Performance Assessment of Agroecology in Makueni and Kiambu counties, Kenya

CGIAR | INITIATIVE ON Agroecology

Sylvia S. Nyawira, Hezekiah Korir, Peter Bolo, Kevin Omondi, Sulman Olieko Owili, Brigid Letty, Christine Wamaitha, Mary Njogu, Edith Anyango, Frederick Baijukya

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INTRODUCTION

Background to the Initiative

Food security remains a significant challenge in Kenya, with many smallholder farmers grappling with low crop yields due to environmental and agricultural constraints. Declining soil fertility and insufficient soil moisture contribute to persistent yield gaps that undermine food production. Production stresses are further exacerbated by biodiversity loss, pollution and greenhouse gas emissions. While synthetic fertilizers and pesticides initially boost productivity, they often lead to long-term soil degradation, nutrient depletion, and biodiversity loss. Addressing these challenges requires sustainable farming practices and innovative approaches to enhance productivity while safeguarding the environment.

Agroecology, which integrates ecological principles into agricultural systems, offers a holistic solution by addressing ecological, economic, and social sustainability. This approach promotes practices like crop diversification, agroforestry, organic amendments, and integrated pest management to improve soil health, biodiversity, and climate resilience. However, its adoption faces barriers such as insufficient evidence of its impacts, weak institutional frameworks, and misaligned policies. Overcoming these requires investment in research, capacity building, supportive policies, and inclusive institutional mechanisms.

The CGIAR Initiative on Transformative Agroecology across Food, Land, and Water systems (i.e., Agroecology Initiative in short) is a collaborative partnership among eight CGIAR entities. Funded by the CGIAR System Council, its first phase (2022–2024) spaned eight countries—five in Africa, including Kenya, two in Asia, and one in the Americas[1]. This initiative aims to promote context-specific agroecological principles through collaboration among farmers, communities, and food system actors. It is organized into five key work packages[2] (see Figure 1):

1. **WP1: Transdisciplinary Co-creation in Agroecological Living Landscapes (ALLs):** Establishes a multi-actor network to co-design and assess context-specific agroecological innovations.
2. **WP2: Evidence-based Agroecology Assessments:** Develops a holistic performance assessment framework for socioecological systems to compare benefits and trade-offs between conventional and agroecological alternatives.
3. **WP3: Inclusive Business Models and Financing Strategies:** Focuses on developing equitable business models and financing mechanisms within ALLs.
4. **WP4: Strengthening Policy and Institutional Enabling Environments:** Facilitates cross-sectoral policy integration to support agroecological transitions.
5. **WP5: Understanding and Influencing Agency and Behaviour Change:** Explores how to drive inclusive and equitable agroecological transformation by understanding and influencing the agency and behaviour of food system actors.

Through these collaborative efforts, the CGIAR Agroecology Initiative seeks to advance sustainable agricultural practices globally, with particular emphasis on addressing the unique challenges and opportunities in the target countries. This report documents activities implemented under the Work Package 2 (WP2) of the CGIAR Agroecology Initiative (AE-I) in Kenya. The aim of the WP2 is to generate evidence-based assessments to compare the benefits and trade-offs between 'business-as-usual' and AE alternatives across the ALLs. In this context we collected data that are globally-comparable and locally-relevant and measured by a Holistic Localized Performance Assessment tool (HOLPA) developed by the AE-I (Jones et al., 2024).

[1] The focal countries that participate in the Agroecology Initiative include Burkina Faso, India, Kenya, Laos, Peru, Senegal, Tunisia, and Zimbabwe.
[2] A work package is a clearly defined set of related tasks within a project that can be managed and delivered as a standalone unit.

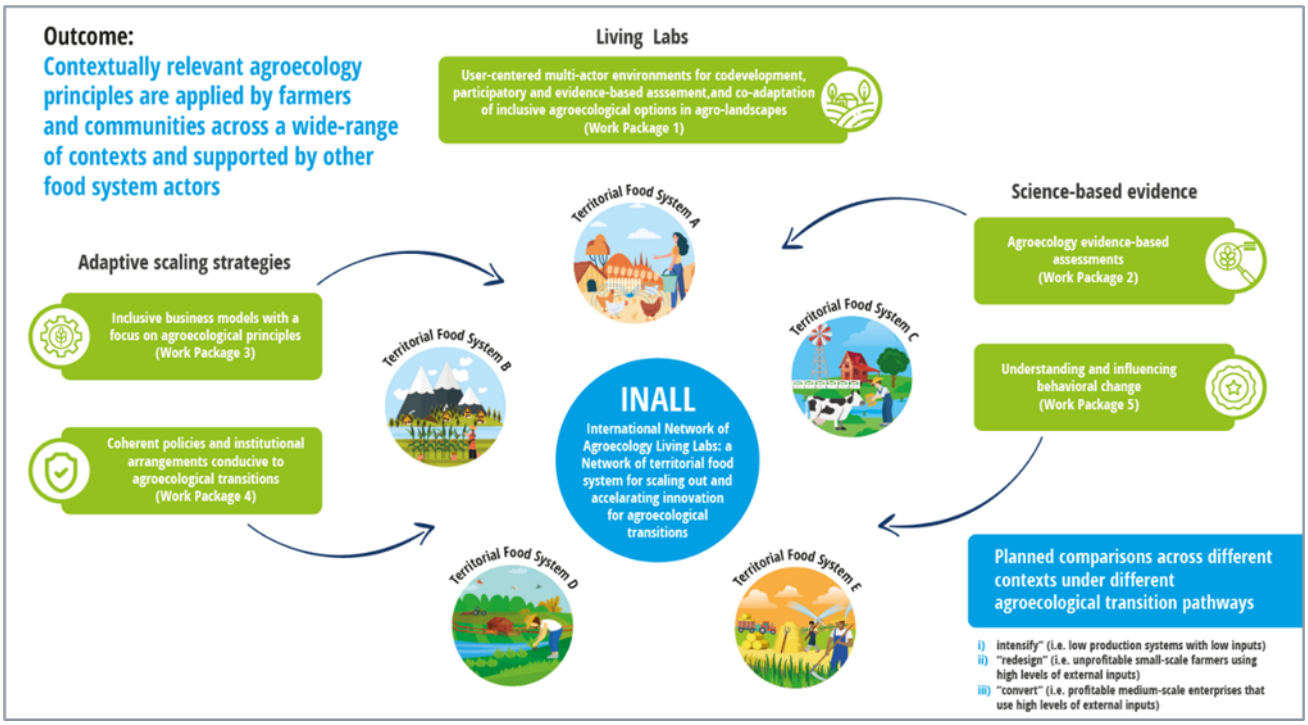

Figure 1: Interactions of the five work packages of the Agroecology Initiative

Context of the Agro-ecology Initiative in Kenya

The agroecological living landscapes (ALLs) are located in Kiambu and Makueni counties. Kiambu County lies between latitude 00°25′ and 10°20′ South and longitude 36°31′ and 37°15′ East. The county covers an area of 2,543.5 km² and borders Nairobi and Kajiado counties to the south, Machakos to the east, Murang'a to the north and northeast, Nyandarua to the northwest, and Nakuru to the west. The two pre-selected ALLs for this assessment are Makueni and Kiambu counties in Kenya (Figure 1). Makueni County is in the eastern part of Kenya, located between latitude 1°35' and 2°59' South and longitude 37°10' and 38°30' East. The county covers an area of 8,214 km² and borders Machakos County to the north, Kitui County to the east, Taita Taveta County to the south, and Kajiado County to the west. Both counties are dominated by mixed crop-livestock farming systems, carried out by smallholder farmers who hold small pieces of land. In the two ALLs, and Kenya in general, several organizations including CGIAR affiliated institutions, the Kenya Agricultural and Livestock Research Organization, and institutions that are part of the Participatory Ecological Land Use Management (PELUM) association have been supporting smallholder farmers through capacity building and testing of improved farming practices. More details on the status of agroecology of the two ALLs can be found in the context assessment report that was part of WP2 activities (Nyawira et al. 2023).

The AE-I initiative in Kenya engaged PELUM in identifying two host centres that were to support the implementation of the WPs activities. In Kiambu, the host centre chosen was the Community Sustainable Agriculture and Healthy Environment Program (CSHEP) located in Ndeiya, in the lower midland zone of Kiambu county characterized by semi-arid climate. The Drylands and Natural Resources Center (DNRC), located approximately 140 km from Nairobi in Mbooni sub-county, was similarly chose in Makueni. CSHEP has been working on promoting organic farming in the Ndeiya area of Kiambu. They offer training to farmers on vegetable production using less inputs, particularly less use chemical fertilizer and pesticides. DNRC has been offering training on permaculture to farmers within the Mbooni area. They promote tree planting and conservation and also encourage the efficient use of trees for energy production. In the two ALLs, the AE-I initiative engaged several stakeholders during the implementation of project activities that included the smallholder farmers, county agricultural officers, private sectors supporting key values chains that were part of WP3, Biovision Africa Trust, University of Nairobi, Jomo Kenyatta University of Agriculture and Technology, and other organizations involved in promoting agroecological practices.

Stakeholders from both ALLs were involved in detailed Vision-to-Action (V2A) exercises to define and envision the sustainable transformation of their respective ALLs. At the outset, the AE-I Kenya team was trained on the Sustainability Planning approach, a framework that was developed in the context of transition planning for an EU-funded Regreening Africa program. This approach draws on the extensive work by teams focusing on Asset-Based Community-driven Development (ABCD) (see Fuchs et al., 2024). After defining and mobilizing the communities of place in both ALLs, the WP1 team, supported by representatives of other WPs, held three-day visioning and planning workshops in each of the ALL-host centres (Fuchs et al., 2023a). In line with the integrated Sustainability Planning process, the workshops focussed on community vision mapping to jointly define the ALL-members' vision for the future, causal analysis for barriers experienced, asset and stakeholder mapping to identify the resources at disposal, integrated community action planning, and defining how to best mobilize external support for action plan implementation.

Following the sharing of the near-finalized WP1 V2A guidelines, the WP1 team in Kenya conducted another workshop in each of the ALLs, building on the results of the first visioning workshops. These one-day workshops focused on review and adaptation of the ALL visioning, identification of the desired future changes, participatory social asset assessment to identify relevant formal and informal food system actors that can support agroecological transitions, and an assessment of the motivating and supporting or enabling environments as well as the monitoring required. The defined vision and desired future changes for the two ALLs are summarized in Table 1.

Table 1: Summary of the vision and desired future changes for each of the ALLs that were defined by stakeholders during the Vision-to-Action workshops.

Kiambu	**Makueni**
Vision: *A sustainable, self-reliant, and economically viable community*	**Vision:** *Resilient community with conserved environment, food* security *and sustainable livelihoods*
Desired changes	**Desired changes**
1. Improved water harvesting and management 2. Improved use of natural farming techniques and inputs 3. Increased social organization for collective marketing, branding, packaging, and value addition, of natural farming techniques and inputs 4. Increased market opportunities for natural produce 5. Increased interaction between producers and consumers 6. Consumer behavior changes and preferences	1. Increased water harvesting and water-use efficiency by the community ○ Farmers diversify their farms by integrating various crops and livestock in their farms. 2. All actors in the supply chain such as farmers, Transporters, processors, input suppliers, and marketers to shorten the supply chains in organic markets by aggregating themselves into marketing groups to improve their bargaining power. 3. Farmers to increase the tree cover by planting a variety of trees (both exotic and indigenous). 4. Farmers to improve on-farm circularity by recycling organic wastes, e.g., farmyard manure to fertilize farmland, and reduce the use of inorganic fertilizers. 5. Farmers to increase efficient use of renewable energy sources such as solar, energy-saving *jikos* (cooking stoves), briquettes from organic wastes.

Assessment of Agroecology: Measurement and Methodology

The Holistic Localized Performance Assessment (HOLPA) tool was developed as part of the CGIAR AE-I (Jones et al., 2024). The tool was developed through multi-stakeholder collaborations through ALLs to propel food systems to sustainable trajectories in landscapes within eight focal countries: Burkina Faso, India, Kenya, Laos, Peru, Senegal, Tunisia, and Zimbabwe. HOLPA was developed through a multi-disciplinary participatory process with researchers engaged in these countries, building on the strengths and learnings from existing tools and focusing on indicator simplicity, robustness, and relevance to local and global food system sustainability challenges. The HOLPA tool provides a comprehensive framework that can be used for assessing the overall context of the ALLs (context module), assess the level adherence to the HLPE 13 principles of agroecology (HLPE, 2019)

(Agroecology module), and also measure performance as the farm-level (Performance module). The Performance module includes 18 themes spanning agricultural, economic, environmental, and social performance dimensions (Figure 2). These themes are designed to capture the performance of the farm related to the major global challenges of our time, including achieving food and nutrition security, halting biodiversity loss, building climate resilience, and improving human wellbeing. HOLPA includes global key performance indicators (KPIs) that were collected using the same guiding questions across all the eight AE-I focal countries. In addition, HOLPA is distinct from other agroecology performance tools as it includes a localization process, designed to ensure the tool responds to local concerns and priorities, making the evidence it generates more relevant to local stakeholders. This followed a localization process to the questions embedded in the tool in addition to the existing global KPIs.

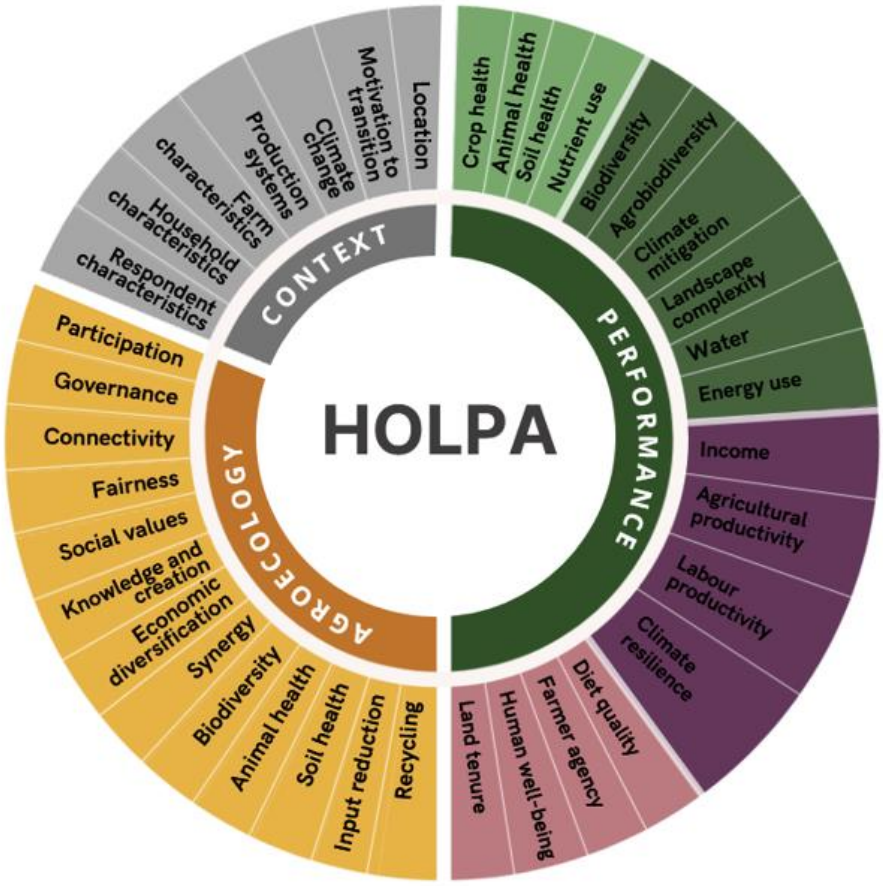

Figure 2: A summary of the different components included in the context, agroecology and performance modules in HOLPA

As highlighted in the context assessment conducted in the two ALLs (reference), detailed evaluations of agroecology in these landscapes remain limited. To address this, the HOLPA tool was applied to assess the overall adherence to agroecology principles and examine whether farm performance varies based on this adherence. Additionally, the tool was used to evaluate the broader context of smallholder farming in the ALLs. The assessment focused on the following key questions:

1. What are the current agroecological practices adopted by farmers in the two ALLs, and to what extent are these practices implemented?
2. What is the current level of adherence to agroecology in the two ALLs, and how does it differ between farmers connected to organizations promoting agroecological practices and those who are not?
3. How does farm performance vary with adherence to agroecology principles and the adoption of key practices?
4. What are the enablers and barriers to agroecological transitions within the landscapes, and how can these support the ALLs in achieving their vision?

The rest of the document is organized as follows. Section 2 describes the methods used, including the approach to localization of the HOLPA tool, sampling techniques, and data collection, cleaning, and analysis. In Section 3, the results are presented and

discussed. The use of the HOLPA assessment results is outlined in Section 4, while Section 5 details the lessons learnt from the activities of the project in Kenya. Section 6 concludes.

METHODOLOGY

Localization of the HOLPA tool

The Localization of Indicator Selection Process (LISP) in both ALLs was conducted in June 2023. LISP workshops were conducted together with the second V2A workshop that was led by WP1. To set the ground for the LISP process and agenda, we recapped the vision of the ALLs and the expected future changes that would be needed to achieve the vision (see Table 1 above). The key objective of the LISP was to select a set of agroecological performance indicators relevant to the ALL, which respond to the vision and goals. The participants were introduced to the concept of indicators and their meaning using local examples. Three dimensions of agroecology (i.e., environmental, social, and economic) were introduced to the participants in the plenary. Participants were informed of the importance of monitoring their progress towards achieving the vision and goals established for the ALL. To refine context-specific indicators, they were guided to identify the desired outcomes aligned with the goals and changes discussed during the V2A workshops and to deliberate on appropriate methods for measuring or tracking these changes.

The participants were divided into three groups, each tasked with discussing indicators for one of the three agroecology dimensions. Each group spent approximately 20 minutes to per dimension, identifying changes the ALL's goals and vision and determining appropriate indicators to assess these changes. After 20 minutes, the groups rotated to review and refine the discussions of previous group, adding any new elements. Following the discussions, participants were introduced to the criteria for a robust indicator. The three selected criteria for easy ranking and evaluation were: (1) importance/meaningfulness, (2) measurability/feasibility, and (3) relevance and likelihood of change. A ranking procedure was also explained, assigning scores of low=1, medium=2, and high=3 to each criterion, with a final score derived from the sum of the three. Participants were encouraged approach the ranking with rationality to avoid overabundance of high-ranking indicators. For the scoring exercise, the participants were encouraged to select the dimension that aligned with their expertise and background.

Table 2 summarizes the prioritized indicators in the two ALLs. The agronomic and economic indicators in both ALLs were already aligned with the global KPIs, with Makueni's economic indicators also included in HOLPA. Social indicators in Makueni focused on post-intervention performance measures, similar to Kiambu's social indicator tracking the number of families achieving food security. In Kiambu, economic indicators emphasized on consumer environments for agroecological products. However, the sampling approach used for the HOLPA assessment lacked specificity and was not targeted enough to allow for a comprehensive analysis of this indicator. The WP2 team confirmed that most prioritized indicators were already integrated into HOLPA, although others required targeted studies or Focus Group Discussions for meaningful assessment.

