Agroecological transitions in value chains

Main findings, challenges, and opportunities for the agroecological transition of the value chains in the Agroecological Living Landscapes

Editors: Andrés Charry, Alejandra Vargas, Manuel Narjes, Carolina Gonzalez

December 2023

Contents

Executive Summary

This report summarizes the main findings from various agroecological value chain analyses conducted in different Agroecological Living Landscapes (ALL) of CGIAR's Agroecology Initiative (AE-I).

The document presents a synthesis of 10 value chains analyses that were conducted in specific subregions from 6 countries, and thus capture a wide range of political, agroecological, socioeconomic and cultural conditions: a dairy value chain in Burkina Faso; a groundnut value chain in India; mango and green leafy vegetables value chains in Kenya; a cacao value chain in Peru; olives, sheep and honey value chains in Tunisia, and sorghum and poultry value chains in Zimbabwe.

Since the analyzed value chains exhibit various degrees of development, each AE-I country team adjusted the recommended overall research approach to their respective contexts, which in turn provided different types of findings and insights. This report is structured in seven subchapters that, for each value chain or region of interest, presents a brief presentation of the regional context, key information regarding the value chain operation in the region and country, a value chain map showing the actors and product flows, and an analysis of the presence, relevance or potential of agroecological principles and practices for each case.

Finally, the last chapter presents conclusions, lessons learned, and recommendations that highlight the common factors that may promote or hinder the agroecological transition of the analyzed value chains. These include the current degree of integration of the agroecological principles and the apparent conditions and factors that have driven or limited their adoption. Specific opportunities for investment and improvements were also identified along the value chain, such as in the service and input provision, better integration of livestock and crop systems, improved technologies and practices for processing and aggregation, and market development for agroecological products. These opportunities are paired with specific challenges or trade-offs, for which potential mitigation actions are briefly discussed.

In that sense, this report presents a first characterization of the initial status of the different value chains under intervention through AE-I, a repository for shared lessons, and a point of reference for assessing the progress of the interventions of the initiative that reshape the value chains by enhancing the agroecological principles.

1. Introduction

This report summarizes the main findings and insights obtained from the various agroecological value chain analyses conducted in the Agroecological Living Landscapes (ALL) that take part of the CGIAR Agroecology Initiative (AE-I).

The document includes a synthesis of the analyses of 10 value chains in 6 countries: Burkina Faso, India, Kenya, Peru, Tunisia and Zimbabwe, which represent different political, agroecological, socioeconomic and cultural conditions. The objective of this report is to place these case studies side to side, to facilitate the identification of commonalities and differences, both in the research process as well as regarding opportunities and challenges for furthering the agroecological transition. This horizontal learning attempts to identify insights that would allow to facilitate the upscaling and replication of similar interventions in other regions of the world, as well as documenting different avenues that can inform and inspire other stakeholders in the process of strengthening agroecology in different landscapes.

The report is organized in a series of short case studies. Each case presents a summary of the country context and main value chain characteristics, followed by the identified state of integration of agroecological principles within the value chain´s main actors, as well as opportunities, challenges, and site-specific recommendations.

The report concludes with general conclusions and recommendations from the institutions leading the AE-I in each country.

2. Burkina Faso: The dairy value chain in Bobo-Dioulasso

Authors: Ollo Sib (CIRAD-Selmet), Eric Vall (CIRAD-Selmet), Christian Corniaux (CIRAD- Selmet), Etienne Sodré (INERA-DPA), and Sanogo Souleymane (CIRDES-USPAE)

2.1. Context

Dairy consumption is growing strongly in Burkina Faso, particularly in urban areas (Ouagadougou and Bobo-Dioulasso) (Hamadou et al., 2007; Ouédraogo and Doanio, 2007), even though it remains relatively low compared with other parts of the world (around 25 kg of milk equivalent/capita/year according to the FAO). Despite significant potential (over 1.6 million dairy cows according to the FAO, for a national production of over 300,000 tonnes per year according to Vias, 2018), local production can barely meet demand due to its weakness, seasonality, insufficient local milk collection and competition from imported milk powder (100,000 tonnes).

In Bobo-Dioulasso, the transition from a production mainly for household consumption, to a more market oriented dairy value chain started in the period of 1991 to 1999 by the BKF 93/011 'Dairy production development' project, financed by UNDP and implemented by FAO and the Burkina government. This project established a Dairy Processing Unit (DPU) and 8 farmer groups to ensure a regular milk supply for the DPU. Despite the efforts, the DPU income was insufficient to cover its expenses leading to its eventual closure. Nevertheless, with the capacities established, former dairy staff set up mini-dairies and started collecting and processing milk privately, as well as establishing producer and processor associations with the support of the Livestock Department.

Around 2014, the World Bank Agricultural Productivity and Food Security Project (PAPSA), funded the creation of Milk Collection Centres (MCCs) to enable livestock farmers and livestock farmer groups to market their milk more effectively. Today, around ten MCCs operate in Bobo-Dioulasso's dairy production area, but their activity remains somewhat modest and is limited to milk collection.

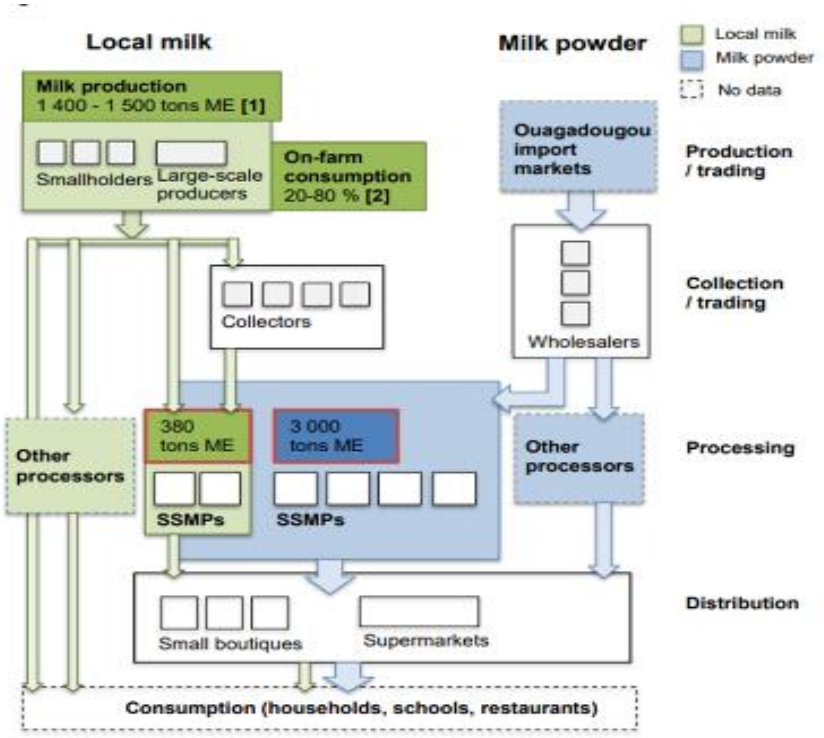
2.2. The Bobo-Dioulasso dairy value chain

The Dairy Value Chain is comprised of direct actors grouped in the following links: dairy cattle farmers, milk collectors, milk processing operators, marketing and distribution actors and consumers. Surrounding the value chain, the set of supporting actors includes feed suppliers, insemination service providers, microfinance institutions, government representatives, NGOs, research institutes, among others. Representatives of direct and supporting actors have gathered in 2020 in a multistakeholder platform known as the Bobo Dioulasso´s Dairy Innovation Platform (DIP).

Production:

Bobo-Dioulasso´s dairy production covers a 50km radius around the city. Nearly 75% of the population in the area is engaged in farming (GRET, 2019), with agriculture being the main economic activity followed by livestock farming, with an estimated cattle population at 1,633,910 heads in 2018 (INSD, 2018) in the Hauts-Bassins region. Producers are scattered across the region, with the more commercial oriented dairy farms located closer to the city and major thoroughfares.

According to the Africa-Milk Project study, milk-producing farms can be divided into two major types according to feeding and health management practices, cattle breeds, farm equipment and technical performance of cows: i) agro-pastoral dairy farming systems (representing nearly 90% of the farms and 95% of total milk production) and ii) dairy farms moving towards more intensive practices, including agroecological ones.



Source: SSMP survey, distribution survey, interviews with milk powder importers
1 Hamadou et al. (2003)
2 Hamadou et al. (2003); Hamadou & Sanon, 2005

Figure 1. Milk Value Chain in Bobo-Dioulasso

Agro-pastoral dairy farms feature extensive livestock herding based on rangeland grazing, with high animal mobility (short and long transhumance) as a resilience strategy (Gonin, 2018). Milk is generally used for own consumption and is almost seen as a by-product of a predominantly suckler farming system designed to continuously increase the number of livestock. Traditionally, milk was mainly farmed by women, who derived most of their income from it. Investments in livestock and infrastructure are very limited, feed supplementation and animal healthcare are low, and the breeds employed have adapted to the environment, but have low milk production. Production varies starkly between rainy and dry season due to forage shortages, going from 1.2-1.3 to 0.6-0.8 l/cow/day respectively.

Dairy farms moving towards more intensive practices are mostly based on the outskirts of small towns and large urban centres. Livestock management remains traditional, with herds mainly made up of local breeds with a small proportion of crosses with higher production breeds. Lactating cows receive feed/mineral supplementation to maintain production during the dry season, however, these farms struggle to achieve high milk production targets because of the very low genetic potential of the dairy cows farmed, the high cost of concentrates and low availability of crop residues.

Dairy farms moving towards more agroecological intensive practices are only marginally represented in the area. These are well equipped with infrastructure for animal housing and storing of fodder and livestock equipment. They combine agroecological practices such as crop and livestock co-product recycling and improved grazing with conventional intensive farming (feed, exotic crossbred, artificial insemination). This type of livestock farming, based almost entirely on stall housing, promotes and increases crop and livestock co-product recycling. In this system, livestock farmers build up substantial feed reserves through scything and preserving natural forage, storing crop residues, and purchasing agro-industrial by-products (oil cakes, cereal bran, brewer's grains, etc.). Milk yields are significantly higher under this system.

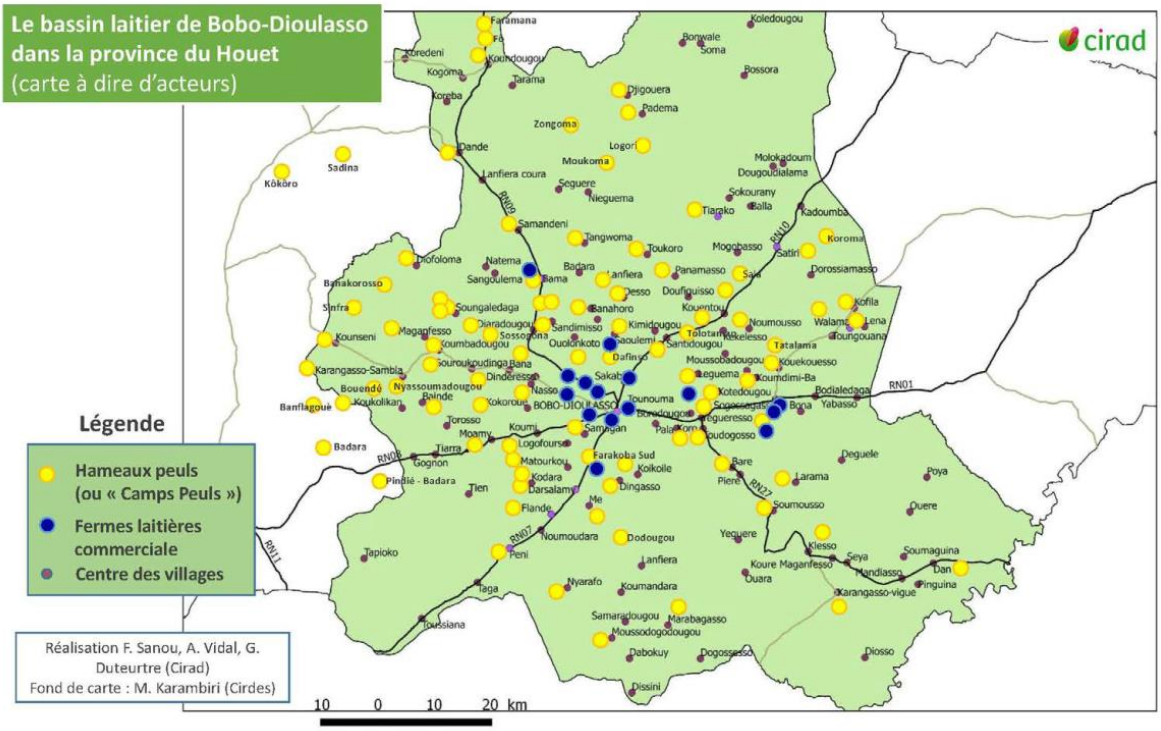


Figure 2. The Bobo-Dioulasso milkshed, in the province of Houet.

Milk collection:

Two collection networks operate in Bobo Dioulasso's dairy production area: 1) Door-to-door collectors or individual/private collectors, and 2) Milk Collection Centres (MCC).

Individual collectors usually sell directly to consumers without prior quality control, while some sell to the Dairy Processing Units (DPU), with established routine procedures. According to Duteurtre and Vidal (2018), most of the milk collected goes through this network of independent individual collectors. With the advent of organised Milk Collection Centres the situation is changing.

There are currently 10 Milk Collection Centres (MCC) operating in the region, which collect between 60 and 190 litres a day by MCC in the high production seasons, and between 60 to 90 litres during the dry season. The high production season corresponds to the rainy season (May to October), and the cool dry season (November to January), when crop residues are grazed in the fields and natural pasture remains. During these season MCCs struggle to sell milk due to a saturation of the retail market and low storage and processing capacities of the DPUs.

Milk processing operators:

The city of Bobo-Dioulasso boasts around thirty Dairy Processing Units (DPUs). These are mainly family-run mini-dairies, processing between 200 and 500 litres of milk a day. Most of the DPUs in Bobo-Dioulasso's dairy production area are small-scale processors with unsophisticated technical facilities Around 72% of DPUs use powdered milk exclusively. Powdered milk is used, partly because of the seasonal nature and quality of local milk, and partly because it is easier and more profitable to process. During periods of high milk production (rainy season), DPUs only use local milk for processing, while during low production periods, they make up the shortfall with powdered milk. Pasteurised milk and yoghurt are the two main dairy products made from processed milk.

Marketing and distribution:

Milk and its by-products are marketed through local and regional distribution channels. The distribution network for dairy products produced by processing units is made up of around fifty dealers/distributors. These products end up in

grocery stores and other sales outlets (shops and kiosks) in the city of Bobo-Dioulasso and surrounding areas such as "Les Cascades" and "La boucle du Mouhoun" regions.

Dairy Innovation Platform (DIP)

Since 2020, Bobo Dioulasso's dairy industry players have established a multi-stakeholder Dairy Innovation Platform (DIP) bringing together dairy farmers, MCCs, private collectors, dairy processing units, government support services (local departments of the Ministry in charge of livestock, farming research, technological research) and private providers (livestock feed suppliers, artificial insemination service providers, microfinance institutions). The DIP has the following vision "By 2024, Bobo-Dioulasso's dairy production area will be producing, collecting and processing 18,000 litres of local milk a day".

2.3. Agroecological principles and the value chain – a general overview

As the adoption and outreach of agroecological practices differs among the various types of actors in each value chain link, this section does present the degree of adoption of agroecological practices, but highlights some of the current practices identified, as well as trade-offs and opportunities that can be harnessed to accelerate the agroecological transition in the region.

Recycling and input reduction: Milk production on dairy cattle farms transitioning to more intensive systems with agro-pastoral features include production and incorporation of manure, using crop residues as fodder and growing forage crops. These practices improve resource recycling, while reducing reliance on external inputs and production costs.

