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CIRCULAR ECONOMY OPPORTUNITY MAP
Ghana Fruits Value Chain

2026

Authors

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MARCH 2026

The mango and pineapple value chains in Ghana demonstrate strong economic vibrancy, but

| Executive Summary

remain characterized by chemically intensive production systems, high post-harvest losses, and persistent gender inequities that limit their transition towards circularity. This study synthesized quantitative data from **81** mango producers and **38** traders in the Somanya-Akuse mango belt, alongside **130** pineapple producers and **51** traders in the Nsawam-Akuapim South corridor, complemented by qualitative engagements and field observations. In addition, two largescale fruit processing companies were engaged for their qualitative insights.

Material flow analysis (MFA) reveals that the mango system is notably leaky with nearly **19% (148,869 kg)** of harvested fruits **(793,640 kg)** lost or unutilized. When the production and marketing nodes are combined, approximately **25%** of harvested mangoes do not reach final consumers. Comparatively, the pineapple value chain performs better, since only **10%** of harvested produce is lost through farm-level spoilage, quality challenges, and market spoilage.

Environmental performance assessment shows high dependence on fossil fuel and synthetic agrochemicals to undertake various value chain operations. Activities along the pineapple value chain utilize about **76,000 kg** of synthetic fertilisers and collectively consume over 10,000 litres of diesel per season, generating about **29.2** tonnes of CO_2-equivalent emissions. Mango traders alone emit an estimated **1.35** tonnes of CO_2 per trading cycle, while pesticide usage among producers is extensive. Unfortunately, the adoption of personal protective equipment (PPEs) during the application of synthetic farm inputs is very minimal, exposing farmers and other value chain actors to health risks. Social analysis highlights a gendered segmentation of roles where women constitute only **15–20%** of producers but dominate trading, while male farmers control significantly larger farm holdings. Youth participation remains low across both pineapple and mango value chains.

Despite the structural inefficiencies identified, several circular practices are emerging, including composting of fruit residues, reuse of mango seeds to produce seedlings to serve as rootstock, sale of pruned branches as fuel wood, and industrial zero-waste models such as those operated by HPW Fresh & Dry. Strategic opportunities exist in decentralized post-harvest processing, community composting, packhouse rehabilitation and revitalization, and gender-responsive circular business model development. Overall, the findings highlight important and achievable pathways for reducing losses, lowering emissions, and accelerating circular economy adoption in Ghana's fruit sectors.

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1.0 Introduction

1.1 Background

The fruit sector plays a critical role in Ghana's agricultural economy, contributing significantly to rural livelihoods, employment creation, export earnings, and food system resilience. Among the leading horticultural commodities, mango and pineapple occupy a central position due to their strong domestic consumption patterns, expanding processing potential, and established export markets. In recent years, demand for both fruits has increased steadily across local and international markets, driven by urbanization, dietary diversification, and rising consumer preference for fresh and processed fruit products. Despite their economic significance, both value chains continue to operate largely under linear production and distribution models, characterized by high level of post-harvest losses, inefficient resource use, limited value addition, and weak waste recovery systems. These constraints significantly undermine profitability and environmental sustainability and limit the full economic potential of the fruit sector.

This report responds to the growing need to identify circular economy opportunities within Ghana's mango and pineapple value chains. Circularity in food systems emphasizes the efficient use of resources, minimization of losses and waste, valorisation of by-products, and the strengthening of sustainable production and consumption pathways. For fruit value chains, where perishability is high and waste streams are nutrient-rich, the potential to close loops and generate new forms of value is particularly significant. Circular approaches can transform organic residues into compost, animal feed, bioenergy, and industrial inputs; reduce dependence on synthetic fertilisers and chemical pesticides; encourage the adoption of reusable packaging systems; and stimulate new economic activities related to processing, storage, and waste valorisation.

The analysis presented in this report is based on a combination of primary field engagements and structured survey data. For mango, the fieldwork covered four major producing communities, Somanya, New Somanya, Akode No. 1 and Akuse Junction, located within the Yilo Krobo and Lower Manya Krobo municipalities. These areas are among the most important mango-growing zones in southern Ghana, supplying companies such as Blue Skies, HPW Fresh & Dry, and Bomarts Farms. For pineapple, data were collected across Nsawam and Akuapim South Districts, areas known for both smallholder and commercial pineapple production, and home to key actors across the fresh, fresh-cut, and dried pineapple sub-sectors. Across these locations, a total of 81 mango producers, 38 mango traders, 130 pineapple producers, and 51 pineapple traders were surveyed, providing a robust empirical foundation for assessing material flows, environmental impacts, and circular opportunities.

The fruit sector faces structural challenges that make circular economy interventions both necessary and timely. High post-harvest losses estimated at continue to erode farmer income and contribute to greenhouse gas emissions. Weak aggregation and grading systems, limited access to cold storage infrastructure and packhouses further intensify inefficiencies, while dependency on synthetic fertilisers and agrochemicals creates long-term environmental risks. At the same time, the value chains are shaped by pronounced gender and social inequalities, with men dominating land ownership and production, while women handle most trading activities but face barriers in scaling their businesses due to limited access to finance, skills, and technology.

Despite these challenges, the fruit value chains also present clear and compelling circular opportunities. The presence of processing companies that operate near-zero waste systems, such as HPW Fresh & Dry, demonstrates the feasibility of circular models within the Ghanaian context. Community-level innovations such as composting from fruit waste, seed reuse for propagation, and small-scale drying provide early signals of circularity that can be scaled with the right support. The rehabilitation of non-functional infrastructure, the promotion of reusable packaging, and the development of decentralised micro-processing hubs represent additional opportunities for structural transformation.

This report therefore aims to map the current state of the mango and pineapple value chains, quantify material flows and system inefficiencies, assess the environmental and social implications of current practices, identify circularity hotspots, and propose actionable strategies to transition towards a more resilient, sustainable, and inclusive fruit sector. By grounding circular economy recommendations in real field data, economic realities, and actor-level experiences, the report provides a practical and evidence-based pathway for enhancing value retention, reducing waste, and improving the livelihoods of actors across the fruit ecosystem.

1.2 Scope of the Assignment

This assignment forms part of a broader effort to identify and promote circular economy interventions within Ghana's horticultural sector, with a particular focus on the mango and pineapple value chains. The scope of work is guided by the need to understand how material, economic, social, and environmental flows operate within these value chains, and to determine the extent to which circular approaches can reduce losses, enhance value retention, and contribute to sustainable livelihoods. The assignment therefore covers the full spectrum of activities from primary production to aggregation, trading, processing, consumption, and waste management, recognizing that circular opportunities may emerge at any stage of the chain.

Geographically, the assignment focuses on two major fruit-producing corridors. For mango, the study concentrates on the Somanya production belt, encompassing Somanya, New Somanya, Akode No. 1 and Akuse Junction, areas within the Yilo Krobo and Lower Manya Krobo municipalities known for large-scale and smallholder mango cultivation with long-standing linkages with industrial processing companies such as Blue Skies, HPW Fresh & Dry, and Bomarts Farms. For pineapple, the analysis covers Nsawam and Akuapim South, including the Nsawam Prison Market, Pokrom, Mangoase, and several peripheral communities where smallholder and medium-scale pineapple farmers operate alongside aggregators and processors. These locations were selected for their high levels of production, market activity, and the presence of key actors relevant to circularity mapping.

The scope includes a detailed assessment of value chain actors, drawing on empirical data from 81 mango producers, 38 mango traders, 130 pineapple producers, and 51 pineapple traders. The assignment integrates quantitative survey data with qualitative evidence from field visits, focus group discussions, and key informant interactions with major private sector partners. The analysis covers key dimensions such as production practices, material flows, post-harvest handling, trading behaviours, processing linkages, waste generation patterns, environmental resource use, and social and gender dynamics.

Central to the assignment is the development of Material Flow Analyses (MFA) for both value chains, quantifying the proportions of fruit sold, consumed, lost, or repurposed at different stages. In addition, the scope includes a quasi–Life Cycle Assessment (LCA) to identify environmental hotspots linked to fuel consumption, agrochemical inputs, water use, and packaging waste. The assessment also extends to a review of circularity indicators, including existing waste-to-resource practices, opportunities for nutrient cycling, potential for energy recovery, and the feasibility of reusable packaging systems.

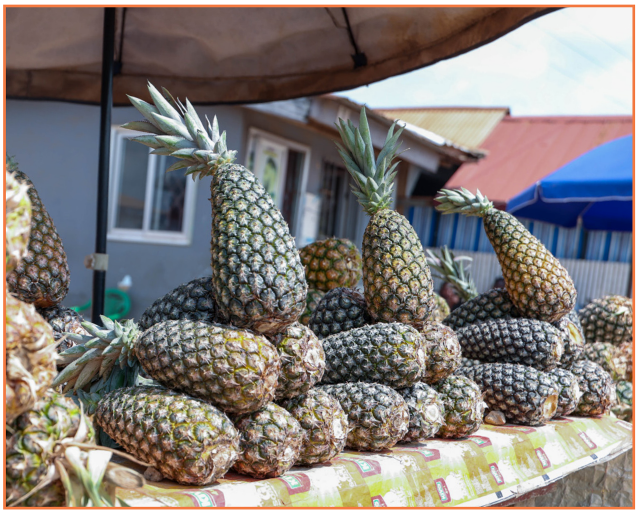


Plate 1: Pineapple for market sale

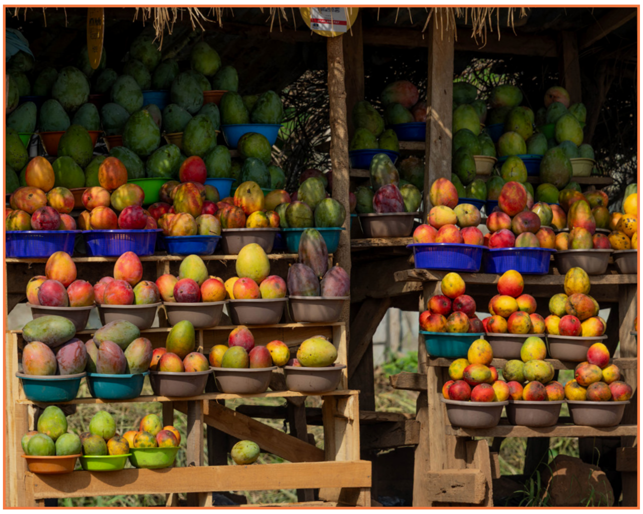


Plate 2: Fresh Mango on display for market sale

The assignment further captures the structural and institutional context shaping opportunities for circularity. This includes evaluating the functionality of existing infrastructure (such as packhouses, storage facilities, and trading spaces), the degree of organisation among producers and traders, the strength of market linkages, and the role of private sector actors in shaping value chain dynamics. Social and gender aspects, particularly access to land, capital, labour, and protective equipment, are examined to ensure that emerging circular interventions are equitable and inclusive.

Overall, the scope of work is designed to produce an integrated and evidence-based mapping of circular economy opportunities across the mango and pineapple value chains. By combining systems analysis with field-level realities, the assignment aims to generate practical recommendations capable of driving sector-wide transformation while simultaneously supporting environmental sustainability, economic growth, and improved livelihoods for farmers, traders, and processors.

2.0 Methodology

This study employed a mixed-methods approach combining quantitative surveys, qualitative field observations, and analytical modelling techniques to assess the circular economy potential within the mango and pineapple value chains in Ghana. The methodological design was structured to capture the complex interactions among actors, the flow of materials from farm to market, the environmental implications of production and distribution, and the social dynamics that shape participation and resource use.

2.1 Field Engagements and Qualitative Data Collection

Fieldwork for mango was conducted across four major communities: Somanya, New Somanya, Akode No. 1 and Akuse Junction, situated within the Yilo Krobo and Lower Manya Krobo municipalities. Engagements included key informant interviews with leaders of farmer cooperatives, aggregators, community leaders, and extension officers, as well as direct observations of orchard management practices, harvesting, on-farm storage, transportation, and trading activities. For pineapple, the fieldwork covered Nsawam, Akuapim South, the Nsawam Prison Market, Pokrom, Mangoase, and adjoining communities. The team interacted with farmers, traders, processors (including Bomarts Farms and HPW Fresh & Dry), and local institutions to document production systems, post-harvest handling, use of inputs, and waste management practices. The qualitative data provided contextual insights into constraints, existing circular practices, and opportunities not easily captured through surveys.

