agroecology;
- Legume production systems (seed and fodder) which, through their production of high-quality fodder biomass, have very important potential links with dairy production systems.

Further information on agriculture and its agro-ecological characteristics can be found in the latest version of the context document, which can be cited as follows:

Kouakou Patrice Koffi, Sib Ollo, Orounladji Boko Michel, Assouma Mohamed Habibou, Ouedraogo Adama, Vall Eric. 2023. Context document Burkina Faso. Agriculture and agroecology in the Hauts-Bassins region, an ALL intervention area in Burkina Faso. Montpellier: CGIAR Initiative on Agroecology, 50 p. https://agritrop.cirad.fr/607595/

3 Getting to grips with the HOLPA tool

Getting to grips with the tool was achieved through a workshop whose main objectives were to :

- Understand the HOLPA tool and how it will be used to answer questions about the performance of agroecological farming systems.
- To examine the processes involved in implementing the HOLPA tool as part of the CGIAR Initiative on Agroecology project in Burkina Faso.
- Identify the next steps in implementing the HOLPA tool.

The implementation of the HOLPA tool will result in the generation of evidence on the performance of agroecological farming systems to deliver sustainable, resilient and inclusive livelihoods and food systems in all contexts.

The questionnaire used to collect the data comprises two parts: 1) a general section; 2) an agroecology-specific section, i.e. the performance of agroecological farming systems specific to each case study.

The general section includes the following parts: general information on the farm, respondent characteristics, farm household characteristics, political context and motivation for transition.

The specific agroecology component addresses the following points: (i) recycling, (ii) input reduction, (iii) soil health, (iv) animal health, (v) biodiversity, (vi) synergy, (vii) economic diversification, (viii) knowledge co-creation, (ix) social values and diets, (x) equity, (xi) connectivity, (xii) governance of land and natural resources, and (xiii) participation.

The HOLPA tool focuses on a set of 19 indicators (Table 1) that are simple, robust and holistic, and are to be assessed on all project sites. Beyond these general indicators, local priority indicators will be assessed at each site.

In a recent publication (Vall et al., 2023), we showed that in the agro-sylvo-pastoral systems of western Burkina Faso, crop-livestock interaction practices and the recycling of plant and animal by-products into fodder and organic manure contribute strongly to the agroecological characteristics and performance of these farming systems. The concerned practices are as follows:

1) Storage of crop by-products (straw, tops) for fodder purposes

2) Production of manure and compost from animal and plant by-products in night pens and manure pits

3) Night-time herd parking in fields for fertilization purposes

4) Reasoned management of organic fertilization of fields

5) The use of animal power for tillage and transport

However, these practices are not taken into account in the 19 indicators of the HOLPA tool. The absence of these indicators in the HOLPA tool will have the consequence of obscuring a very important part of the agroecological characteristics of the farming systems studied in Burkina Faso.

Table 1. Global indicators for evaluating the agroecological performance of farming systems integrated into the HOLPA tool

Dimensions	Indicators	Methods
Agricultural/technical	Plant health	Diseases, losses and disease prevention practices reported by producers
	Animal health and welfare	Animal illnesses and deaths reported by producers and welfare practices
	Fertilizer use/ Nutrient balance	Quantity applied per hectare
	Use of energy	Energy source and end use declared by producer
	Soil health	Soil organic carbon from soil samples
Economical	Climate resilience	Adapted from FAO RIMA
	Crop, animal and fish productivity	Per unit area or head
	Labor productivity	Hours declared by the producer per year, separating adults/children, employees/non-employees
	Income	Income bracket declared by the producer, income in relation to expenses
Environmental	Diversity of crop, animal and fish species	Farmer's declaration, supplemented by a farm transect
	Tree diversity	Farm observation
	Natural vegetation on the plot	Producer's declaration, completed by a farm transect
	Water use and water stress	Irrigation use, sources and dependence, water shortages, rainwater harvesting
	Climate mitigation	Qualitative assessment of the mitigation potential of agricultural practices
Social	Adaptability	State of support networks, access to credit, indebtedness
	Land security	Producer-declared ownership and use, and risk of loss of ownership or use
	Food quality	Questionnaire adapted to the Global Food Quality Project
	Agricultural agencies	Scale of power and freedom
	General index of human well-being	OCED well-being index

4 Identification of specific local indicators to the Burkina Faso case study

The identification of specific indicators to the case study (Local Indicator Selection Process - LISP) to qualify the agroecological character of the agricultural and food systems studied in Burkina Faso was carried out during a workshop (Figure 1). During the workshop, the concepts of performance indicators and agroecology were clarified for the participants.

The four dimensions (i.e. agricultural/technical, social, economic and environmental) on which the identification of local indicators should be based were presented to participants, enabling them to identify indicators in line with the ALL vision for Burkina Faso. As a reminder, the ALL's objective is to produce, collect, process and market 18,000 liters of local milk per day in the Bobo-Dioulasso production basin by 2028.

It was therefore necessary to identify context-specific indicators. To limit themselves to these specific indicators, participants were asked to identify what they would like to see in relation to the various objectives and changes envisaged, and then to discuss how they might measure or monitor the changes.

Once the local indicators had been identified, they were evaluated on the basis of the following criteria:

- Relevance to the sustainability of agricultural systems in the Sahel
- Scientific relevance
- Feasibility
- Usefulness
- Sensitivity

Following assessment of the quality of the indicators, the three priority indicators per dimension are as follows:

- Agricultural dimension: 1) number of manure pits/farm, 2) quantity of fodder produced in all seasons/farm and by type (quality fodder, roughage), 3) number of fodder storage facilities/farm.

- Social dimension: 1) number of local milk industry players trained in innovative agricultural practices, 2) number of public and private services that include local milk in coffee breaks and meals, 3) number of local milk producers who are aware of and master the rules of living together (respect for others).

- Economic dimension: 1) cost of forage production, 2) cost of boreholes, 3) cost of health coverage.

- Environmental dimension: 1) number of mini-dairies equipped with hygiene equipment, 2) areas secured through title documents, 3) number of users of biodegradable packaging.

The 3 priority indicators per dimension were used to develop a complementary questionnaire that was integrated into the household survey form for the application of the HOLPA tool on dairy farms.

Figure 1. Participants in plenary session (left) and discussion group (right) at the workshop to identify local indicators.

5 Application of the HOLPA tool on dairy farms

5.1 Study framework

Data were collected from milk producers located in the ALL intervention area in Bobo Dioulasso, in the Hauts-Bassins region of western Burkina Faso (Figure 2). The region comprises three administrative provinces: Houet, Kénédougou and Tuy. These three provinces comprise a total of 33 communes, three of which have the status of urban communes, corresponding to the regional capitals. These are the communes of Bobo-Dioulasso, Orodara and Houndé. They cover a total area of 25,479 km², or 9.4% of the national territory.