Soil health: In agropastoral systems, the production and use of manure, the practice of rotating paddocks within plots and the growing of leguminous crops help to enrich the soil. In dairy cattle farms, it is particularly relevant to produce forage biomass both on farms and rangeland. Reducing livestock mobility helps to increase the proportion of dairy animal dung recycled as manure. However, this has a slightly negative impact on the organic fertilization of rangeland soils, as they receive less manure.

Animal health: The reduced mobility in dairy farms moving towards more intensive practices may raise welfare issues compared to dairy cows raised in agropastoral system where rangeland grazing is the basis of the feeding system. However, in dairy farms moving towards more intensive practices, farmers maintain regular grazing times every day through the year.

Biodiversity: Herds are mostly made up of local zebus (which are highly adapted to local conditions but produce very little milk). In systems moving towards more intensive practices, animals are being crossed with exotic dairy breeds (Montbéliardes, Holsteins, Brunes des Alpes, etc.), to retain the hardy nature of local breeds whilst offering dairy features that boost milk yields. We note a recent trend for diversification in fodder systems in dairy farms moving towards more intensive practices, as they cultivate more and more fodder to replace costly industrials feeds with quality fodder.

Synergy: These relate mainly to the integration of crop and livestock farming mentioned above.

Economic diversification: Among agro-pastoralists, marketed milk represents a source of income diversification, at least for men and when the volumes sold begin to be regular and substantial (>5 to 10 L/day). Among agro-pastoralists' wives, it represents the main source of income. On dairy farms moving towards more intensive practices, milk is the main source of income. Diversifying production is all about male and female calf management, milk promotion and dam culling. Most young male calves are raised for a long time on mother's milk and are sold when they reach the age of 3 (bull calves). Female calves generally join the herd's core group of breeding cows. Some of the milk produced is kept for household consumption, with the surplus sold directly on the local market or to a dairy. Income from the sale of milk goes to women. However, we found that women often lost control of milk revenues to their husbands when milk was sold to a dairy.

Co-creation of knowledge: Regional Chambers of Agriculture, NGOs and a wide range of partners provide young livestock farmers with training courses covering various topics (production, processing). The UMPL/B (Union Nationale des Mini laiteries et Producteurs de Lait), via its various branches, runs training courses aimed at improving milk quality. These courses provide stakeholders with an opportunity to share their experiences.

Social values and diets: In Western Burkina Faso, most people do not consume large quantities of dairy products, other than Fulani herders for whom milk is a staple. Average consumption is low (< 25 l/capita/year). However, some consumers are keen to purchase dairy products made from local milk, which have a different taste from those made from powdered milk. They also wish to have access to a wider range of traditional dairy products (Dèguè, Gapal, Wagashi cheese, milk soap, milk oil). A key objective would therefore be to replace a large proportion of the imported milk powder with locally produced milk, while producing quality products that are affordable.

Fairness: In 2016, the UPML/B set up the FairFaso advocacy brand, the brand name through which some UMPL/B member mini-dairies sell their milk. The purpose of this label is to provide farmers with a better income: in addition to the price paid to the farmer by the cooperative, a proportion of the price paid by the consumer is passed on to the farmer by the cooperative. The AE-I will be working with the DIP to 1) secure a uniform price for milk from collectors; 2) To improve the distribution system for collected milk in line with processors' requirements.

Connectivity: The setting up of milk collection centers (MCCs) on the outskirts of towns aims to improve connectivity, provide greater proximity, and increase trust between farmers, processors and consumers. At this stage, it's still in its infancy and we believe that its development ought to be supported as it shows great promise.

Land and natural resource governance: In the areas where dairy cattle farmers are based, securing land is a major priority as farmers need arable land for forage production, as well as secure access to pastures and watering points in all seasons (a national priority highlighted by IPROLAIT/BF). This will prevent set-aside areas from being decommissioned after 10 or 20 years. Areas set aside for livestock farming must have adequate infrastructure, primarily establishing water points and creating cattle tracks to ease access to forage and water resources. Regarding the management and improvement of genetic resources, IPROLAIT/BF favors genetic improvement a wider import and use of breeds with high milk production potential. Meanwhile, domestic research efforts are focusing on setting up a community-based selection programme for dairy cows based on the local breeds.

Participation: The Dairy Innovation Platform encourages local value chain stakeholders to get organized, and farmers, collectors, and processors to play a greater part in decision-making.

3. India: The groundnut value chain in Andhra Pradesh

Authors: Shweta Gupta (IFPRI), Muzna Alvi (IFPRI), Nitish Tomar (Institute of Rural Management Anand)

3.1. Context

Groundnut is the sixth most significant oilseed in the world, and with 10.2 million MT produced in 2021, India is its second largest producer after China (18 million MT). In India, most of the production is concentrated in the states of Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, and Madhya Pradesh with over 90% of the total area and production.

Andhra Pradesh (AP) is the eight largest state in India and accounts for nearly 4% of its population, out of which, over 70% live in rural areas. In 2021, Andhra Pradesh (AP) produced over 778 thousand MT of groundnuts (7.6% of the national production) in over 869 thousand hectares (14.3% of the national area) (Directorate of Economics and Statistics, 2021).

Anantapuram is AP largest district, and the location of the sites selected for the ALL implementation[1]. The district's climate is defined by a semi-arid nature, with a prevalent majority of high temperatures throughout the year. It's the country's second-most drought-prone region, receiving an average annual rainfall of 560 mm. The major crops grown in 2019-20 in the district are groundnut (51%), pulses (25.4%) such as red gram and horse gram, cotton (6.5%) and rice (4.1%). Groundnut is grown in both monsoon season (called kharif) and winter season (called rabi). The suitable time for kharif season sowing is from mid-May to end of July and harvesting starts from mid-September to mid-October, immediately after which sowing for rabi starts from November to December and harvesting is done towards the end of rabi season from mid-February to mid-April. Season-wise, groundnut is the major kharif crop in red soil under rainfed conditions covering over 60% of the state´s groundnut area and 40% of the state's total production.

3.2. The groundnut value chain in Andhra Pradesh

The groundnut value chain is comprised of direct actors grouped in the following links: production, aggregation, primary processing, secondary processing, distribution actors and consumers. Surrounding the value chain, the set of supporting actors includes input and seed suppliers, NGOs, technical assistance providers, government representatives, and research institutes, among others.

Production:

Groundnut is grown in the monsoon and winter seasons. The process starts with sowing, which is done at a spacing of approximately 3 to 4 inches between each plant and 12 inches between rows. Anantapur traditionally used to have diversified crop systems in the rainfed areas before groundnut became the dominant monocrop. For example, systems such as Navdhanya involved growing 5-10 crops with multiple harvests over the 2 seasons. But by early 1980s, there was a shift to monocropping of groundnut to promote its high yielding varieties, which led to an increase in its area from 18% in 1960 to 74% in 2005, which resulted in a decrease in the production for millets and pulses for household consumption in addition to depriving soils of biomass.

[1] The administrative divisions of the State are Regions (3), Districts (26), Revenue divisions (77) and Mandals (679). The district of Ananthapur or Anantapuramu was divided into Ananthapuramu and Sri Satya Sai Districts. The two ALL sites selected in the combined Ananthapur district falls under these two districts.

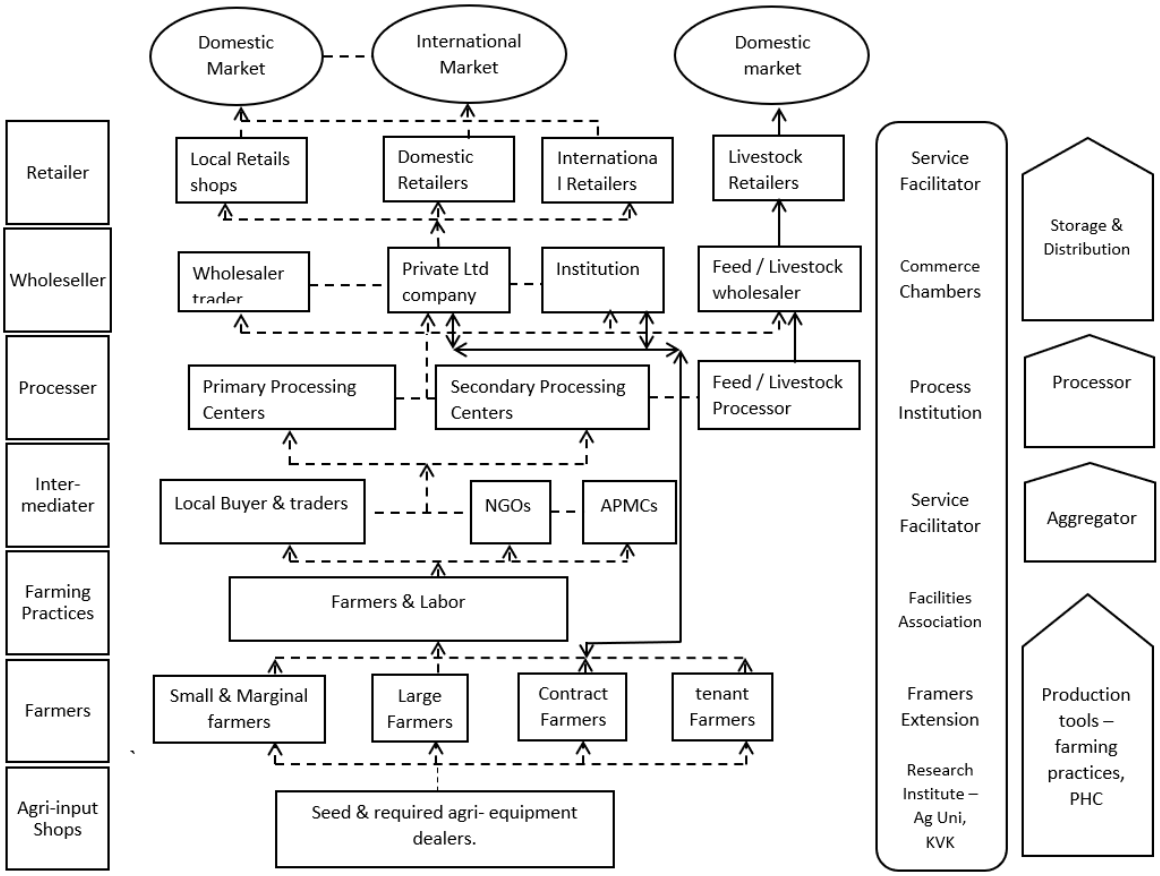


Figure 3. The groundnut value chain in Anantapuram

In groundnut cultivation, the K-6 and TAG varieties have gained widespread popularity in various field areas. K-6 potential yields are estimated at 20 to 25 quintals per acre (4.9 to 6.1 t/ha), whereas for TAG its 14 to 16 (3.45 to 3.95 t/ha)/ Additionally, there are specialized area-specific options, which cater to specific geographical nuances. To ensure successful growth, a seed rate of 80 to 100 kg per acre is commonly employed.

There is a growing number of "natural farmers"[2] in the state, thanks to the APCNF program led by Rythu Sadhikara Samstha (RySS - A farmers empowerment organization under Government of Andhra Pradesh). Unlike conventional farmers, who use monocropping systems and apply chemical inputs, natural farmers are adopting the Navdhanya system and apply various biologically based and self-produced inputs, mainly Beejaamrutam (for seed treatment), Jeevaamrit (a liquid natural fertilizer), Ghanjeevaamrit (a solid natural fertilizer), and Neemastra and Brahmastra (biological products for pest and disease control).

Other relevant practices at the production stage are manual weeding; irrigation (which is uncommon but highly recommended when possible); and manual harvesting.

After harvesting, farmers mostly sort the groundnut using traditional manual methods, segregating produce according to quality and size. After sorting, the crop is either packed into bags or temporarily stored in the fields under protective covers. Farmers in Anantapur don't have lack dedicated facilities for storing their produce. The prevalent practice is to opt for immediate sale post-harvest posing challenges especially for smallholders. The product can take one of various

[2] Natural farming is a term used synonymously for agroecological farming methods. It falls under climate resilient agroecology, more specifically under regenerative agriculture (Fukuoka, 1992).

channels. Some seeds are saved for the next planting, the rest is sold directly to consumers, to Agricultural Produce Market Committees (APMC), to aggregators and traders or to primary processing units.

Aggregation and trading:

Some of the product is sold to the three APMC within the vicinity, nevertheless, many farmers, especially small and marginal farmers, do not opt for these channels, due to low prices (similar to those of intermediaries that buy in the farm gate), lack of premium rats for natural produce, limited logistical services, delays in payment and absence of collective sales due to the diverse harvesting periods of different farmers. As a result, there are many local aggregators who buy the crop from the farmers and sell them to wholesalers or processors.

There are a few organizations engaged in procuring natural groundnut at a premium rate, such as RIDS, Tirumala Tirupati Devasthanams (TTD – a trust that manages temples), Jeevn Palli, and farmer producer organizations (FPOs), who procure groundnut at 10% premium rates, yet their outreach remains limited to a relatively small area.

Processing:

Processing centres have a pivotal role in the value chain. In Anantapuram, a multitude of key stakeholders are intricately involved in direct and indirect collaborations with farmers. Notably, Narpala stands out as the nucleus of processing centres in this region, positioned at approximately 30 kilometres from Anantapuram. This locale hosts a diverse array of processing industries dedicated to various stages of refinement. Additionally, a limited number of non-governmental organizations (NGOs) and farmer producer organizations (FPOs) partake in processing endeavours. However, those are very limited.

Processing centers can be divided into primary and secondary. Primary processing centers (PPCs) clean, sort and shell the groundnuts to obtain the kernel and husk. The husk is used for mulching (helps in soil nutrition), packaging, charcoal crafting, briquette formation, composting, animal feed and kitty litter. The kernel is used for making value added products besides being consumed as it is, such as in making of snacks, oil, peanut butter, milk, etc., which are mostly produced in the secondary processing units. Before this, the kernels in the PPCs are roasted, cooled, blanched, graded, sized, and packaged. Grading and sizing are mostly conducted by women.

Secondary processing centers (SPC) take the prepared peanuts and convert them into more value-added products. A SPC based in Muddalapuram village and run by ICRISAT was visited to understand more of this process. The SPC was dedicated to oil, peanut butter, and snack production such as roasted and flavored nuts, peanut bars, Chikki and coated candies. There is a large domestic consumption of peanuts and peanut based products in India, but 75% of the nearly 25,000 MT of peanut butter produced in India is exported.

Indirect actors:

As mentioned above, there are several actors providing services to the value chain direct actors. RySS is one of the most relevant organizations for the agroecological promotion in the state. Few organizations and NGOs, play as direct and indirect actors, such as TTD, RIDS, Jeevan Palli, and Timbaktu, who have intervened to procure natural groundnut at premium rates, but their scope is limited to specific areas. Additionally, ICRISAT participates both as a research institution and as a buyer.

The government of Andhra Pradesh has initiated Cheyutha Mahila Mart- an initiative to provide a platform to women to sell their produce. There is one Mahila Mart in Bathalapalli where the natural produce from these NF farmers is sold. As input providers the AE-I team identified 3 self-help group heads that are producing natural inputs for selling within its group members and other nearby farmers, but these initiatives are highly insufficient for the demand and scale of groundnut production in the region.

3.3. Agroecological principles and the value chain – practices, challenges, and opportunities

The adoption of agroecological principles in the value chain varies greatly between the type of producers and is highly linked to the type of actors involved. At the production level, conventional farmers have a very low application and knowledge of agroecological principles and practices, but natural farmers show a large range of practices, and the promoted system is greatly aligned with the 13 principles, with achievements in all areas.

In terms of recycling, the husk is used for mulching, other crop residues are used as bedding material for cattle and the manure and urine is used to make compost and other biologically based inputs.

Regarding input reduction, the use of inputs is limited to natural products. Cover crops also reduce the water and input requirements. Regarding diversification, the revival of the Navadhanya system is a great achievement for the region and regarding biodiversity, the reintroduction of introduction of native varieties is key within the systems promoted. There is a large complementarity between animal and crop production as manure and urine from cattle are necessary for the functioning of the system, so much that the current supply is insufficient. Navadhanya also impacts social values and diets, by improving food security and dietary diversity using local products.