2.2 Quantitative Surveys and Sampling

Structured questionnaires were administered to 81 mango producers and 38 mango traders, and 130 pineapple producers and 51 pineapple traders, forming the quantitative foundation for the material flow and quasi-life cycle or environmental assessments. These respondents were selected to reflect the diversity of actors across production scales, gender, age groups, and market roles, ensuring representativeness within the targeted districts. The producer surveys captured data on farm size, input use, chemical application, production volumes, sales, on-farm losses, labour use, and environmental practices. Trader surveys focused on procurement volumes, sales patterns, spoilage rates, transportation, packaging, price variation, and waste handling. This dataset enabled the computation of flows, losses, and resource use at each stage of the value chain. The structured instruments were programed onto android mobile tablets. Trained enumerators were employed to collect the data through personal face-to-face interviews.

2.3 Material Flow Analysis (MFA)

Material Flow Analysis was used to quantify the physical movement of mango and pineapple from production to consumption. MFA maps the input–output balance at each stage, allowing for the identification of critical inefficiencies, hotspots, and opportunities for valorisation. For each fruit, the MFA was conducted at two levels: (i) farm-level flows, distinguishing quantities harvested, sold, consumed, or lost, and (ii) trader-level flows, quantifying volumes procured, sold (full price and discounted), consumed, repurposed, or discarded. The processor level assessment was quite difficult due to limited information from the industrial processors who were reluctant to provide data for trade secret reasons. Loss rates at production and trading nodes of the value chain were calculated as proportions of total harvested or procured volumes, enabling comparisons between the two value chains and generating a clear picture of where circular innovations could have the greatest impact.

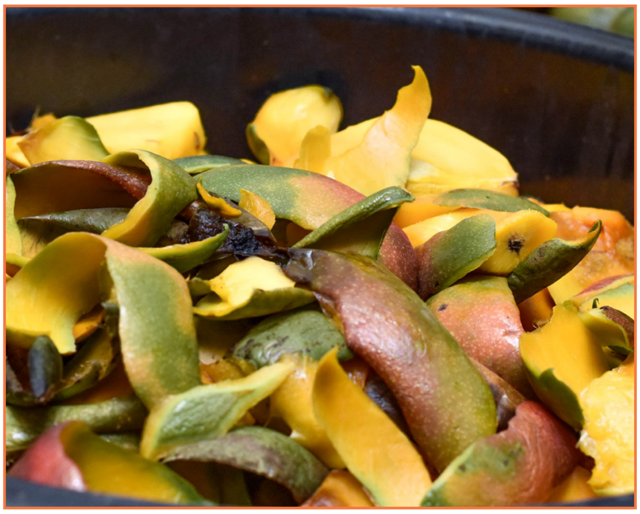


Plate 3: Mango peels for sale

Plate 4: Harvested Pineapple ready for transport

2.4 Environmental Performance Assessment (Quasi-LCA)

A Quasi-Life Cycle Assessment approach was employed to evaluate the environmental footprint of both value chains. Although not a full LCA, the analysis captured the most significant resource-use indicators, including fuel consumption, fertiliser and pesticide use, and water used for agrochemical spraying. Emission factors for diesel combustion were used to estimate CO_2-equivalent emissions from transport and farm operations. Quantities of fertilisers (synthetic and organic), herbicides, and insecticides were analysed to understand input intensity and potential environmental pressure points. Packaging materials, especially the heavy reliance on single-use plastics, were included to identify waste generation trends and opportunities for circular design.

2.5 Social and Gender Assessment

The methodology incorporated a social and gender lens to understand how roles, opportunities, and constraints differ across actors. Gender-disaggregated data were collected on land access, education, decision-making power, cooperative membership, and labour contributions. Occupational health indicators such as the use of personal protective equipment (PPE), were captured to assess exposure risks linked to agrochemical use. Youth participation was also documented to understand inter-generational dynamics and potential barriers to engaging young people in circular opportunities. These insights were triangulated with qualitative evidence to identify equity gaps and to inform inclusive recommendations.

2.6 Analytical Triangulation

Quantitative data, field observations, and discussions with value chain actors were triangulated to enhance the robustness of findings. For instance, reported farm-level mango losses were cross-checked with trader-level spoilage data; fertiliser and pesticide volumes were validated against field observations of chemical storage and application; and circular practices observed on farms or in markets such as seed reuse and pruning waste repurposing were verified through interviews. This triangulated approach ensured that the analysis remained grounded in real-world conditions and that recommendations reflect both quantitative trends and lived experiences of farmers and traders.

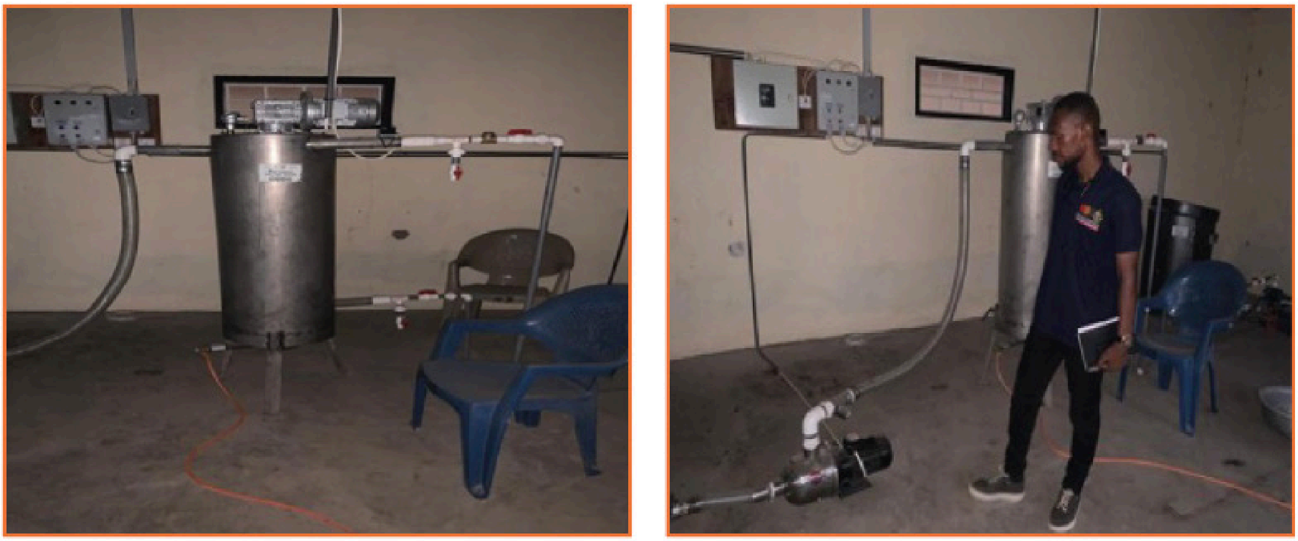


Plate 5: Mango processing unit

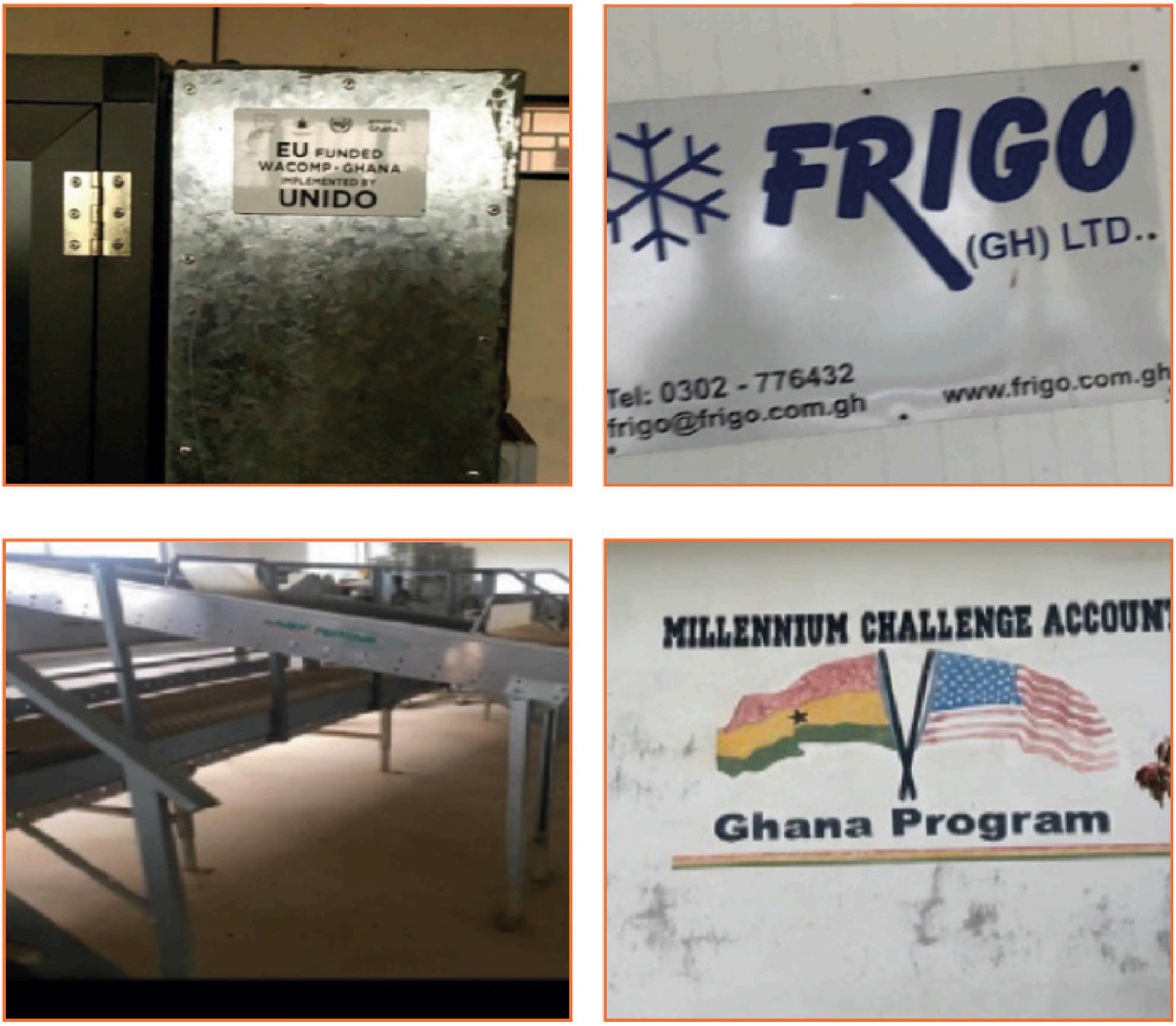


Plate 6: Defunct pineapple cannery at Akuapim South

Photo Credit: Authors/KNUST

3.0 Characteristics Of Value Chain Actors

The mango and pineapple value chains in Ghana are shaped by a diverse set of actors whose demographic, social, and economic characteristics influence the structure, performance, and inclusiveness of each chain. This section presents a detailed profile of producers and traders, highlighting differences in gender composition, age distribution, educational attainment, and marital status across the two commodities. By comparing mango and pineapple actors side-by-side, the section provides insight into the human dimensions of the value chains and establishes a foundation for understanding how circular economy interventions may differentially affect specific groups.

3.1 Socio-demographic Characteristics of Producers

Table 3.1 presents the demographic characteristics of mango producers and pineapple producers covered in the study. The table summarizes the distribution of respondents based on sex, age, educational level, and marital status across the two commodities.

The demographic profiles of mango and pineapple producers presented in the table show both similarities and notable differences across the two commodities. In terms of gender, production remains male-dominated for both value chains. About 80% of mango producers and roughly 85% of pineapple producers are men, reflecting the broader trend of male control over commercial tree-crop farming in many parts of Ghana. Female participation is relatively low, at about 20% among mango farmers and approximately 15% among pineapple farmers.