Table 2: The indicators that were prioritized by the stakeholders in the two ALLs during the Localization of Indicator Selection process workshops

Dimension in HOLPA	Kiambu ALL	Makueni ALL
Agronomic	Productivity, organic matter content, and extent of use of organic manure	Crop and livestock yield
Environment	Number of trees, Number of people harvesting water	Water harvesting techniques
Economic	Number of crop species, Number of orders of organic or agroecological produced products, and speed of sale of agroecological products.	Personal savings, volume of traded agricultural commodities and access to electricity.
Social	Number of families becoming food secure, Number of people practicing agroecology, and number of organizations promoting agroecology	Community resilience, improved lifestyles, and improved access to education for children

Implementation of the HOLPA tool

The HOLPA survey was conducted in Kiambu and Makueni Counties, Kenya in December 2023, to collect primary data from smallholder households. The aim of the survey was to generate evidence-based on the efficacy of agroecological approaches to provide sustainable, resilient, and inclusive livelihoods and food systems in Kenya.

Kiambu County is in the central region of Kenya (See Figure 3). The County has about 1,878.4 square km of arable land. Smallholder farmers own the majority of the arable lands in the county, with average holdings estimated at 0.36 ha for most farmers. In contrast, Makueni County is located in the eastern part of Kenya. Agriculture is the mainstay in Makueni County accounting for at least 78% of the total household income. Of the county's total land area of 482,040 ha, 63% is arable, characterized by fertile soil suitable for agricultural production. Makueni features two distinct farming systems: large-scale farmers with average holdings of 30 ha and small-scale farmers managing less than 3 ha.

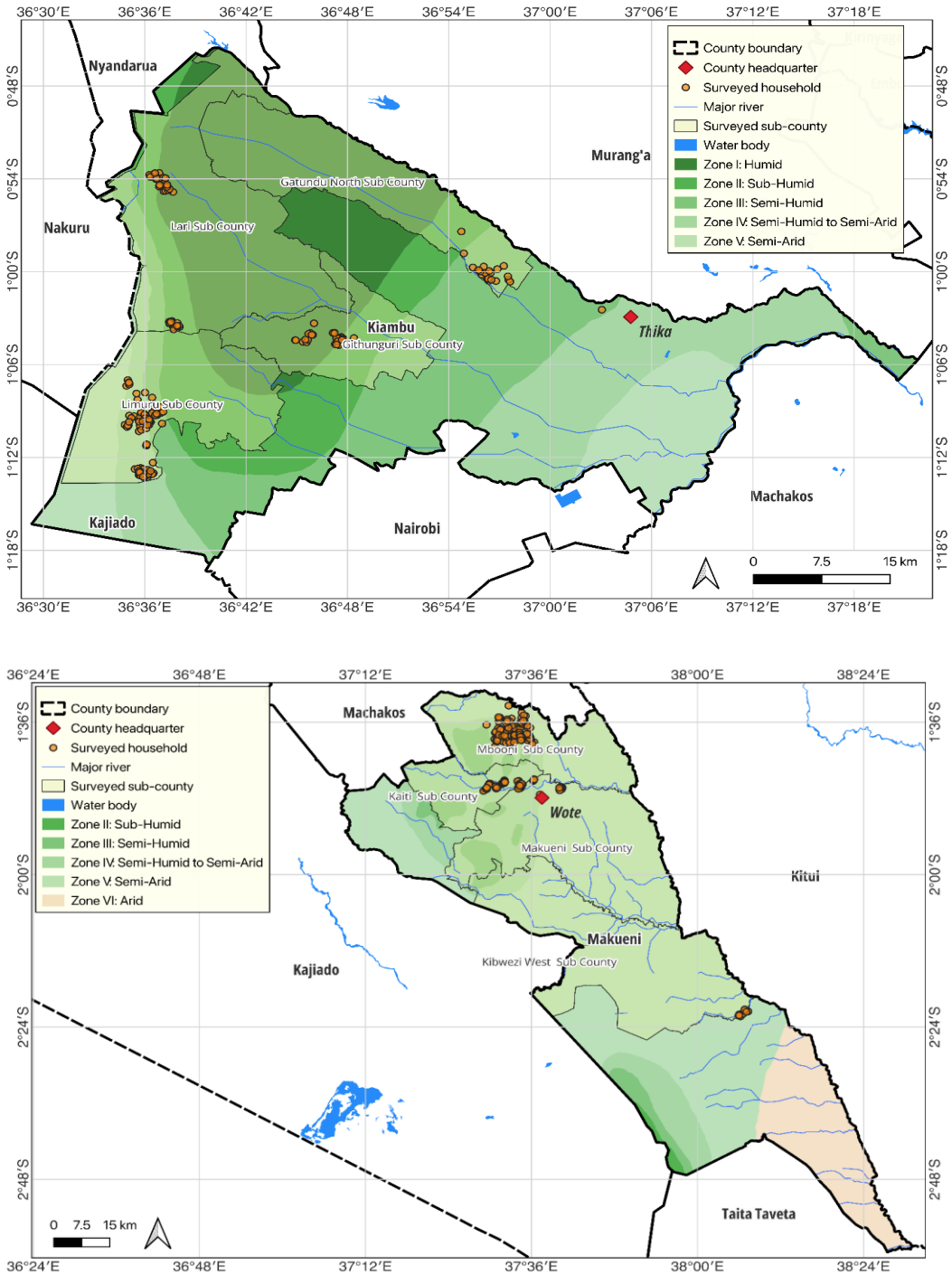

Figure 3: Map of Makueni and Kiambu ALLs showing the distribution of the surveyed households.

Given the widespread smallholder farming systems in Kiambu and Makueni, HOLPA specifically targeted smallholder farmers. A multi-stage sampling design was employed in selection of the respondents. In the first stage, sub-counties were purposively selected based on the coverage of both the Agroecological Living Landscape (ALL) Host Center and the Agroecology Initiative project. The second stage involved randomly selecting farming households from ALL Host Center-affiliated farmer groups from a sampling frame. In the final stage, farmers who did not affiliate to the ALL-Host Centers were systematically sampled. A total sample of 479 smallholder farming households was selected, comprising 237 households from Kiambu County and 242 from Makueni County.

Data collection was conducted through face-to-face interviews by 22 well-trained, experienced and qualified enumerators using a pretested survey programmed in KoboToolbox and implemented in KoboCollect application installed in tablets. The survey was implemented over 26 days in November 2023 under the close supervision of CGIAR research team.

HOLPA Data Management and Analysis

The HOLPA survey data underwent a rigorous data cleaning process to ensure data quality. This involved detecting and addressing duplicated entries, outliers (using statistical methods and respondent confirmation), missing values (through respondent follow-ups), and other inconsistencies. Categorical variables were also numerically coded for analysis.

The cleaned dataset was stored in a secure cloud-based repository and the local server at the Alliance of Bioversity International and CIAT. Regular backups were implemented to safeguard the data against potential loss or damage. A comprehensive data documentation was created to provide essential information about the data, including data source and collection methods, variable definitions and measurement units, data cleaning procedures and decisions, and missing data handling strategies.

The cleaned and prepared HOLPA survey data was analyzed using descriptive statistical techniques to summarize key variables and identify patterns. This involved calculating measures of central tendency, primarily means and standard deviations. To assess the level of adoption of different practices and responses related to various agroecology principles, we calculated the percentage of farmers for each response category. These percentages were determined based on the total number of farmers within specific categories (i.e., ALL host center-affiliated vs. non-ALL host center-affiliated farmers) and the overall number of farmers in the ALLs.

Additionally, the agroecology scores for each of the 13 principles of agroecology were analyzed. These scores were derived by converting all responses in the Agroecology module into a scale from 1 to 5. For each principle, the median score was calculated, excluding missing data, representing the agroecology integration indicator score for that principle. To obtain an overall score reflecting the level of agroecology adherence, we calculated the median across the 13 principles. Performance scores were computed in a similar manner to the agroecology scores. These scores were then scaled to a 0–100 range to enhance interpretability.

Various data visualization techniques were employed to present the results, including pie charts, radar charts, bar graphs, and box plots. The results were also summarized in tables for better comprehension and comparison.

RESULTS OF THE HOLPA SURVEY

Overall context status of the households

The majority of respondents in the HOLPA survey across the two ALLs were female—72% in Kiambu and 62% in Makueni (Figure 4 and Figure 5). Most respondents were aged 31-60, with youth (20-30) participation below 5% in both ALLs. Farming was the primary occupation, though a few respondents in Makueni held salaried jobs. Education levels varied whereby, in Kiambu, 50% of male adults attended secondary school, followed by 28% with university education and 22% with primary education. Female adults showed similar patterns (Figure 4). In Makueni, 51% of male adults attended secondary school, 31% primary school, and 18% university, with similar trends for females (Figure 5).

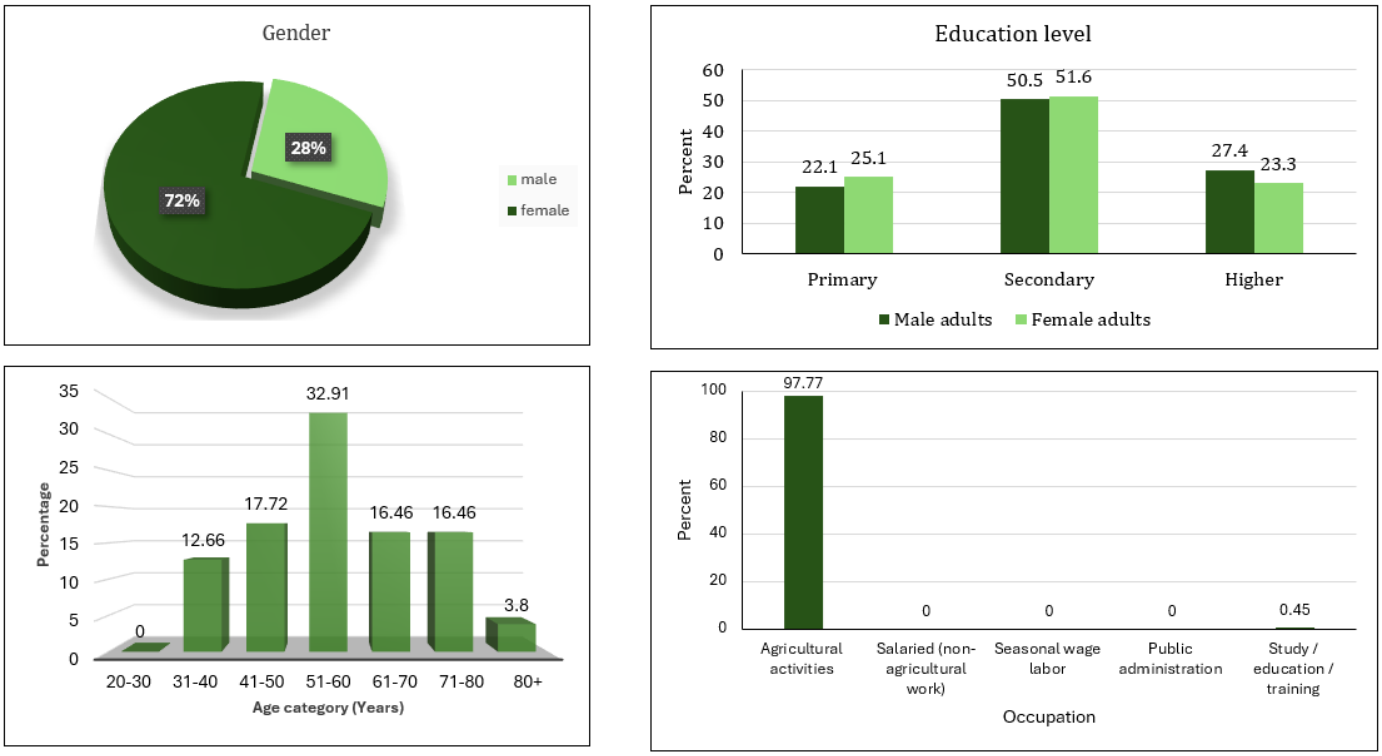

Figure 4: General characteristics of the interviewed households in Kiambu ALL

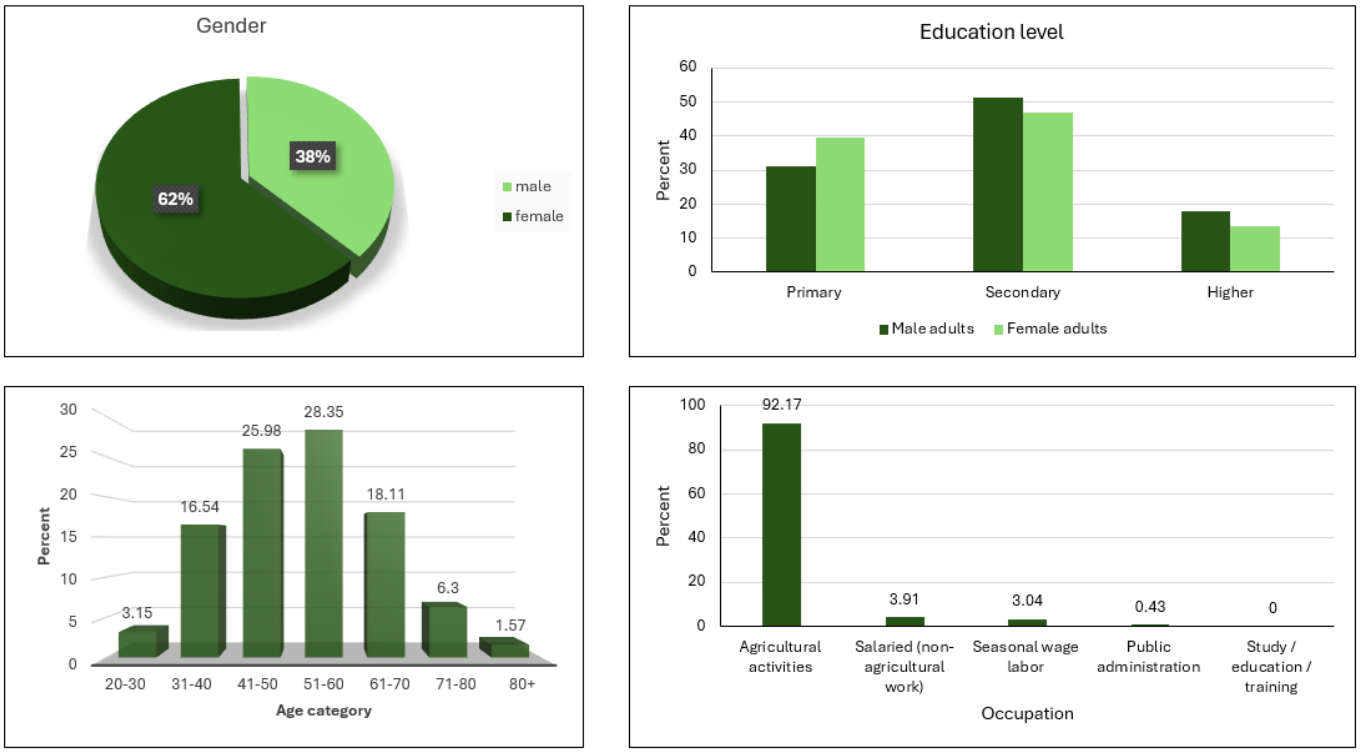

Figure 5: General characteristics of the interviewed households in Makueni ALL

Most respondents identified as agroecological farmers (Table 3), expressing care for nature and autonomy in farm management. They viewed a transition to agroecological practices as a sound business decision and preferred locally produced, chemical-free foods. However, they were largely neutral regarding the need for changes in current farming practices.

*Table 3: A summary of the average scores for the interviewed farmers perceptions regarding aspects relating to agroecology. The values presented are **average scores** derived from responses using a 6-point Likert scale, mapped as follows: **0** = I don't know, **1** = Completely disagree, **2** = Somewhat disagree, **3** = Neutral, **4** = Somewhat agree, **5** = Completely agree.*

	KIAMBU			MAKUENI		
	CSHEP (n=79)	NON-CSHEP (n=158)	OVERALL (n=237)	DNRC (n=114)	NON-DNRC (n=128)	OVERALL (n=242)
I care a lot about nature.	4.7	4.69	4.69	4.83	4.73	4.78
Being in nature benefits me.	4.76	4.7	4.72	4.9	4.77	4.83
I live in a place where most people take good care of the land and nature.	4.09	4.12	4.11	4.15	4.11	4.13
I take care of the land and nature on my farm.	4.72	4.65	4.68	4.8	4.77	4.79
I identify myself as an agroecological farmer.	4.72	4.3	4.44	4.46	4.15	4.3
I have power and freedom to change farm production practices if I want to.	4.61	4.66	4.64	4.52	4.51	4.51
I work together with others in my community, we have power and freedom to solve problems facing farmers.	4.62	4.43	4.49	4.7	4.59	4.64
I would prefer that the food I buy is produced and processed in ways that provide a fair wage and good conditions for workers.	4.38	4.44	4.42	4.25	4.22	4.23
I think shifting to agroecological farming is a sensible business decision.	4.87	4.71	4.76	4.78	4.47	4.62
I think current farming systems are working well and do not need changing.	3.06	3.09	3.08	3.18	3.14	3.16
I make decisions about what food to buy based primarily on price.	4.03	4.03	4.03	4.32	4.3	4.31
I would prefer to eat food that is produced without chemical inputs.	4.92	4.85	4.88	4.61	4.7	4.65
I would prefer to eat food that is grown locally.	4.3	4.59	4.5	4.84	4.69	4.76

Summary results of the 13 Agroecology principles

1. RECYCLING

Households in Kiambu and Makueni exhibited notable differences in energy use, livestock feed sourcing, manure production, and seed reuse practices (Figure 6). In Makueni, 52.5% relied entirely on self-produced energy, while in Kiambu, only 12.7% did, with most using a mix of self-produced and market-sourced energy. Livestock feed in Kiambu was more often purchased (38.8%) compared to Makueni, where it was predominantly self-produced due to larger land sizes.

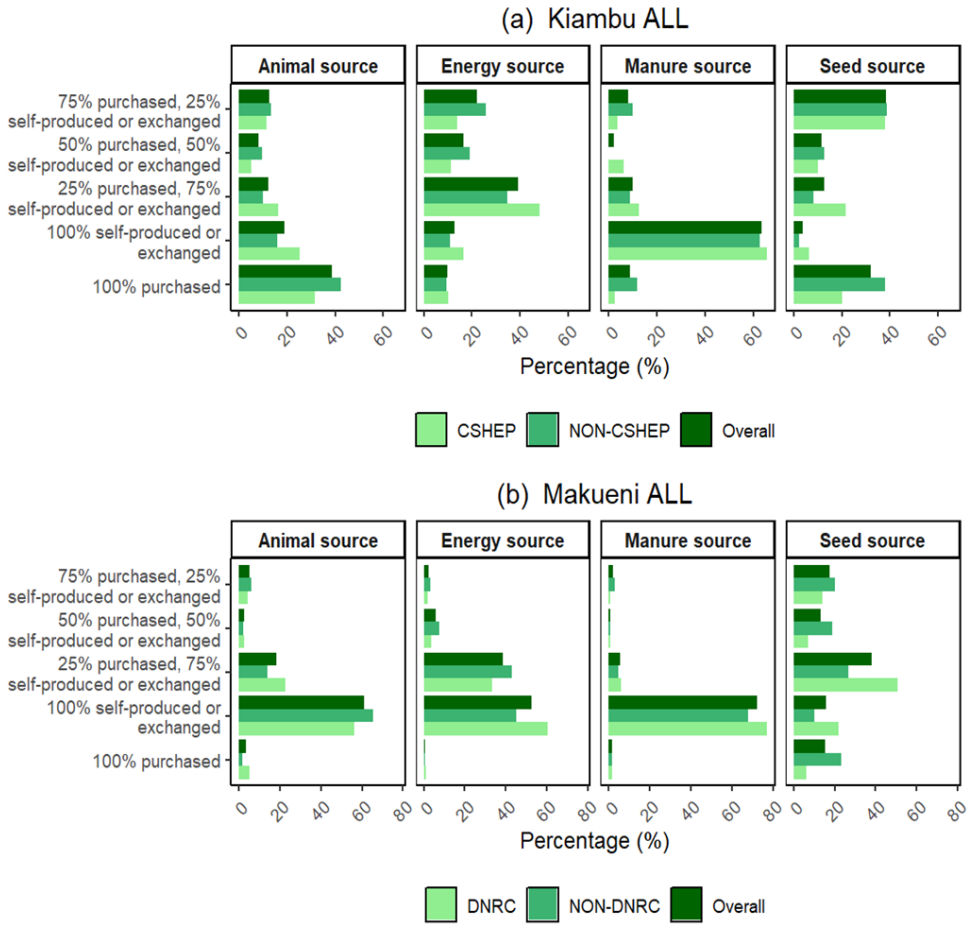

Figure 6: Percentage distribution of the sources of animal, energy, and manure for the interviewed households in (a) Kiambu, and (b) Makueni ALL. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC, and n=242 for Makueni).