On co-creation of knowledge, self-help groups, farmers, government, extension agents and NGOs have been articulated at different extents to implement process of participatory learning and knowledge sharing. Regarding fairness and participation, some initiatives to increase prices for natural groundnut stand out, but these are only limited to certain areas. Efforts to improve participation and improved connectivity with markets are still necessary.

Major challenges and recommendations for strengthening the agroecological transition.

Based on the rapid value chain analysis the AE-I team identified 5 major challenges for the upscaling of agroecological practices in the ALL, and proposed specific actions to tackle them.

1. Inadequate information about natural farming: There is a need of a wider as well as more targeted provision of extension services, and for increasing awareness to enhance adoption of natural farming. The initiative and sector must leverage innovative technology to bridge gaps in information exchange and last-mile connectivity as well as integrating practitioners in the community. For example, exposure visits on successful natural farming field, spreading information through mobile phones, channels, YouTube videos, etc.

2. Lack of storage facilities: Most farmers have limited housing space, leaving them without the capacity to use any area as a dedicated warehouse for storing their crops. Consequently, farmers are compelled to promptly sell their harvests at the prevailing market prices. This can be addressed by providing capacity building and infrastructure for aggregation by FPOs at village level and linking natural farmers with them.

3. Lack of differentiated markets for natural products: Farmers practicing both conventional and natural farming methods share similar market avenues and receive the same prices. Few organizations are procuring at premium rates and have a limited reach. Additionally, the APMCs lack infrastructure for the procurement of natural products. The AE-I proposes creating and improving market channels by improving aggregation and bargaining power of producers (as mentioned above), and selling natural, value-added products through women Self Help Groups and Mahila Marts.

4. Shortage of bio-fertilizers for natural farming: Only 30 to 40 percent of the farmers possess their own livestock, limiting home production of bio-inputs. Additionally, other farmers lack the knowledge and time to prepare the inputs, limiting upscaling. A potential intervention would be to construct local bio-input shops which sell these inputs at nominal rates to farmers who want to adopt natural farming. A cost analysis has been conducted for

these inputs, showing that they can be profitable, but their implementation requires credits and training. Another important step to strengthen the bio-input shops is conducting quality tests and standardizing products to increase its credibility. This will also attract investments from private sector, facilitating the certifications.

5. Challenges in certification of natural produce: In India, there are two ways of certifying a product: i) Through the NPOP (National Programme for Organic Production) or NOP (National Organic Program), where accredited certification agencies (third parties) certify the organic producers; and ii) PGS certification (Participatory Guarantee system) where people in similar situations (in this case smallholder producers) assess, inspect, and verify the production practices of each other and take decisions on organic certification. PGS is easier to conduct in continuous landscape, since this reduces the chance of cross-contamination by chemicals from conventional farmers, but there are several difficulties in the case of fragmented farms. Moreover, it is not as trustworthy among consumers unlike NPOP. RYSS offers a pesticide residue testing as well to enhance credibility of produce but again, there are concerns of sustainability of this support. Such issues create prevent farmers to take full advantage of the organic market.

4. Kenya: The mango value chain in Makueni

Authors: Kevin Onyango (Alliance Bioversity International and CIAT), Peter Bolo (Alliance Bioversity International and CIAT), Manjella Ndiwa Aurillia (IITA), and Christine Kiria Chege (Alliance Bioversity International and CIAT)

For the Makueni ALL, the AE-I team together with local stakeholders conducted a value chain prioritization, as there were various potential alternatives. Five value chains were assessed (moringa, honey, mango, oranges, and pigeon peas), using four criteria: i) existence of a business model, ii) current application of agroecological principles, iii) interest from actors to adopt more agroecological principles and practices, and iv) potential for development and upscaling of business models. The mango value chain obtained the highest score, followed by oranges.

4.1. Context

Makueni County, located in the Eastern part of Kenya, is largely dominated by the Kamba community. The agriculture sector is the main source of income in the region, accounting for 78% of the total household income. Most households are composed of an average of six members. Men are traditionally the heads of the families and mainly engage in economic activities of the community. They are the main decision makers in the family, running most family affairs and responsibilities, while women mostly work on farms to supply meals to their families.

With a production of nearly 650,000 MT annually and a value of USD 84,4 MM (HCD, 2020), mango is the second fruit crop in Kenya in monetary value, and Makueni County leads national production, with over 303,000 MT per season. About 60 - 80% of Makueni County population are directly or indirectly involved in the mango value chain.

4.2. The mango value chain in the Makueni ALL

The mango value chain map in Makueni ALL is presented in Figure 4. The core actors include producers in cooperatives and individuals; formal and informal aggregators; fresh mango wholesalers, exporters, and retailers; processors; processed mango products distributors and retailers; and final consumers. Among the indirect actors in the meso level, the most relevant are the input providers, operational service providers and technical assistance providers. At the macro level, the actors include the Ministry of Agriculture, Livestock, Fisheries, and Cooperatives (MoALFC), the Kenya Plant Health Inspectorate Services (KEPHIS), the Makueni County Investment Authority Act (MCIAA), and the County´s government, assembly, department of trade and department of agriculture.

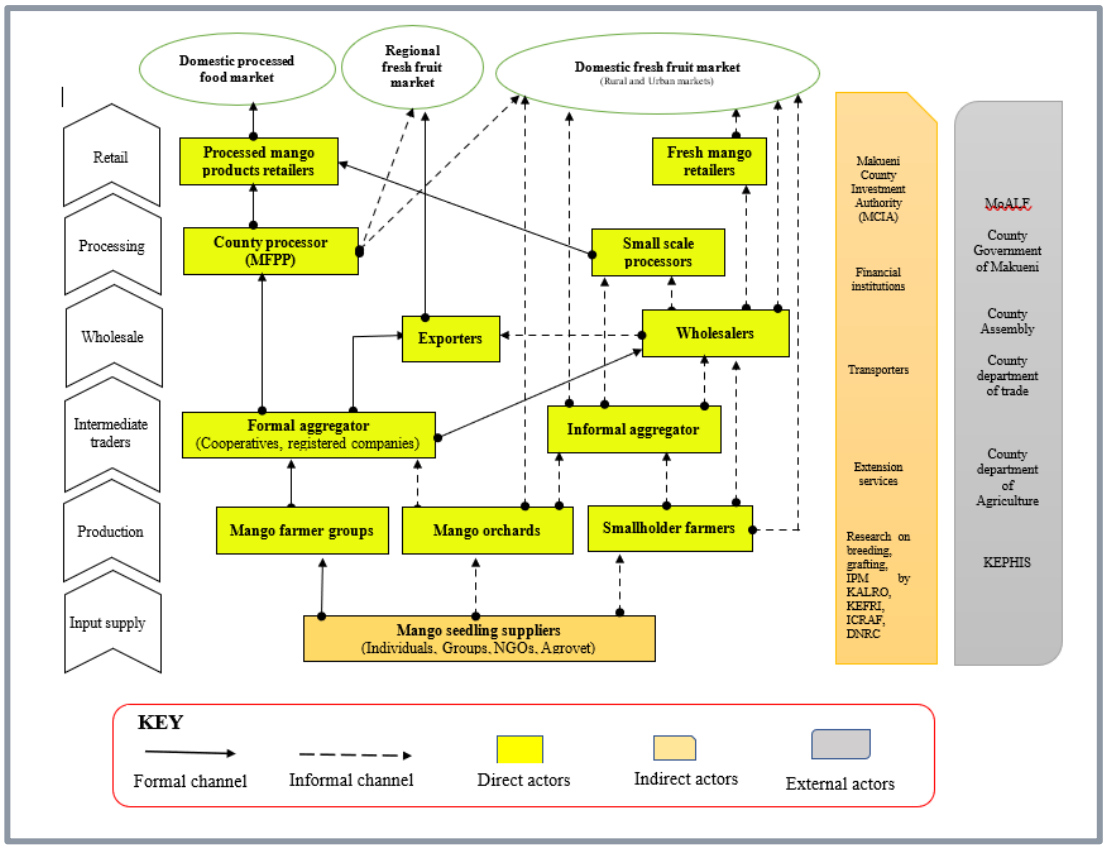


Figure 4. The mango value chain in Makueni

Production:

Makueni County has an estimated 4.3 million mango trees grown by roughly 28,696 farmers in around 14,985 ha, producing nearly 303,000 MT per season. Mangoes season is often between November and March, and the peak season between January and February. Production is rainfed, and the average estimated productivity is 180-300 pieces of fruits per tree depending on management practices and amount of rain received. The potential productivity in the County is at least 500 pieces per tree, or 10 – 15 metric tons per hectare. In Mbooni Sub-County, where the Makueni Agroecological Living Landscape (ALL) is located, the estimated mango productivity is around seven tons per hectare.

Mango production is mainly dominated by smallholder farmers, with a few medium- and large-scale farmers (Musyoka et al., 2021). According to Grant et al (2015), farmers with over 50 trees are considered commercial farmers, and can be classified as medium to large-scale farmers, who in general have up to 500 trees. It is estimated that 75% of mango producers in Makueni County are small-scale farmers with less than 50 trees. Large- and medium-scale mango farmers grow specific varieties of mangoes for commercial purposes and can sell directly to exporters, wholesalers, supermarkets, and agents, unlike small-scale farmers who grow a mix of mango varieties. They also have sufficient capital and can apply the necessary inputs to control pests, diseases, and manage soil fertility.

Two types of mangos are generally grown in Makueni County: the local and the exotic or improved varieties. Improved varieties are usually grafted on local mangoes and are grown for the export market. Local mango varieties tend to be smaller in size with high fibre content, a characteristic that makes them unpopular among consumers. Further, local mango varieties are usually left to grow naturally without much crop husbandry.

Generally, the productive activities carried out by mango producers include pest and disease control, manure and fertilizer application, watering (especially during early stages of crop development), soil and water conservation through mulching, terracing, pruning, top working and drip irrigation in some cases. Weeding and harvesting is mainly done by women while men are mostly involved in pest management practices such as spraying and installing of fruit-fly traps. Although all members of the household are involved in mango production, men mainly make production decisions. A census conducted in Eastern Province found that men owned most of the mango trees (78.7 %), while women owned only 20.7% (Grant et al, 2015).

Aggregation:

Aggregators and brokers are the main link between farmers and the rest of the value chain. They purchase and sell directly to retailers, wholesalers, contracted agents and the few processors and exporters in the County. There are aggregation groups and cooperatives who buy mangoes from farmers, who store and sell mainly to wholesalers and retailers from Makueni and neighbouring counties. Cooperatives such as the Makueni Fruit Processing Cooperative Society also aggregates mangoes from their members. An estimated 3,500 farmers sell their mangoes through cooperatives. These sold an estimated 500 MT of mangoes on behalf of their members. It is estimated that aggregators add only 8% of the total value in the mango industry but earn 22% gross margin in their handling (Bien and Soehn, 2022).

Processing:

In 2017, the County Government through the Makueni County Fruit Development and Marketing Authority (MCFDMA), established a mango processing plant in Kalamba, Makueni. While the plant could process 5 metric tons of raw mangoes, it nearly shuts down operations during the offseason and due to frequent power outages, among other challenges. The plant processes around 3,000 metric tons of mangoes per season, leaving about 300,000 metric tons produced in the County to go to other market actors and to loss and waste. These include mango processors around the country, who transform the fruit into pulp, juice and concentrates, and dried mangoes. Processors rely on brokers and, in some cases, organized farmer groups and cooperatives for delivery of mangoes. Rarely do they venture into production zones to purchase mangoes.

Most of the processing plants, including the MCFDMA, operate at approximately 40% of installed capacity because of supply shortages created by significant postharvest losses (10-31%) (USAID-KAVES, 2015), seasonality of production and competition with local fresh fruit and export markets, which offer better prices. Additionally, there are individual entrepreneurs who process mangoes informally to produce fresh mango juice for retail or home consumption.

Wholesale market:

Mango wholesalers either source fresh mangoes directly from farmers in rural areas or use aggregators These operate both in urban markets and more distant towns. In Makueni, wholesalers largely operate informally, although some of them source formally from farmer groups and cooperatives. Some wholesalers sell high-quality mangoes to exporters or to processors. Wholesalers trade in almost all mango varieties if there is demand, however, the most common varieties among wholesalers include Ngowe, Apple and the local mango varieties. Wholesalers operate largely as sole proprietors and both men and women participate in this segment of the value chain, although men tend to be slightly more represented. There are only a handful of youth in the wholesale segment, and this could be attributed to lack of the required capital to operate as a fruit wholesaler. In 2017, the Association of Kenya Mango Traders (AKMT) was founded and registered with a membership of approximately 71 mango traders who operate from urban markets. The Association has gained traction with the number of traders growing each year.

Export market:

Kenya exports only about 2% of the total mango production, at approximately USD 1.5 million per year (Mujuka et al., 2021). Apple mango makes up 80% of the total exports, mainly due to its large production volume and relatively longer shelf life. Export destinations are mainly Middle Eastern countries, especially the UAE (> 30% of total mango exported) (KEPHIS, 2019). Kenya's export markets largely overlap with India, the largest producer of mangoes in the world. However, Kenya's peak season differs from the Indian season, providing Kenyan exporters with export opportunities.

According to USAID-KAVES (2015), there were about 20 mango exporting companies in Kenya in 2014. These operate formally and are responsible for about 90% of mango exports. To ensure quality fruits and minimal waste, exporters rely more on their own staff to supervise harvesting, sorting, packaging, and transportation. Beside the formal exports, there is also a lot of informal export of mangoes to Tanzania and other East African countries.

Retail market and consumption:

Rural mango retailers source their mangoes directly from farmers, while urban retailers (e.g. Nairobi, Mombasa, and Kisumu) source from brokers and wholesalers/transporters. The retailers also source mangoes from wholesale markets

in the urban centers. In Urban cities such as Nairobi, hawkers and green grocers trade higher volumes of mango fruits at the retail level, while supermarkets and general shops also retail substantial volumes of fresh mangoes. The retail segment is dominated by women who operate informally as sole proprietors handling relatively smaller quantities, an average of one or two 100 kg bags of mangoes per week and sell the mangoes on a per piece basis. Domestic consumption of mangoes in Kenya accounts for nearly 95% of the total production.

Meso level actors (input, technical assistance, and operation service providers):

The main input providers are the nursery operators (seedling suppliers) and agrochemical dealers. Seedling suppliers comprise of individual farmers, farmer groups and non-governmental organizations like Dryland Natural Resource Center (DNRC).

Regarding logistics, the main modes of transportation employed include donkey carts, bicycles, motorbikes, pick-ups and large trucks (USAID-KAVES, 2015), however, the exporters have refrigerated trucks (where humidity and temperature are regulated).

Around the DNRC ALL, mango farmers often get technical assistance from various sources involving the County (i.e., overseen by the Sub-County Agricultural Office and Ward Agricultural Office) and non-governmental organizations like the DNRC. Farmers are mostly trained on pest and disease management, weeding, water management, manure management, good agricultural practices, good harvesting practices, and quality standards. In addition, the County also facilitates the linking of farmers to markets. Research institutions like ICIPE also provide support in integrated pest management. However, the frequency of access is limited due to the long distances of farms. Financial services are provided by microfinance institutions, cooperatives, and community-based organizations.

Macro level actors (regulatory bodies and other institutions):

The Ministry of Agriculture, Livestock, Fisheries, and Cooperatives (MoALFC) and the Ministry of Industrialization, Trade and Enterprise Development (MoITED) set national strategic priorities and allocate budget for agricultural development. Priorities relevant to mango value chain development include improving road infrastructure, developing farmer-facing SMEs to help provide inputs, investment in irrigation, reducing postharvest losses, investing in new agro-processing projects, assisting in tax incentives, and increasing fruit crop production by 35% (MoALFC, 2019).

Other key policy documents are the Kenya Vision 2030 and the LAPSSET corridor development strategy, where large scale mango production has been prioritized. At the County level, the government established the Makueni County Investment Authority Act (MCIAA), to promote and coordinate investments, including the mango industry. The County has also drafted new regulations and amendments to the MCIAA to empower the County to create a positive investment environment and has launched a rigorous campaign towards the establishment of Fruit Fly Free Zones (FFFZ).