Table 3.1: Socio-demographic Characteristics of Mango and Pineapple Producers

Variable	Category	Mango (n=81)	Pineapple (n=130)
Sex	Female	19.8%	15%
	Male	80.2%	85%
Age Group	< 36 years	8.64%	18.3%
	36–39 years	4.94%	10.3%
	40–49 years	30.86%	27.3%
	50–60 years	33.33%	26.5%
	> 60 years	22.22%	17.6%
Educational Level	None	30.9%	19.8%
	Basic	59.3%	62.6%
	Secondary	7.4%	14.2%
	Tertiary	2.5%	3.4%
Marital Status	Single	9.9%	13.1%
	Married	69.1%	67.5%
	Divorced/Separated/Widowed	21.0%	19.4%

Source: Field data, 2025.

Across age groups, both sectors are largely driven by middle-aged adults. Mango producers are concentrated in the 40–60 years bracket, which accounts for nearly two-thirds of respondents. Pineapple producers also show a strong presence in this age range, though with slightly more young farmers under 36 years (18.3% compared to 8.6% for mango). This suggests that pineapple cultivation may be attracting younger entrants at a higher rate than mango production, possibly due to relatively shorter production cycles or market opportunities. Educational levels are generally low across both groups, though pineapple farmers appear slightly more educated. A significant proportion of mango producers (30.9%) have no formal education, compared to about 19.8% of pineapple farmers. Basic education is the most common level attained in both groups (59.3% for mango and 62.6% for pineapple), while only a small minority have secondary or tertiary education. This highlights a need for tailored extension approaches and circular models that consider limited literacy among producers. Marital status patterns are almost identical for the two groups. The majority of farmers are married (nearly 70%), while roughly one in five are divorced, separated, or widowed. Single farmers constitute a small minority in both value chains.

Overall, the data suggest that mango and pineapple production are dominated by older, married men with modest educational backgrounds, though pineapple farming appears slightly more youth-inclusive. These characteristics have important implications for designing training and extension support, as well as circular value chain interventions.

3.2 Socio-demographic Characteristics of Traders

Table 3.2 provides socio-demographic characteristics for mango traders and pineapple traders covered in the survey. Results in the table reveal that the trading node of the value chains of the two crops is predominantly driven by women, relatively youthful, and modestly educated. Mango trading is overwhelmingly female-dominated, with women constituting over 97% of traders, while pineapple trading also shows a strong female presence at about 78%. This aligns with the well-established pattern in Ghana where women play a central role in agricultural marketing, especially in fresh produce trade. Male participation is minimal among mango traders and somewhat higher among pineapple traders, though still relatively low.

In terms of age structure, both groups include a mix of young and middle-aged adults. Pineapple traders tend to be slightly younger overall, with about a quarter under 36 years and a notable share (20.6%) in the 36 -39 years bracket. Mango traders also have a significant youth presence (26.3% below 36 years), but their distribution leans a bit more towards the 40–49 year age group, which represents the largest segment (31.6%). Very few traders are above 60 years, indicating that fruit trading relies heavily on individuals in their economically active years due to the physical demands of the job.

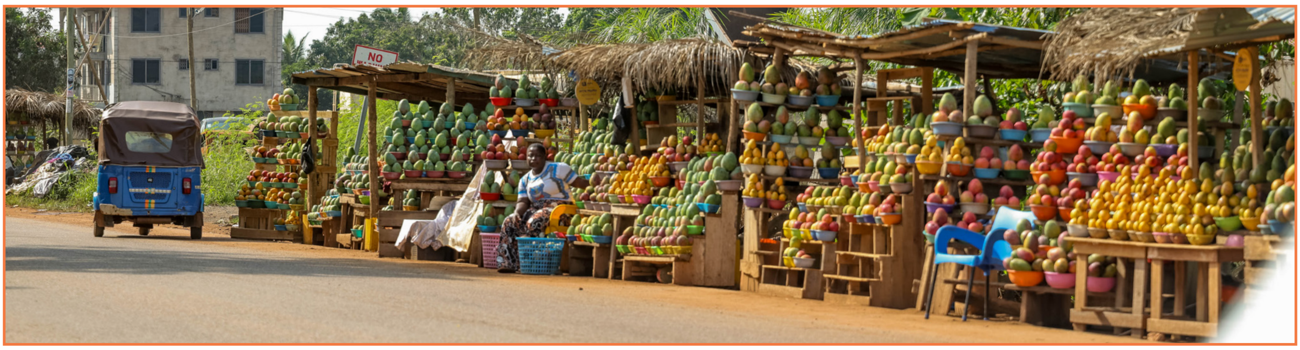


Table 3.2: Socio-demographic Characteristics of Mango and Pineapple Traders

Variable	Category	Mango (n=38)	Pineapple (n=51)
Sex	Female	37 (97.4%)	40 (78.4%)
	Male	1 (2.6%)	11 (21.6%)
Age Group	< 36 years	10 (26.3%)	25.5%
	36–39 years	7 (18.4%)	20.6%
	40–49 years	12 (31.6%)	29.4%
	50–60 years	7 (18.4%)	21.6%
	> 60 years	2 (5.3%)	2.9%
Educational Level	None	11 (28.9%)	11.8%
	Basic	23 (60.5%)	70.6%
	Secondary	3 (7.9%)	15.7%
	Tertiary	1 (2.6%)	2.0%
Marital Status	Single	8 (21.1%)	10.8%
	Married	24 (63.2%)	69.6%
	Divorced/Separated/ Widowed	6 (15.8%)	19.6%

Source: Field data, 2025.

Education levels are generally low but slightly better among pineapple traders. Nearly 29% of mango traders have no formal education, compared to only 12% among pineapple traders. Basic education is the most common level for both groups, accounting for 60.5% of mango traders and 70.6% among pineapple traders. Only a small fraction has secondary or tertiary education, suggesting that most traders acquire their skills informally through experience rather than formal training. Marital status patterns are similar across both commodity groups. The majority of traders are married, while smaller proportions are single. This indicates that fruit trading is often undertaken by individuals with family responsibilities, for whom trading serves as a primary or supplementary household income source.

Overall, mango and pineapple traders share many demographic similarities: they are largely women, mainly within the working-age population, and have modest educational backgrounds. These characteristics highlight the importance of designing circular interventions and market support programs (such as financial literacy programs and business skills training) in ways that are accessible to women and people with limited formal education.

4.0 Value Chain Mapping

The mango and pineapple value chains in Ghana operate through multiple interconnected stages involving input suppliers, smallholder farmers, aggregators, traders, processors, transporters, and end-market actors. Mapping the structure of these value chains provides insights into how fruit flows from production areas to domestic and export markets and helps identify points of inefficiency, loss, and potential circular innovation. The mango value chain is anchored in the Somanya–Akuse corridor, characterized by strong linkages with formal processing companies such as Blue Skies, HPW Fresh & Dry, and Bomarts Farms. The pineapple value chain in Nsawam and Akuapim South exhibits a more diverse structure, involving smallholder producers, market-based aggregators, and large commercial processors. Both chains remain heavily reliant on informal trading systems, manually operated logistics, and minimal post-harvest infrastructure, leading to considerable variability in quality and high susceptibility to losses. The mapping below disaggregates the stages, identifies key actors at each point, and summarizes the flow of products, materials, and waste streams.

4.1 Mango Value Chain Mapping

The key actors, and major activities at the various nodes of the mango value chain as well as product flows and waste streams observed during field engagements are summarized in Table 4.1.

Table 4.1. Structure and Actors in the Mango Value Chain

Stage	Key Actors	Main Activities	Product Flows	Typical Waste Streams
Input Supply	Agro-input shops, seedlings suppliers	Sale of fertilisers, pesticides, herbicides, seedlings supply, extension advice (limited)	Agrochemicals, tools, seedlings	Packaging waste, expired chemicals.
Production	Smallholder farmers (70%) and medium to large-scale producers (30%) of mango	Planting, weed control, disease and pest management, fertilizer application, pruning, harvesting, sales.	Fresh mango harvested and sold to companies or traders	Unharvested fruits, pruned branches, fallen fruits, rejected fruits, etc.
Aggregation	Community aggregators; company agents (Blue Skies, Bomarts, HPW)	Aggregation, sorting, grading, bulking, price negotiation, transportation.	Farm-gate collection to processing companies	Rejected fruit due to poor quality.

Stage	Key Actors	Main Activities	Product Flows	Typical Waste Streams
Trading	Mango traders in markets and along roadside.	Retailing; roadside sales; market sales	Fruit sold to consumers in the producing districts, travelers along the roadside as well as traders and consumers in urban centers such as Koforidua and Accra.	Spoilage during storage, transportation and peel waste during consumption.
Processing	Blue Skies, HPW, Bomarts	Sourcing fruits through agents, cutting, pulping, drying, juice extraction, packaging, sales (locally and through export)	Fresh-cut fruit, juice, puree, dried mango.	Peels, seeds, trimmings (often composted or used as feed), discarded or rejected fruits due to poor quality.
Consumption	Households, supermarkets, export buyers	Purchase and consumption of fresh or processed mango	End consumption	Household organic waste including seeds and peels.

4.2 Pineapple Value Chain Mapping

Table 4.2 summarises the actors and activities across the pineapple value chain in Nsawam and Akuapim South, highlighting the structure from input provision to final consumption.

Table 4.2. Structure and Actors in the Pineapple Value Chain

Stage	Key Actors	Main Activities	Product Flows	Typical Waste Streams
Input Supply	Fertiliser distributors, chemical shops, cooperative nurseries	Sale of fertilisers, planting materials (suckers), herbicides, tools	Planting materials (suckers), fertiliser, crop chemicals	Chemical containers, plastic bags
Production	Pineapple producers Smallholders and large-scale producers	Land preparation, planting, weeding, fertiliser application, harvesting	Fresh pineapple supplied to aggregators, processors, traders	Field residues, unutilized fruits
Aggregation	Market-based aggregators, truck loaders	Bulking, sorting by size/grade, transport arrangement	Pineapple moved to Nsawam markets, Accra, processors	Damaged fruits, rejected sizes
Trading	51 traders (roadside, market, mobile)	Retailing, wholesale to Accra, institutional buyers	Sold as fresh fruit to buyers	Spoilage due to heat and pressure damage
Processing	HPW Fresh & Dry, Blue Skies, Bomarts Farms	Fresh-cut processing, drying, juice extraction, export preparation	Dried pineapple, fresh-cut packs, juice	Peels, cores, trimmings (HPW uses biodigesters)
Consumption	Households, supermarkets, export markets	Domestic consumption, export of processed pineapple	End consumption	Household organic waste

4.3 Combined Mango–Pineapple Value Chain Structure

Table 4.3 presents a side-by-side view of mango and pineapple systems to highlight structural similarities, differences, and shared circularity entry points.

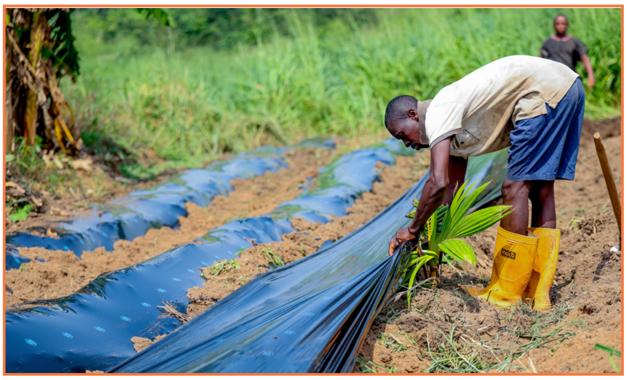
Mango production is generally undertaken on medium to large-scale farms, reflecting the long-term investment and land requirements of tree crops. In contrast, pineapple is grown on smaller to medium-scale plots with more intensive management practices, making it relatively accessible to a wider range of farmers. Post-harvest linkages show that both value chains benefit from strong processor presence, particularly companies like Blue Skies and HPW. However, mango has more consistent relationships with multiple processors, whereas pineapple linkages appear more fragmented.