2. INPUT REDUCTION

In both ALLs, only a small percentage of households did not use any soil fertility management practices (1.7% in Kiambu and 1.2% in Makueni) (Figure 7). Organic fertilizers, such as manure, were the most used soil fertility enhancement method, followed by ecological practices. Chemical fertilizers were more widely used in the Makueni ALL compared to Kiambu, with a notable difference in use between CSHEP-affiliated and non-affiliated households in Kiambu. Pest management in both ALLs was predominantly ecological, with a higher percentage in Makueni (78.1%) compared to Kiambu (71.1%). Chemical pesticide use was more common in Makueni (71.9%), while CSHEP-affiliated farmers in Kiambu used fewer chemical pesticides (5%).

Livestock disease control practices were similar across both ALLs, with antibiotics and vaccinations widely used, and organic treatments more common in Makueni. However, the use of animal quarantine measures was less frequent. Most households in both regions frequently fed their livestock with dry stored feed (Table 4).

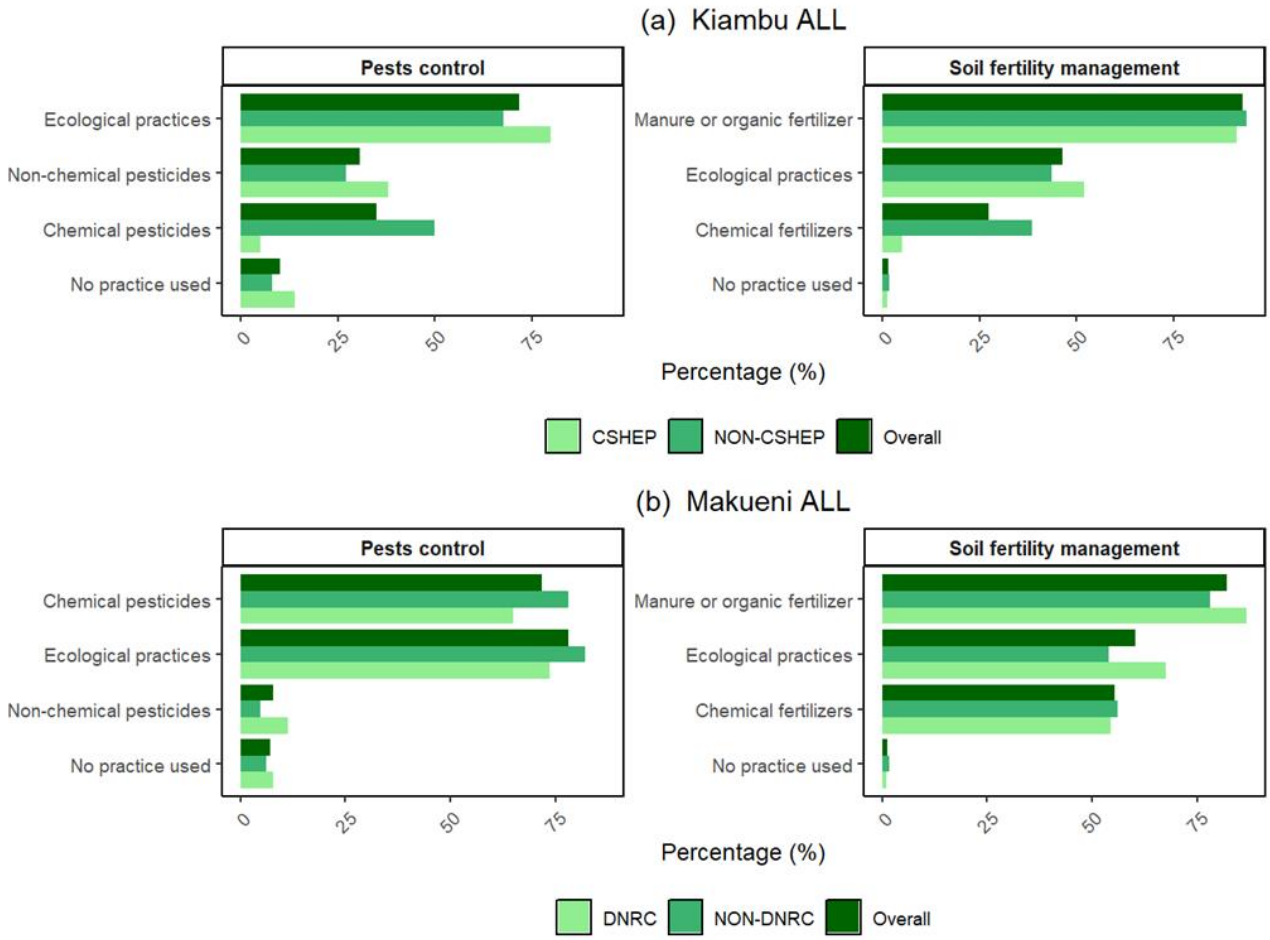

Figure 7: The different methods used in pest control and soil fertility management in the two ALLs. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC, and n=242 for Makueni).

Table 4: The different form of practices used for treating animals in the two ALLs. Values represent the percentage of farmers under each category.

	CSHEP (n=79)	Non-CSHEP (n=158)	Kiambu (n=237)	DNRC (n=114)	Non-DNRC (n=128)	Makueni (n=242)
Antibiotics	43	60.1	54.4	64.9	71.9	68.6
Genetic selection for disease resistance	1.3	4.4	3.4	0	0	0
Herbal remedies or traditional medicine	19	12	14.3	25.4	23.4	24.4
No action taken	13.9	9.5	11	6.1	2.3	4.1
Organic treatments	21.5	12.7	15.6	27.2	32.8	30.2
Quarantine measures	2.5	5.7	4.6	0	4.7	2.5
Vaccination	51.9	62	58.6	66.7	59.4	62.8

3. SOIL HEALTH

Households in the two ALLs employed a variety of ecological practices for soil management (Figure 8). Cover crops were the most used, with 42.1% of households in Makueni and 26.2% in Kiambu adopting this practice. Legume integration was also widely practiced, with 41.7% of households in Makueni and 24.9% in Kiambu using legumes to improve soil health. Mulching was more prevalent in Kiambu (24.1%) compared to Makueni (11.2%), whereas leaving crop residues in the field was more common in Makueni (25.2%) than in Kiambu (18.6%). Practices such as fertilizer microdosing, reduced tillage, and planting basins were less commonly adopted by the interviewed households. Additionally, only a very small percentage of households practiced no-tillage or used soil inoculants, such as fungi and bacteria, to enhance soil health.

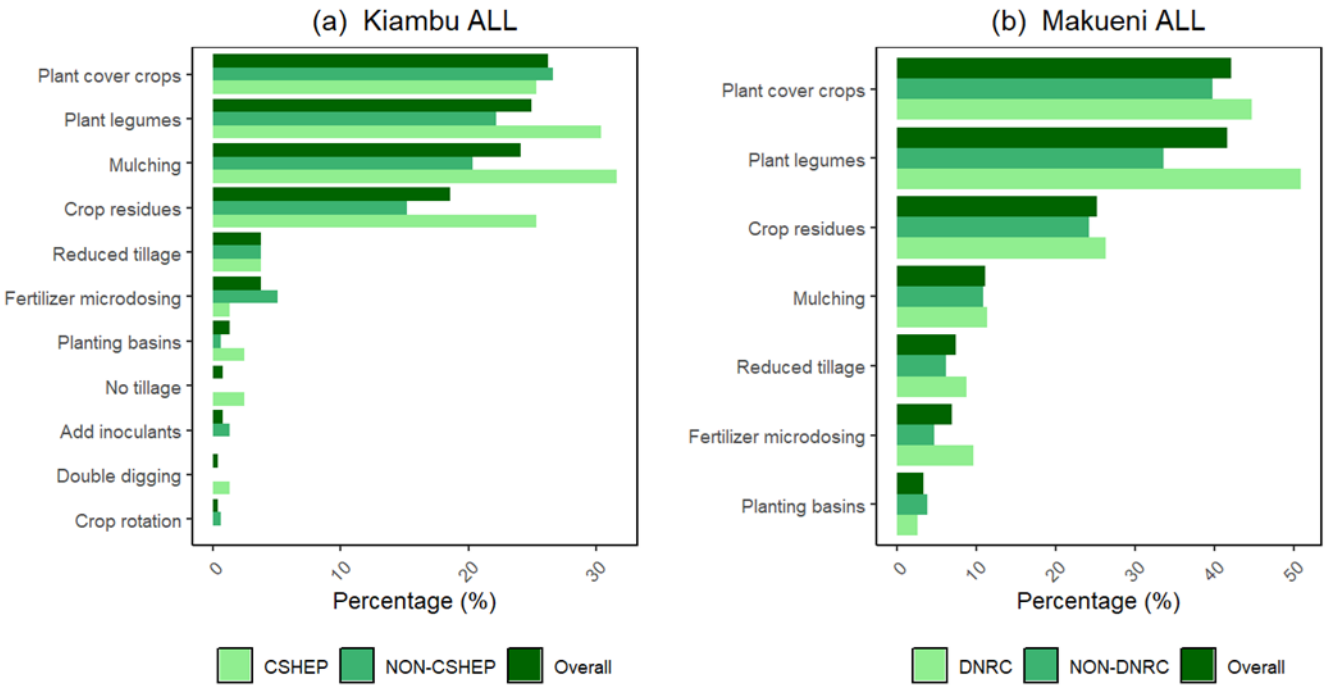

Figure 8: The different ecological practices used in improving soil health in the two ALLs. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC, and n=242 for Makueni).

4. ANIMAL HEALTH

A significant percentage of households interviewed reported that they perceive their animals to be free from stress, hunger, pain, or diseases (43.2% in Kiambu and 43.9% in Makueni) (Table 5). A smaller proportion noted that, while their animals do not suffer from hunger, pain, or diseases, they occasionally experience stress. Only a very small percentage of households indicated that their animals suffer from hunger, diseases, and stress throughout the year (1.3% in Kiambu and 2.5% in Makueni). Most respondents stated that they consistently provide their animals with adequate food and clean drinking water. However, only 46.3% in Kiambu and 44.7% in Makueni considered their animals' diets to be sufficiently diversified. More than half of the households in both ALLs reported providing their animals with shelter, medical assistance when needed, and maintaining good hygienic conditions. A large percentage of the households interviewed indicated that they perceive the animals in their households to not suffer from stress, hunger, pain or diseases (43.2% in Kiambu and 43.9% in Makueni). A smaller percentage indicated that while the animals do not suffer from hunger, pain or diseases, they sometimes can suffer or experience stress. The respondents interviewed indicated they consistently provided the animals with adequate food and clean drinking water. However, only about half of the respondents in Kiambu and Makueni considered the animal diets to be diversified. More than half of the households provided their animals with shelter, medical assistance when needed and also good hygienic conditions in both ALLs.

Table 5: Percentage distribution of the interviewed farmers perception on the animal health and happiness, and the practices used in managing livestock and fish.

		Kiambu			Makueni		
Question category	**Responses**	**CSHEP (n=79)**	**Non-CSHEP (n=158)**	**Overall (n=237)**	**DNRC (n=114)**	**Non-DNRC (n=128)**	**Overall (n=242)**
Perception on animal health and happiness	No hunger or thirst, but suffer from stress, and may be prone to diseases and pain at slaughter.	15.2	13.9	14.3	26.3	23.4	24.8
	No hunger, thirst or diseases but can experience stress, especially at slaughter.	13.9	27.8	23.2	21.1	27.3	24.4
	No stress, hunger, thirst, pain, or diseases, and no unnecessary pain at slaughter.	48.1	41.8	43.9	11.4	13.3	12.4
	Suffer from hunger, thirst, stress and diseases all year long and are exposed to pain at slaughter.	2.5	0.6	1.3	2.6	2.3	2.5
	Suffer seasonally from hunger and thirst, stress or diseases, and are exposed to pain at slaughtered.	10.1	7	8	29.8	23.4	26.4
Practices on livestock	Provide shelter	77.2	88	84.4	68.4	68.8	68.6
	Conduct regular checks for injuries/diseases	35.4	49.4	44.7	64	61.7	62.8
	Provide consistent access to adequate food	82.3	87.3	85.7	86	84.4	85.1
	Provide consistent access to clean drinking water	77.2	82.3	80.6	80.7	81.2	81
	Provide diversified diets	34.2	50	44.7	45.6	46.9	46.3
	Provide hygienic surroundings	62	71.5	68.4	67.5	68.8	68.2
	Provide medical assistance when needed	46.8	60.1	55.7	64	64.8	64.5
	No action taken	1.3	0	0.4	0	0.8	0.4
Practices on fish	Agro-aquaculture: Combining fish farming with crop cultivation	0	0.6	0.4	0	0	0
	Eco-friendly pond designs	0	1.3	0.8	0	0	0
	Efficient water management	0	1.3	0.8	0	0	0
	Improved feed formulation	0	0.6	0.4	0	0	0
	Selective breeding for climate resilience	0	0.6	0.4	0	0	0

5. BIODIVERSITY

The total number of crop species (including perennial crops) produced in Makueni County ALL in the farm in the last 12 months was 51 (Annex 2, Table A1). The top ten crops in Makueni County ALL were maize (94.63%), beans (88.84%), cowpeas (72.31%), pigeon peas (65.29%), mangoes (64.88), oranges (45.87%), green gram (21.49%), bananas (18.6%), avocados (11.16%) and pixies (9.92%). The total number of crop species (including perennial crops) produced in the farm in the last 12 months in Kiambu County ALL was 62 (Annex 2, Table A2). The top ten crop species (in order of dominance) were maize (84.39%), beans (68.78%), kales (65.4%), spinach (58.65%), cabbage (40.93%), forage (39.66%), avocado (36.71%), potatoes (34.6%), Irish potatoes (33.33%) and Amaranthus (29.54%).

In total, 13 different livestock species were kept in Kiambu and Makueni ALL centres (Table 6). In Kiambu ALL, the top four mostly reared livestock species, in order of rank, were cattle (67.5%), chickens (65.4%), goats (20.3%) and sheep (19%). In Makueni County ALL, the top four most reared livestock species were chickens (84.7%), cattle (73.1%), goats (52.5%) and donkeys (11.2%).

Table 6: Animal species that were produced on the farm in the last 12 months in Kiambu County and Makueni County ALLs. Values represent the percentage of farmers that keep the respective animal under each category.

	KIAMBU ALL			MAKUENI ALL		
	CSHEP (%)	NON-CSHEP (%)	Overall (%)	DNRC (%)	NON-DNRC (%)	Overall (%)
Bees	1.3	1.3	1.3	2.6	2.3	2.5
Cattle	57	72.8	67.5	75.4	71.1	73.1
Chickens	68.4	63.9	65.4	86.8	82.8	84.7
Donkeys	6.3	5.1	5.5	15.8	7	11.2
Doves	1.3	0	0.4	0	0	0
Ducks	10.1	3.8	5.9	0.9	1.6	1.2
Goats	30.4	15.2	20.3	57.9	47.7	52.5
Goose	0	1.3	0.8	0	0	0
Guinea fowls	1.3	0	0.4	0	0	0
Pig	2.5	4.4	3.8	0	0	0
Rabbit	0	8.2	5.5	3.5	0	1.7
Sheep	22.8	17.1	19	6.1	4.7	5.4
Turkey	2.5	0.6	1.3	0.9	0	0.4

6. SYNERGY

The adoption of sustainable agricultural practices shows distinct differences between CSHEP and Non-CSHEP groups. In terms of synergistic practices, CSHEP has a slight edge in activities such as planting or conserving trees (68.4% vs. 68.5%) and planting natural vegetation (59.6% vs. 48.0%). CSHEP also shows higher adoption of sowing along contour lines (41.2%) compared to Non-CSHEP (4.1%) (Figure 9) . Both groups exhibit low adoption of mixed farming. For practices on cropland, CSHEP leads significantly in intercropping, with 88.6% adoption compared to 70.4% in Non-CSHEP. Agroforestry is also slightly higher in CSHEP (50.6% vs. 49.1%). However, mulching shows higher adoption in Non-CSHEP (37.8%) than CSHEP (36.7%). In grazing practices, manure collection is the most prominent practice in both affiliations, with equal adoption at 66%. CSHEP has a slight advantage in composting (24.1% vs. 16.4%) and improving manure storage (11.3% vs. 10.5%). However, other grazing practices such as exclosures and reducing grazing pressure remain minimally adopted across both groups. For ecological pest control, CSHEP again leads in cover cropping/intercropping (48.1% vs. 45.3%), while Non-CSHEP shows slightly higher adoption of improved crop varieties (29.6% vs. 25.1%) and repelling plants (Figure 9). In Makueni, farmers who participate in DNRC programs exhibit significantly higher adoption of sustainable agricultural practices compared to non-participants. Among cropland practices, intercropping (75%), mulching (60%), and agroforestry (60%) stand out as the most widely adopted methods by DNRC participants. In contrast, non-participants lag behind, with adoption rates of 50% for intercropping, 25% for mulching, and 30% for agroforestry. Practices like crop rotation (40%) and cover crops (25%) are also more common among DNRC participants, emphasizing the program's influence in promoting soil health and productivity. For grazing practices, DNRC participants prioritize strategies such as manure management (65%), reducing grazing pressure (50%), and keeping improved breeds (50%). Non-participants, however, show much lower adoption rates in these areas, with 30% engaging in manure management and 20% in keeping improved breeds (Figure 9).