The Hauts-Bassins region has a Sudano-Sahelian climate. Rainfall is characterized by an alternating dry and rainy season during the same year. At the Hauts-Bassins latitude, the longer dry season lasts around 8 months (from October to May). The region is then subject to harmattan activity, a warm, dry wind during the day, cool at night, blowing in a north-easterly to south-westerly direction from the Sahara high pressure zone. The shorter rainy season extends from June to September, with maximum rainfall in August. Average annual rainfall over the past 25 years has not exceeded 1,200 mm in the Hauts-Bassins region. Average daily temperatures are also subject to seasonal variation. In the middle of the rainy season, they are low, with an average of 26°C. During the dry season, they are high, with an average maximum of 32 to 33°C. Evapotranspiration (ET) is generally very high. It exceeds rainfall during the period from October to June, i.e. for more than nine months, leading to a significant drop in water resources, which is detrimental to livestock farming. However, the effects of climate change are a reality in the Hauts-Bassins region.

The population of the Hauts-Bassins region is young. According to the Institut National de la Statistique et de la Démographie (INSD, 2022), the 5-14 age group accounts for 27% and the 15-64 age group for 55% of the total population, estimated at 2,239,840 (including 1,094,100 men and 1,145,740 women). The gender structure of the population of the Hauts-Bassins region is similar to that of Burkina Faso as a whole. The population is made up of around 49% men and 51% women. The Hauts-Bassins region, with 10.9% of Burkina Faso's total population, remains one of the most densely populated regions. Over the period 2006-2019, the Hauts-Bassins region recorded an intercensal population growth rate

of 3.29%. The working-age population represents 54.7% of the total. This represents an economic and social challenge for local authorities in terms of health, education and employment.

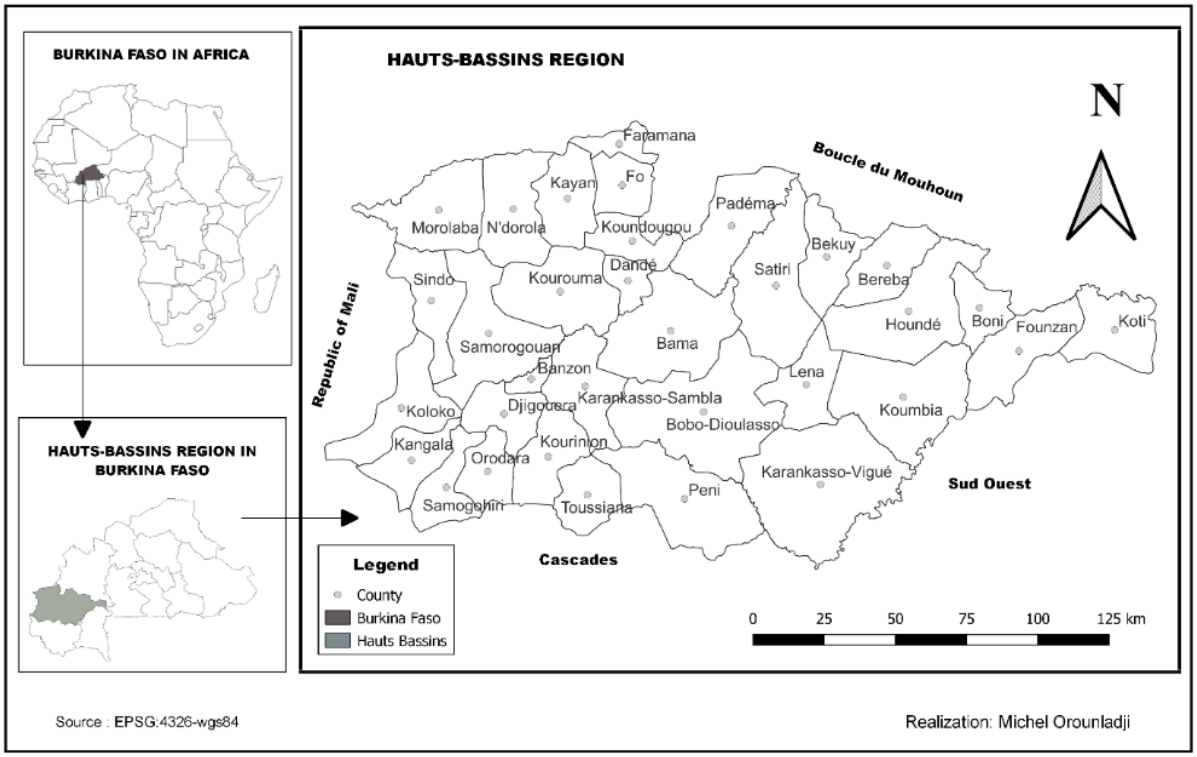

Figure 2. Administrative map of the Hauts-Bassins region

5.2 Sampling

We used non-probability sampling to select producer households for our data collection. Our survey covered 52 producers associated with local milk production systems in 2023. To ensure an agroecological gradient within each production system, farm selection was based on the following inclusion criteria:

- Producers affiliated to the Bobo Dioulasso ALL who may or may not have already participated in agroecology projects.
- Producers who intend to join the Bobo Dioulasso ALL and who express the desire to convert to sustainable practices.
- Voluntary producers implementing the agroecological package (Fodder Demo-Plot, manure pit, reasoned co-product management (with the CoProdScope tool), reasoned dry-season dairy rationing (with the Jabnde tool)).

5.3 Collecting data

Qualitative and quantitative data were collected in this study using an electronic questionnaire loaded onto KoboToolbox. The information is collected by successively applying the household and farm

surveys to each producer. After obtaining the respondent's consent for the data to be published without their personal information, the questionnaire addressed some data on general information such as location, scale (e.g. plot, farm, landscape) and interviewer details. Four modules were covered in the household questionnaire. These were: (i) context module, (ii) agro-ecology (Ae) integration module, (iii) global key performance indicators module and (iv) local indicators module.

The various themes addressed in the context module include the collection of demographic information and involves the recording of respondent characteristics such as age, gender, sociolinguistic group, education, marital status, occupation, length of residence in the community, relationship with the head of household, involvement in farming activities, participation in farmers' associations and involvement in agricultural research or development projects. In addition, farm household characteristics such as household structure, agricultural production system, end use of agricultural products, fertilizer inputs and disease management, farm size and land tenure patterns are collected to assess socio-economic and environmental factors related to the unit of assessment. The context assessment also seeks to explore motivation and attitude towards agroecology by assessing personal perspectives on agroecology.

The agroecological integration module is designed to assess the current state of practices using questions covering the 13 principles of agroecology and two additional questions to determine self-perceived adherence to these principles. The module aims to characterize the current level of adherence to agroecology, or the degree of agroecological transition, by assessing farming practices and the overall benefits derived from these practices. Most questions are multiple-choice, using a five-point Likert scale. All survey responses are scored from 1 to 5. On the basis of a median score reported for all Ae principles, a composite score between 1 and 5 can be generated to characterize the overall agroecological state. The cross-cutting theme on "self-perceived adherence" is assessed on the basis of questions designed to gauge the respondent's opinion of the extent to which their field, farm or landscape is agroecological, with responses varying between extremes of completely non-agroecological to completely agroecological. Self-perceived adherence provides an alternative way of assessing the level of transition to agroecology.