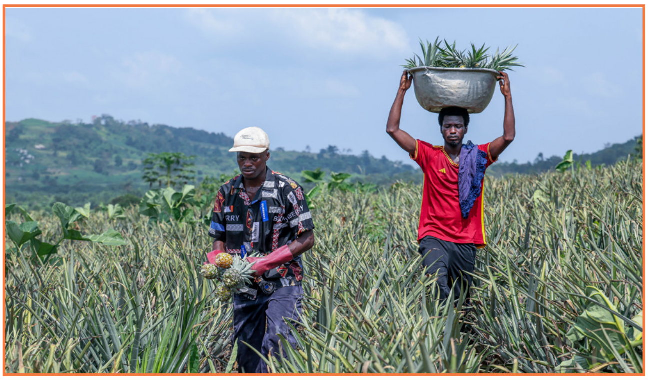
Table 4.3. Comparison of Mango and Pineapple Value Chain Structures

Dimension	Mango Value Chain	Pineapple Value Chain
Production Scale	Medium to large orchards (tree crops)	Smallholder plots to medium scale farms with intensive management
Post-Harvest Linkages	Strong links to major processors (Blue Skies, HPW, Bomarts)	Strong processor presence (HPW), but more fragmented
Trading Structure	Highly female-dominated; direct roadside and market sales	Mixed-gender trading; more mobile and decentralised
Loss Hotspots	Farm-level (18.8%), trader-level spoilage (2%)	Farm-level (8.1%), market-level spoilage (1.9%)
Waste Utilisation	Minor (charcoal from pruned branches, seed reuse)	Strong circular model at HPW; weak at community level
Major Bottlenecks	Inadequate aggregation centres, orchard ageing	Poor packaging, lack of cold storage, abandoned packhouse.

Trading structures differ considerably. Mango trading is highly female-dominated, with many women engaged in direct roadside and market sales. The pineapple trading system is more mixed in terms of gender and tends to be more mobile and decentralised. Loss hotspots also vary. Mango experiences higher losses at the farm level (18.8%) compared to pineapple (8.1%), primarily linked to the seasonality and delicacy of handling tree fruit. Trader-level spoilage for mango remains relatively low (2%), just like pineapple with comparable market-level losses (1.9%) often due to bruising and Improper handling.

Waste utilisation is more advanced in the pineapple chain, especially where processors like HPW operate circular models that convert waste into dried products or animal feed. Mango waste utilisation is minimal, limited mainly to charcoal production from pruned branches and occasional seed reuse. Finally, both value chains face structural bottlenecks: mango production is constrained by ageing plantations and the lack of effective aggregation centres, while pineapple suffers from poor packaging and abandoned packhouse facilities. These constraints highlight the need for targeted post-harvest investments and coordinated value chain support.





5. Material Flow Analysis (Mfa)

Material Flow Analysis (MFA) was conducted to quantify the movement of mango and pineapple along the value chain, from production, through aggregation and trading, to final utilisation. MFA helps identify losses, unutilised fractions, and potential circular economy opportunities at each stage of the chain. The analysis was performed using producer-level and trader-level survey data for 81 mango producers, 38 mango traders, 130 pineapple producers, and 51 pineapple traders. The results provide a clear picture of the proportion of fruit successfully marketed, consumed, repurposed, or lost.

5.1 MFA for Mango Value Chain

5.1.1 Mango Material Flow at Farm Level

Table 5.1 presents the material flow for mango at the farm stage based on the total seasonal quantity harvested by the 81 producers surveyed. The table shows the proportion of mango that was sold, consumed by households, used as animal feed, or lost/ unutilised during the last production season.

Table 5.1. Material Flow of Mango at Farm Level (N = 81 producers)

Flow Category	Quantity (kg)	Percentage of Total Harvest (%)
Sold	644,770	81.2%
Consumed in households	7,496	0.9%
Used as animal feed	505	0.06%
Lost / Unutilised	148,869	18.8%
Total Harvest	**793,640**	**100%**

The results show that a greater proportion of harvested produce is successfully commercialized, with 81.2% (644,770 kg) sold, indicating a strong market orientation among producers. Only a very small share of the harvest is kept for household consumption (0.9%) or diverted to animal feed (0.06%), suggesting that farmers depend heavily on sales as their primary source of income rather than subsistence use. However, the level of losses is significant. Nearly 148,869 kg, representing 18.8% of the total harvest, remains unutilized or is lost along the value chain. This proportion of loss is substantial and highlights inefficiencies in post-harvest handling, storage, and market access. The lack of alternative uses for unsold produce further contributes to the waste burden. It is significant to note that while the commercialisation rate is high, the large share of unutilised harvest points to opportunities for improved post-harvest management, better aggregation and storage systems, and stronger linkages to processing or alternative markets to reduce losses and increase farmer profitability.

5.1.2 Mango Material Flow at Trading Stage

Table 5.2 summarises mango utilisation among the 38 traders surveyed. The quantities represent flows during a typical weekly trading cycle, showing how much mango traders procure, sell, discount, consume, or discard during each cycle.

The data for the mango trading node show that traders are able to sell most of their stock, demonstrating strong market demand and efficient turnover. About 86.7% (17,535 kg) of mangoes procured per trading cycle are sold at full price, indicating that most of the fruit reaches the market in good condition. A smaller portion, 5.25%, is sold at reduced prices, usually reflecting fruit that is slightly damaged, overripe, or of lower market quality but still marketable.

Table 5.2. Material Flow of Mango at Trading Stage (N = 38 traders; per weekly cycle)

Flow Category	Quantity (kg)	Percentage of Trader Stock (%)
Sold at full price	17,535	86.7%
Sold at reduced price	1,092	5.25%
Consumed by traders' households	222	1.1%
Used as animal feed	31	0.15%
Lost / Discarded	415	2.05%
Total Mango Procured per Cycle	**20,235**	**100%**

Evidence from the survey shows that only a small share of the stock is diverted to non-commercial uses. Household consumption accounts for 1.1%, while 0.15% is used as animal feed, showing that traders sell the stocks procured rather than divert them for home use. Losses at the trading stage are relatively low, with 2.05% (415 kg) lost or discarded during a weekly trading cycle due to spoilage or physical damage. This suggests that while traders perform well in managing post-harvest quality, some handling and storage improvements could further reduce losses.

Overall, the trading node is highly efficient, with more than 90% of mango stock sold either at full or reduced price with minimal wastage. This demonstrates strong market integration but also highlights the importance of maintaining quality to minimise markdowns and losses.

5.1.3 Combined Mango Chain Efficiency

Table 5.3 integrates farm-level and trader-level MFA to show the overall efficiency of the mango value chain, indicating the proportion of fruit that ultimately reaches consumers versus the proportion lost across the chain.

Table 5.3. Combined MFA for Mango Value Chain

Flow Category	Integrated Percentage (%)
Final consumption (farm + market)	75%
Total chain losses (farm + market)	25%

The combined mango value chain efficiency analysis shows that 75% of all harvested mangoes ultimately reach final consumers, whether through formal sales, reduced-price transactions, or household use by trader's family. This indicates a moderately efficient value chain in which most of the produce supplied at the farm level is successfully absorbed by markets or end users. The figures reflect the relatively strong performance of traders who sell most of their stock at full price and the substantial proportion of farm-level harvest that enters commercial channels. However, the remaining 25% represents total chain losses, combining both farm-level and market-level inefficiencies. This level of loss is significant for a high-value tree crop such as mango. Losses may arise from issues such as poor harvesting practices, inadequate sorting or grading, pest and disease damage, limited cold storage, transport-related bruising, and the lack of reliable off-taker arrangements during peak season. The fact that one-quarter of the total harvest fails to reach consumers highlights substantial room for improvement in post-harvest handling, storage, and market linkages.

Overall, while three-quarters of mangoes successfully reach end users, the 25% loss rate signals a need for targeted interventions across the chain particularly at the farm level where the bulk of losses tend to occur. Strengthening aggregation systems, improving handling practices, and enhancing access to processing or alternative markets could significantly increase overall value chain efficiency and farmer incomes.

5.2 MFA for Pineapple Value Chain

5.2.1 Pineapple Material Flow at Farm Level

Table 5.4 shows pineapple material flows per 1,000 kg of harvest based on the producer survey.

The pineapple mass flow analysis indicates a highly market-oriented production system, with 91.4% of harvested pineapples sold, reflecting strong demand and efficient movement from farms to buyers. Very little of the harvest is retained for home consumption (0.5%) and none is diverted to animal feed, underscoring the crop's primary role as a commercial income source for producers.

Losses at the farm level are relatively modest at 8.1%, especially when compared with other perishable fruit value chains. These losses may result from factors such as over-ripeness at harvest, fruit defects, limited market access during peak periods, or improper post-harvest handling. Nonetheless, the low loss percentage suggests that producers generally manage harvest timing and buyer relationships effectively. Overall, the data portrays a well-functioning pineapple production system with minimal wastage and a high proportion of produce successfully entering the market.

Table 5.4. Pineapple MFA at Farm Level (per 1,000 kg harvest; N = 130 producers)

Flow Category	Quantity (kg)	Proportion (%)
Sold	914	91.4%
Consumed at home	5	0.5%
Used as animal feed	0	0.0%
Lost / Unutilised	81	8.1%
Total	**1,000**	**100%**

5.2.2 Pineapple Material Flow at Trading Stage

Table 5.5 outlines trader-level flows of pineapple per 1,000 kg purchased. The trading-stage data for the pineapple value chain also shows a highly efficient marketing system with very minimal losses. Of the 1,000 kg of pineapples handled by traders, an impressive 97.8% is successfully sold to consumers. This reflects strong market demand, effective turnover, and generally good handling practices that preserve fruit quality through the trading process.

Table 5.5. Pineapple MFA at Trading Stage (per 1,000 kg; N = 51 traders)

Flow Category	Quantity (kg)	Proportion (%)
Sold to consumers	978	97.8%
Used as animal feed	3	0.3%
Lost / Discarded	19	1.9%
Total	**1,000**	**100%**

Only 0.3% of the stock is diverted to animal feed, indicating that very little produce becomes unsuitable for sale but still retains some value. Losses and discarded fruits account for only 1.9% of the volume handled per cycle, which is low for a perishable and bruise-sensitive product like pineapple. These minor losses could stem from transport damage, over-ripeness, or improper handling during display and storage at sales points.

Overall, the results highlight a trading node that functions smoothly and efficiently. The combination of high sales and low spoilage suggests that traders are well-adapted to managing pineapple perishability through rapid turnover and responsive pricing strategies. This efficiency also strengthens the overall value chain by ensuring that most farm-level production reaches consumers with minimal waste.

5.2.3 Combined Pineapple Chain Efficiency

Table 5.6 integrates farm-level and market-level MFA to summarise the proportion of pineapple that ultimately reaches consumers. The combined mass flow analysis shows a highly efficient system, with 90% of total harvested pineapple ultimately reaching final consumption through sales at the farmgate and market levels. This high rate of utilisation reflects strong demand, fast turnover, and effective coordination between producers and traders. It also suggests that both actors manage perishability well by harvesting at the right maturity, moving produce quickly, and maintaining produce quality along the chain.

Table 5.6. Combined MFA for Pineapple Value Chain

Flow Category	Integrated Percentage (%)
Final sales (farm + market)	90%
Total chain losses (farm + market)	10%

Source: Field survey, 2025.

Only 10% of pineapples are lost across the farming and trading nodes of the value chain. This relatively low loss rate is notable for a perishable fruit and demonstrates that bottlenecks such as delayed purchasing, poor storage, or excessive handling are less severe in pineapple than in many other horticultural value chains. The small loss share likely results from efficient harvesting practices, ready market access, and traders' ability to sell most of their stock rapidly.

Overall, the integrated analysis highlights a well-performing pineapple value chain, characterized by high market absorption and low wastage. Continuous improvements in handling, transport, and storage could potentially reduce losses even further and enhance profitability for all the actors involved in the chain.