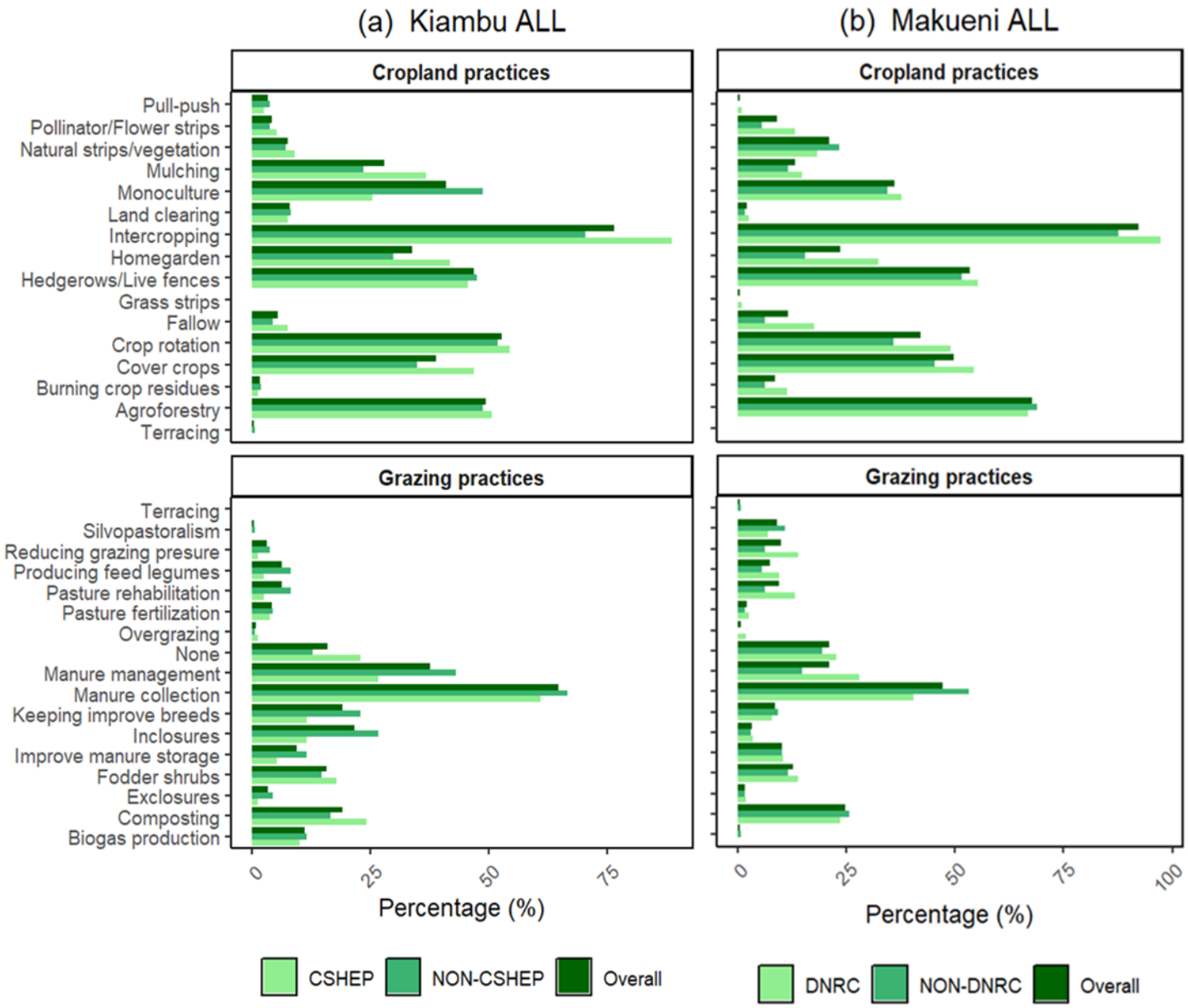

Figure 9: The percentage level of adoption of the different cropland and grazing practices among the interviewed households in the two ALLs. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC and n=242 for Makueni).

The comparison between DNRC and Non-DNRC reveals higher adoption of most sustainable agricultural practices in DNRC. Among synergistic practices, DNRC exhibits higher uptake of planting natural vegetation (53.3% vs. 48.0%) and sowing along contour lines (39.4% vs. 4.1%). Both DNRC and Non-DNRC have comparable high adoption of planting or conserving trees (68.5% vs. 68.6%). In practices on cropland, DNRC significantly outperforms Non-DNRC in intercropping (92.1% vs. 76.4%) and agroforestry (67.8% vs. 49.4%). However, Non-DNRC shows a higher preference for mulching (37.8% vs. 18.1%). Land clearing has minimal adoption across both affiliations, reflecting the general focus on sustainable land-use practices. Regarding grazing practices, DNRC shows higher adoption of composting and improving manure storage. However, Non-DNRC leads in manure collection (64.6% vs. 47.1%) and manure management (51.8% vs. 37.6%). Practices like reducing grazing pressure and exclosures have very low adoption in both affiliations. For ecological pest control, DNRC outperforms Non-DNRC in cover cropping/intercropping (72.7% vs. 43.4%) and improved crop varieties (33.5% vs. 19.6%). Both affiliations have minimal adoption of practices like favoring biodiversity and beneficial organisms (Figure 10b). In Kiambu, CSHEP participants demonstrate significantly higher adoption rates of sustainable agricultural practices compared to non-participants. Among ecological pest control methods, rotation and intercropping (55%), repelling plants (40%), and cultural control (30%) are widely adopted by

CSHEP farmers, while non-participants lag behind with much lower adoption rates. Practices like encouraging biodiversity and using resistant varieties are moderately adopted, but promoting beneficial organisms remains underutilized, even among participants (Figure 10a).

For synergistic practices, CSHEP participants excel in planting and conserving trees (50%), planting natural vegetation (45%), and mixed farming (35%), showcasing a strong commitment to integrated and regenerative farming systems. In contrast, a significant portion of non-participants (20%) do not adopt any synergistic practices. While practices like irrigation with rainwater (25%) are less common overall, CSHEP participants still outperform non-participants in these areas (Figure 10).

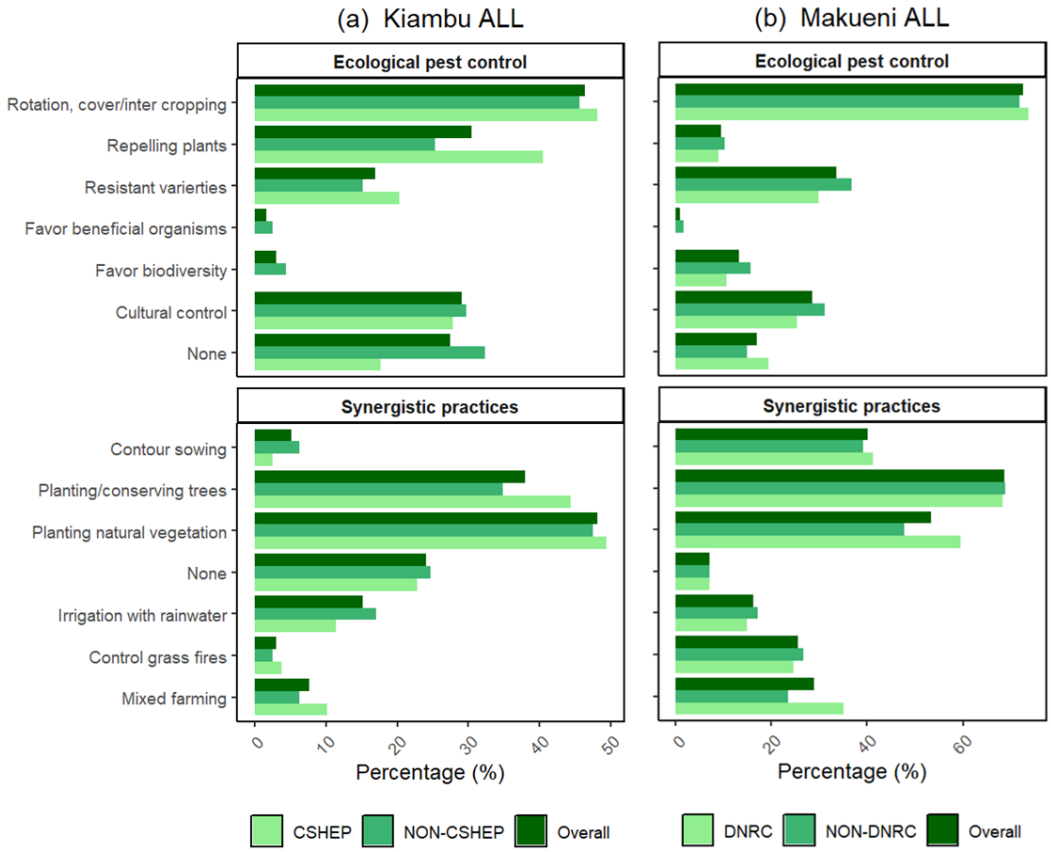

Figure 10: The percentage level of adoption of the different ecological pest control and crop and animal synergistic practices among the interviewed households in the two ALLs. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC, and n=242 for Makueni).

7. ECONOMIC DIVERSIFICATION

When comparing the income sources of CSHEP and Non-CSHEP affiliation, both groups relied on casual labor to a similar extent, with 29.1% for CSHEP and 28.9% for Non-CSHEP. Similarly, formal labor contributions were nearly identical, at 7.6% and 7.5%, respectively, while land leasing played a minimal role for both, accounting for 2.5% in CSHEP and 1.3% in Non-CSHEP. However, differences became more apparent in other income sources. Non-CSHEP members demonstrated a significantly higher reliance on livestock production (81.8%) and crop production (86.2%) compared to CSHEP members, who reported 70.9% and 53.2% for these sources, respectively. This indicated a stronger focus on agricultural activities among Non-CSHEP members. Majority of CSHEP members are located in the semi-arid part of the county where crop production activities are limited by environmental conditions. Additionally, the lower dependence on crop production among CSHEP farmers could have been due to CSHEP's emphasis on sustainable and organic farming practices, which may encourage alternative income streams such as participation in value-addition and specialized organic and agroecological markets. Conversely, CSHEP members exhibited slightly greater reliance on cash transfers (21.5%) compared to Non-CSHEP (20.8%). While both groups showed limited engagement in other family businesses, Non-CSHEP had a marginally higher share (25.8%) compared to CSHEP (24.1%). Fish production was negligible for both groups, though Non-CSHEP reported a small contribution (0.6%) compared to none for CSHEP (Figure 11a).

Comparison of the income sources of DNRC and Non-DNRC farmers, revealed several differences and similarities. Both DNRC and Non-DNRC had minimal reliance on land leasing, with DNRC at 1.7% and Non-DNRC at 0.8%. However, there were significant differences in other income sources. DNRC members exhibited a higher reliance on livestock production (71.1%) compared to Non-DNRC members (66.9%). In contrast, crop production played a more prominent role for Non-DNRC members, who derived 83.5% of their income from this source, compared to 72.8% for DNRC members. Casual labor was another key area of difference, with DNRC members showing a significantly higher dependence (46.5%) compared to Non-DNRC members (39.4%). Non-DNRC members, however, relied more heavily on cash transfers, which accounted for 39.5% of their income, whereas this source contributed only 23.6% for DNRC members. Formal labor made up a larger portion of income for DNRC members (16.7%) compared to Non-DNRC members (11.0%). Additionally, DNRC members earned substantially more from other family businesses, with this source contributing 36.8% to their income, compared to 18.9% for Non-DNRC members (Figure 11b).

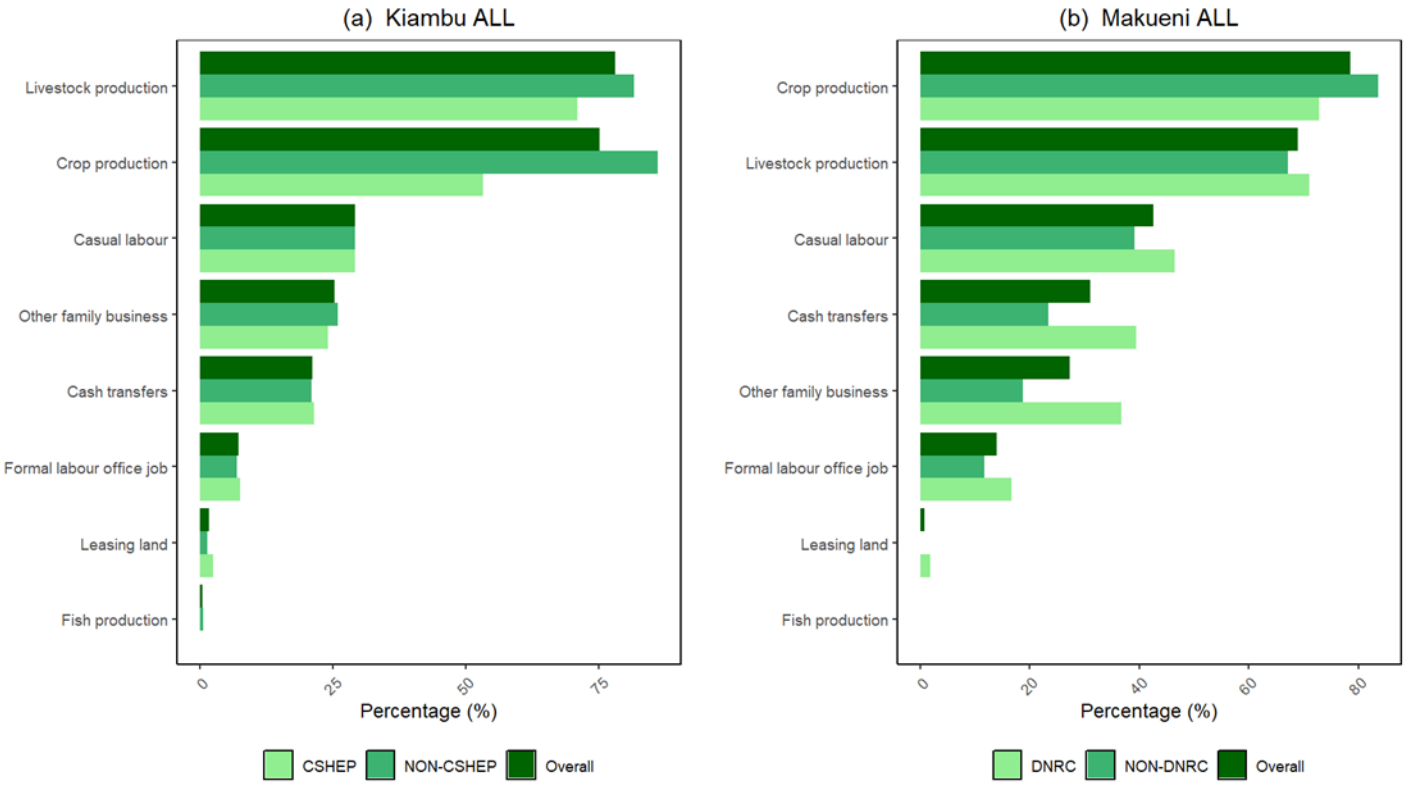

Figure 11: The percentage distributions of the various sources of incomes for the farmers in the two ALLs. The percentages are calculated using the total number of interviewed farmers in each of the category (i.e. n=79 for CSHEP, n=158 for NON-CSHEP, n=237 for Kiambu, n = 114 for DNRC, n=128 for Non-DNRC, and n=242 for Makueni).

8. CO-CREATION OF KNOWLEDGE

Table 7 presents data on the average number of times households exchanged information with various food system stakeholders over 12 months. The data is disaggregated by the two counties, Kiambu and Makueni, along with an overall average for both regions combined to show level of engagement in co-creation of knowledge among the farming households. The table categorizes interactions with different stakeholders, reflecting the frequency of information exchange among households in the specified regions. Results show that farmers interacted more with fellow farmers and consumers. Households showed the highest frequency of engagement with fellow farmers, with Kiambu households exchanging information 10.9 times and Makueni households even higher at 14.7 times, with an overall sample average of 12.8 times a year. Additionally, households in Kiambu reported a substantially higher average interaction (8.3 times) with consumers compared to Makueni (5.8 times), and an overall sample average interaction of 7.1 times a year. Regarding engagement with agricultural extension workers, results show a notable difference between the two regions, with Kiambu households engaging more frequently (2.8 times a year) than those in Makueni (1.7 times a year). On the other hand, farmer engagement with Government and Higher Learning Institutions had the lowest interaction frequencies across all regions, indicating limited engagement in these areas.

Table 7: The average frequency of knowledge exchanges among interviewed farmer households with various stakeholder groups over the past year in the two ALLs.

Food system stakeholders	Kiambu (n=237)	Makueni (n=242)
Agricultural extension workers	2.8	1.7
Consumers	8.3	5.8
Food traders	7.4	4.4
Government (Trade fairs, Agricultural shows, etc)	0.5	1.1
NGOs	2.7	4.3
NGO researchers	1.5	2.8
Other farmers	10.9	14.7
Higher learning institutions	0.3	0.2

9. SOCIAL VALUES AND DIETS

Table 8 presents a comparative analysis of Household Dietary Diversity Scores (HDDS) between Kiambu and Makueni ALLs based on the consumption of various food groups. Results show that cereals form the primary dietary component in both regions, with near-universal consumption rates of 98.3% in Kiambu and 95.0% in Makueni, underscoring their importance as staple foods. Vegetables also feature prominently, but with slightly higher consumption in Kiambu (95.8%) compared to Makueni (86.0%), reflecting their widespread availability and dietary importance. The data further reveals substantial regional disparities in the intake of roots and tubers, where Kiambu records a notably higher consumption at 61.2% compared to Makueni at 22.3%. Similarly, the consumption of fruits is higher in Kiambu (47.3%) compared to Makueni (38.8%). Protein sources, such as meats, poultry, and offal, show low but comparable consumption levels in both regions (15.2% in Kiambu and 12.8% in Makueni). A similar trend is observed for eggs, where intake remains modest (16.5% in Kiambu and 9.9% in Makueni), and fish/seafood, which are virtually absent from diets in both regions (0.8%). Interestingly, pulses, legumes, and nuts exhibit an inverse trend, with higher consumption in Makueni (68.6%) than in Kiambu (50.2%), reflecting their role as affordable and accessible protein alternatives in arid or semi-arid contexts. Additionally, milk and milk products are moderately consumed in both areas, with Kiambu reporting slightly higher intake (53.6%) compared to Makueni (49.6%), possibly due to greater dairy farming activity in Kiambu.

Figure 12 compares access to different types of food (diversified, healthy, seasonal, and traditional) in two ALLs. Overall, "good access" is the most prevalent response across all food types and both counties, highlighting a generally high level of food accessibility for most respondents. "Fairly good access" follows closely, indicating that while the majority have sufficient access, some individuals face minor limitations. Seasonal food shows greater variability, with higher reports of "limited access," likely due to natural fluctuations in availability. Among the food categories, diversified and healthy foods stand out as the most accessible, with consistently high levels of "good access" and very few cases of "no access at all." Traditional food also remains widely accessible, reflecting its continued importance in local diets and its alignment with the accessibility patterns of other food categories.

Table 8:Proportions of households consuming different food groups in the past 7 days.