The global indicators module is used to assess the agro-ecological performance of the farming system at a selected scale, using a set of survey questions and field measurements of indicators. The sections of the survey questionnaire and field measurements cover several different elements related to the four general domains of agriculture, economy, environment and social. The data collected in this module are used to estimate agricultural, economic, environmental and social performance when formulating the following questions: 1) What are the impacts of increased adherence to agroecology?, 2) What are the trade-offs between sustainability dimensions?

The local indicators module addressed questions on the four dimensions of farm performance evaluation. In terms of the technical/agricultural dimension, questions concerned the number of manure pits/farm, the quantity of fodder produced per farm and per type (quality fodder, roughage) in all seasons, and the number of feed storage facilities. As for the social dimension, data are collected on local milk industry players trained in innovative farming practices and farm management, and on local milk producers who are aware of and master the rules of living together (respect for others, hygiene). The costs of fodder production, boreholes and sanitary coverage were collected for the economic dimension. Finally, the environmental dimension focused on areas secured through title deeds and the use of biodegradable packaging.

For the farm survey, data on biodiversity, soil health and crop health are collected for use in assessing these different parameters. Soil samples are also taken for laboratory analysis to determine soil organic carbon on these farms.

Before launching the survey, the questionnaire was tested by the interviewers on a few farms in order to :

- finalize the survey questionnaire and make final adjustments;
- check that interviewers are familiar with using the tablets and the questionnaire (understanding the questions and possible answers).

5.4 Data analysis

Analyses were performed using R 4.3.2 software (R Core Team, 2023). Data on socio-demographic profiles and farm technical performance were subjected to descriptive statistics. Producers' perceptions of agroecology and their well-being are presented in the form of likert-scale graphs after subjecting the data to tests through the tidyverse (Wickham et al., 2016 and 2019) and likert (Bryer and Speerschneider, 2016) packages.

Data from local indicators taking into account the four dimensions of farm performance evaluation were subjected to Factorial Analysis of Mixed Data with Hierarchical Ascending Classification using the factoextra package (Kassambara and Mundt, 2020). This data analysis enabled the emergence of homogeneous groups of farms with regard to the 11 selected variables (Table 3). An analysis of variance (ANOVA) was performed on the 9 quantitative variables. This was supplemented by a Student Newman-Keuls test for comparison of means in the event of significant differences ($p < 0.05$) observed between farm groups using the agricolae package (de Mendiburu, 2023). However, Kruskal Wallis tests were applied when certain data failed to meet the conditions for applying ANOVA.

Table 2. Variables used to classify farms

Variables	Unit	Description
Total area	ha	Total farm area declared by respondent
Area with uncontested ownership	ha	Area of farm for which the respondent holds full ownership rights
Cattle herd size	TLU	Number of cattle declared x 0.7 (conversion coefficient)
Manure pits	U	Number of working manure pits per farm
Quantity of quality forage	kgDM/UBT	∑quantity of $_{\text{quality forage}}$ [Number per means of transport (U) x Conversion coefficient (kgDM)]/Total number of cattle (TLU). Conversion coefficients: Boots: 3; Rickshaw: 35; Motorcycle: 20; Dump truck: 100; Small platform cart: 170; Large platform cart: 250; Tricycle: 150; Trailer: 530
Quantity of roughage	KgDM/TLU	∑quantity of $_{\text{roughage}}$ [Number per means of transport (U) x Conversion coefficient (kgDM)]/Total number of cattle (TLU). Conversion coefficients: Boots: 3; Rickshaw: 40; Motorcycle: 30; Dump truck: 100; Small platform cart: 170; Large platform cart: 250; Tricycle: 150; Trailer: 540
Silos	U	Number of functional silos per farm
Hayloft	U	Number of hayloft units per farm
Feed sheds	U	Number of forage sheds per farm
Annual cost of cow health monitoring	FCFA	Annual health monitoring costs for a cow
Raising awareness of the rules of living together	%	Proportion of respondents who have been made aware of the rules of living together

Legend: ha: hectare; TLU: Tropical Livestock Unit (1 TLU = 1 cattle of 250 kg live weight); U: unit; kgDM: kilogram of dry matter; 1 USD = 605 FCFA

6 Results and discussion

6.1 Respondents and their understanding of agroecology

6.1.1 Socio-professional characteristics of respondents

The majority of respondents are men, representing 90.38% of the sample, while women make up only 9.62% of the sample (Table 4). Most respondents (65.38%) can neither read nor write, while 32.69% can read and write. Only 1.92% can write. The majority of respondents have no level of education (59.62%), followed by primary (19.23%), secondary (13.46%) and university (7.69%). The vast majority of respondents are cohabiting (90.38%), followed by those who are single (3.85%) and married (3.85%). The Peulh community is the most represented in the sample with 71.15%, followed by respondents from other sociolinguistic groups such as the Bissa and Gouroussi (5.77%), the Dafing (5.77%), the Mossi (13.46%), and the Bobo (3.85%). The vast majority of respondents (98.08%) are engaged in agricultural and/or livestock work, while a small proportion work in public administration (1.92%). As

far as capacity-building activities are concerned, most respondents attended training courses focusing on innovative or better management agricultural practices (53.85%), followed by agri-food management and value-added (15.38%), and other training (7.69%). Other training topics included animal husbandry practices, entrepreneurship, cooperative management and livestock feed formulation.

Table 3. Socio-professional characteristics of respondents

Variables	Number	Relative frequency (%)
Type		
Men	47	90.38
Women	5	9.62
Can you read and write in any language?		
Can't read or write	34	65.38
Can read and write	17	32.69
Can only write	1	1.92
Education level		
No	31	59.62
Primary	10	19.23
Secondary	7	13.46
University	4	7.69
Marital status		
Concubinage	47	90.38
Single	2	3.85
Married	2	3.85
Divorced / Separated	1	1.92
Sociolinguistic group		
Peulh	37	71.15
Mossi	7	13.46
Other (Bissa, Gouroussi)	3	5.77
Dafing	3	5.77
Bobo	2	3.85
Main activity		
Agricultural and/or livestock work	51	98.08
Public administration	1	1.92
Capacity building		
Innovative farming or better management practices	28	53.85
Agri-food management and added value	8	15.38
Other training	4	7.69

6.1.2 Age of respondents and demographic status of surveyed households

The average number of men aged between 18 and 65 in the households surveyed was 4 (Table 5). The minimum number is 0 and the maximum is 12. For women aged between 18 and 65, the average is 3, with a minimum of 1 and a maximum of 15. For men over 65, the average is 0 (minimum 0 and maximum 2). Similarly, for women over 65, the average is 0, with a standard deviation of 0. The minimum and maximum numbers are both 0 to 2. In the households surveyed, there is an average of 3 men under 18, with a maximum of 12. For women under 18, the average is 3, with a maximum of 9 women of this age per household.

The average age of respondents is 49, with a standard deviation of 8. The minimum age is 23, and the maximum is 73. This indicates a certain variability in the age ranges of respondents, with a concentration around the mean of 49 years.