6.0 Environmental Performance (Quasi-Lca)

This section presents a quasi–Life Cycle Assessment (LCA) of the mango and pineapple value chains, focusing on input use, emissions, chemical application, water utilisation, and waste generation at production and trading stages. Because full cradle-to-grave LCA data were not available, the analysis relies on primary data collected from producers and traders to estimate environmental hotspots and resource intensities. The assessment highlights significant dependence on fossil fuels and synthetic agrochemicals in both value chains, minimal uptake of organic nutrient sources, and high organic waste volumes, indicating substantial opportunities for circular interventions such as composting, cleaner energy options, regenerative agricultural practices, and eco-friendly packaging systems.

6.1 Mango Value Chain Environmental Performance

Table 6.1 summarises key environmental indicators for mango producers and traders, including fertiliser use, pesticide application, fuel consumption, emissions, and seasonal waste generation. These indicators are derived from the analysis of the mango dataset and represent resource and environmental pressures present within mango-producing communities. The environmental indicators for the mango value chain point to a production and trading system with several sustainability challenges, particularly around chemical use, waste generation, and carbon emissions. Farmers used about 759 kg of synthetic fertilizer, supplemented by 1,101 kg of organic manure, although only 17% of farmers use organic inputs. This suggests that soil fertility management is still dominated by inorganic fertilisers, with limited integration of organic amendments that could support longer-term soil health.

Table 6.1: Key Environmental Indicators for the Mango Value Chain

Environmental Indicator	Value (Producers/Traders)	Interpretation
Total synthetic fertiliser applied	**759 kg (81 farms)**	High reliance on chemical fertilisers with limited nutrient cycling.
Total organic manure applied	**1,101 kg (17% of farmers)**	Organic input usage remains very low; potential for scaling compost systems.
Insecticide use	**211 L (63 farmers; 78%)**	High exposure risk; indicates persistent pest pressure.
Herbicide use	**118 L (44 farmers; 54%)**	Heavy chemical weed control with associated soil health risks.
PPE utilisation	**0 farmers reported PPE use**	Extreme occupational safety vulnerability.
Diesel consumption (traders)	**498 L per market cycle**	Significant fossil fuel dependence for market-bound transport.
Estimated CO_2 emissions (traders)	**≈1.35 t CO_2 per cycle**	Reflects fuel-intensive distribution; high seasonal footprint.
Farm-level mango waste	**148,869 kg (18.8% of harvest)**	Major organic waste hotspot with valorisation potential.

Chemical use is quite significant. Insecticides are used by 78% of farmers (211 litres in total), indicating heavy reliance on chemical pest control which is due to the prevalence of mango pests such as fruit flies. Herbicide use is reported by 54% of farmers, although in lower volumes (118 litres), reflecting a moderate degree of chemical weed management. A major concern is that no farmer reported using personal protective equipment (PPE), highlighting serious occupational health risks and unsafe handling of agrochemicals.

Environmental impacts are also present at the trading stage. Traders consume 498 litres of diesel per market cycle, resulting in an estimated 1.35 tonnes of CO_2 emissions, which contributes to the carbon footprint of the value chain. Additionally, the system generates substantial organic waste, with 148,869 kg of mangoes lost at the farm level, representing 18.8% of total harvest. This level of wastage not only reduces farmer income but also contributes to methane emissions during decomposition if not properly managed.

The indicators reveal a value chain that is chemically intensive with notable carbon emissions and produces significant organic waste. Addressing these issues will require promoting safer chemical use, expanding integrated pest management practices, improving waste valorisation, and enhancing low-carbon transport options.

6.2 Pineapple Value Chain Environmental Performance

Table 6.2 presents environmental performance indicators for pineapple producers and traders, capturing input intensities, greenhouse gas (GHG) emissions, water utilisation for chemical application, and chemical dependency. These indicators highlight substantial resource use concentrated at the production stage, with comparatively lower environmental burdens at the trading stage.

The environmental indicators for the pineapple value chain highlight both intensive input use and relatively efficient waste management compared with mango. Pineapple production relies heavily on synthetic fertilisers, with 76,550 kg applied across 130 farms, while organic fertiliser use is minimal at 217 kg. Chemical use is notable, with 755 L of herbicides and 165 L of insecticides applied, necessitating large quantities of water (1,781,700 L) for mixing. This intensive use of agrochemicals raises potential concerns for soil and water quality, particularly if safety and runoff management is inadequate.

Table 6.2: Key Environmental Indicators for the Pineapple Value Chain

Environmental Indicator	Value (Producers/ Traders)	Interpretation
Synthetic fertiliser use	76,550 kg (130 farms)	Extremely high nutrient input levels; potential for runoff and soil degradation.
Organic fertiliser use	217 kg	Less than 0.3% of total nutrients applied; negligible contribution to soil regeneration.
Herbicide use	755 L	Indicates heavy reliance on chemical weed management.
Insecticide use	165 L	Points to pest challenges and routine chemical spraying.

Water for chemical mixing	**1,781,700 L**	Large water footprint for agrochemical application.
Diesel consumption (producers)	**9,700 L per season**	Represents significant fuel use for land preparation, transport, and field operations.
Diesel consumption (traders)	**1,197 L per season**	Lower than producers but still contributes to GHG emissions.
Estimated CO_2 emissions	**29.2 t CO_2e (producers + traders)**	Reflects the carbon intensity of pineapple production and distribution.
Farm-level pineapple waste	**81 kg per 1,000 kg harvested (8.1%)**	Waste hotspot primarily due to gluts and quality downgrading.

Energy consumption was also found to be quite substantial. Producers use 9,700 L of diesel per season, while traders consume an additional 1,197 L, contributing to an estimated 29.2 tonnes of CO_2e emissions from the value chain. This represents a significant carbon footprint associated with production and transportation activities. On a positive note, farm-level losses are relatively low, with only 8.1% of harvested pineapples lost or unutilised, indicating effective harvesting, handling, and market linkages. Compared with mango, which has higher post-harvest waste, the pineapple chain demonstrates more efficient utilisation of produce.

In summary, the pineapple value chain is input-intensive and energy-demanding, with a notable carbon footprint, but demonstrates relatively low farm-level waste. Environmental sustainability improvements could focus on integrated nutrient and pest management, efficient water use, renewable energy adoption, and strategies to further reduce chemical runoff and emissions.

6.3 Integrated Environmental Insights

Table 6.3 synthesizes cross-cutting environmental hotspots for mango and pineapple. The comparative summary supports identification of circular economy entry points such as composting, regenerative agriculture, low-carbon logistics, and waste-to-resource processing.

A comparative assessment of the environmental hotspots in the mango and pineapple value chains highlights notable differences in input intensity, energy use, and waste generation. Fossil fuel consumption is higher in the pineapple chain than in the mango chain. Mango traders consume 498 L of diesel per market cycle, whereas the pineapple chain (including both producers and traders) uses a total of 10,897 L per season, reflecting the energy-intensive nature of pineapple production, which requires frequent field operations such as land preparation, planting, and chemical application, as well as transportation over longer distances.

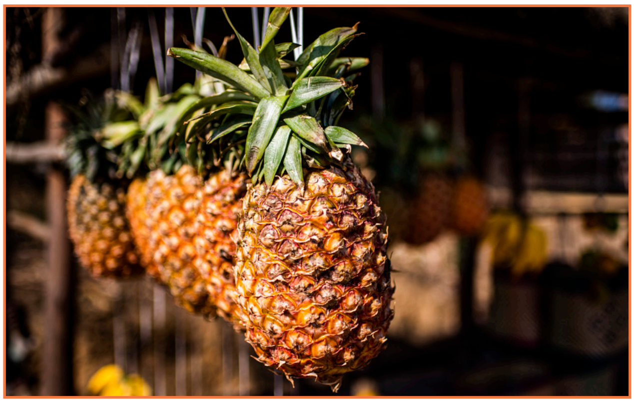
Fertiliser use also shows stark contrasts. Mango producers apply 759 kg of synthetic fertiliser supplement this with 1,101 kg of organic manure while pineapple production relies heavily on 76,550 kg of synthetic fertiliser and minimal organic inputs (217 kg), indicating a strong dependence on chemical nutrients and limited incorporation of organic amendments. This suggests a higher potential for soil degradation, nutrient runoff, and associated environmental impacts in the pineapple chain.

Table 6.3: Comparative Environmental Hotspots: Mango vs. Pineapple

Category	Mango Chain	Pineapple Chain	Interpretation
Fossil fuel use	High (traders: 498 L/cycle)	Very high (producers + traders: 10,897 L/ season)	Pineapple more fuel-intensive overall; mango more transport-heavy.
Synthetic fertilisers	759 kg	76,550 kg	Pineapple production is disproportionately nutrient-intensive.
Organic fertilisers	1,101 kg	217 kg	Mango producers apply more organic inputs but still insufficient.
Pesticides (insecticides + herbicides)	329 L combined	920 L combined	Pineapple chain heavily reliant on chemicals.
Major waste hotspot	148,869 kg mango waste	81 kg per 1,000 kg pineapple	Mango waste volume significantly larger.
PPE use	0%	Not reported (likely similarly low)	Occupational hazards remain a major concern.

Pesticide application is another hotspot for consideration. Mango producers use 329 L of combined insecticides and herbicides, while pineapple producers apply 920 L, almost three times more, highlighting the intensive chemical management required for pineapple cultivation. Waste generation differs markedly between the two chains. Mango experiences very high losses, with 148,869 kg of waste, representing 18.8% of total harvest, primarily at the farm level. Pineapple losses are considerably lower, at 81 kg per 1,000 kg harvested (8.1%), reflecting more efficient handling, shorter harvest-to-market intervals, and strong market linkages.

Overall, the mango chain's primary environmental hotspot is post-harvest waste, whereas the pineapple chain is more input- and energy-intensive, with high synthetic fertiliser and pesticide use and significant diesel consumption. Both chains share challenges in occupational safety due to low PPE adoption. Interventions should thus be tailored: mango interventions should focus on reducing post-harvest losses, while pineapple strategies should target sustainable input management and energy efficiency.



7.0 Social, Labour & Gender Analysis

The mango and pineapple value chains in Ghana are shaped by deeply rooted social structures, gender roles, labour dynamics, and inequalities that directly influence productivity, market access, resource control, and the ability of actors to adopt circular economy innovations. Understanding these dimensions is critical, as circular interventions can only be effective and sustainable if they respond to the lived realities of men, women, and young people within these systems.

7.1 Gendered Distribution of Roles

A striking feature of both fruit value chains is the strong gender segmentation of economic activities. In the mango value chain, quantitative evidence shows that only 16 out of 81 producers (19.8%) are women, whereas 37 out of 38 traders (97%) are women. This means mango production is overwhelmingly male-dominated, while mango marketing and distribution are almost exclusively handled by women. In the pineapple value chain, the pattern is similar though slightly less extreme. Approximately 15% of pineapple producers are women, while nearly 78% of pineapple traders are women. Women, therefore, dominate front-end market interactions but have limited control over land, finance, and decision-making spaces within production segments.

These gendered patterns reflect broader inequalities in land inheritance, access to credit, labour availability, and exposure to extension services. Women's dominance in trading also means that they experience the highest exposure to post-harvest losses, market price fluctuations, and packaging waste challenges.

7.2 Land Access and Control

Access to land is one of the most significant drivers of gender disparity. In the mango chain, male producers cultivate an average of 16.3 acres compared to 3.5 acres for female producers. This suggests that women operate on less than one-quarter of the land cultivated by men. This disparity directly affects output volumes, income potential, and capacity to invest in sustainable or circular practices such as composting units, improved irrigation, or on-farm sorting structures.

In the pineapple chain male producers manage an average of 10.4 acres of total agricultural land with about 3.8 acres under pineapple. In the case of female producers, the total landholding is about 5.4 acres out of which 2.8 acres are used for pineapple production. Despite having smaller land sizes, female pineapple farmers report higher yields per acre (11,340 kg/acre) compared with men (9,980 kg/acre), demonstrating strong efficiency despite structural constraints. These findings indicate that women often achieve more with less, reinforcing the need for gender-responsive investments and targeted circularity interventions.