4.3. Agroecological principles and the value chain – challenges and opportunities

There are numerous technological and institutional opportunities to improve the performance of the value chain. The agroecological principles are especially useful at informing which practices to promote, how to promote them, what objectives should be considered, and who should participate. Below we present some of these opportunities, as well as challenges for their implementation.

At the farm and landscape level, there following practices have been identified for its potential and alignment with the principles of **recycling**, **input reduction**, **soil health**, **biodiversity**, **synergy**, **economic diversification**:

Promotion of organic production, laboratory testing of manure and efficient manure application, production and use of biopesticides, use of fruit fly traps, investment in equipments (motor pumps), training on correct use of fertilizers and pesticides, investment in technologies and training to reduce post-harvest losses, promotion of grafting and promoting the use of high quality seedlings (including local and exotic varieties), definition of harvest protocols and sector

standards, promotion of diversified systems introducing crops, poultry and livestock, training in technologies and practices for soil and water conservation, promoting activities to maintain biodiversity and natural resource conservation, and evaluating feasible storage facilities and technologies at farm level. All the previous practices and activities can be included in programmes that promote the association of producers, strengthen collective bargaining and participation, and integrate local knowledge, while responding to the cultural elements that favour male decision making and asset control, thus contemplating the principles of **co-creation of knowledge**, **fairness**, **governance of natural resources** and **participation**.

At the aggregation and processing levels, working on the following opportunities would impact the principles of **fairness**, **connectivity**, and **input reduction**, as the latter would imply a reduction of losses along the value chain:

Improved access to credit for aggregators and processors, increased investment in road infrastructure, definition of sector standards, promotion of cooling options for cooperatives (evaporative cooling chambers and zero-energy brick coolers), establishment of more aggregation points, incentivizing the formation of cooperatives and marketing groups, and promoting the use of cushioning materials in fruit packages to prevent post-harvest damage.

Finally, at a meso and macro levels, there are major opportunities for improving access to agricultural inputs by incentivizing the presence of sales agents and distributors, increasing the provision of high-quality seedlings and the number of certified nursery operators, and extending the reach of technical assistance through associations and farmer groups. Nevertheless, relevant institutional challenges still prevail, including a recent ban placed on mango exports to Europe due to the fruit fly, a fragmentation of policies between national and county levels, and the preference by national institution of working on cash crops, which limits the support to the mango value chain.

5. Kenya: The green leafy vegetables value chain in Kiambu

Authors: Kevin Onyango (Alliance Bioversity International and CIAT), Manjella Ndiwa Aurillia (IITA), Peter Bolo (Alliance Bioversity International and CIAT), Rosina Wanyama (Alliance Bioversity International and CIAT), and Christine Kiria Chege (Alliance Bioversity International and CIAT)

For the Kiambu ALL, the AE-I team together with local stakeholders conducted a value chain prioritization, as there were various potential alternatives. Five value chains shortlisted were (green leafy vegetables – GLV-, avocado, poultry, dairy and maize), using four criteria with various sub criteria: i) economic, ii) environmental, iii) social, and iv) institutional. The GLV value chain obtained the highest score, followed by avocado.

5.1. Context

Kiambu county is located in the central region of Kenya and is the second most populous after Nairobi, with an estimated population of about 2.53 million. Vegetable production, especially the GLV, stand out as a key agricultural commodity, mostly produced for subsistence or commercial purposes. Green leafy vegetables produced in the region include a variety of African leafy vegetables (ALVs) (such as black nightshade, cowpea, amaranthus, among others); and exotic leaf vegetables (ELVs) (such as spinach, cabbages, among others). These products have gained popularity because of their nutritional content, income generation potential and medicinal uses.

Between 2018 and 2021, the national land allocated for ELVs has increased from 143 to 149 thousand hectares, whereas for ALVs went from 53 to 45 thousand hectares sin the same period. National production of ELVs in 2021 reached over 3,100 MT and ALV reached 278 MT. (AFA-Horticultural Crops Directorate, 2022). In Kiambu, production of Kale and Cabbage alone (ELVs) reached 100 and 29 thousand MT respectively in 2021.

5.2. The African and Exotic leafy vegetables value chains in Kiambu

The GLV value chain in Kiambu can be differentiated between the African leafy vegetables (ALV) and Exotic leafy vegetables (ELV). Both value chains are composed of (i) **Direct actors,** who are involved in the processes of bringing the vegetables from production to consumption. They include producers, assemblers, brokers, distributors, wholesalers, retailers, processors, and consumers; and (ii) **Indirect actors**, who have an influence on the value chain but do not take ownership or direct possession of the vegetables. These include input dealers, extension agents, transporters, financial institutions, NGOs and government institutions. While they share a similar structure, the prices, activities, trends, and type of actors differ among value chains, for example, production of ALVs is dominated by women (Wild, 2022), while men dominate the ELV value chain, since it is mostly commercial and associated with large investments.

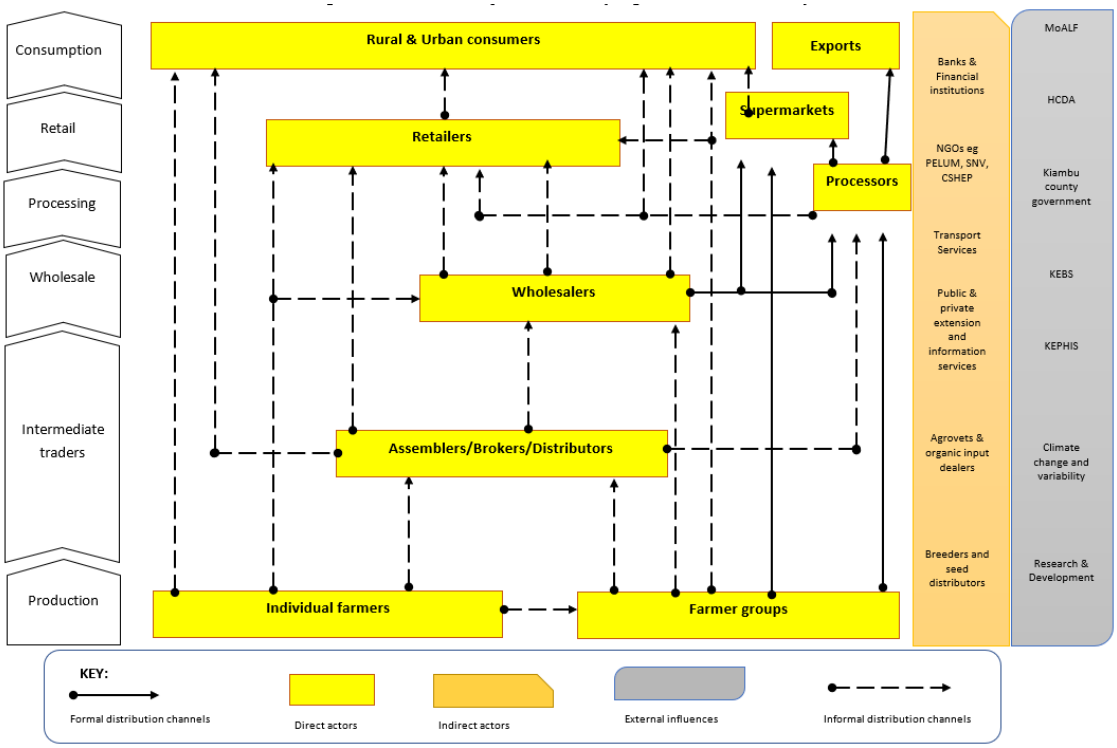


Figure 5. The African leafy vegetables value chain in Kiambu county

Production:

ALVs: These include a diverse range of vegetables, such as amaranth (terere), cowpeas (kunde), spider plant (sagaa), black nightshade (managu), African kale (kanzera), pumpkin leaves, cucurbita ficifolia (kahurura), vine spinach (nderema), sweet potato leaves, stinging nettle (thabai), jute mallow (mrenda), and slender leaf (miroo/mito). 70 % of all vegetable farmers surveyed by the research team produced ALVs. Most of them are small-scale farmers who own an average of 1.3 acres and grow these vegetables on less than an acre. Overall, land for cultivation in the County is largely owned by men (87%).

Producers often employ traditional farming methods, which include ploughing, intercropping, cover cropping, mulching, and use of organic manure, in mostly rain-fed systems. The high dependency on rain contributes to post harvesting losses, as lots of vegetables are produced at the same seasons, leading to excess supply. Many ALV farmers also practice modern farming methods such as row planting, monoculture, inorganic fertilizer application, irrigation, and use of agrochemicals for pest and disease management. In recent years, agroecology (AE) has been promoted in Kiambu County among farming communities, with high adoption rates of AE practices. Additionally, in recent years there has been an increase in urban and peri urban ALV producers. According to Otieno (2019), rural households consume about 40% of their total ALV production and sell about 60%, out of which 85% is destined to urban and peri-urban areas. Even though some farmers sell their vegetables directly from the farm, most clean, sort, and package the vegetables, before selling them. Since ALVs are typically sold or consumed fresh, producers don't store the vegetables for more than a day.

Production of ALVs in Kiambu has been growing over recent years. For instance, in 2022, the County produced 1,042 tons of amaranth and 1,699 tons of African nightshade, compared to 725 tons and 1,441 tons respectively recorded in 2019.

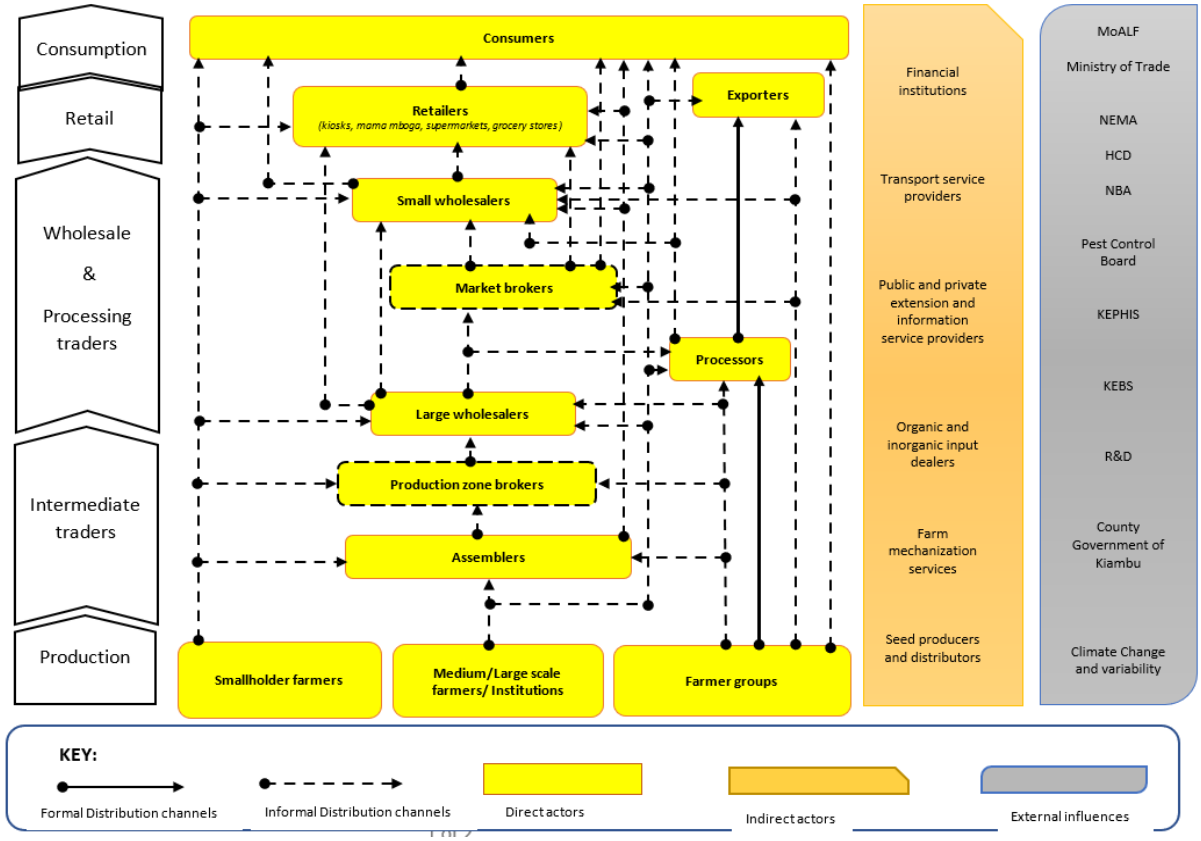


Figure 6. The Exotic leafy vegetables value chain in Kiambu county

ELVs: Some of the most common ELVs include Cabbage, Kale, Spinach and Lettuce. ELV producers range from small-scale subsistence farmers to commercial enterprises and farmer groups. Small-scale farmers own an average of 1.4 acres, constitute the majority in the County, and often grow vegetables alongside staple crops such as maize and beans for selling and self-consumption. Commercial producers usually dedicate substantial acreage (>1.5 acres) for intensive ELV production, usually for a pre-identified market.

Producers employ a mix of traditional and modern agricultural practices. These include manual land preparation (but some farmers employ ox and tractors), manual planting, irrigation (especially during the dry periods and the drier parts of the County), fertilization using both organic and inorganic fertilizers, pest and disease management, and weed control. Harvesting is mostly manual. In 2021, the area planted with Kale, Cabbage and Spinach in the County amounted to 20,000 acres for, with a production of over 159,000 MT (Kiambu County, 2023). Most ELV farmers in Kiambu County have adopted agroecological practices to promote sustainable farming. These include crop rotation, intercropping, cover cropping, and the use of organic fertilizers.

Aggregation - Assemblers, distributors, and brokers:

Assemblers are the first commercial purchasers of ALVs in the value chain. Their role is to buy low volumes from farmers, assemble/aggregate, and sell to other actors higher up the value chain. Assemblers pay for the vegetables in cash on the spot, have a good relationship with the producers and some conduct supervised harvesting. For ELVs, assemblers usually inspect the produce for freshness, appearance, and overall physical condition, sorting the vegetables based on freshness, size, and type. After sorting and quality control, ELVs are often packaged according to wholesale market requirements (e.g. 0.5 to 1kg bundles). While both men and women participate in this segment, women are mostly involved in quality control, sorting, cleaning, and bundling. Men are mostly involved in collection, transportation, loading and off-loading, and negotiations with buyers.

Distributors purchase relatively large volumes of ALVs from assemblers, as well as farmers and farmer groups. They then transport the vegetables to wholesale markets within the County, or in major cities. Despite their relevance, there aren't many distributors and don't operate in all villages.

ALV brokers operate in various locations, often within or near local markets, agricultural trading centers, and collection hubs. They source vegetables mostly directly from local farmers and assemblers and then resell them to wholesalers, retailers, businesses, and households.

The ELV value chain has two types of brokers: Production zone brokers and wholesale market-based brokers. Production zone brokers connect producers with intermediaries. Market-based brokers connect assemblers and distributors with market-based wholesalers, earning a brokerage fee in the process.

Wholesale and retail markets:

Wholesalers participate in sourcing, purchasing, and distributing products to the local and regional markets. For ALVs, they sort, grade, and sometimes package the vegetables before distributing them, mainly to local and other city retailers. ALV retailers in the County are mostly located in open-air markets, roadside stalls, and green groceries. Women, both young and aged, dominate the ALV retail segment. Some retailers engage in value addition activities, such as washing, cutting, and packaging.

For ELVs, wholesalers can be categorized into two main groups: larger distributing wholesalers and smaller, market-based wholesalers. Distributing wholesalers focus on gathering produce directly from assemblers and local farmers within the County. They often travel through the County to procure vegetables from spot markets and aggregation centers. To streamline their operations, these actors frequently engage purchasing agents to operate on their behalf within the production villages. Market-based wholesalers purchase vegetables (in most cases through brokers), and sell them mainly to retailers in bags. Their customer base is diverse, and includes retailers in traditional open-air retail markets, grocery stores, roadside vendors, supermarkets, hospitals, and hotels.