Table 4. Number of individuals by age category in surveyed households and age of respondents

Variables	Mean	Standard deviation	Min	Max
Men (≥18 and ≤65years old)	4	2	0	12
Women (≥18 and ≤65 years old)	3	2	1	15
Male (>65 years old)	0	0	0	2
Women (>65 years old)	0	0	0	2
Male (<18 years old)	3	2	0	12
Female (<18 years old)	3	2	0	9
Age	49	8	23	73

6.1.3 Dairy farmers' level of theoretical knowledge about the meaning of agroecology

The majority (61%) of dairy farmers have only a little theoretical knowledge about the meaning of agroecology, but have ambitions to learn more (Figure 3). Those who know nothing about its meaning represent 31% of respondents, while only 8% claim to have a clear understanding of what agroecology means.

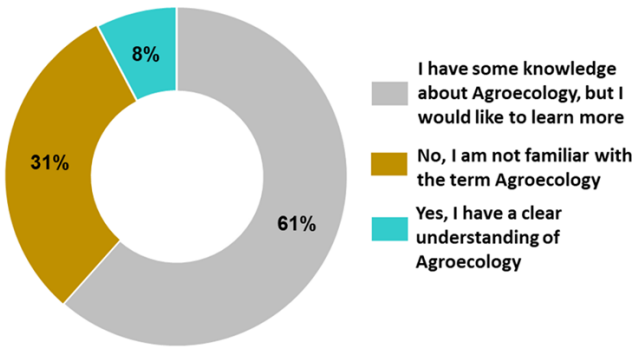

Figure 3. Producers' level of theoretical knowledge of agroecology

6.1.4 Dairy farmers' understanding of the meaning of agroecology

Of the 13 items that gathered producers' understanding of what agroecology means, 10 items received a favourable opinion: (i) eating local food, (ii) eating chemical-free food, (iii) caring for nature on one's farm, (iv) enjoying nature, (v) caring about nature, (vi) offering fair wages to workers, (vii) agroecology enables sound business decisions, (viii) opportunity to change community decisions, (ix) power to change production practices, (x) identifying oneself as an agroecological farmer (Figure 4).

On the other hand, producers recognize that current agricultural systems are not working well and need to be changed. They also say that decisions about what food to buy are not made primarily on the basis of price. As for the assertion that people take care of nature, opinions are rather mixed.

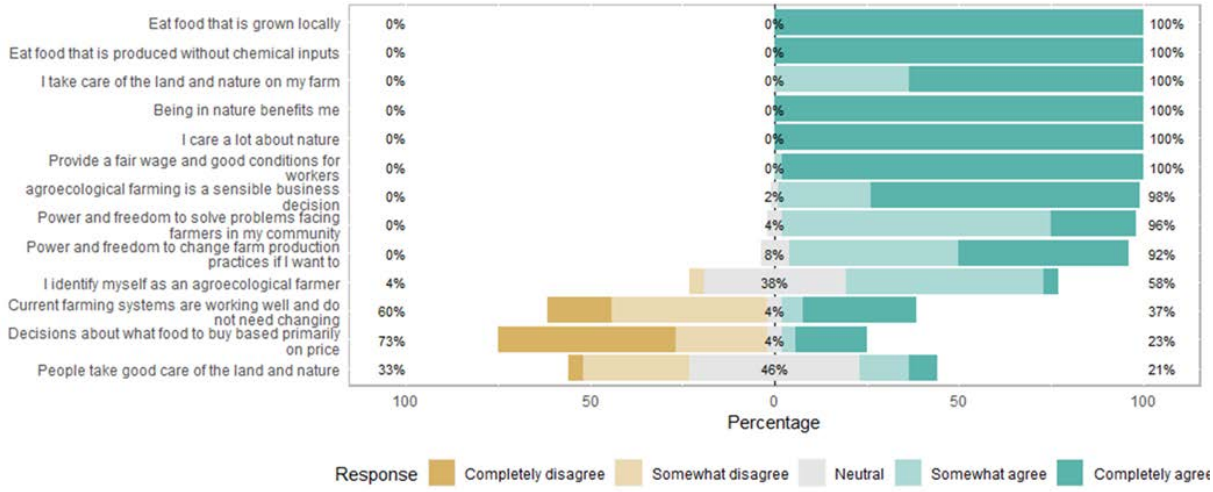

Figure 4. Producers' understanding of the meaning of agroecology

6.1.5 Dairy farmers' satisfaction and concern about their living conditions

Overall, producers expressed a sense of satisfaction with specific aspects of their lives (Figure 5). The assertions for which satisfaction is good are: (i) fulfilment in life, (ii) nutritional security, (iii) feeling integrated into the community, (iv) personal relationships, (v) standard of living, (vi) own life and personal situation, (vii) profession, (viii) time available to do the things one likes to do, (ix) health, (x) economic security, (xi) quality of the local environment. Opinions are mixed, however, when it comes to "feeling safe".

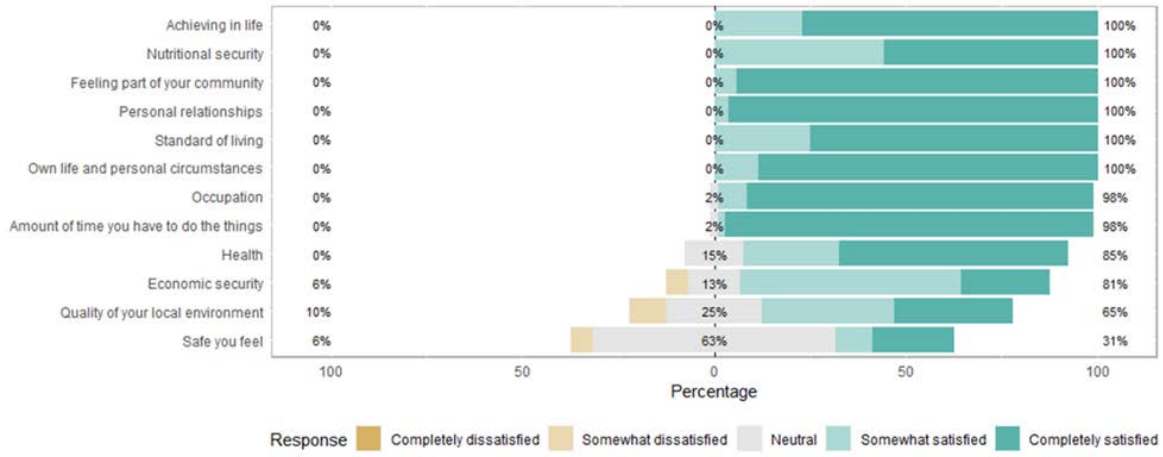

Figure 5. Producers' satisfaction with specific aspects of their lives

6.1.6 Power and freedom to make important decisions in the food system

Among men, the feeling of having the power and freedom to make most of the important decisions in the life of their household was total 10 years ago (100%), but today it has decreased slightly (96% - Figure 6). Among women, the feeling of not having the power and freedom to make most of the important decisions in the life of their household remains ultra-dominant (96%), even if the situation has improved slightly over the past decade.