7.3 Labour Dynamics and Employment Patterns

Labour arrangements differ significantly across the two value chains. In mango production, farm labour is seasonal and heavily reliant on family members and hired male labour. Activities such as pruning, harvesting, spraying, and orchard management are labour-intensive and physically demanding, limiting women's participation in certain tasks. In the pineapple chain, however, the labour system is somewhat more commercialized. Male traders employ an average of 2.2 workers, whereas female traders employ just about one (0.6) worker. Female traders often rely on unpaid family support, while male traders mobilise more hired labour for loading, unloading, transport, and wholesale activities. This uneven distribution of labour contributes to gendered differences in scale, bargaining power, and profit margins.

Youth participation in farming remains low across both value chains. Many young people view fruit farming as risky due to long maturation periods (particularly for mango), limited access to land, and insufficient financial incentives. However, youth involvement is more visible in trading and transport services, especially within pineapple markets.

7.4 Education, Skills and Access to Information

Educational levels among value chain actors are relatively low, particularly among women traders. In the mango chain, over 62% of female traders and 59% of female producers had only basic education or no formal education. A similar pattern appears in the pineapple value chain, where most women traders have primary or junior high school education.

These educational constraints are likely to affect value chain actors' ability to adopt improved and/or circular technologies, access to formal finance, keeps business records and undertake business planning, engage with certification schemes (e.g. GlobalGAP., organic standards) and understand waste management, composting and input optimization. Therefore, circular economy interventions must include skills training suited to low-literacy environments.

7.5 Occupational Health and Chemical Exposure

Both chains exhibit high levels of agrochemical use combined with zero use of Personal Protective Equipment (PPE).

Among mango farmers:

- 78% use insecticides, totaling 211 litres
- 54% use herbicides, totaling 118 litres
- 0% use PPE

Pineapple producers demonstrate similar patterns:

- 755 litres of herbicides
- 165 litres of insecticides
- 76,550 kg of chemical fertiliser
- With minimal organic fertiliser use (217 kg)

The absence of PPE exposes farmers, especially male farmers in mango and pineapple production, to acute and chronic health risks while also posing contamination risks for communities. Traders also face hazards through handling spoiled fruits, packaging waste, and exposure to vehicular emissions during transportation.

7.6 Social Trust, Institutional Relations and Community Dynamics

Fieldwork revealed widespread frustration due to years of engagements with external organisations that did not provide feedback or tangible benefits. This mistrust affects:

- Willingness to adopt innovations
- Participation in future surveys or training
- Acceptance of circular models requiring collective action

For instance, in Somanya and surrounding communities, multiple actors explicitly expressed survey fatigue and skepticism towards new interventions, underscoring the need for transparent, consistent engagement throughout any circular economy rollout. Also, some cooperatives exist but remain underutilized. Membership is moderate but coordination is weak, limiting their role in aggregation, price negotiation, and investment in shared circular assets (e.g., composting centres, crates, shared cold storage, etc.).

7.7 Implications for Circular Economy Interventions

These social, labour, and gender dynamics have direct implications for the feasibility and sustainability of circular models:

i. Women traders are key entry points for reusable packaging, sorting, and waste recovery systems.

ii. Female producers achieve high efficiency, making them strong candidates for training in value addition and composting.

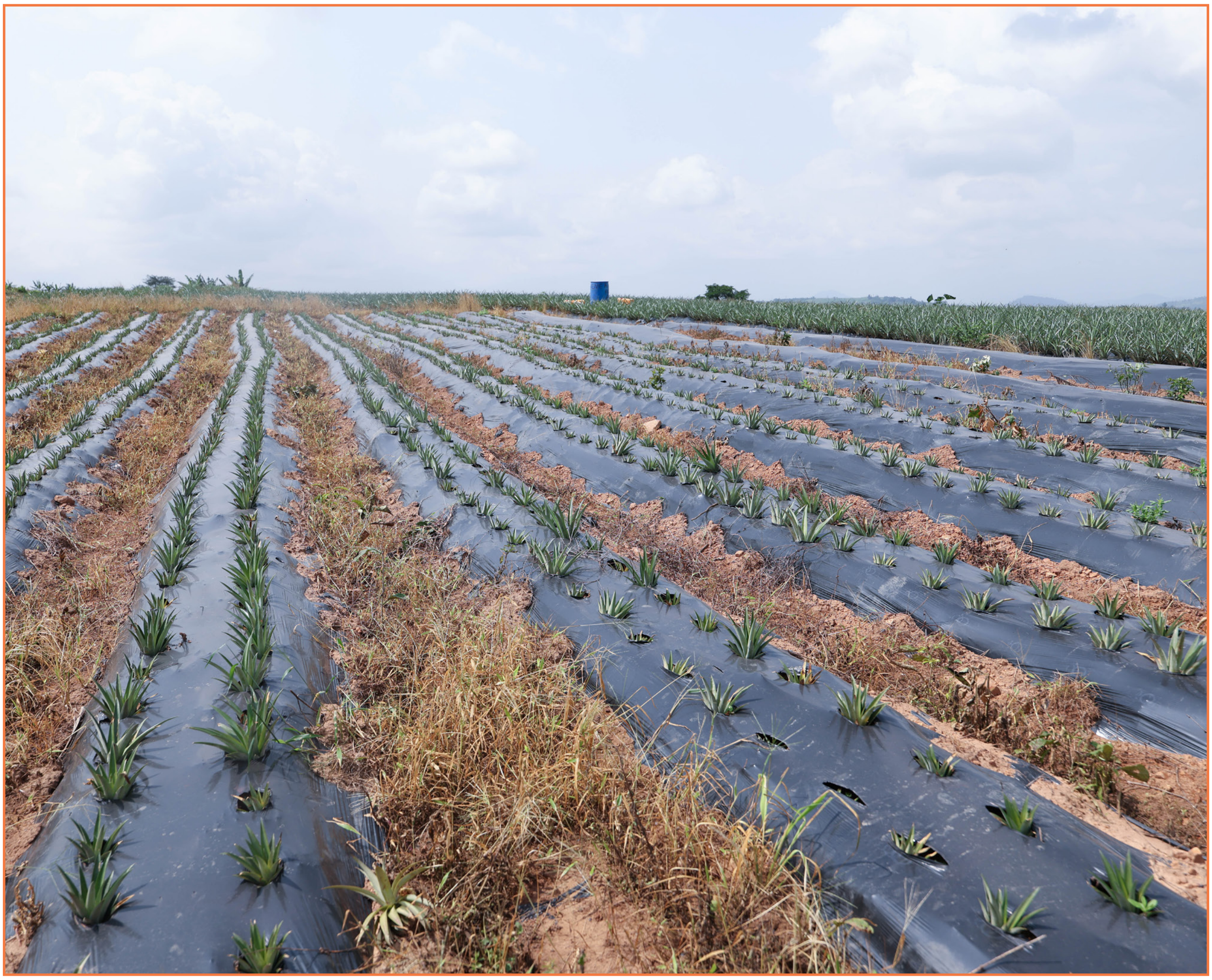
iii. Low educational levels require tailored, practical training approaches rather than theory-heavy models.

iv. Lack of PPE use signals a need for circular models that reduce chemical dependence, such as compost use, biofertiliser adoption, or integrated pests and disease management.

v. Youth can be mobilised into new circular business models, such as waste aggregation, seedlings production, drying, logistics, and crate management.

vi. Trust-building is essential, requiring feedback mechanisms, transparent monitoring, and long-term engagement.

vii. Gender-responsive finance will be critical to enable women, who dominate trade but have limited capital, to invest in circular assets such as crates, small dryers, or storage boxes.



8.0 Circularity Assessment & Hotspots

This section assesses the circularity performance of the mango and pineapple value chains by examining current waste streams, material inefficiencies, existing circular practices, and potential points of intervention for resource recovery, nutrient cycling, and value addition. The analysis synthesizes evidence from material flow quantification, environmental input use, observed farmer and trader practices, and infrastructure conditions across the Somanya–Akuse mango belt and the Nsawam–Akuapim South pineapple corridor. Circular hotspots were identified at farm, aggregation, market, and processing levels, revealing both areas of significant inefficiency and opportunities for scalable circular interventions.

8.1 Circularity Hotspots Across the Mango and Pineapple Value Chains

The table below summarises the major circularity hotspots identified across both value chains, describing the nature of each hotspot, the evidence supporting its significance, and the opportunities it presents for circular interventions.

Table 8.1. Circularity Hotspots Identified in the Mango and Pineapple Value Chains

Circularity Hotspot	Evidence From Value Chain Assessment	Circular Opportunity
High on-farm fruit losses (mango)	148,869 kg of mango left unutilised (18.8% of total harvest) at producer level	Solar drying, puree production, fruit leather, decentralised processing
Unutilised pineapple residues	81 kg per 1,000 kg harvested remains unutilised (8.1%)	Composting, animal feed pellets, bio-fermentation
Trader-level spoilage	2.05% discard per mango trading cycle; 1.9% pineapple discard per 1,000 kg	Market-level cold storage, grading, reusable crates
Abandoned packhouse infrastructure	Ajankiti packhouse inactive since 2013 (Nsawam corridor)	Rehabilitation for aggregation, sorting, light processing
High agrochemical dependence	Pineapple: 76,550 kg fertiliser; Mango: 759 kg synthetic fertiliser, heavy insecticide/herbicide use	Composting systems, organic fertiliser uptake, integrated pest management
Packaging waste accumulation	Heavy reliance on single-use polybags, sacks, boxes	Reusable crates, community packaging banks, deposit-return systems
Untapped biomass from pruning and peels	Mango pruned branches and pineapple crowns discarded; HPW demonstrates viable valorisation	Charcoal briquettes, compost, bioenergy, enzyme extraction

Circularity Hotspot	Evidence From Value Chain Assessment	Circular Opportunity
Limited nutrient cycling	Organic input use <1% in pineapple; 17% of mango farmers use organic inputs	Compost hubs, manure blending, circular soil fertility models
Low PPE use and chemical exposure	0% of mango producers use PPE; high chemical volumes used	PPE provision models, eco-input training, cooperative procurement
Weak producer–processor linkages	Surplus mango and pineapple not absorbed by buying companies	Contract-based aggregation, off-taker-linked value addition

8.2 Existing Circular Practices Already in Use

The following table documents circular practices already occurring informally or institutionally within the fruit value chains, forming a basis for scalable circular models.

Table 8.2. Existing Circular Practices in the Mango and Pineapple Value Chains

Existing Practice	Observed Among Which Actors	Circular Function
Use of pruned mango branches for charcoal/firewood	Mango farmers (Somanya and Akode No. 1)	Biomass recovery and energy substitution
Using mango seeds for planting material production as rootstock	Nursery managers, HPW, local growers	Seed reuse and propagation
Purchase of compost derived from mango waste	Mango farmers linked to Blue Skies compost facility	Nutrient cycling
HPW's zero-waste pineapple processing model	Industrial processor (Adeiso)	Bio-digestion, composting, animal feed production
Feeding damaged pineapples to pigs	Pineapple farmers and aggregators	Organic waste valorisation
Use of pineapple crowns (suckers) for planting/propagation	Pineapple farmers	Biological regeneration of planting materials

8.3 High-Potential Circular Opportunities

This table summarises priority circular opportunities with high feasibility and high impact potential, supported by MFA and environmental data.

Table 8.3. Priority Circular Opportunities for Mango and Pineapple

Opportunity Area	Justification / Evidence	Potential Impact
Community-level solar drying hubs	~149 tonnes of mango wasted; 81 kg per 1000 kg pineapple unutilised	Reduced losses, new products, women/youth employment
Rehabilitation of Ajankiti packhouse	Underutilised infrastructure; traders lack aggregation space	Improved sorting, grading, lower spoilage
Reusable crate packaging systems	High trader-level waste from sacks and polybags	Reduce mechanical damage, reduce plastic waste
Organic fertiliser integration	Pineapple organic inputs <1%; Mango 17% farmers use organics	Reduced chemical footprint, improved soil health
Micro-composting units	Large organic volumes from both value chains	Soil improvement, reduced fertiliser costs
Fruit peel valorisation (vinegar, enzymes)	High acidity and sugar content in mango/pineapple residues	New income streams, SME development
Contract farming & aggregation centres	Weak formal linkages with processors	Stable income, reduced gluts

8.4 Barriers to Circularity Adoption

Key constraints that currently limit the adoption of circular practices in the fruit value chains are summarized in the table.