Food groups (HDDS)	Kiambu (n=237) %	Makueni (n=242) %
Cereals	98.3	95.0
Roots and tubers	61.2	22.3
Vegetable	95.8	86.0
Fruits	47.3	38.8
Meats, poultry, offal	15.2	12.8
Eggs	16.5	9.9

Fish and sea food	0.8	0.8
Pulses, legumes, nuts	50.2	68.6
Milk and milk products	53.6	49.6
Oil/fat	100.0	100.0
Sugar/honey	2.1	0.0
Miscellaneous	86.9	61.6

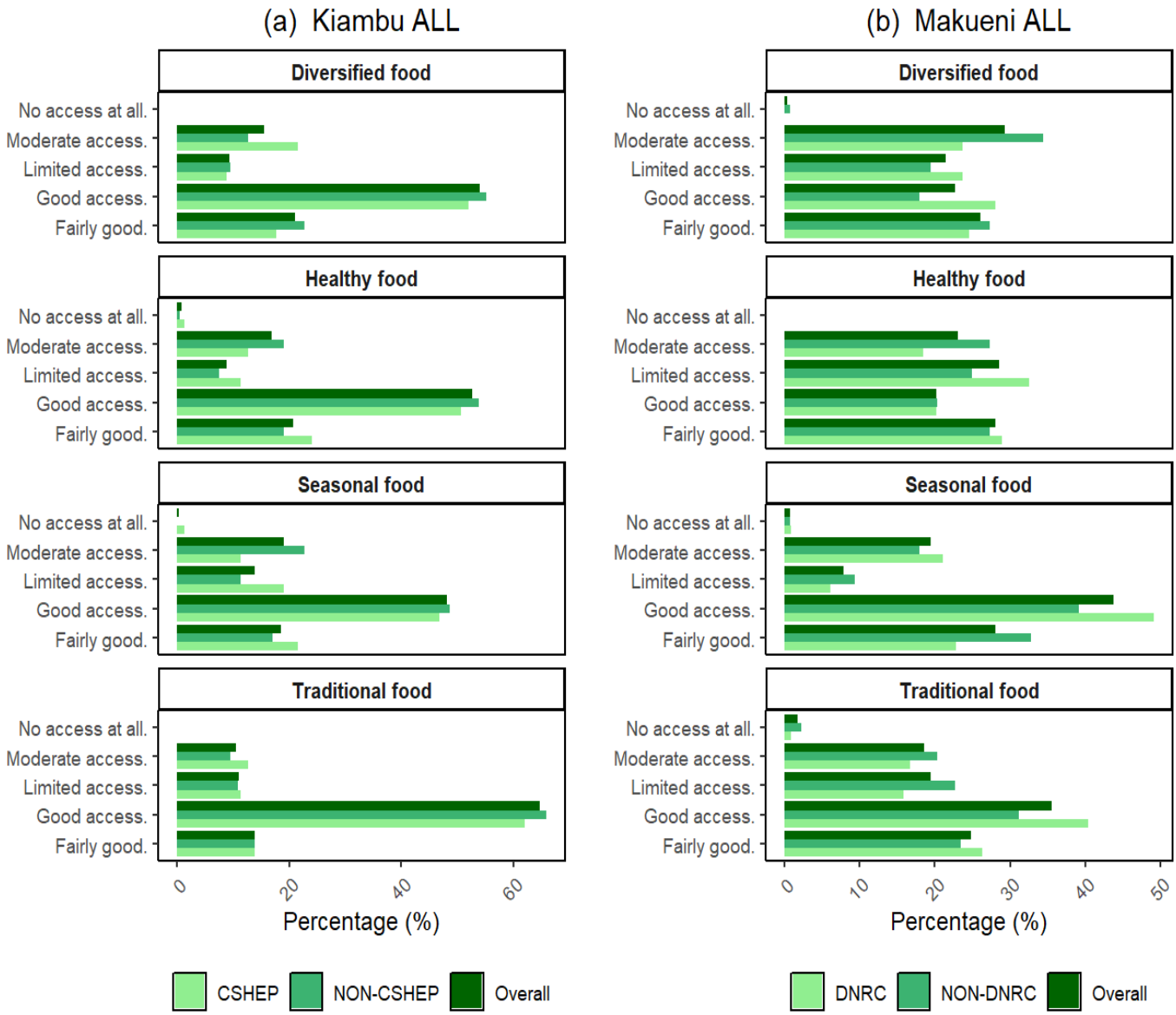

Figure 12: Perception of the interviewed households on access to diversified, healthy, seasonal and traditional foods

10. FAIRNESS

Across all ALLs and affiliations, it is notable that while completely fair or completely unfair pricing scenarios are uncommon, a consistent guarantee of fair pricing is also not the norm (Figure 13). Instead, farmers frequently experience sporadic or uncertain conditions when it comes to obtaining fair prices for their goods. Differences across affiliations and ALLs further highlight the complexity of these market dynamics. For example, CSHEP and Kiambu farmers sometimes report relatively higher "Always" or "Usually" percentages in certain product categories—such as livestock—indicating more stable pricing arrangements or better bargaining mechanisms. In contrast, affiliations like Non-CSHEP, Non-DNRC, and counties like Makueni often see moderate percentages distributed among "Occasionally" and "Rarely," suggesting that fair pricing is neither strongly

guaranteed nor systematically withheld. Honey and tree products, in particular, performed poorly in the ratings, hinting at less mature or transparent markets for these commodities and more volatility in the prices that farmers receive.

Several factors likely contribute to these patterns. The limited occurrence of "Always" suggests that long-term stable relationships, effective farmer cooperatives, or strong institutional support may be lacking in many contexts. The presence of moderate "Occasionally" and "Rarely" responses indicates that farmers remain vulnerable to fluctuations in demand, middleman influence, and the absence of robust market information systems. Furthermore, differences across affiliations and product categories highlight how localized interventions, such as collective bargaining, quality standardization, and transparent pricing information, could help improve pricing towards more fairness.

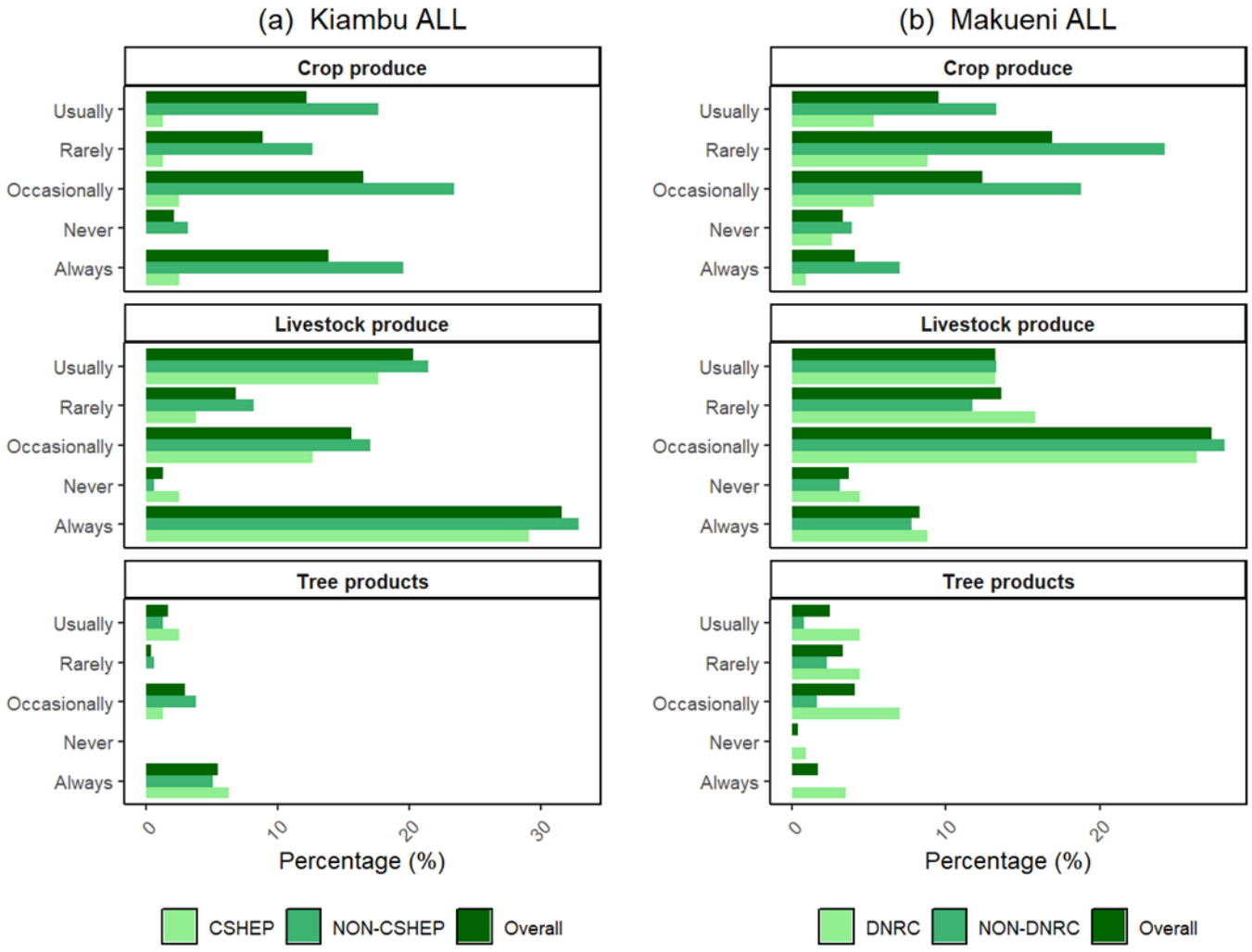

Figure 13: Perception on fairness in pricing of agricultural products and produce.

11. CONNECTIVITY

Both ALLs exhibit different channel usage patterns (Figure 14). Kiambu often shows a balanced distribution, with notable shares of farmers trading directly with consumers, and a significant portion with traders or supermarkets. Makueni, while also using supermarkets and direct consumer sales, occasionally constitute small but distinct percentages of farmers utilizing other channels, though never as dominantly as direct or supermarket pathways. Direct-to-consumer and trader/supermarket channels dominate as sales channels for most affiliations and counties, while cooperatives and other channels play a secondary role. Kiambu county, similar to DNRC farmers, demonstrates more balanced distributions but still shows limited reliance on cooperatives and virtually no presence of other channels. These patterns hint at varying

degrees of market access, organization, and bargaining power. Direct consumer sales and supermarkets likely offer more immediate returns or established networks, while the lower use of cooperatives and other channels may indicate insufficient institutional support, weaker collective marketing efforts, or less formalized alternative routes.

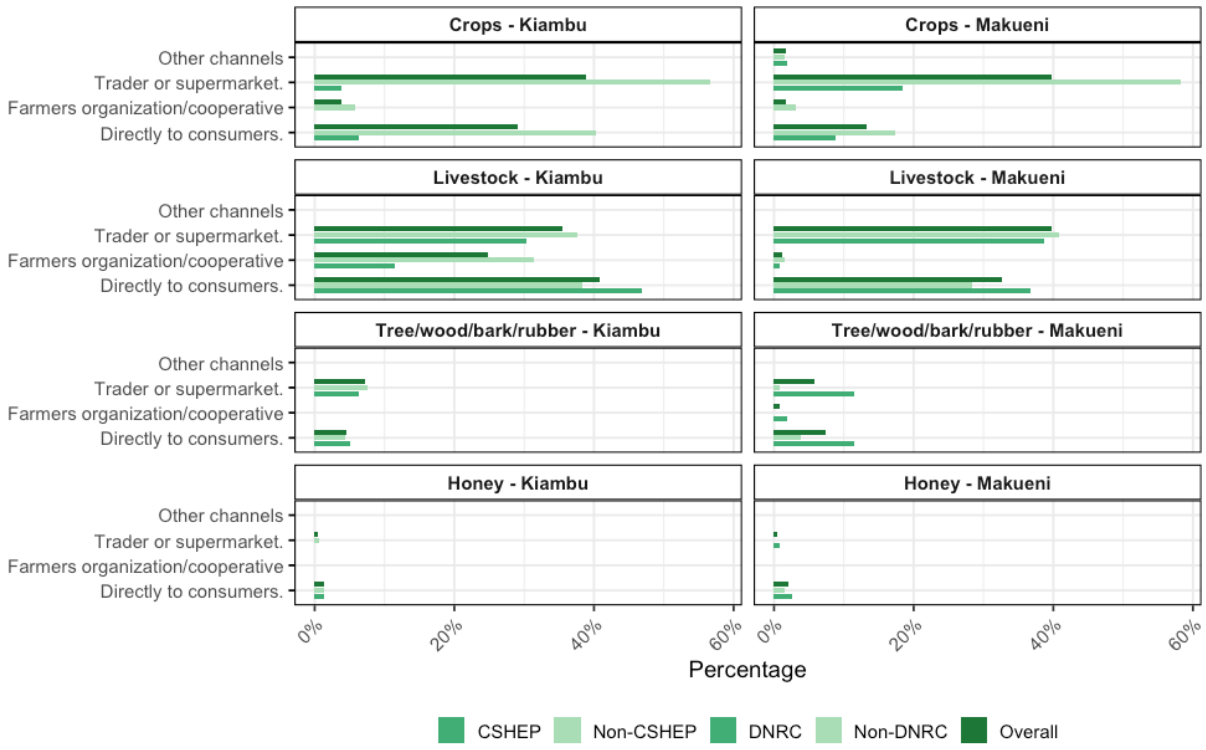

Figure 14: Marketing channels for agricultural products and commodities.

When comparing within affiliations, non-CSHEP farmers stand out for crop sales, with 56.6% of the farmers selling via traders or supermarkets. A large share of farmers in this category (40.3%) also reported selling directly to consumers. By contrast, CSHEP relies more evenly on direct consumer sales and supermarkets for crops and shows virtually no usage of farmers organizations or other channels. DNRC presents moderate usage of multiple channels across product types—less extreme than non-CSHEP's dominance in one channel but still leaning more toward traders and supermarkets than cooperatives or other channels. In contrast, livestock sales see higher overall percentages and more even distribution across channels, with certain affiliations like CSHEP and DNRCstrongly engaging consumers directly and also selling through traders and/or supermarkets. For tree products, while direct consumer and trader routes remain significant, the reliance on cooperatives or other channels is minimal, reflecting a possibly less organized marketing structure for these products. Honey production activities are still generally low in the study sites and are primarily sold directly to consumers, though some farmers also sell to traders or supermarkets.

12. GOVERNANCE

Figure 15 presents the frequency of participation in governance activities related to community land and natural resource management in Kiambu and Makueni counties and the overall frequency for both counties combined. The table shows that a significant proportion of respondents in both counties have never participated in governance decision related to the management of community and natural resources, with 31.2% in Kiambu and 19.0% in Makueni reporting that they have never participated in governance activities. A similar trend is observed for those who rarely participate, with 22.8% in Kiambu and 14.1% in Makueni. While the proportion of respondents who sometimes, most of the time, or always participate is higher in Makueni compared to Kiambu, the overall trend indicates that a considerable number of households in both counties have limited involvement in governance activities related to community land and natural resource management.

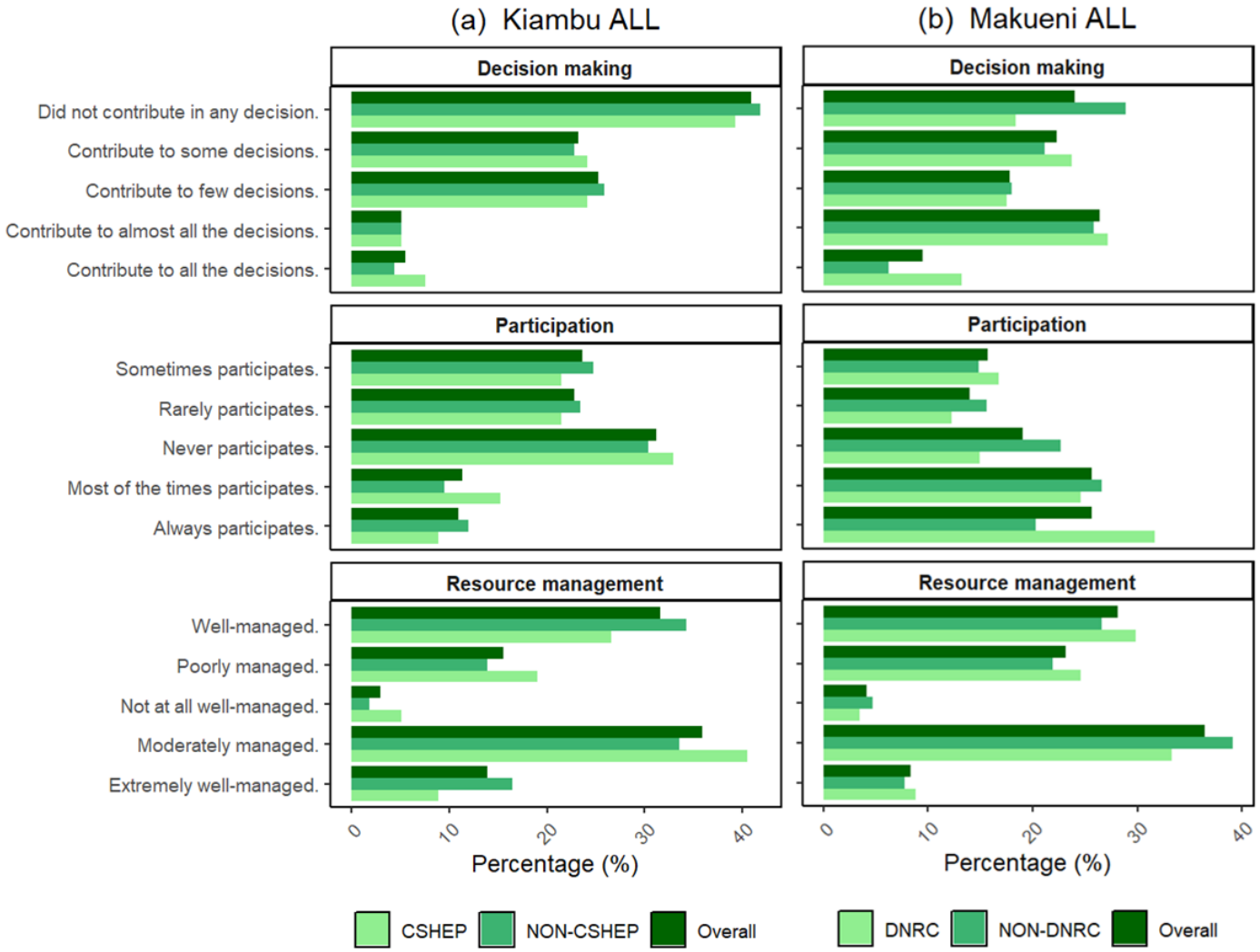

Figure 15: The interviewed farmers perceptions on their contribution to decision making (top row plot) and participation (second row plot) on activities related to the management of the community land natural resources and their perception (bottom row plots) on the management of land and resources management.

13. PARTICIPATION

The data presented in Table 9 highlights strong participation in women's associations and farmer/producer organizations, reflecting their socio-economic importance. Women associations have the highest representation across all categories, ranging from 23.73% (DNRC) to 31.97% (Non-DNRC). This indicates a significant role of women groups in the surveyed regions, likely tied to socio-economic empowerment or community initiatives. Farmer/producer organizations rank second in prominence. This reflects the importance of agriculture as a central economic activity and the strong participation in producer cooperatives for improved productivity and collective bargaining. NGO and environmental group participation shows region-specific variability, while youth and political group involvement remains marginal.

Table 9: The average frequency of participation in groups/associations among interviewed farmer households with various stakeholder groups over the past year in the two ALLs. The values represent the percentages per category.