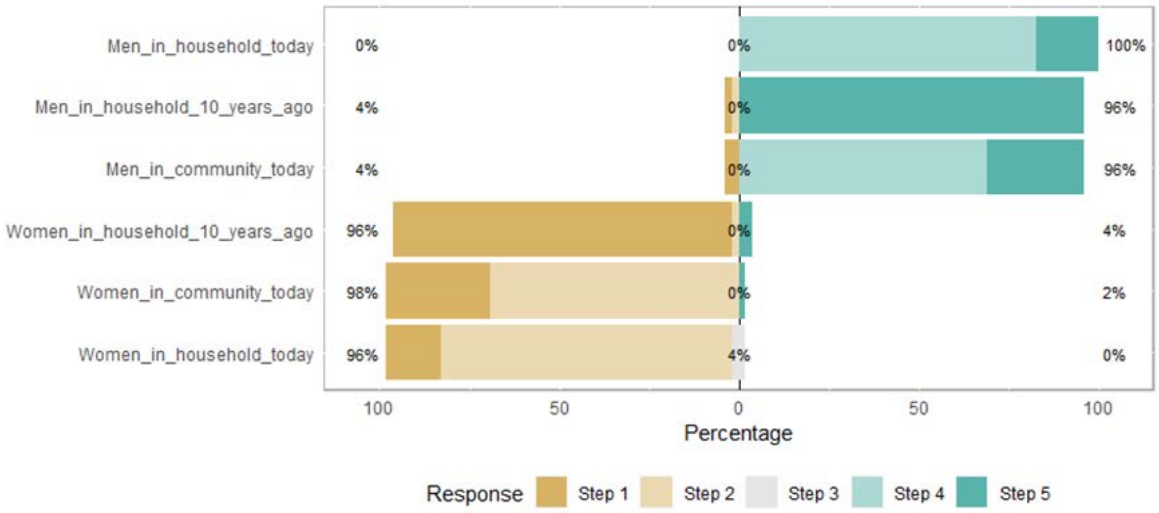

Figure 6. Power and freedom of decision-making

Legend: Step 1: Almost no power or freedom to make decisions; Step 2: Only a small amount of power and freedom; Step 3: Power and freedom to make important life decisions; Step 4: Power and freedom to make many important life decisions; Step 5: Power and freedom to make most important life decisions.

6.2 Breeding systems

6.2.1 Animal species diversity on farms

The various animal species raised on the farms and their numbers are shown in Table 6. Cattle come first, with a mean of 41 head/farm (ranging from 3 to 180 head). For goats, the mean is 15 head/farm, with numbers ranging from 4 to 50. For sheep, the mean is 17 head/farm, with figures ranging from 4 to 40. For poultry, mainly chickens, the mean is significantly higher at 207 head/farm. Values range from 0 to 1000 head, reflecting great variability in chicken numbers, with some flocks being very large.

Table 5. Diversity of animal species on farms

Species	Mean	Standard deviation	Min	Max
Cattle	41	33	3	180
Goat	15	11	4	50
Sheep	17	10	4	40
Poultry	207	261	0	1000

6.2.2 Origin of livestock

The majority of producers (61%) self-produce, exchange with their peers or collectively manage all animal genetic resources (Figure 7). For 29% of producers, 25% of animal genetic resources (e.g. chicks, young animals, semen) are purchased on the market, and the remaining 75% are self-produced or exchanged. A minority of producers (6%) declare that all animal genetic resources are purchased on the market and 4% of respondents estimate that 75% of animal genetic resources are purchased on the market and the remaining 25% are self-produced or exchanged.

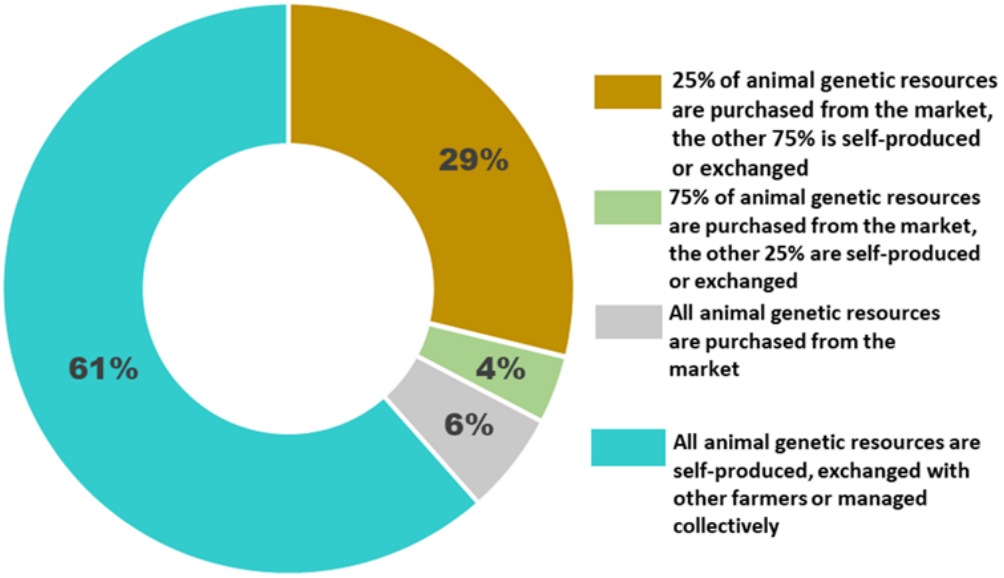

Figure 7. Origin of animals raised on the farms

6.2.3 Watering sources, grazing practices and animal welfare activities

The majority of respondents (73.08%) rely on surface water (dams/lakes) as a source of watering, while groundwater (wells, boreholes) is used by almost half of respondents (48.08% - Table 7). In terms of pasture, fodder and organic manure practices, manure collection (88.46%), parkland (80.77%) and the production of fodder legumes are the most common on farms. The practices concerning animal feeding, care and welfare, such as providing constant access to adequate feed, providing clean drinking water, offering shelter, carrying out regular checks for injuries/diseases, maintaining a hygienic environment, and providing medical assistance when needed, are declared by all respondents (100%) as widely adopted. Nearly all respondents (98.08%) felt that a diversified diet was offered to the animals. Vaccination and the use of antibiotics are the disease management practices implemented by all respondents (100%).