Table 8.4. Barriers to Circularity in the Value Chains

Barrier	Evidence	Implication
High cost of technology	Farmers lack access to dryers, shredders, composters	Limits processing and waste valorisation
Infrastructure gaps	Non-functional packhouse; lack of cold storage	Continues post-harvest losses
Limited finance for women traders	97% of mango traders are women but lack capital	Constrains adoption of reusable crates & processing
Low cooperative strength	Weak organisation in both chains	Limits aggregation and circular activities
Lack of PPE and safety training	No mango farmer reported PPE use	Chemical exposure; limits organic transition
Weak extension support	Minimal training on composting, organic alternatives	Limits introduction of CE practices

8.5 Circularity Readiness Summary

A synthesis of the overall circularity readiness of the mango and pineapple value chains is summarized in Table 8.5.

Table 8.5. Circularity Readiness Index (Qualitative Assessment)

Dimension	Mango Chain Readiness	Pineapple Chain Readiness	Interpretation
Resource Efficiency	Low–Moderate	Moderate	Pineapple more efficient (10% loss vs. 25% for mango)
Waste Valorisation	Low	Moderate–High (HPW model)	Mango lacks industrial model; pineapple has model but not community scale
Infrastructure Support	Low	Low–Moderate	Packhouse nonfunctional/unused; markets lack cold storage
Actor Organisation	Moderate	Moderate	Both chains have partial cooperative presence
Gender Inclusion	Low	Low	Women face major barriers in both chains
Environmental Sustainability	Low	Low	High pesticide/fertiliser use in both chains

9. Priority Opportunities & Recommendations

This section outlines the critical circular economy opportunities identified across the mango and pineapple value chains and proposes strategic recommendations to enhance efficiency, reduce post-harvest losses, minimise environmental impacts, and strengthen the social inclusiveness of both systems. The recommendations draw directly on the quantified losses, environmental indicators, actor characteristics, and structural bottlenecks analysed in the preceding sections. They are presented with the intention of guiding policymakers, development partners, private sector stakeholders, and farmer organisations toward interventions that are technically viable, economically feasible, and socially equitable.

9.1 Priority Circular Economy Opportunities

9.1.1 Waste Valorisation and Post-Harvest Utilisation

Across both fruit value chains, large volumes of organic waste emerge at farm and market stages. Mango producers experience farm-level losses of 148,869 kg per season, representing a major circular resource stream. In pineapple, roughly 81 kg per 1,000 kg harvested remains unutilised at farm level. These losses present high-value opportunities for:

- Solar drying of ripe mangoes and pineapple slices
- Production of mango puree, pineapple juice, vinegar, and fruit leather
- Extraction of bromelain from pineapple residues
- Composting and biofertiliser production
- Livestock feed formulation using peels and pulp residues

Valorisation models such as HPW Fresh & Dry's near zero-waste system demonstrate operational feasibility and offer transferable lessons for community-level adoption.

9.1.2 Reduction of Post-Harvest Losses Through Infrastructure Strengthening

Evidence from the value chain mapping indicates that both mango and pineapple systems lack adequate aggregation, grading, storage, and handling facilities. The abandoned Ajankiti packhouse remains a critical missed opportunity for post-harvest management. Priority actions include:

- Rehabilitation of the Ajankiti packhouse as a multi-value chain aggregation and light-processing hub
- Establishment of community fruit collection centres equipped with shade structures and sorting tables
- Dissemination of reusable crates to reduce mechanical damage during transport
- Introduction of basic cold storage or evaporative cooling technologies at market points

These measures have the potential to reduce mango and pineapple losses at the market level by up to 50 percent.

9.1.3 Circular Input Systems and Soil Nutrient Management

The quasi-LCA demonstrated heavy reliance on synthetic agrochemicals, 76,550 kg of fertiliser in pineapple and 759 kg of synthetic fertiliser in mango, with minimal uptake of organic alternatives. Opportunities include:

- Scaling community composting units using mango and pineapple residue
- Developing public–private compost

distribution models linked to processors such as Blue Skies

- Training farmers in integrated soil fertility management (ISFM)
- Piloting organic-chemical fertiliser blends tailored to fruit crops

These interventions could reduce chemical dependency, enhance soil health, and promote nutrient circularity.

9.1.4 Gender-Responsive and Youth-Inclusive Circular Solutions

The social analysis revealed stark gender disparities: only 19.8 percent of mango producers and 15 percent of pineapple producers are women, while women dominate trading activities. Youth presence in production remains low. Recommendations include:

- Establishing women-led processing cooperatives
- Designing youth-focused business models for waste collection, seedling production, and market logistics
- Providing gender-focused microfinance packages targeting female traders and smallholder female farmers
- Delivering skills training in solar drying, juice extraction, and low-cost processing technologies.

These interventions ensure that circularity delivers social as well as environmental benefits.

9.1.5 Strengthening Institutional Linkages and Private Sector Collaboration

Both value chains currently suffer from fragmented coordination. Strengthening institutional and private sector partnerships will support:

- Outgrower schemes with guaranteed off-takers
- Expansion of subcontracting opportunities with HPW, Blue Skies, and Bomarts
- Integration of circularity metrics into district agricultural planning
- Support for farmer-based organisations (FBOs) to facilitate bulk purchasing and marketing

Such institutional alignment is essential for sustained circular transition.

9.2 Recommendations

Short term, medium term and long-term recommendations have been summarized below.

Short-Term (0–12 months)

1. Rehabilitate the Ajankiti packhouse and reactivate it as an aggregation and light-processing node.
2. Deploy reusable crate programmes among traders to replace single-use plastic packaging.
3. Train farmers and traders in sorting, grading, and improved post-harvest hygiene.
4. Establish pilot composting facilities in Somanya and Nsawam using market-level and farmgate fruit waste.
5. Organize farmer field schools on pesticide safety and PPE use.

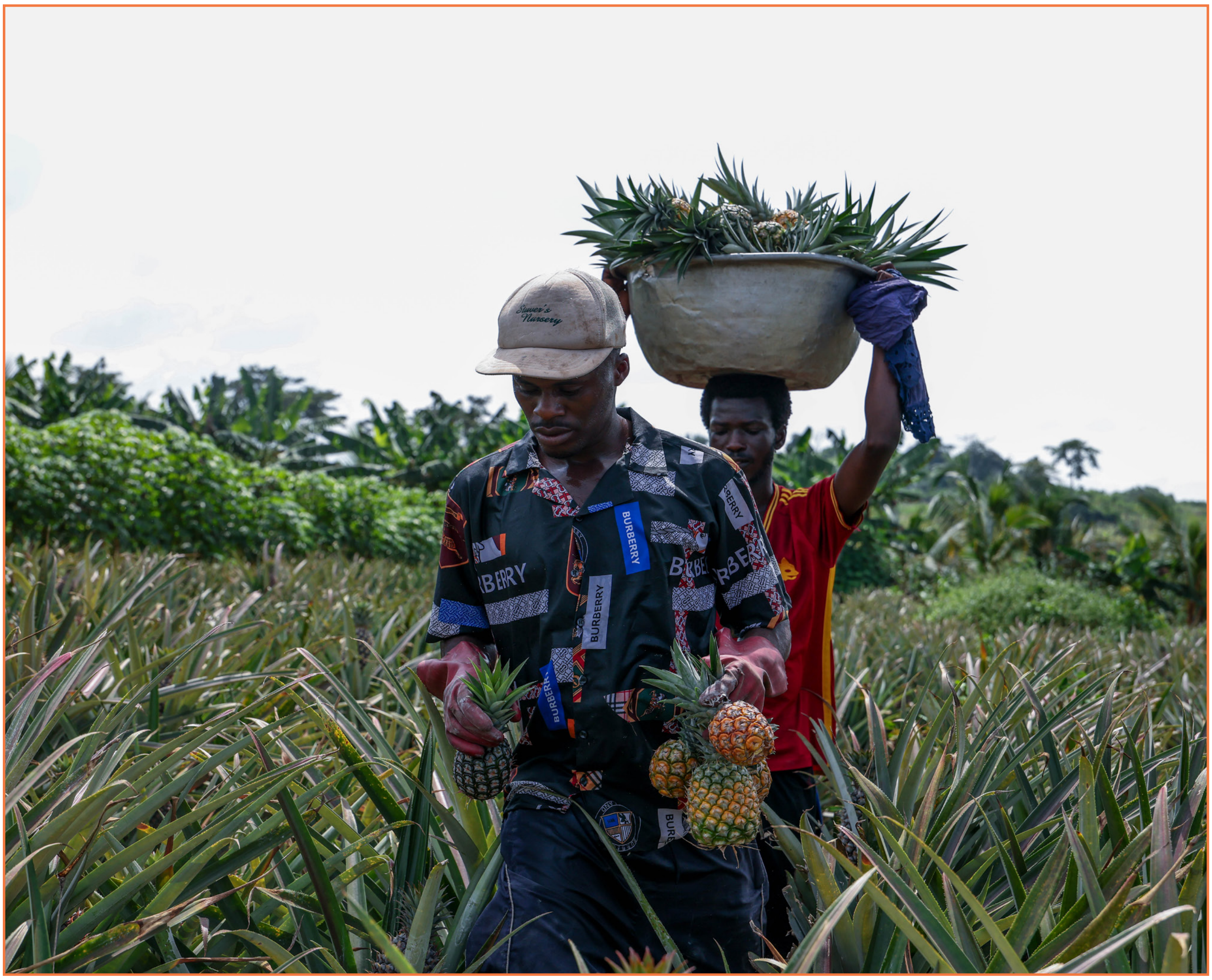
Medium-Term (1–3 years)

1. Introduce solar drying micro-enterprises for mango and pineapple in producer communities.

2. Develop mobile aggregation services to reduce on-farm losses during peak seasons.
3. Facilitate access to low-interest financing for women and youth engaged in processing and logistics.
4. Expand collection centres in trading hubs with shade structures and basic post-harvest infrastructure.

Long-Term (3–7 years)

1. Promote industrial symbiosis models, where fruit residues fuel biogas plants, compost facilities, or animal feed operations.
2. Integrate circular economy indicators into district agricultural planning and monitoring frameworks.
3. Strengthen export-oriented circular processing for dried fruits, concentrates, and powders.
4. Establish a national circular horticulture platform to coordinate actors, innovations, and financing.



10. Conclusion

The analysis of Ghana's mango and pineapple value chains reveals two dynamic but structurally constrained systems that hold significant potential for circular economy transformation. Across both commodities, the study demonstrates that value creation is currently undermined by high post-harvest losses, heavy reliance on synthetic inputs, weak storage and aggregation systems, and limited waste valorisation. Material Flow Analysis shows that approximately 25 percent of mango and 10 percent of pineapple fruits produced across the surveyed regions fail to reach consumers, representing major inefficiencies in labour, land, inputs, and environmental resources. These losses occur predominantly at the production level in mango and at both production and market levels in pineapple, driven by challenges such as seasonality, inefficient harvesting and sorting practices, and absence of appropriate storage infrastructure.

The environmental assessment indicates substantial dependence on fossil fuels and agrochemicals, with diesel consumption exceeding 10,000 litres in the pineapple chain and considerable fertiliser and pesticide application recorded across both fruit chains. Such practices contribute to greenhouse gas emissions, soil degradation, and occupational health risks. Social and gender analysis further highlights systemic inequalities with men dominating land ownership and primary production, while women, who form the majority of traders operate smaller businesses with lower access to finance and equipment. Youth engagement remains limited, reflecting deeper challenges in land access, capital constraints, and perceived risks in fruit farming.

Despite these constraints, the findings reveal a landscape that is rich with opportunities for circular innovations. Existing practices such as composting of fruit waste, reuse of mango seeds for seedling production, conversion of pruned branches into energy products, and industrial-scale zero-waste processing model at HPW Fresh & Dry demonstrate the feasibility of circular models in the Ghanaian context. Underutilised infrastructure such as packhouses, coupled with emerging local innovations such as small-scale drying, present practical entry points for community-led circular economy interventions. The potential to expand solar drying, decentralised processing units, nutrient recycling systems, reusable crate networks, and waste-to-energy or composting platforms offer clear pathways to reduce losses and enhance value retention.