Retailers promote the integration of AE principles in the ELV value chain in various ways. First, they encourage producers to reduce synthetic inputs, as they give feedback on consumer demand for high-quality produce with reduced chemical inputs. Second, they offer a diverse range of exotic leafy vegetables, and provide information on the environmental and health benefits of AE practices to educate consumers about their choices. Additionally, they implement a waste management strategy that includes composting vegetable waste.

Processing:

Processed ALV products include dried vegetables, chopped vegetables, vegetable powder, and canned vegetables. Dried and powdered vegetables are the most common types of processed vegetables, and they are often used in soups, stews, and salads. Canned vegetables are less common, but they are becoming more popular. Dried vegetables are typically processed by sun drying or using solar bubble driers. Canned vegetables are processed using a variety of techniques, including blanching, cooking, and canning. One of the ELVs processors interviewed, Cheer-up, is engaged in blanching and drying kale and spinach within the County. The cheer-up program has the support of the County Government to expand its drying and vegetable milling capacity.

Consumption:

The demand for ALVs in Kiambu County has been on the rise in recent years despite the seasonal variation in their supply in the County. The consumers appreciate the cultural, nutritional, and economic value of vegetables and incorporate them into their diets in various ways. In most cases, they are added to stews, soups, sauces, and side dishes. Consumption of kale and cabbage is particularly high in the County. Even though most consumers cannot differentiate between organic and non-organic vegetables in the market, the level of awareness of the potential dangers associated with consuming chemical-riddled vegetables is growing.

Meso level actors (input, technical assistance, and operation service providers):

Farmers in Kiambu ALL either recycle seeds from previous seasons or purchase new seed every season depending on the type of vegetable. Seed recycling is common among open pollinated African leafy vegetable, while seeds of exotic varieties like kales and cabbage are often purchased every season.

A substantial proportion of vegetable farmers use chemical pesticides and synthetic fertilizers, and these are often easily available. However, farmers are embracing the use of organic fertilizers like manure and compost, and biopesticides.

Technical assistance is offered mainly by the County, but NGOs and Community based organizations (CBOs) also provide technical services. For instance, CSHEP, a community-based organization is working with small scale farmers to promote sustainable organic and bio-intensive gardening with GLVs as their priority, and NGOs like Biovision, World Vegetable Center, SNV, FAO, and Community Sustainable Development Empowerment Programme (COSDEP) have been supporting farmers with technical knowledge in vegetable production and marketing.

There are various financial institutions that offer loans, savings, insurance products, money transfer services, investment products, and financial advisory services to vegetable farmers in Kiambu County. These include commercial banks, microfinance institutions, state owned agricultural finance institutions, savings and credits cooperatives and Mobile Money Services Providers.

Macro level actors (regulatory bodies and other institutions):

The Ministry of Agriculture is the main change agent of agriculture in the government, supported by other public agencies including Trade and Regional Development Authorities. Other relevant institutions are the Department of Crops Development and the Kenya Agricultural and Livestock Research Organization (KALRO); the Kenya Plant Health Inspectorate Service (KEPHIS), who provides services on the testing of plants on pests and diseases as well as advice to farmers on control measures and regulation of seed production and commercialization; Kenya Bureau of Standards (KEBS), who provides certification for products that meet certain standards especially for the value added GLVS; and the Pest Control Product Board of Kenya which regulates the manufacturing, distribution, usage of pesticides as well as importation.

5.3. Agroecological principles and the value chain – current adoption, challenges, and opportunities

Numerous opportunities were identified for strengthening the agroecological transition in the Kiambu GLV value chain, as the sector enjoys a conducive enabling environment and has already made considerable progress along this path. There are multiple AE practices currently taking place at varying degrees, especially among ALVs producers. Working on ALV is itself has a positive impact in the principle of **social values and diets**. Regarding the principles of **input reduction**, **recycling**, **soil health**, **animal health**, **synergies**, **biodiversity**, and **economic diversification**, the practices include organic fertilization, intercropping, cover cropping, mulching, use of biopesticides, incorporation of nitrogen fixing crops, planting of trees to prevent soil erosion, use of organic dewormers for treating animals, water harvesting and recycling, using rabbit urine and other animal excreta as fertilizers and producing biogas. On the other hand, community-based organizations, government institutions and NGOs, are key players currently promoting a more inclusive participation of women, a fairer market system, improving connectivity to markets and enhance participation in decision making, thus promoting the principles of **co-creation of knowledge**, **fairness**, **connectivity, land and natural resource governance** and **participation**.

Nevertheless, there is plenty room for improvement and various opportunities to harness. The AE-I team identified five key challenges and recommendations to address them:

First, there is a complex situation of low explicit demand and supply of biological pesticides and fertilizers, which is derived from a lack of knowledge of how to produce and/or use these products, a limited availability of products in the market, and a lack of standardization of locally produced and marketed inputs which impacts the reliability and trust from the farmers. To facilitate the transition to biological inputs, there is a need for both sensibilization and training of farmers on how to produce (when possible) and use these products, as well as the development of affordable, accessible, and reliable products. The latest demands the establishment of policies and standards for locally produced inputs and the promotion of enterprises.

Second, water is a major constraint for the adequate and profitable development of the cropping systems. Therefore, there is a critical need to design strategies to improve water access and use, especially in the drier parts of the county. This includes trainings on water recycling where possible.

Third, the high level of intermediation in the value chain usually translates in lower prices to farmers and higher prices for consumers. This is intensified due to a lack of proper transportation, storage facilities, and poor road networks which leads to high logistic costs as well as lack of efficient market linkages between mango producers and buyers. Thus, there is a need to improve market connection and market linkages, through effective collaboration between government, NGOs, the private sector, and producer organizations.

Fourth, processing and export remain relatively low due limited access to credit, inadequate infrastructure, high operational costs, outdated processing technologies, limited local market for processed vegetables, and a lack of standards for processed ALVs, among others. Domestically, there is a potential to increase consumption of value-added/processed leafy vegetables by enhancing the consumer knowledge on the use of processed vegetables so that the taste doesn't differ much, compared with their fresh counterparts.

Fifth, while there are several NGOs and CBOs working with farmers to support GLV production, their efforts need to be more harmonized to avoid overlapping and enhance efficiency. Notably, most organisations are focussed in promoting agroecological transition at farm level. It is therefore important to consider other actors beyond the farm, to achieve a systems-level agroecological transition.

6. Peru: The cocoa value chain in Ucayali

Authors: Andrés Charry (Alliance Bioversity International and CIAT), Nelson Torres (Alliance Bioversity International and CIAT), Cristina Fonseca (CIP), Manuel Narjes (Alliance Bioversity International and CIAT), and Carolina Gonzalez (Alliance Bioversity International and CIAT)

The AE-I in team determined to work in the cocoa value chain in Ucayali based on multiple factors, such as the local government interest, commitment and projects related to the agroecological transition, the relevance of the cocoa value chain for the local economy, previous experiences of the organization working with key actors on the sector, and the existence of current projects that allow harnessing resources and capabilities.

6.1. Context

With nearly 160,000 MT of cocoa harvested in 2020, Peru ranks as the 9th largest cocoa producer in the world, the second largest organic cocoa producer (MIDAGRI, 2023; Alvarado, Iturrios, 2017). Peruvian cocoa is sold, on average, above the international price due to the large share of organic cocoa and the rise in specialty cocoa varieties (also known as fine or flavour cocoa).

Ucayali is the third largest cocoa producer department in the country. The department is located on the peruvian amazonic basin, at the central-eastern region of the country, bordering with Brazil. It has a total surface of 102,410.55 km2 divided into four provinces and 15 districts. It has a population of over 589,000 inhabitants, including over 63,000 belonging to 296 indigenous communities (GORE Ucayali; 2008). The territory climate is mostly tropical rainforest and holds mainly two large agroecosystems, i) non-flooding terraces (or high lands) with superficial soils and high risk of erosion, and flooding terraces, used mainly for producing rice, corn, cassava, among others (GORE Ucayali; 2008). The agricultural and forestry sector represent 12.2% of the department's GDP, with mainly 6 crops: plantain, oil palm, cassava, cocoa, rice and papaya. The largest exports from the department are palm oil, timber and cocoa. Regarding cocoa, in 2022 the department reached 25,461 ha and produced 22,013 MT of beans. Production is concentrated in 2 of the 4 provinces (Padre Abad and Coronel Portillo), corresponding to the area of the ALL.

6.2. The cocoa value chain in Ucayali

The cocoa value chain in Ucayali is comprised of (i) **Direct actors**, who produce, process, and trade the relevant VC products, including producers, assemblers, intermediaries, exporters, processors, and consumers; and (ii) **Indirect actors**, including input dealers, extension agents, transporters, financial institutions, NGOs, certification bodies, and government institutions.

Production:

There is an estimated of 5,340 cocoa producer families in the department, mostly smallholders with an average of 5 ha per family. Nevertheless, planted area varies among districts, with an average of 4.8 ha in Padre Abad and 2.8 ha in Coronel Portillo. The expansion of the crop in the region is mostly derived from the government's illicit crop substitution programs, starting in the year 2000 and continuing nowadays with the support of UN agencies and international cooperation projects. In Ucayali, the cocoa plantations were initially promoted in agroforestry systems with plantain, timber species and 1.111 cocoa trees per hectare, using mainly the variety CCN-51 (a highly productive and resistant

variety, but not considered fine or flavour.) In the decade of 2010, "Alianza Cacao Perú", a public private initiative supported by USAID, steered the country's strategy towards the promotion fine or flavour varieties aiming for higher value markets. Despite the promotion of agroforestry systems, the number of actual tree species in the cocoa plantations is considerably reduced, as producers perceive lower cocoa yields because of the additional shade and have not perceived sufficient benefits from the associated species. This has driven them to remove some or most of the trees planted during the initial years (except in the contours of the farms).

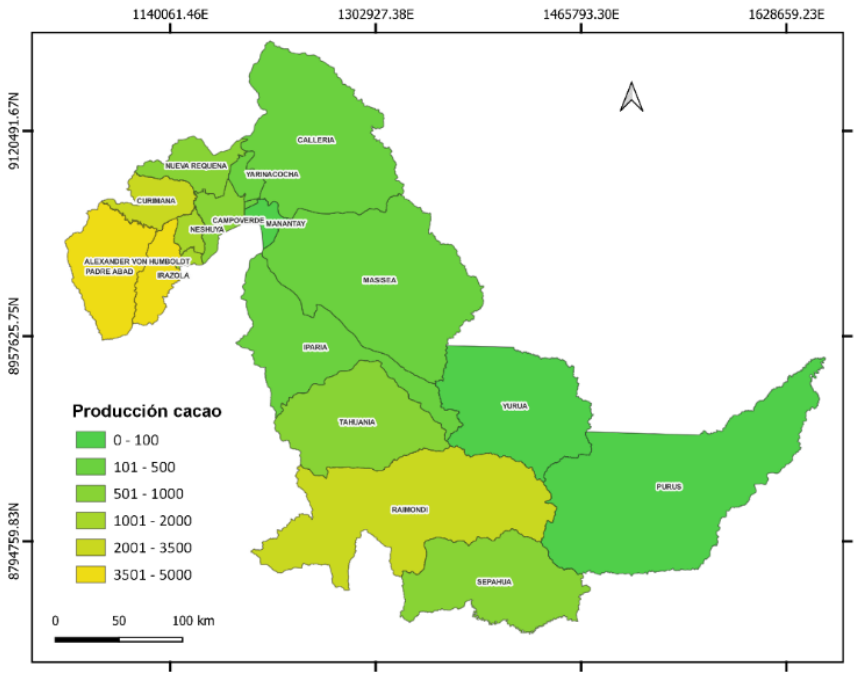


Figure 7. Cocoa production in Ucayali by district (in MT)

Over the past 2 decades, government and cooperation programs have supported the development of producer associations and cooperatives as a strategy to promote collective marketing and facilitating service provision. It is estimated that between 10% and 20% of the region's producers belong to one of these types of organizations.

Producers can be classified in 4 types according to their type of varieties used, level of inputs and market channels: i) low input conventional producers, ii) medium intensity conventional producers, iii) bulk-organic certified producers, and iv) fine or flavour organic certified producers. Yields in the region range from 500 to 700 kg/ha from the least intensive systems to around 1,500 kg/ha for the conventional medium intensity producers (Charry et al., 2020). While some actors claim that conventional production with CCN-51 is more productive and profitable, other producers and organizations have steered towards fine or flavour varieties with organic certifications to tend higher value markets.

Aggregation and exports:

Cocoa in the region is traded as dry or wet beans, through two types of channels: i) cooperatives and associations, or ii) intermediaries and agents. Most of the production in the region is traded in the form of dry beans through intermediaries and agents. Cocoa beans are fermented using yute bags or fermenting boxes and then sun dried at the farms. Dry beans are then sold to intermediaries and agents from cocoa exporters and processors who have established buying points across the region. Dry beans are mostly traded at conventional prices without, any price differentiations for quality or management. These beans are directed mainly to the largest national and multinational cocoa enterprises based in the capital.

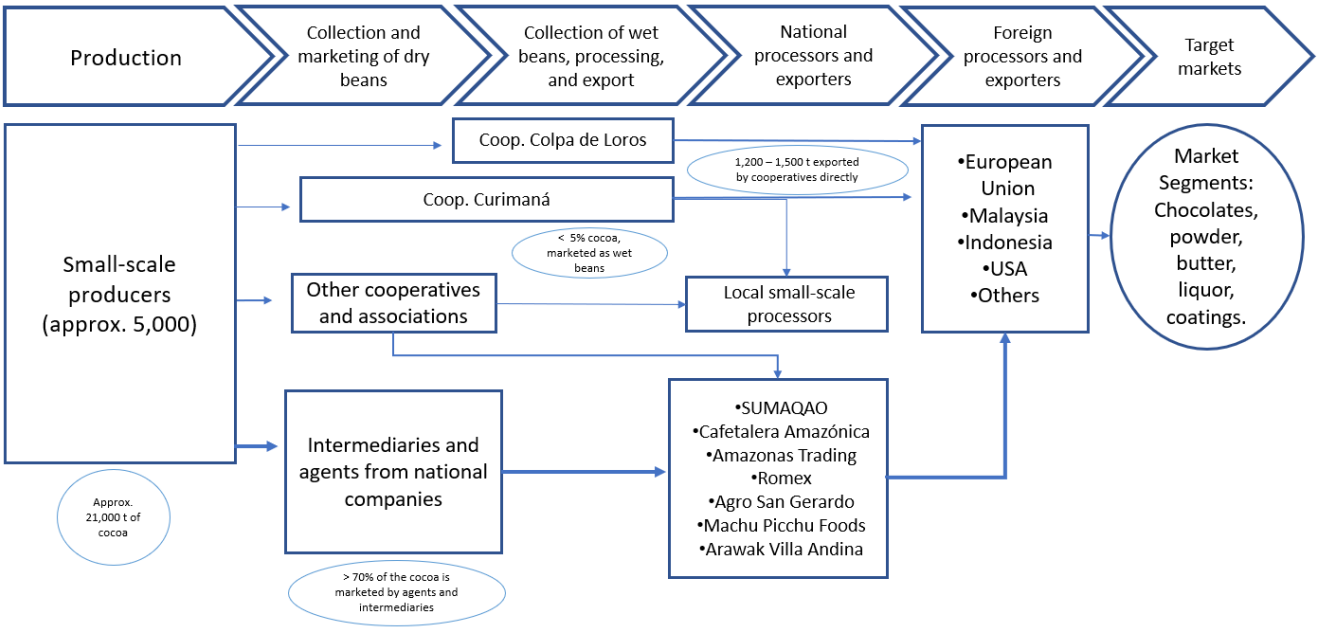


Figure 8. The cocoa value chain in Ucayali

Some cooperatives and associations purchase dried beans from their associates and other producers in their region of influence. One of the most important cooperatives in the region is Banaqui Curimaná, an organization that promotes the use of the variety CCN-51 along with organic certifications. The CCN-51 allows for a higher productivity (one of the current challenges in the region both for producers and associations), while the organic certification allows them to export to different European customers with slightly higher prices. Organic certified cocoa is sourced solely from its associates with a price surplus of 5 to 10% above conventional prices, but the cooperative also purchases conventional beans without certification from other producers in their area of influence, which are then sold to exporters. The cooperative's associates and customers receive different benefits such as extension services and access to development projects, inputs at reduced prices, among others.