Table 6. Watering sources, grazing practices and animal welfare activities

Variables	Numbers	Relative frequency (%)
Watering sources		
Surface water (dam/lake)	38	73.08
Groundwater (sumps, wells, boreholes)	25	48.08
Pasture, forage and organic manure practices		
Manure collection	46	88.46
Parkland	42	80.77
Production of forage legumes	36	69.23
Improving manure storage	21	40.38
Keeping improved breeds	10	19.23
Enclosure (with branches or barbed wire for stocking)	3	5.77
Reducing pressure on grazing areas	2	3.85
Animal feeding, care and welfare practices		
Provide constant access to adequate food	52	100
Provide constant access to clean drinking water	52	100
Providing shelter	52	100
Perform regular injury/illness checks	52	100
Providing a hygienic environment	52	100
Provide medical assistance when needed	52	100
Offer diversified diets	51	98.08
Animal health management		
Vaccination	52	100
Antibiotics	52	100
Herbal remedies or veterinary pharmacopoeia	16	30.77
Quarantine	7	13.46

6.2.4 Agroecological nature of livestock systems

The farms studied are mainly cattle-oriented, and most producers rely on the farm's own herd for animal renewal. This enables them to better control the risk of diluting the farm's existing genetic resources, to maintain the performance of the best sires and to limit the risk of disease coming from other animals outside the farm. These practices do, however, have a negative impact on the risk of inbreeding if reproduction is not properly controlled. The farms collect sufficient quantities of manure and dispose of sufficient quantities of paddock soil, which is used to improve soil fertility or sold to other producers. This limits the use of mineral fertilizers. All respondents claim to want to guarantee perfect feeding, watering, shelter and care for their animals. They show a strong interest in the production of fodder legumes to ensure animal feed, without worrying about the grazing load. Watering is mainly provided by surface water, and animal health is managed more through conventional veterinary care that does not meet agroecological principles. If we compare the livestock farming systems described with the principles of agroecology suggested by Wezel et al. (2020), we find that the practices implemented align with the following principles: recycling, input reduction, soil health, animal welfare, biodiversity, synergies and economic diversification.

6.3 Agricultural production systems

6.3.1 Soil fertility levels and soil fertility improvement practices

Information on producers' perceptions of soil erosion, the fertility level of their farmland, and the practices they use to improve soil fertility is presented in Table 8.
As far as soil erosion is concerned, half of the respondents (50.00%) consider this to be a minor problem on their farm, and a significant proportion (48.08%) feel that soil erosion is not a problem on their farm.

As for the level of fertility of farmland, the vast majority of respondents (80.77%) stated that their farmland was moderately fertile.

As far as soil fertility improvement practices are concerned, all respondents (100%) apply organic fertilizers or manure to improve soil fertility. However, a significant majority of respondents (51.92%) also use mineral fertilizers.

Table 7. Level of erosion and fertility problems and soil fertility improvement practices

Variables	Numbers	Relative frequency (%)
Level of soil erosion problems		
Soil erosion is a minor problem on my farm.	26	50.00
Soil erosion is not a problem on my farm.	25	48.08
Soil erosion is a major problem on my farm.	1	1.92
Level of soil fertility on farmland		
Moderately fertile	42	80.77
Low fertility	10	19.23
Soil fertility improvement practices		
Application of organic fertilizers or manure	52	100
Application of mineral fertilizers.	27	51.92
Use of ecological practices (e.g. cover crops, leguminous plants, mulching, etc.)	1	1.92
No ecological practices, no chemical or organic fertilizers were applied	0	0

6.3.2 Agricultural practices implemented on farms

On the farms, five of the 16 agricultural practices included in the HOLPA questionnaire are implemented. Crop rotation is declared by 90% of respondents. Apart from this practice, other practices such as monoculture with annual crops (25%), agroforestry (10%), intercropping (10%) and other practices (10%) were declared by respondents (Figure 8).

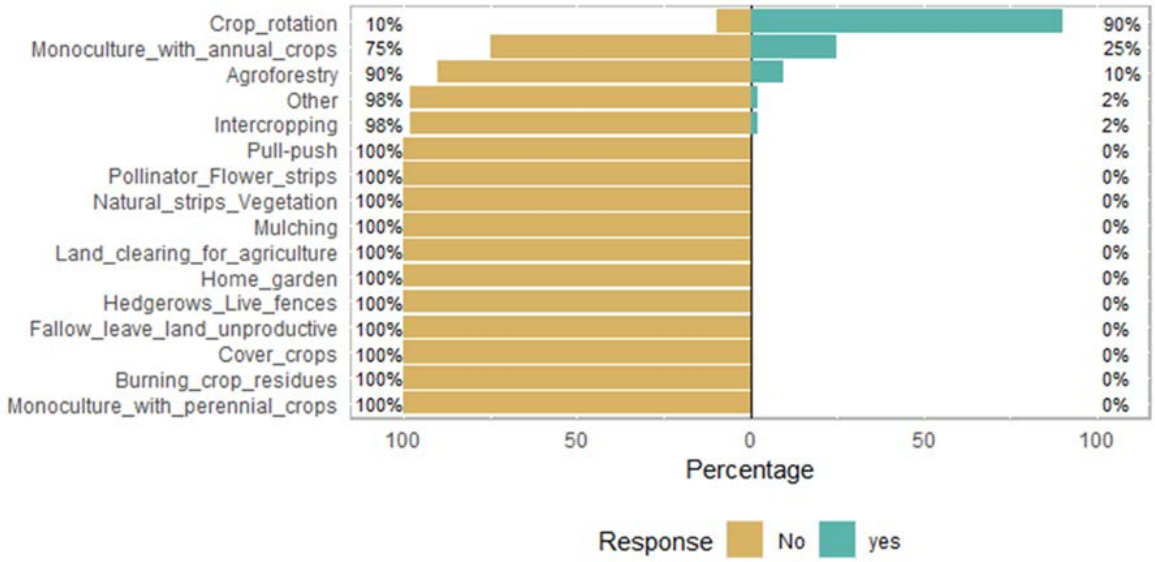

Figure 8. Agricultural practices implemented on the farms

6.3.3 Pest management on farms

Crop pest management practices are presented in Table 9. The most widely adopted method is the planting of improved or resistant varieties (90.38% of farms). The majority of respondents (65.38%) prefer approaches such as the use of cover crops, intercropping and crop rotation to promote biological interactions. A minority of respondents (1.93%) opt for cultural control, manually removing plants and fruit showing signs of disease.

Table 8. Pest management practices for crops and cropland

Variables	Number	Relative frequency (%)
Crop pest control practices		
Planting improved or resistant varieties	47	90.38
Use of cover crops/intercrops/crop rotation to increase biological interactions	34	65.38
Cultural control (plants and fruit showing signs of disease are removed by hand)	1	1.93
Promoting biodiversity and spatial diversity within the agroecosystem	1	1.92
Use of chemicals	1	1.92

6.3.4 Crop diversity and yields

The various crops grown on the farms and information on their average yields are shown in Table 10. In terms of cereals, maize has an average yield of 777.57 kg/ha. Sorghum and millet yield 215.99 kg/ha and 170.33 kg/ha respectively. Rice had an average yield of 488.89 kg/ha, with significant variability represented by a standard deviation of 571.28 kg/ha. As for legumes, soya has an average yield of 600 kg/ha, and groundnuts 480 kg/ha. Cowpea yields average 98.87 kg/ha. Sesame yields 83.33 kg per hectare. Grain yields measured in 2023 are extraordinarily low compared with local averages (maize between 2 and 2.5 t/ha, millet and sorghum between 0.8 and 1 t/ha, rice between 1.5 and 2 t/ha, groundnuts and cowpeas between 0.5 and 1 t/ha).