	Kiambu ALL			Makueni ALL		
Group/Association	CSHEP (n=79)	NON-CSHEP (n=158)	Overall (n=237)	DNRC (n=114)	NON-DNRC (n=128)	Overall (n=242)
Agriculture/trade organization	10.87	7.66	8.75	7.20	5.96	6.63
Cooperative.	7.83	10.81	9.79	3.20	5.64	4.32
Cultural/health/school group.	3.48	5.18	4.60	2.40	3.76	3.03
Environmental group.	2.61	5.18	4.30	8.53	4.39	6.63
Farmer producer organization.	24.35	18.69	20.62	19.47	17.55	18.59
NGO.	5.22	1.58	2.82	20.00	5.33	13.26
Other groups	2.61	3.83	3.41	2.40	3.13	2.74
Political organization.	0.00	0.68	0.45	0.27	0.94	0.58
Village board.	6.96	9.46	8.61	9.07	15.05	11.82
Women association.	30.87	29.73	30.12	23.73	31.97	27.52
Youth association.	2.61	2.93	2.82	0.80	0.94	0.86
None	2.61	4.28	3.71	2.93	5.01	3.89
I don't know.	0.00	0.00	0.00	0.00	0.31	0.14

Overall scores bases on the 13 Agroecology principles

There results indicate variable scores in the two ALLs across the 13 Principles. Most of the households in Kiambu had an overall score of 3, which indicates a moderate adherence to the principles (Figure 16a). Animal health, social values and fairness had the highest scores in the Kiambu all in both the ALL-host and non-ALL-host affiliated households, with fairness and animal health having the same scores. Farmers affiliated with CSHEP had higher median scores for the recycling, input reduction, and soil health principles. The higher scores for the input reduction principle can be explained using less chemical pesticides and chemical fertilizers by the CSHEP farmers (Figure 16a). The higher scores for the recycling principle are mainly because of the larger extent of use of self-produced manure and compost, energy, livestock resources among the farmers. Despite the wide range of soil health management practices among the farmers in Kiambu ALL, the farms had a low score for the soil health principle with the CSHEP having slightly higher scores. These results can be explained by the fact that most farmers are currently not adopting a wide range of practices with most having one to two practices within the farm. In addition, the soil organic carbon content was also low in some of the farms. The farms in Kiambu ALL also had a low score for synergy, knowledge co-creation and governance principle.

Similar to Kiambu, the Median scores of the households in Makueni was also 3. The farms scored highly in recycling, animal health, and social values and diets indicators. In addition, the median score for the biodiversity principle was also relatively high. Similar to Kiambu, the scores for the soil health principle were also low. DNRC farms had a high median score for the participation principle compared to the Non-DNRC farmers. However, for most of the other principles, the scores were relatively the same for other principles (Figure 16b).

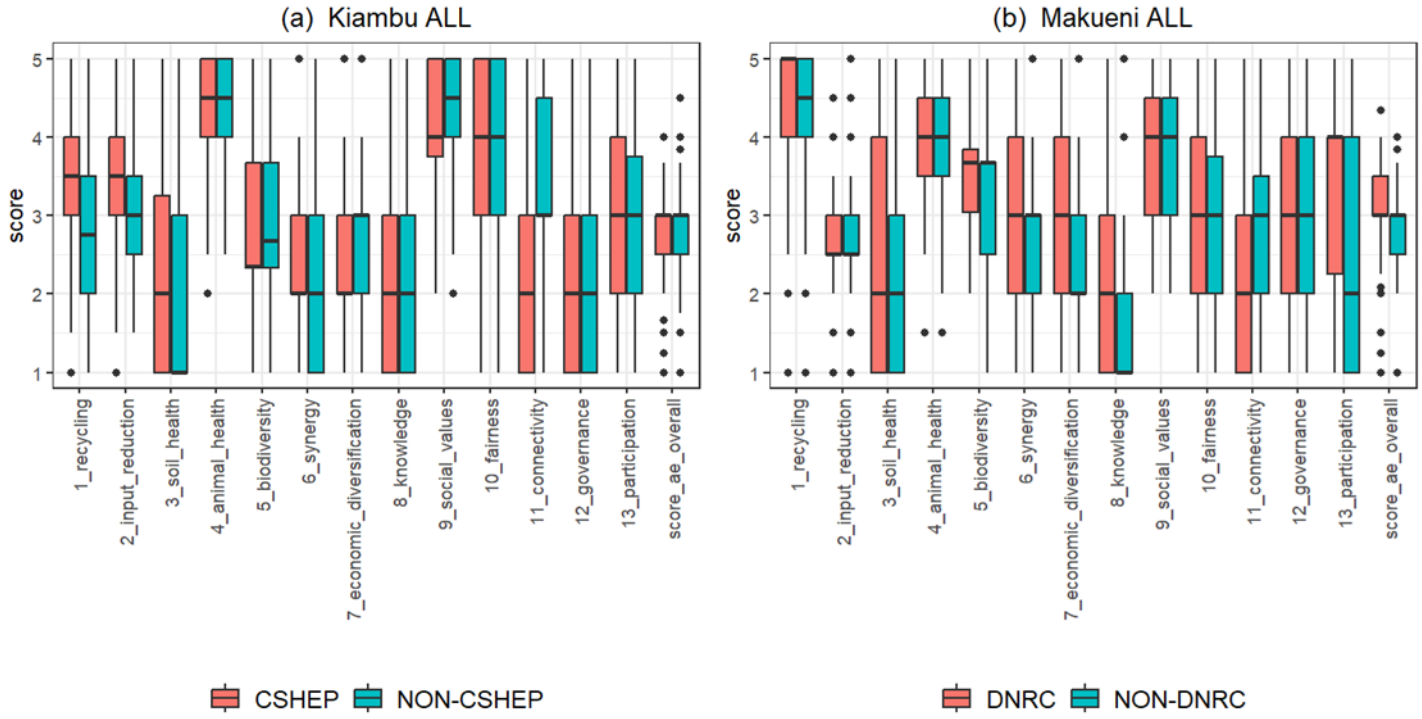

Figure 16: The scores for the 13 HLPE principles of agroecology for the Kiambu and Makueni ALLs.

In both ALLs the results show that most of the interviewed farmers (50-60%) can be categorized to have a moderate adherence to the 13 principles of agroecology (Table 10). A very small percentage of the farmers show no adherence to the principles and also a very small percent has a very strong adherence (i.e., score of 5). A relatively good percentage also had a weak and strong adherence. There were no substantial differences in the percentage of farmers in the different adherence categories between the CSHEP and NON-CSHEP farmers. However, most DNRC farmers were in the category of moderate and strong adherence compared to the NON-DNRC farmers who ranged from weak to strong adherence categories. The higher adherence to agroecology for the DNRC farmers is likely because of their involvement in trainings related to agroecology, mainly on permaculture.

Table 10: Table summarizing the percentage of households adhering to agroecological principles across the two ALLs.

	Kiambu			Makueni		
Score classification	**CSHEP (n=79)**	**NON-CSHEP (n=158)**	**Overall (n=237)**	**DNRC (n=114)**	**NON-DNRC (n=128)**	**Overall (n=242)**
No Adherence	1.27	0.63	0.84	0.88	1.56	1.24
Weak Adherence	17.72	16.46	16.88	9.65	17.19	13.64
Moderate Adherence	62.03	66.46	64.98	51.75	60.94	56.61
Strong Adherence	18.99	15.82	16.88	36.84	20.31	28.1
Very strong Adherence	0	0.63	0.42	0.88	0	0.41

Summary of the key performance indicators results

Agronomic

The results showed that farmers scored highly on soil health, animal health, and crop health (Figure 17). The scores for the soil health were based on the farmers perception soil erosion and soil fertility. Including the soil carbon analysis results in the scoring of this indicator is likely to yield different results. The scores for animal health were high as the extent of livestock injury and illness in both ALLs was small.

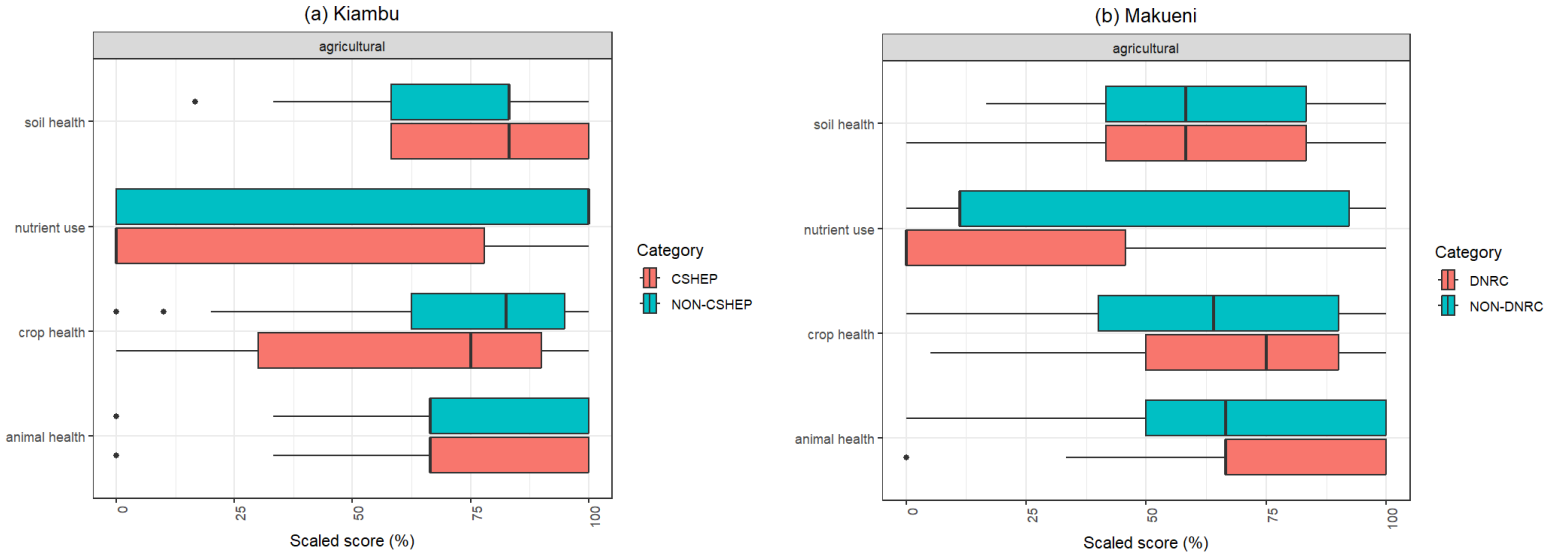

Figure 17: The agronomic indicators performance for (a) Kiambu and (b) Makueni ALLs. The scores were calculated using a set of questions related to each of the respective key performance indicators (KPIs) that were in the HOLPA tool.

In both Kiambu and Makueni, the interviewed farmers perceived their soils to be moderately fertile. In Kiambu about 30% of the farmers perceived the soils to be highly fertile, while only 5% of the farmers in Makueni perceived the soils to be highly fertile. In Makueni 30% of the farmers thought their soils had a low fertility. Erosion was perceived to be a major problem for 15% of the interviewed farmers in Makueni. 38% of the farmers thought it was a minor problem in Kiambu while 48% saw it as a minor problem in Makueni. A large percentage of the farmers in Kiambu considered erosion to not be a major problem (Table 11). Drought was the major cause of crop damage and loss in both ALLs followed by pests and diseases (Table 12). The extent of livestock injury and illness in both ALLs was small. However, most farmers still rely on livestock vaccinations in treating their animals (Table 13).

Table 11: Perception of the household on the soil health of their farms. The values represent percentages of farmers that responded to each of the categories.

	Choice	CSHEP (n=79)	Non-CSHEP (n=158)	Overall (n=237)	DNRC (n=114)	Non-DNRC (n=128)	Overall (n=242)
Perception on soil fertility	Highly fertile	35.4	31	32.5	5.3	4.7	5
	Moderate fertile	64.6	66.5	65.8	63.2	60.9	62
	Low fertility	0	2.5	1.7	26.3	33.6	30.2
	Infertile	0	0	0	5.3	0.8	2.9
Perception on soil erosion	Major problem	0	3.2	2.1	13.2	15.6	14.5
	Minor problem	36.7	38.6	38	48.2	48.4	48.3
	Not a problem	63.3	58.2	59.9	38.6	35.9	37.2

Table 12: Cause of crop damage and loss in Kiambu and Makueni ALLs. The values represent percentages of farmers per category.

	Kiambu ALL			Makueni ALL		
Loss/damage cause	CSHEP (n=79)	Non-CSHEP (n=158)	Overall (n=237)	DNRC (n=114)	Non-DNRC (n=128)	Overall (n=242)
Pests	12.7	21.5	18.6	46.5	37.5	41.7
Diseases	8.9	20.3	16.5	13.2	13.3	13.2
Drought	72.2	50	57.4	54.4	51.6	52.9
Post-harvest losses	0	1.3	0.8	3.5	3.9	3.7
Wildlife destruction	0	0	0	2.6	2.3	2.5
Poor agronomy	2.5	1.3	1.7	2.6	0.8	1.7
Lack of markets	2.5	2.5	2.5	0.9	0	0.4
Lack of input and seeds	2.5	1.3	1.7	0.9	2.3	1.7
Poor soils	0	1.3	0.8	0.9	0	0.4
Frost	3.8	2.5	3	0	0	0
Excess rainfall	1.3	2.5	2.1	0	0.8	0.4

Table 13: Animal health practices in Kiambu and Makueni ALLs. The values represent percentage of farmers.

		Kiambu ALL			Makueni ALL		
	Choice	CSHEP (n=79)	Non-CSHEP (n=158)	Overall (n=237)	DNRC (n=114)	Non-DNRC (n=128)	Overall (n=242)
Livestock vaccinations		53.2	65.2	61.2	71.9	69.5	70.7
Preventative antibiotics		46.8	59.5	55.3	70.2	72.7	71.5
Extent of livestock illness, death or injury	High	5.1	5.1	5.1	7.9	4.7	6.2
	Medium	15.2	11.4	12.7	13.2	18	15.7
	Low	40.5	47.5	45.1	46.5	40.6	43.4
	None	29.1	27.2	27.8	23.7	26.6	25.2
Extent of fish injury, illness or death	Low	0	0.6	0.4	0	0	0
	None	0	0.6	0.4	0	0	0

Environmental

The median animal diversity score was lower for households in Kiambu compared to Makueni (Figure 18). On average, households in Kiambu kept two livestock species over the past 12 months, whereas Makueni households kept three, with no notable differences between ALL-host and non-ALL-host-affiliated households. In Kiambu, approximately 75% of livestock kept by non-CSHEP households were exotic breeds, compared to an almost equal distribution of exotic and local breeds among CSHEP-affiliated households. Additionally, most crops in Kiambu were grown from certified seeds, supplemented by some locally adapted varieties. In Makueni, 25% of livestock were exotic breeds, and 75% were local breeds, a pattern consistent across DNRC and non-DNRC households. Both ALLs showed low crop richness indices, indicating limited crop diversity within a year. Tree diversity scores varied significantly between the two ALLs (Figure 18).

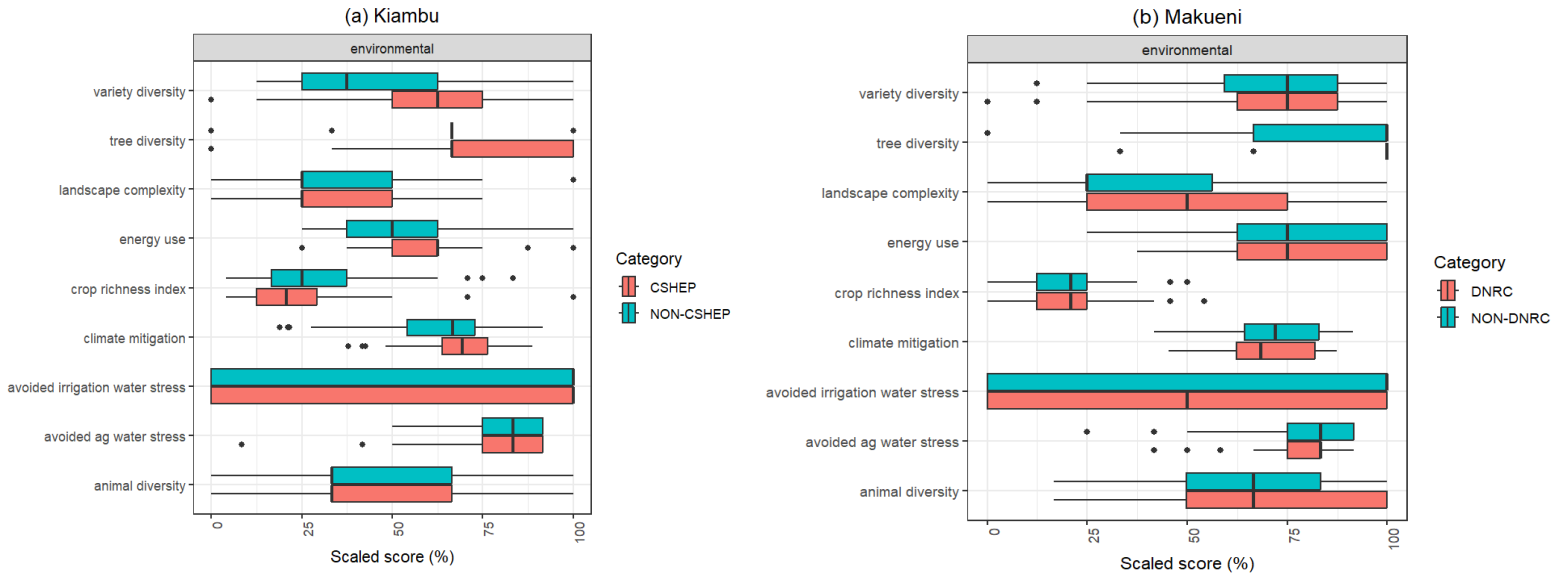

Figure 18: The environmental indicators performance for (a) Kiambu and (b) Makueni ALLs. The scores were calculated using a set of questions related to each of the respective key performance indicators (KPIs) that were in the HOLPA tool.

In Kiambu, most households had 1–20 trees per acre, while in Makueni, 21–50 trees per acre were common (Annex 2, Table A3). ALL-host-affiliated households (CSHEP and DNRC) had slightly more trees per acre than non-affiliated households. The dominant biodiversity covers in both ALLs included: (1) hedgerows/live fences, (2) other natural vegetation such as bushland, fallow land, natural grassland, and forest patches, and (3) woodlots.

Variety diversity scores were higher in Makueni compared to Kiambu (Figure 18). In Kiambu, respondents reported low diversity in crop and livestock pests, insect pollinators, mammals, and natural pest enemies, consistent across CSHEP and non-CSHEP households. Conversely, Makueni respondents noted high diversity in these categories, along with greater tree diversity, across both DNRC and non-DNRC households. Households in both ALLs scored highly on climate mitigation (Figure 18) due to diverse crop and grazing practices.

In Kiambu, 15 practices were employed on grazing and croplands over the past year. The dominant grazing land practices included manure collection (64.56%), manure management (37.55%), and composting (18.99%), consistent across household categories. On croplands, intercropping (76.37%), crop rotation (52.74%), and agroforestry (49.37%) were the most common. In Makueni, 16 practices were employed in both grazing and croplands. The top grazing land practices were manure collection (47.11%), composting (24.79%), and manure management (21.07%). On croplands, intercropping (92.15%), agroforestry (67.77%), and hedgerows/live fences (53.31%) were the most prominent (see Figure 9).

Energy use scores were average for Kiambu and above 75% for Makueni, indicating greater diversity in energy use practices in Makueni (Figure 18). Common energy sources for cleaning, processing, and transporting food included animal traction and petrol/diesel (Annex 2, Table A5). For example, in Kiambu, 31.6% of CSHEP-affiliated and 13.3% of non-CSHEP households used animal traction, while petrol/diesel use was 50.6% and 51.9%, respectively. Electricity was the main energy source for irrigation in Kiambu, whereas petrol/diesel was more common in Makueni. Almost all households (97% in Kiambu and 95% in Makueni) used human labor for tillage, sowing, and harvesting (Annex 2, Table A5).

Water sources for irrigation also varied. In Kiambu, piped regional water (20.7%), groundwater, rainwater harvesting, and rivers were the main sources. Among CSHEP-affiliated households, 29.1% relied on piped regional water, compared to 16.5% of non-CSHEP households ((Annex 2, Table A6). In Makueni, DNRC households primarily used dams (7.9%) and rivers (7.0%) for irrigation, while non-DNRC households relied on rivers (21.1%) and dams (10.2%) (Annex 2, Table A6).