Wet beans are extracted straight from the cocoa pod and sold with their mucilage to aggregators and cooperatives with infrastructure for centralized post-harvest processes. This is the least common channel in the region and is mostly limited to one of the largest cooperatives in the region: Colpa de Loros. Colpa de Loros purchases cocoa exclusively from its associates. A large share of their cocoa is of fine or flavour varieties, as they have been promoting them among their associates due to the demands of their exclusive buyer and close partner. Their cocoa is also certified organic and fair trade. Their associates receive a considerable price premium derived from the certification and quality of their product, as well as other services and benefits.

Processing:

There are few local cocoa processing enterprises in the region. Pucallpa, the region's capital, has two small enterprises that produce confectionary products and ice-creams sold at a local and national levels, nevertheless, the volumes of cocoa traded through these channels are minimal. On the other hand, Peru has a growing industry of butter and cocoa powder. These enterprises are based in the capital and export cocoa beans and semi-elaborate products (Macchu Pichu Foods, SUMAQAO, Romex, among others). It is assumed that most of the regional cocoa is purchased by these companies through agents, producer associations and intermediaries.

Indirect actors:

Extension services were provided in the past, mostly through the Alianza Cacao Perú programme and the produces cooperatives and associations. As the programme is currently finished, extension services in the region are mostly

limited to those provided by the regional government and the cooperatives. The National Institute for Agricultural Research (INIA) has a team focused on research for the cocoa sector in the region and works along with other actors to conduct research and transference activities. The Alliance Bioversity International and CIAT, ICRAF, UNDP and other international cooperation agencies have operations in the region and work in different areas of the cocoa value chain.

Financial services are provided to farmers and small enterprises by microfinance institutions, savings and credit cooperative societies (SACCOs), Agrobanco and other private banks. Producers have access to finance but may be reluctant to request credits from banks due to existing debts, lack of trust, high perceived risk and high interest rates.

Some of the regional value chain representatives participate in the Regional Technical Cocoa Roundtable, a multistakeholder platform that aims at improved coordination between the public sector, NGOs and producer representatives. While the roundtable has been in operation for several years, there are multiple challenges regarding participation, commitment and effective results derived from its operations.

6.3. Agroecological principles and the value chain – current adoption, challenges, and opportunities

The adoption of agroecological practices varies withing types of actors and channels. In general cocoa producers have a limited use of synthetic fertilizers due to the increasing prices and lack of resources, nevertheless, chemical weed and pest control is more common. Some agroecological practices at farm level are becoming more popular, like the use of compost, organic fertilizers, biological pest and disease controls. The maintenance of agroforestry systems remains controversial and is mostly valued by associated producers with "fine or flavour" varieties, nevertheless planting trees in the contours as wind breakers and as additional sources of timber and other products are of general interest among producers.

Similarly, there are other opportunities to increase the use production and use of organic inputs in face of the increasing prices of synthetic fertilizers, and the strengthening of complementary productive systems that help improving the household's food security and diversifying their sources of income, such as backyard gardens, minor species, and other relevant crops. Payment for ecosystem services and other similar schemes can also help as additional incentives and complementary sources of income for the families.

Regarding the agroecological principles on social equity and responsibility some of the opportunities include strengthening the successful cooperatives and enterprises, promoting more co-creation of knowledge and information sharing, as well as a more gender-equitable participation in access to services, asset ownership and decision making. Nevertheless, it is important to consider mechanisms to reach out non-associated producers for promoting the adoption of agroecological practices, as these represent the largest share of the farmers.

The main challenges of the value chain in general, and for increasing the adoption of agroecological practices and principles are the lack of resources of producers resulting from increased production costs and non-equivalent increases in prices, and adverse climatic conditions that can greatly affect the years' harvest and limit future investments in the plantations. A particular challenge derives from the EU regulation on cero deforestation, which will increase requirements for producers and cooperatives to monitor and prove that their production is not related to deforestation, which may lead to a reduced access to EU markets and a shift to markets with markets with lower prices, as the demands of increased traceability can be prohibitive. The compliance of this regulation will require the integration of digital technologies and the support of the private and public sector.

7. Tunisia: Olive oil, sheep, and honey value chains in Siliana and El Kef

Authors: Boubaker Dhehibi (ICARDA), Asma Souissi (ICARDA), Aymen Frija (ICARDA), Hassen Ouerghemmi (ICARDA), Veronique Alary (ICARDA), Zied Idoudi (ICARDA), Udo Rudiger (ICARDA), Mourad Rekik (ICARDA), Mohamed Zied Dhraief (INRAT), Meriem Oueslati Zlaoui (INRAT), Rihab Mejri (INRAT), and Mourad Ouji (INRAT)

In Tunisia, the AE-I team identified two contiguous regions for establishing ALL: the protectorates of Siliana and El Kef. Together with local stakeholders, the team conducted various workshops in each region for selecting the value chains with the highest potential for AE transition. As a result, the value chains prioritized were honey in the Siliana ALL, sheep in the Kef ALL and olive oil for both ALLs (northwestern region of Tunisia).

7.1. Context

Kef: The governorate of Kef is located in the northwest of the country, along the Algerian border. It covers an area of 5,081 km2 and has a population of over 243,000 inhabitants (2.2% of the national population), 43,5% of which live in rural areas. The governorate is a traditionally agricultural region, producing nearly 10% of the national cereals and 7% of the red meat. Four agricultural products are of relevance in the region: cereals (196,900 ha), olive trees (50,810 ha), fruit trees, vegetable crops (2,475 ha); as well as four livestock products: goats, sheep, cattle, and beekeeping (CRDA El Kef, 2020; ODNO El Kef, 2021). One of the characteristic production systems involves an integration of cereals and small ruminants in extensive fashion.

Siliana: The governorate of Siliana is located in the north-west of Tunisia, east of El Kef governorate. It covers an area of 4,642 km2 and has a population of 223,087 inhabitants, among which 57% live in rural areas. The agricultural sector is of particular relevance, representing 27.2% of the total labor force (INS, 2014). There is a large cereal plantation in the north of the governorate while in the center and south there are small trees, cereal or fodder farms based mainly on mountain farming and extensive livestock farming. Five main crops are cultivated: cereals (159,850 ha), olive trees (81,369 ha), fruit trees (8,164 ha), fodder (45,800 ha in forages and 5,590 ha in leguminous) and vegetables (2,215 ha); as well as four livestock products: sheep, goats, cattle and beekeeping. (CRDA Siliana, 2020; ODNO Siliana, 2021)

7.2. Value chains in the Agroecological Living Landscapes

The sheep value chain in El Kef: The value chain is comprised of five links including producers (farmers, breeders, and fatteners), intermediaries, processors (butchers, abattoirs), marketing and consumers. There are also relevant service providers including input suppliers and regulatory actors such as the regional commissariat to the agricultural development (CRDA), the Office of Livestock and Pasture (OEP) and the Interprofessional group of red meats and milk (GIVLAIT). A single stakeholder can play different roles as he can be breeder, butcher, and intermediary. The channels also vary depending on the season and type of product sold. The following figure displays the different channels and product flows of the sheep value chain.

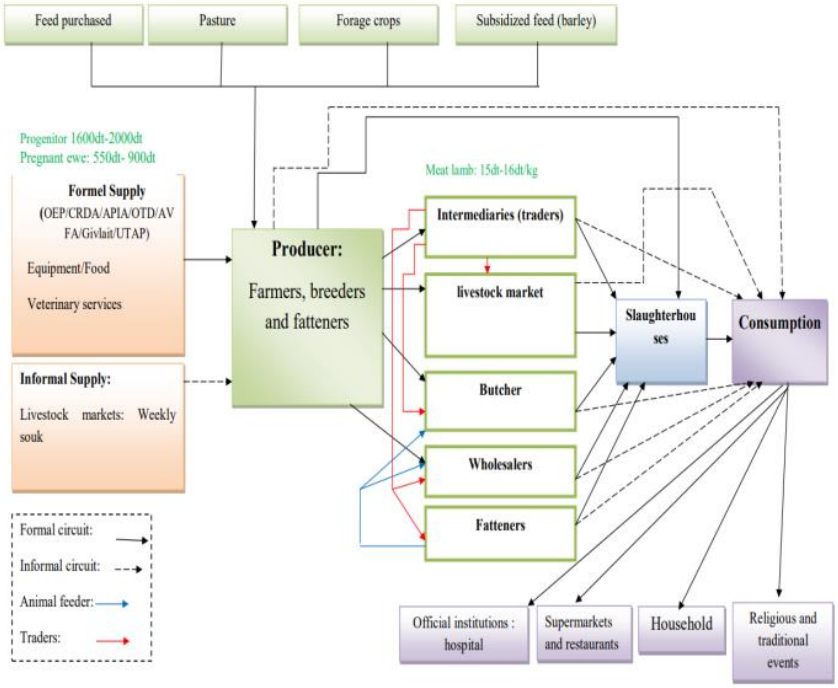


Figure 9. The sheep value chain in El Kef

The honey value chain in Siliana: There are 1,140 beehives registered in the governorate of Siliana, in the sectors of Kesra, Hammam and Bouabdellah. Siliana's honey production is close to 18 MT per year, with 98% of the production systems considered modern, and a hive yield of 9kg of honey per year. The sector of Kesra is of particular interest due to the numerous almonds and cherry trees planted in the area. This sector has 121 beekeepers, a yearly production of 2.4 MT. The sales circuit for beekeeping products is based essentially on the local market through direct sales in one kg glass bottles purchased on the market and with a price of at least 40 TND/kg. The honey market is attractive and expanding, especially as Kesra is a mountainous zone which offers a specific taste and a good quantity of honey. The following figure displays the different channels and product flows of the honey value chain.

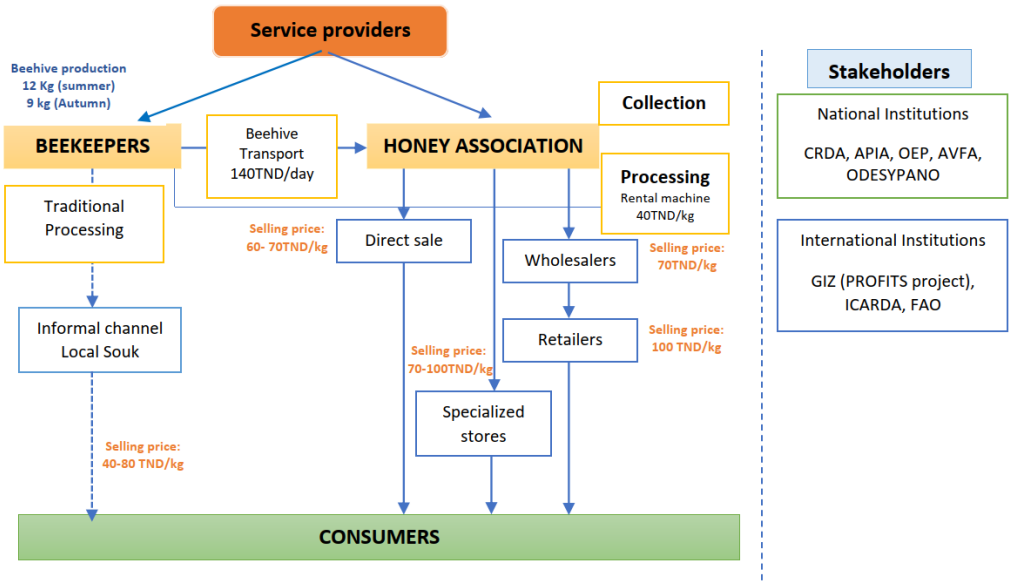


Figure 10. The honey value chain in Siliana

The olive oil value chain in the north-west of Tunisia

The olive sector is one of the most traditional sources of income in Tunisia, particularly to the rural poor households. Olives provide seasonal work and can be grown traditionally and without any advanced technology.

In Siliana, the olive oil value chain is characterized by relatively small producers who market their produce through wholesalers or through other farmers. There are 8 million olive trees planted in 88,000 Ha, with an estimated production in 2022 of 28000 MT. Olives are sold to intermediaries and other farmers coming from different regions, especially from Sfax, at 2.5 TND/kg. These intermediaries then sell the olives to the oil mills at 3,5 TND/Kg. Olive by-products such as margin, leaves and wood are sold in the local market. After milling, the olive oil is sold at 14 TND/kg, with a ratio of 4 kg of fruit per liter of oil. Olive oil is sold to retailers and wholesalers who commercialize it in the local market or to exporters.

The olive oil value chain in El Kef, is structured similarly as in Siliana's. It is comprised mostly of small producers displays similar commercialization channels. There are 50,810 ha planted, with an estimated production in 2022 of 18,699 MT. Most of the land is planted with the variety "Chetoui", which is well adapted to the region. Olives are sold between 2,5 and 3 TND/kg, but producers can pre-sell the total harvest to intermediaries, mills, and other farmers at 25,000 TND/ha. There are 12 oil mills in El Kef, two of them organic. From the oil mill, the olive oil is sold at 15 TND/kg to local vendors and wholesalers. Olive oil is then commercialized in the local market or abroad. 95 of the exports are sold in bulk.

The main input suppliers in the value chain are private nurseries and fertilizer providers, especially for large olive plantations, and the renters of water cisterns due to the region's low precipitation (particularly in El Kef). Other public institutions provide relevant services to the value chain such the agricultural extension and training agency (AVFA), the different ministries (agriculture, trade, industry), the regional commissariat to the agricultural development (CRDA), the research centers and stations, the center for the promotion of exports (CEPEX), the national office of olive oil (ONH), and the olive institute. The olive oil value chain is also supported by the development projects, the financial institutions, and the private investors.