Table 9. Diversity and yield of crops grown on the farms

Crops	Average yield (kg/ha)	Standard deviation	Min	Max
Cereals				
Corn	777.57	390.04	275	2300
Sorghum	215.99	107.51	33.33	500
Mil	170.33	77.45	100	350
Rice	488.89	571.28	166.67	1500
Pulses				
Soybeans	600	-	600	600
Peanut	480	-	480	480
Cowpeas	98.87	52.71	33.33	300
Other				
Sesame	83.33	-	83.33	83.33

6.3.5 Agroecological character of cropping systems

On farms in the Bobo-Dioulasso dairy basin, which are more livestock-oriented, farming is also practiced. According to the respondents, the soils are moderately fertile and do not seem to have soil erosion problems. Organic manure from livestock is mainly used to improve soil fertility. On the farms, crop rotation is widely practiced. Yields are very poor, indicating the weak character of the agroecological cropping system. Although respondents consider their soils to be moderately fertile, this factor alone cannot explain the very low crop yields recorded. These very low yields could be linked to a number of factors, such as: biases in estimating production and area per crop, failure to subtract the area of plots decimated by animals, thus making reported production per unit area low, and pockets of drought recorded during the data collection reference period (October 2022-September 2023). These cropping systems respect only two of the 13 principles of agroecology suggested by Wezel et al. (2020): soil health and synergies.

6.4 Analysis of the diversity of dairy farmers in relation to their agroecological character

Based on the 11 variables shown in Table 3, three groups of producers were distinguished (Figure 9 and Figure 10).

Producers with the most advanced plant and animal co-product recovery and recycling practices, and therefore a priori the most agroecological, are in the minority (11%) (Table 11). Group 3 is characterized by producers with 4.17 ± 2.32 ha of land under their ownership. These producers have at least one manure pit and distribute the largest quantities ($p<0.001$) of quality fodder (76.25 ± 58.04 kgDM) and roughage (160.42 ± 160.44 kgDM) per TLU. They are also the only producers with an average silo for forage storage. They have also all (100%) been made aware of the rules of living together, with the exception of expenditure on veterinary inputs, which seems to be higher in this type.

Group 2 is made up of 33% of producers with the worst indicators of practices for valorizing plant and animal by-products into fodder and organic manure (with the exception of the level of fodder shed equipment). These group 2 producers have the largest ($p<0.001$) areas of cultivated farmland, and 94% of these areas have non-negotiable property rights. These group 2 producers have the largest ($p<0.001$) herd sizes (39.90 ± 28.80 LU) and have an average of one forage shed. They spend an average of 2,500 FCFA/cow per year on health monitoring.

Group 1 comprises 56% of producers with plant and animal by-product management practices similar to those of G2 (with slightly higher indicators). The only indicator that characterizes them positively is that they spend an average of 2,500 FCFA/cow/year on health monitoring.

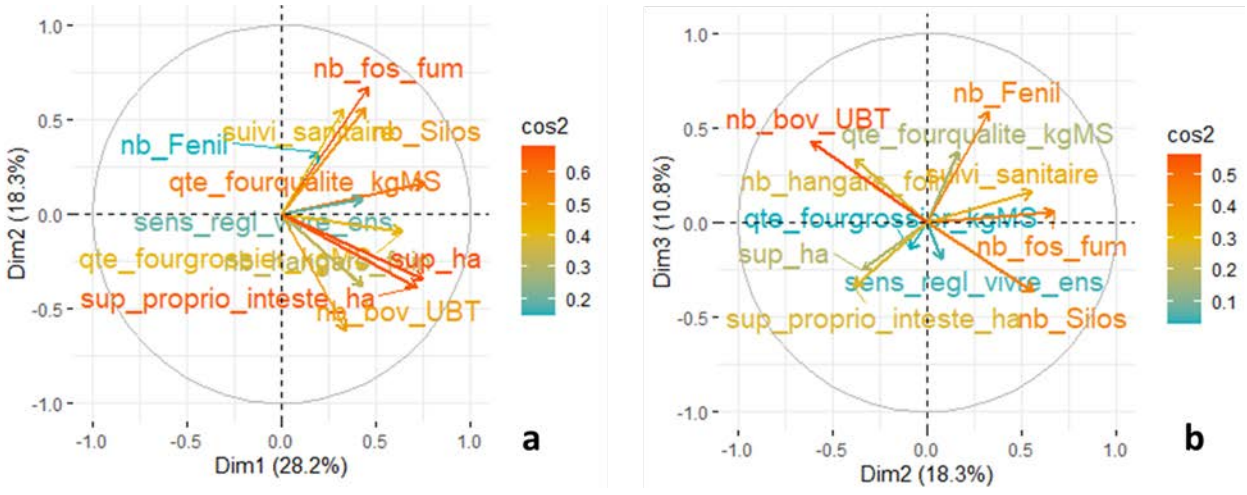

Figure 9. Correlation circles of variables between dimensions 1 and 2 (a) and between dimensions 2 and 3 (b)

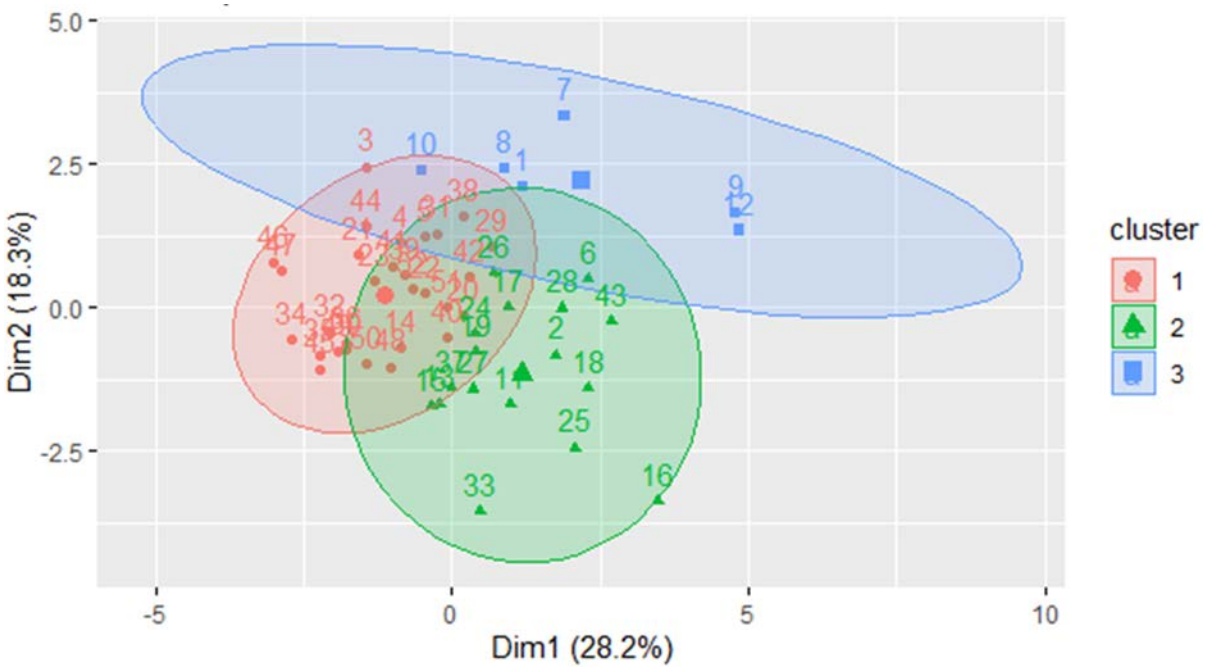

Figure 10. Projection of farms rising up the three agricultural performance groups in the plan