Economic

The results show that households in Kiambu generally have higher incomes compared to those in Makueni and are better able to meet their basic needs (Figure 19). Although their incomes are more substantial, households in both areas display similar levels of income stability. The comparison between income and expenditure reveals that, on average, households in Kiambu enjoy a slightly larger surplus, suggesting a stronger financial position. Kiambu's households also record significantly higher labor productivity, which likely contributes to their greater income sufficiency. At the same time, Makueni faces a larger yield gap,

indicating that current agricultural outputs are much lower than potential levels. While both counties have made efforts to reduce labor inputs, Kiambu's households achieve more value per unit of labor. On measures of resilience, Makueni households appear more adept at coping with climate-related stresses, reflecting long-term adaptation strategies to challenging environmental conditions. However, Makueni's households struggle more to recover from shocks, possibly due to their overall weaker economic position. Taken together, these findings suggest that Kiambu's households benefit from stronger economic advantages, while Makueni's households have developed greater resilience to certain environmental factors, though they remain more vulnerable when it comes to bouncing back after adverse events.

Figure 19: The economic indicators performance for (a) Kiambu and (b) Makueni ALLs. The scores were calculated using a set of questions related to each of the respective key performance indicators (KPIs) that were in the HOLPA tool.

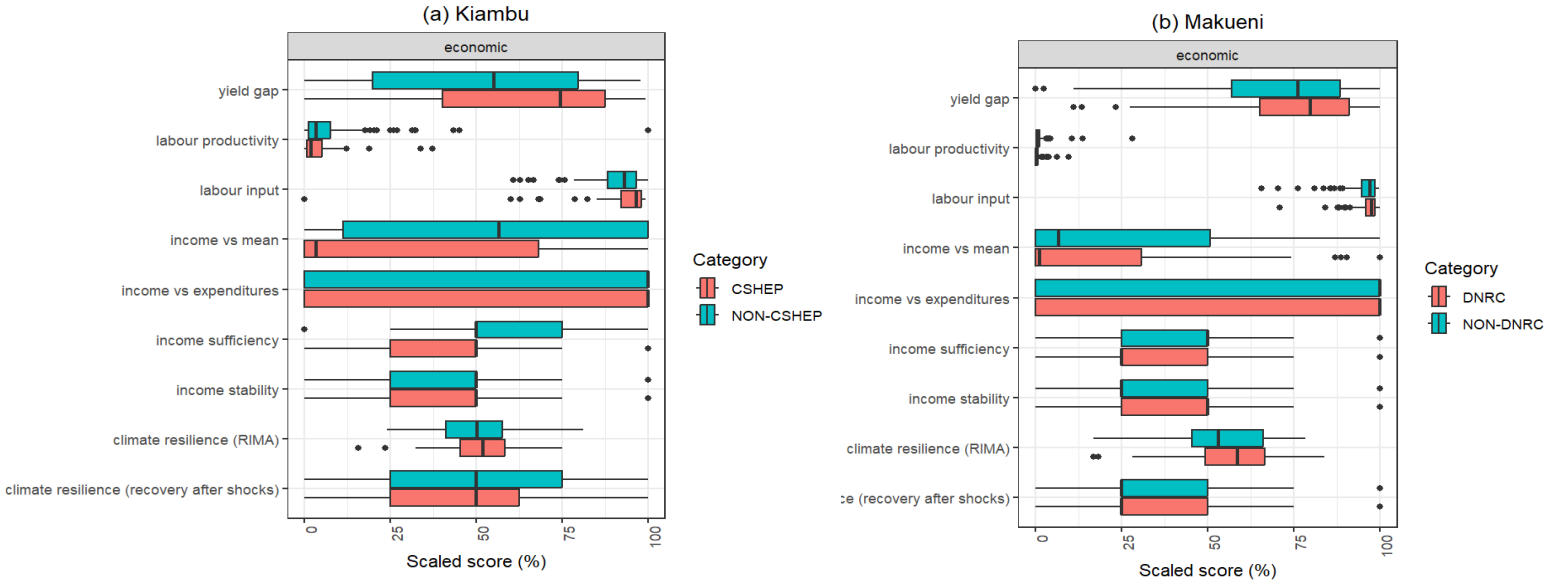

Table 14 presents a comparative analysis of economic income sources between Kiambu and Makueni Counties, revealing both similarities and differences in livelihood strategies across the two regions. Crop production emerges as a dominant income source in both areas, with slightly higher reliance in Makueni (78.4%) compared to Kiambu (75.9%). This highlights the critical role of agriculture as a primary economic activity, particularly in rural settings where subsistence and smallholder farming are prevalent. Livestock production also features prominently but with a notable regional variation. In Kiambu, 78.1% of households derive income from livestock compared to 68.6% in Makueni, indicating that Kiambu households may engage more actively in livestock-related economic activities, possibly due to favorable climatic conditions or greater market access for animal products such as milk and manure. The contribution of fish production is negligible in both regions (0.4%), reflecting its limited role in household incomes, likely due to minimal aquaculture activity. Conversely, other family businesses contribute modestly to incomes, with slightly higher participation in Makueni (27.3%) than Kiambu (25.3%), suggesting diversification into small-scale enterprises to supplement agricultural earnings. Results show that casual labor is an important income source in Makueni, where 42.6% of households depend on it compared to 29.1% in Kiambu. Similarly, formal labor contributes substantially to household incomes in Makueni (14.0%) than in Kiambu (7.2%), reflecting either increased formal employment opportunities or a greater outflow of workers to salaried jobs in Makueni.

Cash transfers, including social support programs, play a more prominent role in Makueni (31.0%) compared to Kiambu (21.1%). This suggests a higher reliance on safety net programs in Makueni, potentially as a response to economic hardship or lower agricultural productivity in semi-arid areas. Similarly, leasing of agricultural or non-agricultural land contributes minimally to incomes, with negligible figures reported for both regions (1.7% in Kiambu and 0.8% in Makueni). Notably, no households reported receiving subsidies, indicating either limited availability of government support programs in the surveyed regions. Finally, other income sources contribute marginally to overall earnings, with similar proportions in Kiambu (4.2%) and Makueni (3.7%).

Table 14: Percentage of households obtaining incomes from various sources in the last 12 months

Income sources	Kiambu (n=237) %	Makueni (n=242) %
Crop production	75.9	78.4
Livestock production	78.1	68.6
Fish production	0.4	0.4
Other family businesses	25.3	27.3
Casual labor	29.1	42.6
Formal labor	7.2	14.0
Cash transfers	21.1	31.0
Leasing agricultural or non-agricultural land	1.7	0.8
Subsidy	0.0	0.0
Other income	4.2	3.7

Results presented in Table 15 shows that both Kiambu and Makueni households draw income from a mix of sources. Although income from formal labor is received by relatively few farmers (see Table 14), it stands out as the primary income contributor for the households that have access to it. Kiambu households benefit significantly from livestock and crop production, while Makueni households show a stronger reliance on formal and casual labor. Crop production serves as a crucial source of income in both regions, but its contribution is notably higher in Kiambu (KES 92,863.8 per annum) compared to Makueni (KES 49,548.9 p.a), suggesting greater agricultural productivity and market access in Kiambu. Similarly, livestock production is a major income source in Kiambu (KES 225,181.3 p.a) but is far less significant in Makueni (KES 35,260.2 p.a), reflecting regional differences in livestock farming systems, climatic conditions, and market opportunities. While fish production provides a relatively modest income of KES 41,000.0 in Kiambu, it is entirely absent in Makueni, highlighting the limited role of aquaculture in the latter, likely due to geographic and environmental constraints. Other family businesses contribute significantly to household incomes in both regions, though earnings are higher in Kiambu (KES 168,830.1 p.a) compared to Makueni (KES 106,353.8 p.a), pointing to greater entrepreneurial opportunities or higher returns from non-agricultural activities in Kiambu. Cash transfers provide modest but comparable support to households in both regions, with slightly higher earnings reported in Kiambu (KES 47,212.1 p.a) compared to Makueni (KES 39,132.2 p.a). Income from leasing agricultural or non-agricultural land is minimal but present, particularly in Kiambu (KES 62,125.0) compared to Makueni (KES 20,000.0), suggesting higher land values for land use in Kiambu.

Table 15: Average annual household income (in KES) from various sources

Income sources	Kiambu (n=237) KES	Makueni (n=242) KES
Crop production	92,863.8	49,548.9
Livestock production	225,181.3	35,260.2
Fish production	41,000.0	-
Other family businesses	168,830.1	106,353.8
Casual labor	74,534.9	85,370.5
Formal labor	284,882.4	337,729.4
Cash transfers	47,212.1	39,132.2
Leasing agricultural or non-agricultural land	62,125.0	20,000.0
Subsidy	-	-
Other income	102,550.2	116,800.0

Social performance

The results indicate that households in Kiambu and Makueni differ in several key aspects related to their livelihoods and wellbeing (Figure 20). Diet diversity scores are relatively modest in both areas, with Kiambu showing a slightly higher figure than Makueni. This suggests that while both regions have room to improve the variety of foods consumed, Kiambu's households may have somewhat better access to a wider range of food options. In terms of farmer agency, measured by the ability of farmers to make decisions and influence outcomes, Kiambu shows a slightly higher level, though the difference between the two counties is not large. Land tenure security is high in both Kiambu and Makueni, indicating that farmers in these areas generally feel confident in their long-term rights to the land they use. Makueni's households report even stronger land tenure security than those in Kiambu, as well as a higher percentage of land that is fully owned rather than rented or informally used. This may provide Makueni's farmers with a more stable foundation for making long-term investments in their farms. Despite this, human wellbeing, measured through broader indicators of quality of life, is higher in Kiambu than in Makueni

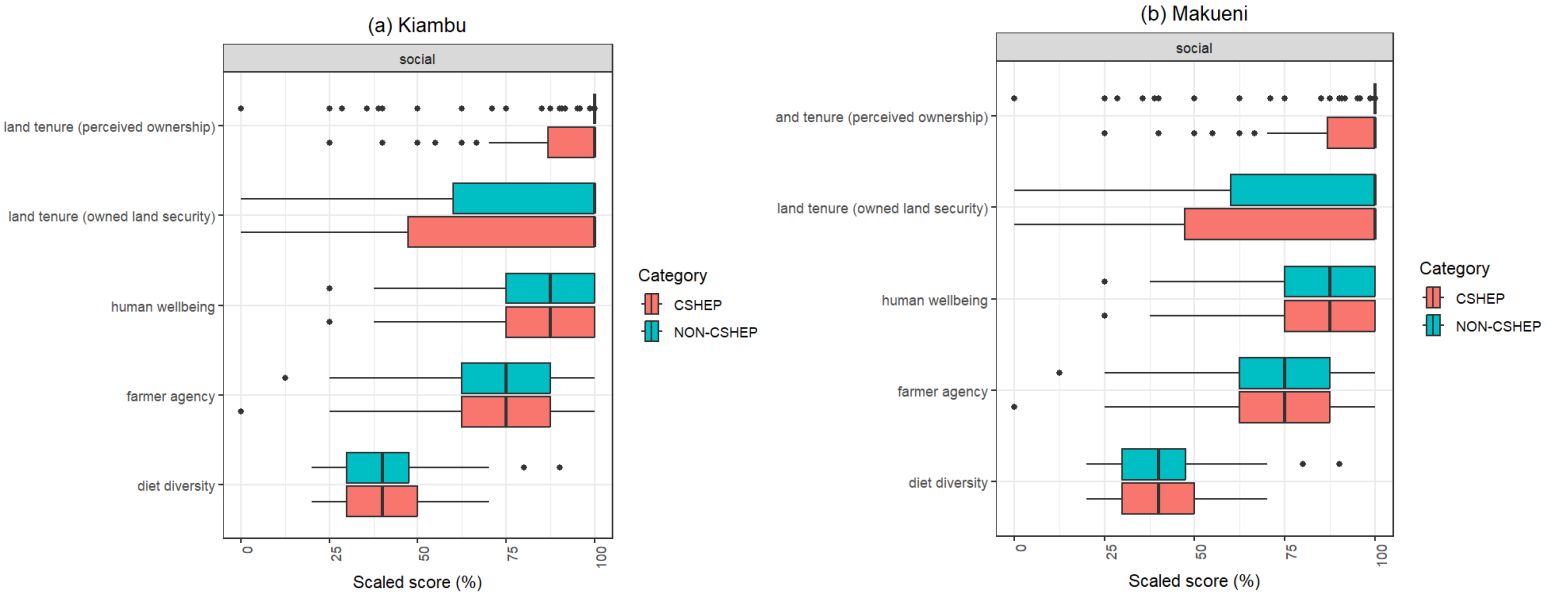

Figure 20: The social indicators performance for (a) Kiambu and (b) Makueni ALLs. The scores were calculated using a set of questions related to each of the respective key performance indicators (KPIs) that were in the HOLPA tool.

USE OF THE ASSESSMENT RESULTS

The V2A conducted at the initiation of the project was primarily informed by stakeholders' perspectives on the status of the ALLs of Kiambu and Makueni. However, there was a lack of detailed data or a proper baseline to inform the vision and goals effectively. The HOLPA survey and its results provide a comprehensive baseline assessment of the current status of agroecology within the two ALLs. These results are crucial for evaluating whether the ALLs are on track toward achieving the V2A goals, identifying existing gaps, and determining the actions required to close them. This discussion highlights three key entry points where HOLPA data can inform the V2A plan.

- **Evidence on Agroecological Practices, Crop Diversity, and Biodiversity:** In the Kiambu ALL, stakeholders identified an increase in the natural farming practices as one of the key changes they would want to see while in Makueni, improved on-farm circularity was one of the key desired changes to support the V2A. In addition, increase in tree cover and crop diversification were also key future changes in the Makueni ALL. The HOLPA data provides detailed insights into agroecological practices adopted by farmers, including agroforestry, crop rotation, intercropping, organic manure, and organic pesticides. Additionally, the data includes information on the integration of trees within farms, the different crop types, and overall biodiversity. This information is critical for organizations such as PELUM and NGOs supporting agroecology projects within the ALLs. The data can stimulate action-oriented discussions among farmers and stakeholders on practices that have shown promising results. In addition, the data can provide guidance on which practices are adopted in which context, for instance for farmers with small land area or farmers growing particular crops. For the past cropping seasons, WP1 has been involved in farmer-led trials of practices/innovations that were co-designed in each of the ALL (Fuchs et al., 2023b). With the on-going trials of the innovations, the results from the HOLPA can inform more co-designing of trials to integrate wider and focused innovation/technologies especially in soil and water management. In addition, follow up with farmers can shed lights on to the drivers of adoption of the practices and the current challenges that are likely to limit wider adoption.
- **Enabling environment to achieve the ALLs vision:** Capacity building, knowledge co-creation, and engagement with relevant stakeholders are vital for realizing the desired changes within the ALLs. The HOLPA data sheds light on the institutions and stakeholders that farmers interact with and offers comparative insights into the practices of farmers engaged with agroecology-promoting organizations versus those who are not. For example, in Kiambu, farmers affiliated with CSHEP, an agroecology-focused organization, use fewer pesticides and have a higher adoption of organic manure. In Makueni, farmers associated with DNRC tend to have more trees on their farms. These findings highlight the importance of farmer support through capacity building, training, and knowledge exchange. HOLPA data also reveals gaps in the enabling environment. For instance, it identifies limited interaction of farmers with the agricultural extension services. This information can guide agroecology-focused organizations and county governments in designing targeted capacity-building initiatives and prioritizing support areas. Policymakers can also use the data to develop or refine policies and action plans that create a conducive environment for agroecology to thrive and support the achievement of V2A goals.
- **Pathways for Improving Water Harvesting and Efficiency:** A significant portion of the area covered by the two ALLs falls within arid and semi-arid regions, where access to water remains a critical challenge. Addressing this challenge is essential for achieving the V2A goals and ensuring sustainable crop and livestock production. The HOLPA data provides valuable insights into the water harvesting techniques adopted by farmers and the ways harvested water is utilized within households. This information can aid in co-designing innovative water harvesting technologies and identifying strategies for sustainable water use on farms. NGOs involved in water harvesting initiatives can also use this data to identify focus areas within the ALLs and tailor their interventions accordingly.

LESSONS LEARNT

The application of the HOLPA tool shows that the selection of the households to include in implementing the surveys matters to derive meaningful and insightful results. In the selection of the interviewed households, we employed the criteria of choosing farmers based on whether they are affiliated to the ALL host centres on not. This was a first step in understanding the differences that could arise as a result of access to training and knowledge on agroecology. In addition, training of the enumerators is key for achieving meaningful results. Proper training helps build a shared understanding among data collectors, ensuring consistency in interpretation and application of the survey questions. This not only improves the reliability and accuracy of the collected data but also reduces errors during the data collection process. Overall, these lessons underline the need for careful planning in household selection and investment in enumerator training to maximize the effectiveness of the HOLPA survey in generating actionable insights for scaling agroecological innovations.

The HOLPA tool collected data that can be quite useful for assessing the status of agroecology and performance. The data collected with the tool can be quite useful in understanding context, and designing context-specific interventions that can improve the scaling of agroecological innovations at the landscape level. Despite these positive aspects of the HOLPA tool, the tool is quite long and was tiring to the respondents during the survey. With the lengthy interviewing time, the quality of information given by the respondents is likely to be unreliable. A more simplified version of the tools that targets context specific aspects of agroecology and performance can be more useful. Although not presented in detail in this report, some of the performance data collected using the tool may not be a true representation of the ground. For example, the yield and nutrient use data were collected based on the diverse units of measurements that are used by farmers, e.g., animal carts, wheelbarrows, buckets etc. The units of scaling these values are not well construed and, in some cases, resulted in very unrealistic yield values and manure application rates. This would imply that the interpretation of some of the key performance indicators such as yield gap, and nutrient use would result in biases. This could be improved through taking photographs of the measurement tools used by farmers and developing standardized guidelines for measurements. In addition, a lot of data cleaning was also needed before the analysis. This can be improved by reviewing the structure of the HOLPA questionnaire and also automating conversion rates to ensure that the collected data has minimal data cleaning requirements.