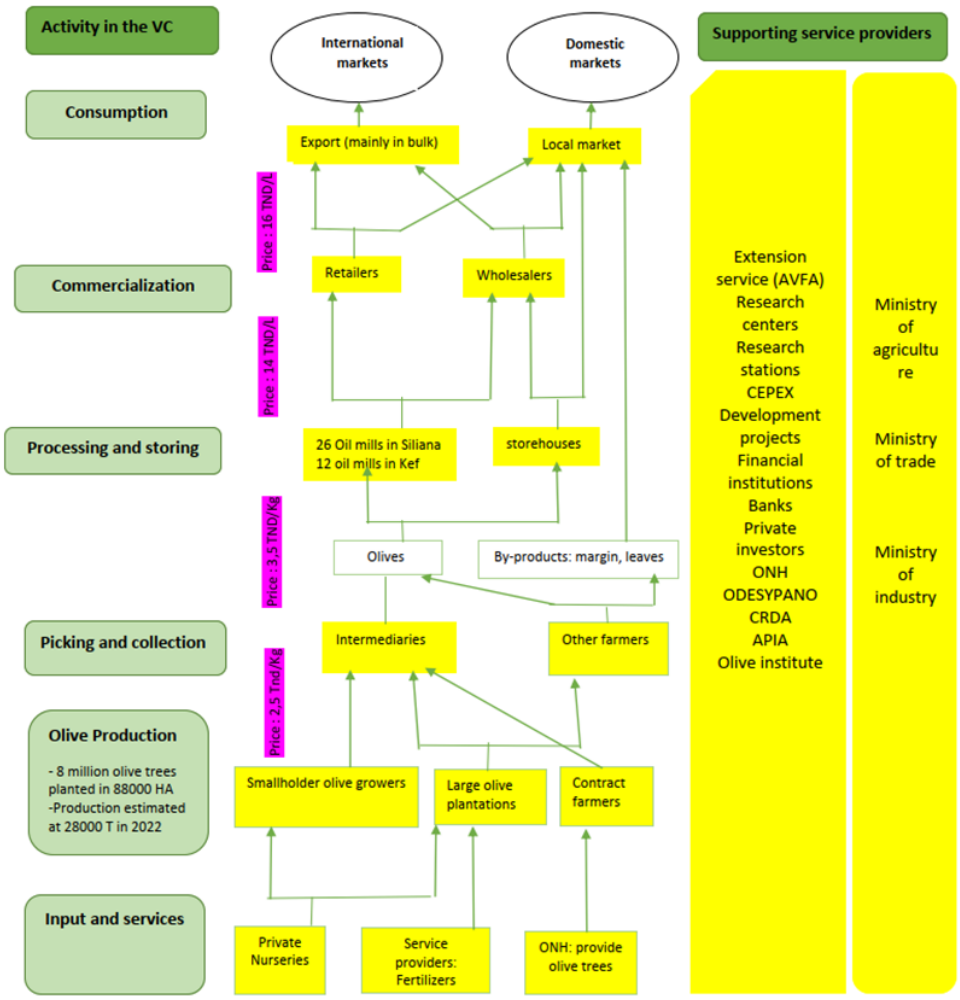


Figure 11. The olive oil value chain in north-west Tunisia

7.3. Agroecological principles and the value chain – challenges and opportunities

There are several challenges and opportunities in all value chains, not only regarding the agroecological transition, but also in its general performance. For the sheep VC, the challenges include overgrazing, unbalanced feed intake, low availability of feed due to rangeland degradation, low quality of forages, low productivity, and risks of consanguinity (genetic erosion of local breed). The impacts of droughts also represent a major challenge on pasture and forage production. On the other hand, the value chain stands out for its low production costs, sturdiness and resistance to diseases, high demand of meat and the advantages derived from crop-livestock integration. At a farm level there are various opportunities for recycling manure and by-products, improve crop rotation and integrate legumes to improve feed quality and availability, improve the health and zoo sanitary practices, improve grazing practices, and strengthen the promotion of all sheep products. To upscale these practices, it is necessary to improve the participation and knowledge sharing among stakeholders, as these are currently limited.

For the honey VC, the challenges include a lack of specialized transport for beehives, lack of laboratory analysis and low availability of packaging and other inputs. The team also highlights the risks due to the fragility of the ecosystem, low precipitation, and high competition with cheaper and adulterated honey. On the other hand, there is a large demand for honey and an opportunity to explore the hive by-products (wax, pollen, royal jelly). At the farm level there are opportunities for recycling wax and other inputs, motivation to reduce pesticide use in tree plantations, replace, and

replant trees and other plants to increase soil fertility and improve pollination, as well as promoting initiatives for the conservation of mountain ecosystem. There is a particularly interesting potential in agroecological systems related to economic diversification and synergies with other production systems, as it creates supplementary income sources in off-seasons, creates more consciousness on the relevance of reducing chemical products, protecting wild ecosystems, and improves the productivity of orchards and forages.

Finally, for the olive oil VC, the challenges include the production alternation which leads to a lower productivity, an insufficient application of the technical package, lack of labour availability during the harvest and a lack of skilled labour. This sector suffers also from a low success rate of new plantations, a sensitivity to some diseases, a lack of an organized market for olives, bad management of olive water (margine), insufficient professional organization, high levels of intermediation and a low valuation of by-products. On the other hand, there are numerous strengths and opportunities for the sector, such as the plants adaptation to the local conditions, its capacity to prevent soil erosion, and the possibility of developing local brands highlighting the advantages of agroecological olive production. At a farm level there are multiple options for increasing resource efficiency, such as composting and use of margine for plant nutrition, charcoal production, incorporation of legume crops, biological pest and disease management, integration with bee production, association with other tree species and improve water management.

8. Zimbabwe: The sorghum value chain in Mbire and the poultry value chain in Murehwa

Authors: Hambulo Ngoma (CIMMYT), Dorcas Matangi (CIMMYT), Taurai Zingwena (CIMMYT), Moti Jaleta (CIMMYT), and Frederic Baudron (CIRAD).

In Zimbabwe, the AE-I team identified two contrasting districts for establishing the ALLs and promoting the agroecological transition: Mbire and Murehwa. In these districts, eleven value chains were preselected for conducting a rapid value chain assessment and stakeholder mapping, with the objective of identifying potential business models for upgrading, along with their main risks, challenges, and opportunities. As a result of this exercise, a business model was selected for each district: one based on sorghum in Mbire and another based on poultry in Murehwa. In this section we present the main characteristics of these two value chains and their corresponding districts.

8.1. Mbire

8.1.1. Context

Mbire is 240 km north of Harare in the mid-Zambezi agroecological zone. The district covers an area of approximately 4 696 km2 and has 17 wards with a total of 83,724 inhabitants (ZIMSTATS, 2022) (The AE-I is operating in wards 2 and 3). Mbire is in an arid region with high temperatures and low precipitation, nevertheless, the district faces several hydrometeorological threats which impact livelihoods due to its location in the floodplains of the Zambezi River basin. Moreso, the district is characterized by a variety of soil types, some of which are frequently rich in sodium and deficient in organic matter. While crop production in the district is low, crop and livestock production are the main sources of livelihoods for smallholder farmers. Livestock production, particularly goats, is well adaptable because of the sweetveld, although incidences of tsetse flies make livestock rearing difficult. The district is also partly falling in the wildlife conservation area and human-wildlife conflicts are common. Due to its distance from Harare, there is no banking system in the district.

Wards 2 and 3 have 2,801 farming households, reporting production of sorghum, sesame, groundnut, cotton and cowpea. They also have livestock production in their farms, mainly goats (5-10 heads on average), cattle (3-10 heads on average), as well as beehives, sheep, fowls, chickens, and pigs. Households in Ward 2 have relatively larger farms, with an average of 5 ha, compared with 2 ha in ward 3.

8.1.2. The sorghum value chain

For Zimbabwe in general, sorghum production increased by 135% in the 2020/2021 season from 0.31 MT to 0.67 MT with Mashonaland Central and Mashonaland East provinces having an average yield of 1.08t/ha and 0.75t/ha in 2022 (GoZ, 2021). Generally, the communal sector dominated sorghum production accounting for 80% of total production, with an average yield of 0.64t/ha. A study by Hungwe et al., (2020) identified an increase land area for sorghum in Mbire from 7,000ha in 2015 to approximately 12,000 ha in 2020. The average yield was 0.29 t/ha with upper and lower limits of 0.41 t/ha and 0.10 t/ha respectively.

Sorghum is produced by almost all farm households in the district, mainly for home consumption, with some proportion being sold. Farmers use chemical fertilizer provided under the Presidential free input scheme (Pfumvudza) and cattle

manure. Seed is mostly recycled, and they get some from some NGOs. Use of chemical fertilizer in sorghum production has increased over time as farmers are less interested in using labor-intensive manure application when chemical fertilizer is made available for free. Use of high yielding seed varieties is low in sorghum production when compared to maize hybrid varieties. Research and extension services are provided by the Government (AGRITEX/ARDAS) and other private partners like ICRISAT. In the private sorghum seed system, seed production is done through large international seed companies such as PANNAR and SeedCo. There are limited options for smallholder farmers in the Mid Zambezi Valley to acquire improved seed varieties.

On average, farmers produce 3 tons of sorghum where they sell about 1 ton and consume the rest. According to the focus group discussions conducted, the decision to sell sorghum grain is a joint decision between household head and spouse. However, the participants indicated that the household head is the one in charge of controlling the income realized from sales. The grain is generally sold to traders in 20lt buckets at nearly $0.1/kg to $0.2/kg.

Surplus produce is purchased by the Grain Marketing Board (GMB), a government parastatal marketing institute which controls the grain prices and movement in the country. Local collection is made by small traders at village level, who buy from farmers at nearly US$0.25/kg. Once they aggregate a certain amount, they supply to GMB depots at Mushumbi. Most of the sorghum purchased by GMB is transferred to Food Grain Reserve, and some proportion is sold to different processing industries for feed and beverages. GMB also gives some quantity of grain back to the communities under the social welfare program. For instance, in 2021, 10% of the 5,000 t of sorghum collected at Mushumbi were given back to the community. The Mushumbi GMB depot has a carrying capacity up to 8,000 tons – but it is not very secure, hence they transfer produce to other depots with silos.

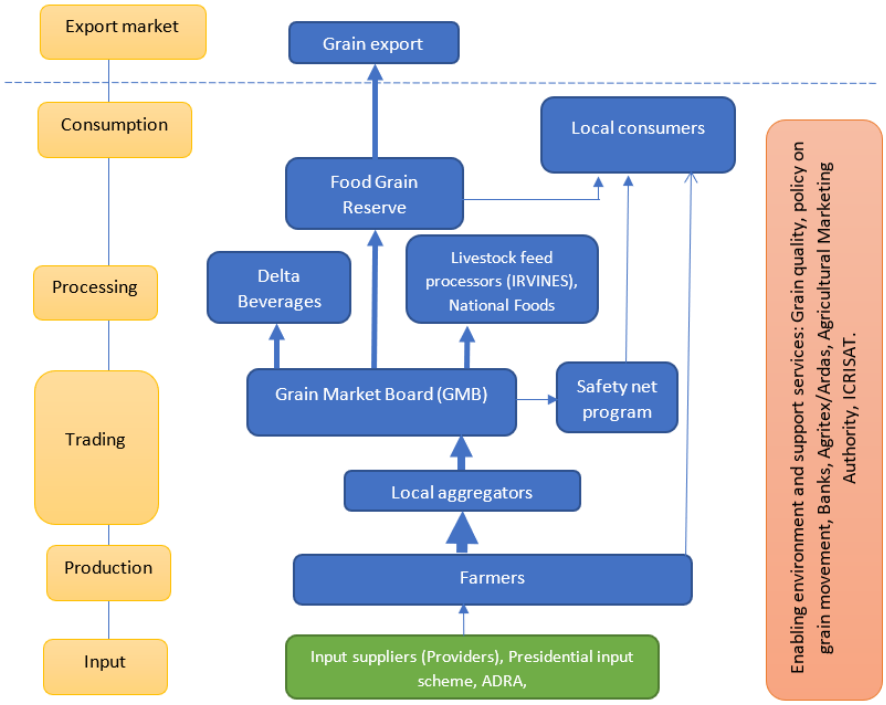


Figure 12. The sorghum value chain in Mbire

8.1.3. Agroecological principles and the value chain – challenges and opportunities

There are various challenges and opportunities not only for the agroecological transition of the VC, but also for its general performance. Amongst their challenges we identified the wildlife attacking and destroying sorghum plants, high losses from pests, erratic rainfall distribution, poor marketing system deriving in little bargaining power for the producers and low production. Regarding marketing and logistics, other challenges include a lack of secure storage

space (covered) and weighing equipment at the Mushumbi depot, and delayed payments from GMB. Additionally, farmers lack bank accounts (lack of access to banking services), making them more prone to dealing with aggregators and receive lower prices. Lower prices are further impacted due to the remoteness of production areas (high transaction costs).

On the other hand, there are key opportunities of addressing the previous challenges through training and investment in equipment and infrastructure both at the farm and aggregation links through community managed schemes or enterprises at ward level. These include integrating biological fertilization and pest and disease management practices, establishment of seed multiplication enterprises, collection centres, and threshing and dehulling centres which may include women as operators to improve inclusiveness. These also have the potential to greatly reduce the intensity of their household labour, as these activities are mostly conducted manually. To improve farmgate price and stimulate demand, there are also relevant contract farming opportunities with large national breweries.

8.2. Murehwa

8.2.1. Context

Murehwa district is located 90 km north-east of Harare in Mashonaland East Province. The district has 30 wards (AE-I is operating in wards 4 and 27), with an area of 3,556 km^2 and total population of 205,442 out of which 91.7% live in rural areas. The district has good climatic conditions, receiving relatively high and fairly distributed rainfall. The main crops include maize, groundnut, sweet potato, and horticulture, grown by smallholder farmers under dryland production, as well as with supplementary irrigation. Livestock production systems include beef, dairy, piggery, and poultry. However, due to the outbreak of theileriosis in the district, 74% and 86% of the households do not own any cattle nor goats respectively (ZIMVAC, 2021). Most of the households normally produce surplus commodities and supply other markets, nevertheless, poor market access results in high post-harvest losses especially of horticulture products. The average land size per household is 1.2 ha (Mujeyi et al., 2015)

Wards 4 and 27 have 3,738 farming households, all of them reporting production of grean leafy vegetables and poultry. Other activities (in order of prevalence) include maize, goats, cattle, tomato, groundnut, and sweet potato. Households in Ward 4 have relatively larger farms, with an average of 3 ha, compared with 1 ha in ward 27.

8.2.2. The poultry value chain

Most farm households in Murehwa keep indigenous chicken both for home consumption and sale. They are easy to acquire and cheap to raise as they are often free range and scavenge for food (Kitalyi, 2012). In Zimbabwe, preference is shifting towards local chickens from broiler chickens for taste and health benefits (Hailu et al., 2014). Tembachako and Katanha, (2019) found that on average households have 5 or more chicken for subsistence purposes. Chickens are mainly considered women's livestock such that even in male headed households, women make decisions on chickens (Muchadeyi et al., 2004).

There are various suppliers of chicks and vaccines in the district. Regarding the breeds, ordinary local chickens are common, but lately there is an increasing adoption of the the Boschveld, which is good for meat and eggs, and can also scavenge for food. Local chickens scavenge for most of the time from as early as 5am to 6pm, it is only delayed to 11am during the planting season to protect crops (Muchadeyi et al., 2004). This is the time where most farmers supplement their chicken feed by giving energy supplements of maize, sorghum and millet and sunflower.

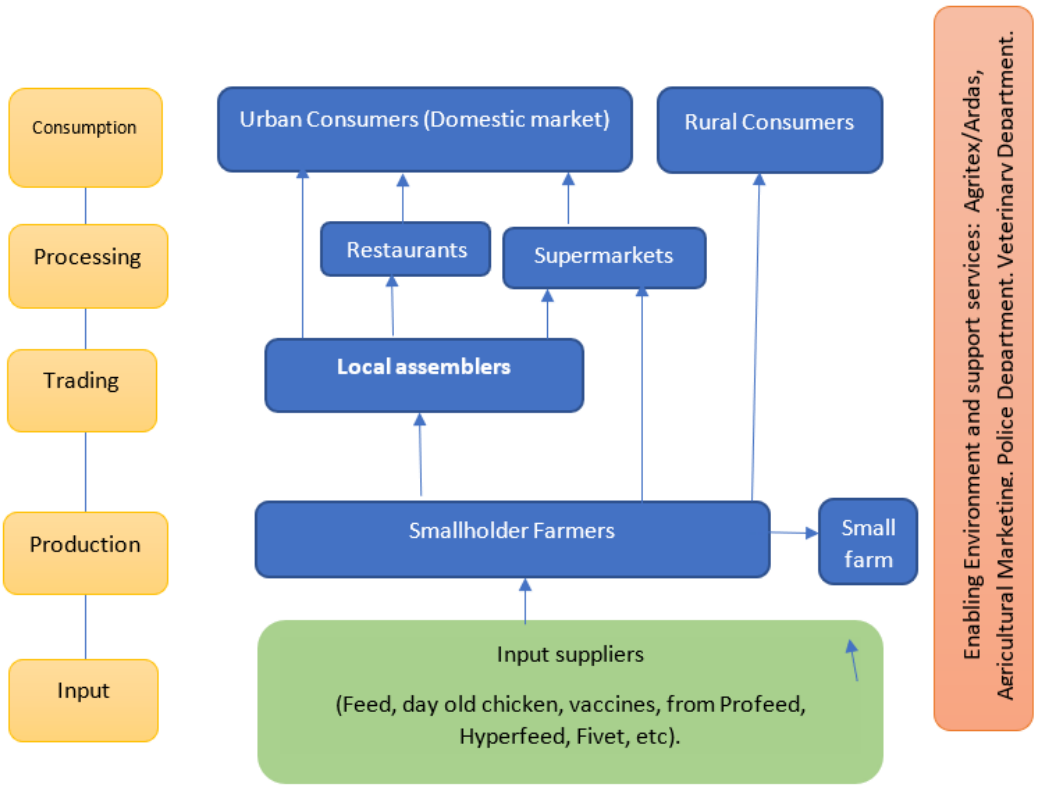


Figure 13. The poultry value chain in Murehwa

The local chicken farmers sell directly to assemblers, supermarkets and consumers. There also middlemen who buy from farmers and sell native chickens directly to urban markets and consumers in Harare and Murehwa. Local chickens are considered organic and a delicacy, thereby fetching a higher price in restaurants and on the market (Ayieko et al., 2015). Padhi (2016) reports that local chickens meat fetches a higher price up to 13% and 27% in compared to prices of meat from commercial chickens. In the project sites local chickens sell from $5 to $7/bird.