Table 10. Distinctive parameters of dairy producer groups

Parameters	Unit	Mean	Median	Group 3	Group 2	Group 1	*p-value*
				6	17	29	
Total area	ha	3.82	3	4.17 ± 2.32^{b}	5.62 ± 1.22^{a}	2.69 ± 1.00^{c}	<0.001***
Area with uncontested ownership	ha	3.38	3	4.17 ± 2.32^{a}	5.26 ± 1.44^{a}	2.12 ± 1.39^{b}	<0.001***
Number of cattle	TLU	26.45	23	12.02 ± 8.96^{b}	39.90 ± 28.80^{a}	21.56 ± 17.41^{b}	0.001**
Manure pits	U	0.67	1	1.33 ± 0.52^{a}	0.59 ± 0.51^{b}	0.59 ± 0.50^{b}	0.005**
Quantity of quality forage	kgDM/TLU	29.93	18.22	76.25 ± 58.04^{a}	20.45 ± 16.42^{b}	25.89 ± 27.92^{b}	<0.001***
Quantity of roughage	kgDM/TLU	53.30	37.03	160.42 ± 160.44^{a}	31.52 ± 19.67^{b}	43.90 ± 30.71^{b}	<0.001***
Silos	U	0.12	0	1.00 ± 0.00^{a}	0.00 ± 0.00^{b}	0.00 ± 0.00^{b}	<0.001***
Fenil	U	0.13	0	0.17 ± 0.41	0.06 ± 0.24	0.17 ± 0.38	0.552
Feed sheds	U	1.17	1	1.16 ± 0.41^{ab}	1.35 ± 0.49^{a}	1.07 ± 0.26^{b}	0.048*
Annual cost of cow health monitoring	FCFA	> 3000	> 3000	> 3000	~2500	~2500	-
Raising awareness of the rules of living together	%	77	100	100	94	62	-

ha: hectare; TLU: Tropical Livestock Unit (1 TLU = 1 cattle of 250 kg live weight); U: unit; kgDM: kilogram of dry matter; 1 USD = 605 FCFA

7 Conclusion

Most of the respondents to the 2023 HOLPA survey conducted on 52 farms in the CGIAR Initiative on Agroecology (IAE) intervention area in Burkina Faso (an area corresponding to the Bobo-Dioulasso dairy production basin and the Agroecological Living Landscape intervention area) are men (90.38%), illiterate (65.38%), of Peulh origin (71.15%) and live in cohabitation (90.38%). On the whole, they say they are satisfied with their living conditions, with the exception of concerns about insecurity. The men expressed a feeling of freedom in their decision-making, unlike the women.

A majority of respondents (61%) claim to have very little theoretical knowledge of agroecology. For them, agroecology is a concept that mainly means: (i) eating local food, (ii) eating food without chemicals, (iii) taking care of nature on the farm, (iv) enjoying nature, (v) caring for nature, and (vi) offering fair wages to workers.

Farms are mainly cattle-breeding operations, with the renewal of animals mainly ensured from the farm's own herd. All respondents claim to want to guarantee perfect feeding, watering, shelter and care for their animals. Watering is mainly provided by surface water. Although there is a strong interest in forage crops for feeding, few respondents seem to be concerned about managing the grazing load. There is also a strong interest in organic manure management.

On these farms, where agriculture is also practiced, there do not appear to be any major soil fertility or erosion problems. Pest management is mainly ensured by the use of pesticides. Of the 16 agroecological practices listed in the HOLPA tool, only crop rotation is widely practiced by respondents. The yields recorded for 2023 are very poor (although it is quite possible that a methodological problem led to these yields being significantly underestimated). Given that most producers are livestock farmers, field sizes are not very large, while herd sizes are high. Thus, we would normally expect to see better crop yields because the producers had enough parkland which is used to further improve soil fertility. However, this was not the case, and these low yields can be explained by a number of factors, such as: biases in estimating production and area per crop, failure to subtract the area of plots decimated by animals, thus making reported production per unit area low, pockets of drought recorded during the reference period of data collection (October 2022-September 2023), etc.

When we refer to the agroecological factors highlighted for the area's farming systems by the study by Vall et al (2023), we see that a minority of producers (G3) have globally agroecological practices, which still leaves enough room for progress to be made in the ALL of the Bobo-Dioulasso dairy production basin. It remains to be seen whether these practices translate into improved technical, economic, environmental and social performance.

As the data used to arrive at the results presented in this report are limited to 52 farms, they are not yet very representative of the population of dairy farmers in the ALL area in the Bobo-Dioulasso dairy basin.

With data collection underway to cover at least two hundred households and farms, the final results to come will enable more objective conclusions to be drawn about the agroecological performance of these farming systems.

8 References

Bryer J, Speerschneider K (2016). _likert: Analysis and Visualization Likert Items_. R package version 1.3.5; https://CRAN.R-project.org/package=likert

de Mendiburu F (2023). agricolae: Statistical Procedures for Agricultural Research. R package version 1.3-7. https://CRAN.R-project.org/package=agricolae

INSD, 2022. 5ème RGPH. Cinquième Recensement Général de la Population et de l'Habitation du Burkina Faso. Synthèse des résultats définitifs. Comité National du Recensement, Institut National de la Statistique et de la Démographie. Ouagadougou, Burkina Faso. 136p. Accessed February 11, 2024. https://www.insd.bf/fr/resultats

Kassambara A, Mundt F (2020). factoextra: Extract and Visualize the Results of Multivariate Data Analyses. R package version 1.0.7, https://CRAN.R-project.org/package=factoextra

R Core Team (2023). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Vall E, Orounladji B M, Berre D, Assouma M H, Dabiré D, Sanogo S, Sib O (2023). Crop-livestock synergies and by-products recycling: major factors for agroecology in West African agro-sylvo-pastoral systems. Agronomy for Sustainable Development (2023) 43:70. doi.org/10.1007/s13593-023-00908-6

Wezel A, Gemmill Herren B, Bezner Kerr R, Barrios E, Rodrigues Gonçalves A L, Sinclair F, 2020. Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. Agronomy for Sustainable Development (2020) 40: 40. https://doi.org/10.1007/s13593-020-00646-z

Wickham H, Averick M, Bryan J, Chang W, McGowan LD, François R, Grolemund G, Hayes A, Henry L, Hester J, Kuhn M, Pedersen TL, Miller E, Bache SM, Müller K, Ooms J, Robinson D, Seidel DP, Spinu V, Takahashi K, Vaughan D, Wilke C, Woo K, Yutani H (2019). Welcome to the tidyverse. *Journal of Open Source Software*, 4(43), 1686. https://doi.org/10.21105/joss.01686

Wickham H. 2016. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York. https://ggplot2.tidyverse.org