The HOLPA results were presented to stakeholders in each of the ALLs during separate dissemination workshops. To ensure accessibility, the content of the presentations was simplified and made less scientific to facilitate understanding among diverse stakeholders who included officials from county governments, representatives from ALL host centres, national research institution and farmers. Participants found the results to be a true reflection of the realities within the ALLs and appreciated the effort to make the findings relatable and actionable. One of the highlights of the workshops was guiding stakeholders and farmers through the interpretation of HOLPA soil sample analysis reports. This exercise was well-received, with participants noting that the feedback was both informative and instrumental in understanding the current soil health status in their regions. Additionally, the workshops served as a platform for stakeholders to revisit the V2A plans and evaluate progress toward achieving the desired outcomes. Overall, stakeholders noted that the ALLs are on a promising path towards achieving the V2A plans. However, they highlighted several gaps and priorities that need to be addressed to enhance this transition:

1. **Targeted Advisory Services**: Stakeholders emphasized the need for tailored advisories to farmers regarding the types of crops they should prioritize based on soil health data. This would help farmers optimize production, enhance soil fertility, and improve land management.
2. **Youth Engagement**: A key concern was the limited involvement of youth in farming, based on the age categories of interviewed farmers. Stakeholders called for more efforts to engage and empower young people to embrace farming and agroecological innovations as viable livelihood options.
3. **Addressing Water Scarcity**: Water scarcity, particularly in semi-arid areas, was identified as a major barrier to agricultural productivity. Stakeholders recommended innovations in water harvesting, retention, and management.
4. **Increased Awareness and Context-Specific Agroecological Practices**: Participants underscored the importance of raising awareness about agroecological farming practices, coupled with clear information on the specific contexts and conditions under which these practices are most effective.
5. **Access to Financial and Technical Support**: Stakeholders highlighted the lack of financial resources and technical support for farmers and community-based organizations. There is a need to strengthen capacity-building initiatives and improve access to credit, grants, and funding mechanisms tailored to support agroecological transitions.
6. **Strengthening Market Linkages**: Farmers in the ALLs face challenges in accessing reliable and profitable markets for agroecological products. Stakeholders suggested creating stronger market linkages, promoting value addition, and developing certification mechanisms to enhance the marketability of sustainably produced goods.
7. **Policy Advocacy and Enabling Environments**: The workshops revealed gaps in supportive policies that incentivize the adoption of agroecological practices. Stakeholders called for stronger policy advocacy to integrate agroecology into national and local development frameworks, including subsidies, tax breaks, or incentives for adopting sustainable practices.
8. **Improved Collaboration Among Stakeholders**: While the ALLs provide a platform for multi-stakeholder collaboration, participants noted the need for deeper partnerships and improved coordination between governmental agencies, NGOs, research institutions, and private sector players to address systemic challenges comprehensively.

CONCLUSIONS AND NEXT STEPS

Generating evidence is a crucial step in agroecological transitions, as it provides a foundational understanding of the status of farming practices within the ALLs. This report presents the first detailed analysis of the status of agroecology and performance in selected households within the Kiambu and Makueni ALLs. The survey results reveal a moderate level of adherence to agroecological principles among farmers in the two ALLs, with most farmers demonstrating moderate adherence. Furthermore, the findings indicate that farmers with strong adherence to the 13 principles of agroecology tend to achieve better performance

across a range of agronomic, environmental, social, and economic indicators. The varying degrees of adherence to agroecology among farmers across the ALLs highlight the need for tailored interventions and targeted support to enhance performance. The results also demonstrate that farmers' engagement with organizations promoting agroecological technologies positively influences their adherence to certain principles. For example, in Kiambu, farmers working with CSHEP scored higher on the recycling and input reduction principles due to reduced use of synthetic pesticides and increased use of organic manure. Similarly, DNRC farmers exhibited greater tree diversity, reflecting a stronger emphasis on agroforestry practices.

The benefits of the HOLPA assessment and analysis extend beyond understanding the current practices; they also offer a roadmap for the co-design of innovations and technologies that align with agroecological principles. By identifying opportunities, barriers, and existing gaps, stakeholders can develop realistic goals and visions for transitioning to agroecological systems. This evidence-based approach ensures that future projects are designed to address the unique challenges faced by farmers while leveraging opportunities for growth and resilience.

The survey results further reveal that adherence to agroecological practices positively influences performance across various indicators, including biodiversity, soil health, and sustainable resource use. However, the findings also indicate that more support is needed to scale adoption rates of agroecological practices, including enhanced crop and on-farm diversification. Enhanced knowledge co-creation, capacity-building initiatives, and the establishment of co-learning platforms are critical for empowering farmers. Market linkages, which also reduce middlemen and ensure that farmers get fair practices for their commodities, must also be strengthened to enable farmers to benefit economically from their adoption of agroecological practices.

Building on these results, the first key way forward involves using the data to guide the design of the next phase of the Multifunctional Landscapes Science Program. While the HOLPA implementation and assessment focuses primarily on the household level, the data provides critical insights that can inform the scaling interventions at the landscape level. Additionally, the findings highlight the importance of identifying and addressing key gaps and opportunities in farming practices, responding to priorities identified by farmers, and fostering collaboration among stakeholders. By taking these steps, the ALLs can create a more enabling environment for agroecology to thrive, paving the way for sustainable agricultural systems that are resilient to both current and future challenges.

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ANNEX 1: ADDITIONAL RESULTS

Table A1: The different crop types produced by farmers in the Kiambu ALL.

Crop	CSHEP (%) (n=79)	NON-CSHEP (%) (n=158)	Overall (%) (n=237)	Crop	CSHEP (%) (n=79)	NON-CSHEP (%) (n=158)	Overall (%) (n=237)
Maize	83.54	84.81	84.39	Sugarcane	2.53	5.06	4.22
Beans	79.75	63.29	68.78	Cassava	3.8	3.8	3.8
Kales	53.16	71.52	65.4	Courgette	2.53	4.43	3.8
Spinach	56.96	59.49	58.65	Pawpaw	2.53	4.43	3.8
Cabbage	34.18	44.3	40.93	Orange	3.8	3.16	3.38
Forage	18.99	50	39.66	Pears	0	3.8	2.53
Avocado	41.77	34.18	36.71	Beetroot	2.53	1.9	2.11
Potatoes	35.44	34.18	34.6	Loquat	3.8	1.27	2.11
Irish potatoes	30.38	34.81	33.33	Plantain	0	3.16	2.11
Amaranthus	11.39	38.61	29.54	Spider plant	0	3.16	2.11
Black nightshade	18.99	31.01	27	Tea	0	3.16	2.11
Banana	5.06	24.68	18.14	Broccoli	0	2.53	1.69
Peas	18.99	15.19	16.46	Dragon fruits	2.53	1.27	1.69
Plums	12.66	18.35	16.46	Cowpeas	1.27	1.27	1.27
Pumpkin	7.59	10.76	9.7	Lemon	2.53	0.63	1.27
Tomatoes	7.59	10.13	9.28	Thorn melon	2.53	0.63	1.27
Coffee	0	13.29	8.86	Peaches	0	1.27	0.84
Carrots	8.86	7.59	8.02	Pomegranate	0	1.27	0.84
Coriander	3.8	8.86	7.17	Rosemary	2.53	0	0.84
Onion	8.86	6.33	7.17	Sorghum	2.53	0	0.84
Sweet potatoes	7.59	6.33	6.75	Sunflower	0	1.27	0.84
Arrowroot	1.27	8.86	6.33	Asparagus	0	0.63	0.42
Mangoes	7.59	5.7	6.33	Butternuts	1.27	0	0.42
Ethiopian kale	0	8.86	5.91	Cauliflower	0	0.63	0.42
Passion fruit	6.33	5.06	5.49	French beans	0	0.63	0.42
Pepper	3.8	6.33	5.49	Green gram	1.27	0	0.42
Vegetables	6.33	5.06	5.49	Pepino melon	1.27	0	0.42
Apple	8.86	3.16	5.06	Pigeon peas	1.27	0	0.42
Tomato tree	2.53	6.33	5.06	Strawberry	1.27	0	0.42
Macadamia	2.53	5.7	4.64	Trees	0	0.63	0.42
Guava	6.33	3.16	4.22	Yams	0	0.63	0.42

Table A2: Name of the crop species (including perennial crops) that were produced on your farm in the last 12 months in Makueni County ALL

Crop	DNRC (%) (n=114)	NON-DNRC (%) (n=128)	Overall (%) (n=242)	Crop	DNRC (%)(n=114)	NON-DNRC (%) (n=128)	Overall(% (n=242)
Maize	99.12	89.84	94.63	Forage	0	3.13	1.65

Beans	99.12	78.91	88.84	Lablab	1.75	0.78	1.24
Cowpeas	76.32	67.97	72.31	Moringa	2.63	0	1.24
Pigeon peas	78.07	53.91	65.29	Coriander	1.75	0	0.83
Mangoes	61.4	67.19	64.88	Eggplant	0	1.56	0.83
Orange	33.33	56.25	45.87	French beans	0	1.56	0.83
Green gram	20.18	22.66	21.49	Peas	1.75	0	0.83
Banana	20.18	17.19	18.6	Trees	1.75	0	0.83
Avocado	17.54	5.47	11.16	Vegetables	0.88	0.78	0.83
Pixies	1.75	17.19	9.92	Apple	0	0.78	0.41
Cassava	7.02	11.72	9.5	Beehives	0	0.78	0.41
Kales	3.51	10.94	7.44	Black nightshade	0	0.78	0.41
Lemon	10.53	3.91	7.02	Butternuts	0	0.78	0.41
Pawpaw	7.02	7.03	7.02	Cabbage	0	0.78	0.41
Spinach	1.75	9.38	5.79	Coconut	0	0.78	0.41
Sorghum	10.53	0.78	5.37	Groundnuts	0.88	0	0.41
Millet	7.89	1.56	4.55	Horticultural crops	0	0.78	0.41
Pumpkin	2.63	5.47	4.13	Jute mallow	0.88	0	0.41
Tomatoes	0.88	7.03	4.13	Maniola	0.88	0	0.41
Pepper	0	6.25	3.31	Mulberry	0	0.78	0.41
Sunflower	4.39	0.78	2.48	Onion	0	0.78	0.41
Okra	0	3.91	2.07	Passion fruit	0	0.78	0.41
Sweet potatoes	3.51	0.78	2.07	Potatoes	0.88	0	0.41
Tangerines	0.88	3.13	2.07	Sugarcane	0.88	0	0.41
Amaranthus	0	3.13	1.65	Syzygium	0.88	0	0.41
Guava	2.63	0.78	1.65				

Table A3: The percentage coverage of different land cover/vegetation types in rented, owned or leased land for the interviewed households in the two ALLs

Vegetation type		KIAMBU COUNTY			MAKUENI COUNTY		
	Percentage of Land	C-SHEP (n=79)	Non-CSHEP (n=158)	OVERALL (n=237)	DNRC (n=114)	NON-DNRC (n=128)	OVERALL (n=242)
Bushland patches	1-10%	12.66	11.39	11.86	40.35	27.34	33.47
	11-20%	5.06	1.9	2.97	24.56	10.94	17.36
	21-50%	0	1.27	0.85	10.53	2.34	6.2
	51-100%	0	0	0	1.75	3.13	2.48
	No presence or occurrence.	82.28	85.44	84.75	24.56	53.13	40.08
Fallow land	1-10%	12.66	6.33	8.47	18.42	10.16	14.05
	11-20%	2.53	3.16	2.97	5.26	5.47	5.37
	21-50%	1.27	0	0.42	3.51	0.78	2.07
	51-100%	0	0	0	0	0.78	0.41
	No presence or occurrence.	82.28	90.51	88.14	75.44	79.69	78.1
Hedgerows/Live fences	1-10%	59.49	76.58	71.19	71.93	70.31	71.07
	11-20%	15.19	8.86	11.02	9.65	4.69	7.02
	21-50%	11.39	1.27	4.66	0.88	1.56	1.24
	51-100%	2.53	1.27	1.69	0	0	0
	No presence or occurrence.	11.39	12.03	11.86	19.3	21.09	20.66
Natural grassland	1-10%	18.99	23.42	22.03	38.6	41.41	40.08
	11-20%	3.8	4.43	4.24	29.82	21.09	25.21
	21-50%	1.27	72.15	0.42	4.39	4.69	4.55
	51-100%	0	0	0	2.63	0.78	1.65
	No presence or occurrence.	75.95	0	73.73	24.56	31.25	28.51
Ponds or lakes	1-10%	3.8	8.23	6.78	14.04	12.5	13.22
	11-20%	0	0	0	1.75	0	0.83
	21-50%	0	0	0	0.88	0.78	0.83
	51-100%	0	0	0	0	0.78	0.41
	No presence or occurrence.	77.22	87.97	84.75	68.42	84.38	77.27
Remnant forest patches	1-10%	3.8	5.06	4.66	16.67	12.5	14.46
	11-20%	2.53	0	0.85	1.75	1.56	1.65
	21-50%	1.27	0	0.42	0.88	0	0.41
	51-100%	0	0	0	0	0.78	0.41
	No presence or occurrence.	92.41	94.94	94.49	78.95	85.16	82.64
Wetlands	1-10%	0	5.7	3.81	12.28	22.66	17.77
	11-20%	0	0.63	0.42	0	5.47	2.89
	21-50%	0	0	0	0.88	0.78	0.83
	51-100%	0	0	0	0	0.78	0.41
	No presence or occurrence.	100	93.67	96.19	85.96	70.31	78.1
Woodlots	1-10%	51.9	41.14	44.92	56.14	45.31	50.83
	11-20%	8.86	15.19	13.14	21.05	6.25	13.22
	21-50%	7.59	2.53	4.24	1.75	0	0.83
	51-100%	1.27	0	0.42	0	0.78	0.41
	No presence or occurrence.	30.38	41.14	37.71	19.3	47.66	34.3

Table A5: Types of energy used for various activities in the households

	CSHEP (%) (n=79)	NON-CSHEP (%) (n=158)	Kiambu (%) (n=237)	DNRC (%) (n=114)	NON-DNRC (%) (n=128)	Makueni (%) (n=242)
Types of energy used for: Cleaning, processing or transporting harvested food						
Animal traction	31.6	13.3	19.4	42.1	39.8	40.9
Biogas	2.5	0.6	1.3	0	0	0
Burning plant materials	1.3	1.9	1.7	0.9	0	0.4
Coal	0	3.8	2.5	0.9	0	0.4
Electricity (national grid)	3.8	8.9	7.2	0	0	0
Gas LPG	0	9.5	6.3	0	0.8	0.4
Petrol or diesel	50.6	51.9	51.5	21.1	21.1	21.1
Solar panel	0	0	0	0.9	0	0.4
Types of energy used for: Cooking						
Burning plant materials	16.7	17.5	17.3	18.4	19.2	18.8
Coal	10.1	29.1	22.8	78.9	81.2	80.2
Electricity (national grid)	2.5	5.1	4.2	1.8	4.7	3.3
Gas LPG	14.6	15.3	15.1	9.6	9.3	9.5
Types of energy used for: Irrigation						
Burning plant materials	0	0	0	0.9	0.8	0.8
Coal	0	0	0	0	0.8	0.4
Cow dung cakes	1.3	0	0.4	0	0	0
Electricity (national grid)	3.8	20.3	14.8	0	0.8	0.4
Gas	0	0	0	0	0.8	0.4
Petrol or diesel	1.3	3.8	3	7.9	25	16.9
Solar panel	1.3	0	0.4	0.9	2.3	1.7
Wind turbine	0	0.6	0.4	0	0	0
Types of energy used for: Tillage, sowing or harvesting						
Animal traction	10.1	3.8	5.9	61.4	49.2	55
Human power/by hand only	97.5	96.8	97	94.7	95.3	95
Petrol or diesel	22.8	8.9	13.5	0.9	1.6	1.2

Table A6: Sources of water used for irrigation by the households

	CSHEP (%) (n=79)	NON-CSHEP (%) (n=158)	Kiambu (%) (n=237)	DNRC (%) (n=114)	NON-DNRC (%) (n=128)	Makueni (%) (n=242)
Borehole	0	0.6	0.4	0	0	0
Dam/lake	2.5	1.3	1.7	7.9	10.2	9.1
Groundwater	1.3	21.5	14.8	0.9	2.3	1.7
Kitchen	0	0	0	0	0.8	0.4
Piped regional water	29.1	16.5	20.7	0.9	1.6	1.2
Rainwater harvesting	10.1	7.6	8.4	2.6	1.6	2.1
Recycled water	1.3	0	0.4	0	0	0
Rivers	0	8.9	5.9	7	21.1	14.5
Well	0	0	0	0	0.8	0.4
Wetland	0	0.6	0.4	0	0	0

Table A7: Percentage of households that consumed the different food items

Food items	Kiambu (n=237) %	Makueni (n=242) %
Maize ugali, maize porridge, rice, bread, chapati, pasta, or noodles	96.2	90.5
Ugali made from millet or sorghum, porridge made from millet or sorghum, green maize, oats, or popcorn	36.3	45.9
Irish potato, white sweet potato, green banana, arrow roots, yam, or cassava	49.0	15.3
Beans, green gram, black gram, lentils, pigeon peas, or chickpeas?	49.8	68.6
Carrots, pumpkin, butternut, or sweet potato that is orange inside?	27.9	10.3
Sukuma wiki, Ethiopian kale, spinach, managu, terere, saget, or kunde?	78.1	67.8
Broccoli, pumpkin leaves, mrenda, nderema, mitoo, or mchunga?	12.2	8.3
Tomatoes, cabbage, green capsicum, mushrooms, or cauliflower?	70.5	55.8
Ripe pawpaw, ripe mango, passionfruit, or matunda ya damu?	9.7	11.6
Orange, tangerine, or grapefruit?	20.3	14.9
Banana, pineapple, avocado, watermelon, or thorn melon?	32.5	20.3
Apple, pear, grapes, or guava?	3.0	1.2
Cakes, cupcakes, sweet biscuits, or kaimati?	12.7	5.8
Candy, chocolates, ice cream, or ice lollies?	2.1	0.0
Eggs?	16.5	9.9
Cheese?	0.4	0.0
Yogurt or mala?	3.4	2.5
Sausages, Smokies, hot dogs, salami, or ham?	0.4	0.4
Goat, beef, minced beef, offal, or mutton?	11.8	11.2
Pork, rabbit, camel, or wild game?	0.0	0.4
Chicken, duck, turkey, quail, guinea fowl, or wild birds?	3.0	0.8
Fish, dagaa, sardines, canned tuna, or seafood?	0.8	0.4
Groundnuts, peanut butter, cashews, pumpkin seeds, or simsim?	0.8	0.8
Crisps, Ringoz, Chooze, or Chevda?	0.4	0.0
Indomie?	9.7	3.7
Chips, ngumu, mandaazi, samosa, or bhajia, or fried chicken?	11.8	10.3
Milk, tea with milk, or powdered milk?	77.2	51.2
Tea with sugar, coffee with sugar, Milo, or cocoa?	52.7	47.5
Fruit juice or fruit drinks?	2.1	0.4
Soft drinks such as Coca-Cola, Fanta, or Sprite, or Red Bull?	1.4	4.1

Sylvia S. Nyawira, Alliance of Bioversity and CIAT, s.nyawira@cgiar.org

Hezekiah Korir, IIITA, h.korir@cgiar.org

Peter Bolo, Alliance of Bioversity and CIAT, p.bolo@cgiar.org

Kevin O. Onyango, Alliance of Bioversity and CIAT, k.onyango@cgiar.org

Sulman O. Owili, IITA, s.owili@cgiar.org

Brigid Letty, Institute of Natural Resources NPC, bletty@inr.org.za

Christine Wamaitha, Alliance of Bioversity and CIAT, c.kagunya@cgiar.org

Mary Njogu, Alliance of Bioversity and CIAT, m.njogu@cgiar.org

Edith Anyango, CIFOR-ICRAF, e.anyango@cifor-icraf.org

Frederick Baijukya, IITA, f.baijukya@cgiar.org

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Sylvia S. Nyawira, Alliance of Bioversity and CIAT, s.nyawira@cgiar.org
Hezekiah Korir, IIITA, h.korir@cgiar.org
Peter Bolo, Alliance of Bioversity and CIAT, p.bolo@cgiar.org
Kevin O. Onyango, Alliance of Bioversity and CIAT, k.onyango@cgiar.org
Sulman O. Owili, IITA, s.owili@cgiar.org
Brigid Letty, Institute of Natural Resources NPC, bletty@inr.org.za
Christine Wamaitha, Alliance of Bioversity and CIAT, c.kagunya@cgiar.org
Mary Njogu, Alliance of Bioversity and CIAT, m.njogu@cgiar.org
Edith Anyango, CIFOR-ICRAF, e.anyango@cifor-icraf.org
Frederick Baijukya, IITA, f.baijukya@cgiar.org

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