8.2.3. Agroecological principles and the value chain – challenges and opportunities

Given the very rudimentary practices in chicken production, there are some agroecological principles taking place in the value chain, such as the use of chicken manure for crops and horticulture, and the use of local breeds, but also major opportunities for improvement. Timely information on disease outbreaks and the incorporation of practices to prevent predation and zoo sanitary management can help prevent frequent loses due to mortality. Additionally, the introduction of Boschveld, Sasso chicken and other dual-purpose breeds adapted to the local conditions and with low investment requirements, can help increase growth rate, productivity, and profitability.

9. Conclusions, learnings, and recommendations

Current integration of agroecological principles (AEP) across the different value chains and regions: Most of the practices taking place were related to the first 7 AEP, which relate to practices at the farm level, and these were usually related to traditional knowledge which implied long known practices for improving the efficient use of scarce resources such as manure incorporation and intercropping. The India ALL reported a relatively high prevalence of AEP, as agroecology has been strongly promoted in the region by local community and public organizations.

Factors driving the adoption of AEP: While the driving factors for the adoption of AEP varied across cases, there were various commonalities. The reduction of production costs, linked to an increased cost of fertilizers, and a need to increase resource efficiency was one of the prevalent factors across ALL. Similarly, a wider adoption was usually related to the existence of extension, training and capacity building programs in the regions. These were usually led by NGOs during its initial stages and reached a specific area of intervention, whereas larger scales were related to programs ran by government and local organizations. In this line, a higher relevance and salience of AE in the agenda of the political sector and other local stakeholders was also related to areas with higher adoption of AEP. The presence of farmer and other grassroot organizations appeared as another relevant factor in most cases for the promotion and dissemination of AEP, which can be an indicator of stronger social networks. Other relevant factors included risk reduction, due to increasing climate challenges and market instability.

It's important to highlight some implications from these findings; first, in many cases there was a thematic correlation between agroecological practices and traditional (and sometimes not very productive practices). In that sense there is a need to move past this conceptualization of agroecology among the local actors, towards one that highlights the combination of traditional and modern practices in the services of better overall performance. Additionally, some of these factors may imply a circular logic, where the previous identification of AEP is presented as a precondition for the adoption of practices, preventing the differentiation between the initial drivers and the consequences. For example, is the presence of grassroots organizations a factor for an enhanced adoption of AEP or is it an indicator for measuring the presence of principles 8, 9 and 13.

Factors limiting the adoption of AEP: There was a consensus on various factors limiting the adoption of AEP and practices. These include lack of access and availability of inputs, of standardized and reliable products that can be used on the farms. Similarly, there was a lack of raw materials in some areas and farm types to produce biologically based inputs, such as manure. All cases reported a lack of knowledge on AE practices by most of the farmers, as well as labor constraints (lack of available labor and increased labor demand), lack of land, lack of capital for investing in changes and a lack of market incentives.

There were also barriers related to the value chain structuring, as storage or collection facilities, logistic channels and other infrastructure were not set up to differentiate between conventional and agroecological products.

Some limitations were present regarding associativity and improved collaboration between actors, related to lack of trust derived from past experiences marked with lack of transparency and mismanagement of resources.

The actors also highlighted challenges from the institutional framework, as there were few policies and incentives for agroecological production, and lack of recognition and inclusion of the themes in national and regional policies.

Finally, a lack of access to finance adjusted to the conditions of the producers and the type of practices, as well as the costs of organic certification, when this was part of the vision.

Most relevant opportunities: At the farm level, there were various specific practices and technologies to be promoted in the different ALLs, nevertheless, they generally are related to a better livestock and crop integration, better use of plant and animal residues, improvements in biological pest and disease control (both inputs and practices), and evaluation of different intercropping and crop rotations. Additionally, improving the food security of the households by strengthening the production of crops for self-consumption.

For other value chain actors, mainly aggregators and processors, there was an opportunity to strengthen their capacities by providing services, capacity building, more technification and diversification of activities and products for final consumers. Investments were most needed at collection centers, threshers, and local aggregation points. At the consumer level, there was a generalized need to increase awareness of the different products, their characteristics, and benefits, as well as identifying market avenues for complementary products in the systems.

One key opportunity for most ALLs was the standardizing and improving of biofertilizer production and commercialization, to increase reliability and ease of access. This can be done through cooperatives, associations and grassroot collectives.

Finally, the research teams highlight more site-specific interventions such as biochar use, certification, controlled designation of origin, and working and planning all interventions from the initial stages with customers that value the products.

The identification and relevance of these opportunities comes from various elements such as emerging consumer demand, leveraging available resources and relationships such as digital tools, self-help group platforms, and biological resources that are not being fully used (biomass from pruning, processing, etc.). But more importantly, these are relevant since they were identified and selected with the local communities.

Challenges for the implementations and how to respond to them: There are various cultural challenges along the supply chain. At the producer level, there are limitations for a better integration of livestock and crop production, a tradition of using synthetic inputs, a resistance to change and risk aversion, linked to their high vulnerability and age. Given the smallholder labor and capital constraints, partial subsidizing for farmers is recommended in most cases. Strong investment in sensibilization for farmers and consumers, training and capacity building, and a timely execution of activities and delivery of inputs are also key for the success of the practices.

There is a need to showcase examples of successful cases to dissipate fears and inspire the adoption of AE practices. Model farms and pilots should consider the different farm typologies as risk aversion and farming needs are different between smallholder and larger farmers. A careful selection of beneficiaries is also key, since some of the practices require considerable investments and commitment from the AE-I and the farmers, as well as relatively long periods to perceive benefits. For this reason, it's important to start with a few "champions" and expand from there, as widespread unsuccessful cases may generate drawbacks and limit future attempts to promote the AE transition in the region.

In some cases, the markets have not been fully identified. For these, there is a potential to reduce risks and facilitate planning, through arrangements such as contract farming and opening or strengthening local market channels.

Other challenges are related to legal and institutional factors, as processing and product handling specification may not facilitate some developments, as well as land ownership and legal restrictions tenure for some of the farmer in some regions. Addressing legal barriers can be especially challenging, but these must be brought to light and advocated for with the relevant institutions.

References

Agriculture and Food Authority (AFA) Kenya (2022). Yearbook of Statistics 2022. Retrieved on 27th September 2023 from https://www.agricultureauthority.go.ke/index.php/en/statistics/afa-year-books-of-statistics?download=411:afa-year-book-of-statistics-2022

Alvarado, J., Iturrios, J. (2017). *Determinantes de la productividad en pequeños productores de cacao de las regiones de San Martín, Huánuco y Ucayali (SM/H/U): una aproximación exploratoria al modelo tecnológico de productividad en estas regiones Alianza Cacao Perú, Lima, Perú*. International Symposium on Cocoa Research (ISCR), Lima, Perú, 13-17 November 2017. https://www.icco.org/wp-content/uploads/T7.251DETERMINANTES-DE-LA-PRODUCTIVIDAD-EN-PEQUENOS-PRODUCTORES-DE-CACAO-DE-LAS-REGIONES-DE-SAN-MARTIN-HUANUCO-Y-UCAYALI-SMHU-UNA.pdf

Ayieko, M. O. D., Bett, E. K., & Kabuage, L. W. (2015). Analysis of indigenous chicken marketing participation decisions: The case of producers from Makueni County, Kenya. *East African Agricultural and Forestry Journal*, 81(1), 12-17.

Bien J, and Soehn I. (2022). Unlocking the Kenya mango value chain. Available at: https://www.hks.harvard.edu/sites/default/files/degree%20programs/MPAID/files/Bien%2C%20James%20%26%20Isabella%20Soehn_SYPA.pdf.

Charry, A., Romero, M., Ivanova, Y., Tristán Febres, M. C., Vélez Betancourt, A. F., Lema, S., ... & Jäger, M. (2020). *Estrategia integral para el fortalecimiento del plan de competitividad de la cadena de cacao y chocolate en Ucayali 2020-2030*.

CRDA Kef Commissariat Régional au Développment Agricole. (2020). Technical report in El Kef.

CRDA Siliana Commissariat Régional au Développment Agricole. (2020). Technical report in Siliana.

Deli we Tembachako and Anyway Katanha. (2003). Roadrunner (Indigenous chickens): The role of chickens in addressing food insecurity in a semi-arid environment of Mukoma village in Mt Darwin District, Zimbabwe

Duteurtre, G., et A. Vidal. (2018). La filière laitière à Bobo-Dioulasso », rapport final, étude réalisée à la demande d'Afdi, CIRAD Montpellier, Mai 2018, 38 p. + annexe

Gobierno Regional de Ucayali (GOREU). (2019). *Plan de Competitividad del Cacao Ucayali 2019–2029. Ucayali*

Gonin A. (2018). Des pâturages en partage. Territoires du pastoralisme en Afrique de l'Ouest. Revue internationale des études de développement N° 233 : 33-52. Éditions de la Sorbonne. DOI10.3917/ried.233.0033.

Otieno, A. B (2019). Emergent value chains for African indigenous vegetables and food security: Participation of smallholders in Kenya. Berlin: Verlag Dr. Köster.

GOREU. (2008). Plan Estratégico Regional del Sector Agrario de Ucayali 2008 – 2012. Oficina de Planificación Agraria. https://www.midagri.gob.pe/portal/download/pdf/conocenos/transparencia/planes_estrategicos_regionales/ucayali.pdf

Government of Kenya. (2018). Kiambu County Integrated Plan, 2018-2022

GoZ (2021). Mashonaland Central Province Zimbabwe Vulnerability Assessment Committee (ZimVAC) 2020 Rural Livelihoods Assessment Report.

GoZ (2021c) Zimbabwe Vulnerability Assessment Committee (ZimVAC) 2021 Mashonaland East Rural Livelihoods Assessment Report. www.fnc.org.zw

Gret (2019) « Étude filière lait dans les Bassins Laitiers de Ouagadougou et de Bobo-Dioulasso au Burkina Faso », 64p.

Hamadou, S., Palé E., Hébié D. (2007). Déterminants de la consommation des produits laitiers à Bobo-Dioulasso au Burkina Faso : facteurs sociaux et sensibilité aux prix. Rev. Élev. Méd. vét. Pays trop., 2007, 60 (1-4) : 51-58.

Horticultural Crops Directorate (HCD). (2020). Horticulture Validated Report for 2019-2020. HCD, Nairobi, Kenya.

Hungwe, E., Masaka, J., Makuvaro, V., & Tombo, E. (2020a). Increased Sorghum (Sorghumbicolor, L) Productivity: Unlocking its potential for food crisis mitigation for small holder communal farmers in the Semi-Arid regions: A case of the ZambeziValley Region in Zimbabwe. *International Journal of Agriculture, Biology & Environment*, *01*(03), 01–14. https://doi.org/10.47504/ijagri.2020.5122

KEPHIS (2019). Creation of mango pest free areas against fruit fly, Batrocera Dorsalis: A Kenyan Case Study. Available at: https://assets.ippc.int/static/media/files/publication/en/2019/11/Day2_5.1_Creation_of_mango_PFA_against_fruit_fly_in_Kenya_2019_10_23.pdf.

Kitalyi, A.J. (2012). Village chicken production systems in developing countries: what does the future hold? FAO. Retrieved from WAR 89 Village chicken production systems in developing countries: what does the future hold? (fao.org)

MIDAGRI. (2023). Sistema Integrado de Estadística Agraria [Base de datos]. https://siea.midagri.gob.pe/portal/siea_bi/index.html

MoALFC (2019). Agricultural Sector Transformation and Growth Strategy: Towards Sustainable Agricultural Transformation and Food Security in Kenya 2019-2029. National Strategy Document. Ministry of Agriculture, Livestock, Fisheries, and Cooperatives p. 45. Available at: http://kilimodata.developlocal.org/dataset/3ed81f6d-3b3d-4494-b14e-382ab59c59f6/resource/a46e7a7c-78f6-4fea-b3a0-5d91764a8c86/download/moai-astgsabridged- v.4.pdf .

Grant, W., Kadondi, E., Mbaka, M., & Ochieng, S. (2015). Opportunities for financing the mango value chain: A case study of lower eastern Kenya. Nairobi, Kenya: FSD Kenya.

Muchadeyi, F. C., Sibanda, S., Kusina, N. T., Kusina, J. and Makuza, S. (2004). The village chicken production system in Rushinga District of Zimbabwe. *Livestock Research for Rural Development, Vol. 16, Art. #40.* Retrieved November 28, 2022, from http://www.lrrd.org/lrrd16/6/much16040.htm

Mujeyi, A., Mutenje, M., J. Manyawu, G., Gwiriri, L., & Chakoma, I. (2015). Spearheading Development through Empowering Smallholder Farmers Along Beef Cattle Value Chains: A Case of Goromonzi and Murehwa Districts, Zimbabwe. *International Journal of Managing Value and Supply Chains*, *6*(4), 31–44. https://doi.org/10.5121/ijmvsc.2015.6403

Mujuka, E., Mburu, J., Ackello-Ogutu, C., & Ambuko, J. (2021). Willingness to pay for postharvest technologies and its influencing factors among smallholder mango farmers in Kenya.

ODNO Office de Développement du Nord-Ouest. (2021). Gouvernorat de Siliana en chiffre 2020.

ODNO Office de Développement du Nord-Ouest. (2021). Gouvernorat de El Kef en chiffre 2020.

Ouédraogo, S., Douanio H. (2007). Déterminants de la consommation de lait frais pasteurisé local à Ouagadougou au Burkina Faso. Rev. Élev. Méd. vét. Pays trop., 2007, 60 (1-4) : 59-65.

Padhi, M.K. (2016) Importance of Indigenous Breeds of Chicken for Rural Economy and Their Improvements for Higher Production Performance. *Scientifica,* 2016, Article ID: 2604685. https://doi.org/10.1155/2016/2604685

USAID-KAVES Mango Value Chain Analysis (2015). Retrieved from on 10th December 2022 from https://pdf.usaid.gov/pdf_docs/PA00M2SZ.pdf

Vias, G. (2018). Etat des filières laitières dans les 15 pays de la CEDEAO, de la Mauritanie et du Tchad. Annexe 2 : Fiche Burkina Faso. Cirad, Vétérinaires sans Frontières Belgique, Offensive lait. Montpellier, France, 44p.

Wild, A. S. (2022). *Women and African Leafy Vegetables (ALVs): Cultivation and the informal seed system in Vihiga County, Kenya* (Doctoral dissertation).

ZIMSTATS. (2022). Population distribution by district and wards. https://zimbabwe.opendataforafrica.org/fujalme/population-distribution-by-district-and-wards

Carolina Gonzales, Thematic Leader • Performance, Innovation and Strategic Analysis for Impact (PISA4IMPACT), c.gonzalez@cgiar.org

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

To learn more about this Initiative, please visit this webpage.

To learn more about this and other Initiatives in the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar-portfolio

CGIAR INITIATIVE ON Agroecology

Carolina Gonzales, Thematic Leader • Performance, Innovation and Strategic Analysis for Impact (PISA4IMPACT), c.gonzalez@cgiar.org

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

To learn more about this Initiative, please visit this webpage.

To learn more about this and other Initiatives in the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar-portfolio

CGIAR | INITIATIVE ON Agroecology