The need to coordinate efforts across institutions and mobilize resources to build capacity, improve existing infrastructure and introduce new ones as pathways for circular interventions in Ghana's fruit industry is quite apparent now.

Appendix

Appendix: Data Collection Instruments

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
&
GHANA CIRCULAR ECONOMY PROJECT, UNIDO

CIRCULAR ECONOMY STUDY ON SELECTED AGRICULTURAL AND AGRO-PROCESSING VALUE CHAINS IN GHANA

(BASELINE & CIRCULAR OPPORTUNITIES MAPPING SURVEY)

QUESTIONNAIRE FOR PRODUCERS/FARMERS

Consent note:
My name is.. I am from KNUST working on the Ghana Circular Economy Project in collaboration with UNIDO and HTU. You have been approached to help respond to some questions on your role and general operations along the agriculture & Agro-processing value chain because of your special position and activities in the chain. Any information you provide will be used solely for research purposes, and no information shared with us will be disclosed to any person or group without your prior consent or notification. While we don't promise any direct benefit to you from this interview, the findings have the potential of making a contribution to our understanding of the circular opportunities along the value chain that can be explored for enterprise development to create employment in the near future. There are no known risks associated with your participation in this research other than your time spent with us. Your participation is voluntary, and you have the right to withdraw from the interview at any point when you are not comfortable. However, your participation to the end would be very much appreciated.

Thank you.

Are you willing to participate in this study? 1. Yes|__| 2. No|__|
If YES, proceed but If NO, end survey.

Are there any questions you want to ask about the research? 1. Yes|__| 2. No|__|
If YES, please ask your question. If NO, proceed.

A. Screening / Identification Questions

No.	Question	Response
A.1	Questionnaire ID	
A.2	Name of Enumerator	
A.3	Name of Respondent	
A.4	Contact of respondent	
A.5	Date of interview	
A.6	Starting time of interview	
A.7	Region	1. Ashanti [ ] 2. Brong [ ] 3. Bono East [ ]
A.8	District/Municipality	1. Mampong [ ] 2. Techiman [ ] 3. Amanteng [ ] 4. Kintampo North [ ] 5. Sunyani West [ ] 6. Akuapim South [ ] 7. Ga West [ ] 8. Asuogyaman [ ] 9. Others (----- --------------------
A.9	Community	
A.10	Value chain Type	1. Cassava [ ] 2. Mango [ ] 3. Pineapple [ ] 4. Fish [ ]

SECTION 1: DEMOGRAPHIC INFORMATION

1. Sex of respondent	Female |__| Male |__|
2. Age of respondent	<36yrs|__| 36-49yrs|__| 50-60yrs|__| >60yrs|__|
3. Highest educational level	None|__| Basic|__| Secondary|__| Tertiary|__|
4. Marital status of respondent	Single, never married |__| Married |__| Separated/ Divorced/widowed|__|
5. Total Household size	|__|
6. Number of adults in the household (>18years)	|__|
7. Number of women in the household	|__|______
8. Religion	Christianity|__| Islam|__| Traditionalist|__| Others (Specify) |__|...............
9. Primary occupation	Farming|__| Salaried work|__| Agro-processing|__| Trading|__| Other (Specify) |__|..................
10. Secondary occupation	Farming|__| Salaried work|__| Agro-processing|__| Trading|__| Other (Specify) |__|..................
11. Residential Status	Native|__| Non-native|__|
12. Member of Association/ Cooperative	Yes|__| No|__|
13. Total membership of your cooperative/group	|__||__||__|

SECTION 2: FARM LEVEL INFORMATION

1. For how many years have you been farming .... years
2. How many years have you been producing the target commodity (*Cassava/Mango/Pineapple/Fish*) .... years

3. What is the total agricultural land available to your household? (Including rented or leased lands)	|_____|acres
4. What was the total agricultural land (*size of pond/cage in the case of fish*) used for the production of the target commodity last year?	|____| acres
5. How did you acquire the land?	Purchased|__| Family/Inherited|__| Rented/Leased|_| Gifted |_| Others|__...................................... |
6. What was the main method of land preparation?	Manual|__| Mechanical (tractor)|__|
7. What variety of the target commodity did you cultivate last year?	.... Code 1 (codes below the table)
8. What was the dominant source of your planting material? (Single selection)	Own farm|__| Fellow farmers|__| Agro-input dealers|__| NGO|__| FBO|__| Open market|__| Research Center [ ] Others|_..............._|

Code 1: Cassava varieties; 1=Tek Bankye 2=Capevas Bankye 3= Bankye Esam 4=Debo 5=Kuffour Bankye 6=Akosua tuntum; 7=others (Specify….)

Mango Variety; 1=Keitt 2=Kent 3=Palma 4=Others (Specify...

Pineapple Variety: 1=Sugar loaf 2=Smooth Cayenne 3=MD2 7= others (Specify..............................

Fish type grown: 1=Tilapia 2=Catfish 3=Others (Speify..

9. Production inputs

Please provide information on the inputs used for your commodity (---------------------) production last year per Acre

Input	Main source (codes)	Quantity	Unit price (GHC)	Total Cost (GHC)
i. Planting material/seedlings*				
ii. Fertilizer (NPK - 50 kg)				
iii. Fertilizer (Urea - 50 kg)				
iv. Organic Fertilizer (FYM – Kg)				
v. Herbicides (liters)				
vi. Insecticides (liters)				
vii. Fuel for ploughing (liters)				
viii.Fuel for transporting inputs (Litres)				
ix. Water for spraying chemicals (litres)**				
x. Waste associated with Planting material preparation/planting (pieces of cassava sticks and pineapple suckers left over, black polybags holding mango seedlings removed during planting)				
xi. Fuel for transporting harvested produce (Litres)				
xii. Packaging material (e.g. sacks, plastic crates, paper, cartons, etc.)				
xiii.Other_1:				
xiv. Others_2:				
xv. Others_3:				

***Codes for source of planting materials & agrochemicals:** 1=own production; 2= Fellow farmers; 3=Government Agency; 4=Research Center; 5= Private nursery; 6=Agro-input shop; 7= Poultry/livestock farm; 8=Open market; 9=others______

****Code for water sources:** 1=Rainfall; 2=Borehole; 3=stream/river; 4= Dam/small-scale irrigation scheme; 5=others______

10. Output from production, Losses and Waste Generated

Item	Quantity (kg)	Unit Price (GHC)	Market Value (GHC)
a. Total quantity of commodity harvested			
b. Quantity of commodity sold			
c. Quantity used for own household food consumption & quantity gifted			
d. Quantity used for animal feed			
e. Quantity lost (during harvesting, gathering, loading and transportation).			
f. Quantity of waste/debris generated after harvest (leaves, sticks, fruits, rotten tubers, peels, etc.)			

11. Qualitative Losses

In your estimation, what proportion (%) of the **economic value (price)* of your commodity did you lose *<u>because of quality deterioration</u>*** when undertaking various value chain activities during your last year?	Proportion of Loss during **Last year** *1= 5% or less, 2= 6-10%, 3= 11-15%, 4= 16-20%, 5= 21-25% 6= 26-30%, 7= more than 30%.*
i. Proportion/Percentage loss in value (price*) of commodity during harvesting	
ii. Proportion/Percentage loss in value (price) of commodity during post-harvesting on-farm (i.e. during gathering and loading, etc.)	
iii. Proportion/Percentage loss in value (price*) of commodity due to Rodents or insect attack	
iv. Proportion/Percentage loss in value (price*) of commodity during storage	
v. Proportion/Percentage loss in value (price*) of commodity during processing	
vi. Proportion/Percentage loss in value (price*) of commodity during carting/transportation	

*Use the unit price of wholesome tuber/fruit that has suffered no quality defects as the standard.

12. Marketing Outlets

i. Indicate the main sales point of your commodity	Farm gate|__| Market within community|__| Market within district|__| Market outside the district|__| Market outside the region|__| Market outside Ghana |__|
ii. Indicate the main off-taker of your commodity	Aggregator|__| Wholesaler|__| Retailer|__| Processors/Food Vendors|__| Institutional buyers *(e.g., Hotels, schools, hospitals)* |__| Others *(Specify)* ....
iii. Average distance covered to deliver commodity (Km)	
iv. Means of transport to deliver commodity? *(bicycle/motorbike/ tricycle(aboboyaa)/public transport/Own truck/head carriage/others)*	
v. Did you experience any challenge in finding buyers or off-takers for your commodity last year?	Yes|__| No|__|
vi. If ***"Yes"*** what was the main reason?	....

SECTION 3: CIRCULAR OPPORTUNITIES

1. What proportion of the waste generated in your production process do you reuse or recycle back into your production process? ___%

2. In which ways do you reuse the waste?
   1. Composting/Farm Yard Manure [ ] 2. Mulching [ ] 3. Cooking fuel [ ]
   4. Animal feed [ ] 5. Others (_________________________) 6. Not Applicable [ ]

3. Are there other local uses for the waste generated from your commodity? Yes [ ] No [ ]

4. If yes, in which ways are the waste products being reused currently?

5. In which other ways do you think the waste products could be reused?

6. What technologies or approaches would be required to be able to reuse/recycle the waste from your production process?

7. Describe the employment generation potential of the ways in which the waste products could be reused or recycled

8. Are there opportunities to reduce waste in your production process? Yes [ ] No [ ]

9. If yes, in which ways?
10. What technologies or approaches are required to achieve reduce waste in your production process?

11. Describe the socio-economic benefits that can be derived from reducing waste in your production process?

SECTION 4: CONSTRAINTS ANALYSIS

Please, rank each of the following constraints in the production of your commodity in order of severity (Scale: 1=Very Low; 2=Low; 3=Quite High; 4=High; 5=Very High)

Constraint	Rank
Limited access to land	|__|
Limited access to quality planting materials	|__|
Erratic rainfall pattern	|__|
High incidence of pests and diseases	|__|
Limited knowledge in handling agro-chemicals	|__|
Limited access to improved production technology	|__|
Limited access to labour	|__|
High labour cost	|__|
High cost of other inputs	|__|
Limited access to market to sell produce	|__|
Limited access to market information	|__|
Limited knowledge about circular opportunities	|__|
Inadequate storage facility	|__|
High postharvest losses	|__|
Others 1 (Specify).....................................	|__|
Others 2 (Specify).....................................	|__|
Others 3 (Specify).....................................	|__|

SECTION 5: OTHER ISSUES

1. Has land use change over time resulted in deforestation, soil degradation, etc? (Yes/No)
2. If yes, how has this affected your production?

3. Describe the conservation measures you have adopted to maintain soil quality

4. How would you describe the relationship between you and your input suppliers?
   1. Very weak [ ] 2. Weak [ ] 3. Quite strong [ ] 4. Strong [ ] 5. Very strong [ ]

5. Do you have any formal contract (written) with some of your input suppliers?
   Yes [ ] No [ ]
6. If yes, are contract terms respected by input suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

7. If yes, do you respect the contract terms with your input suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

8. Do you have any formal contract (written) with some of your offtakers?
   Yes [ ] No [ ]

9. If yes, are contract terms respected by offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

10. If yes, do you respect the contract terms with your offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

11. What are your main sources of finance for your production/farming business?
    1. Own funding [ ] 2. Family and friends [ ] 3. Credit from Banks [ ]
    4. Credit from Cooperative Credit Union [ ] 5. Rotating Credit scheme/Susu [ ]
    6. VSLA [ ] 7. Private money lender [ ] 8. Others______________________

12. Suggest three key things that you require to improve the efficiency of your operations?
    i.____
    ii. ____
    iii.____

13. Is there anything you want to tell me about your business that I have not asked about?
    ____
    ____

14. Do you have any questions for me?
    ____
    ____

End of survey

GPS location of respondent	*I__I*
Ending time of Interview	*I_hh_:_mm_:_ss_I*
End note & Appreciation	We have come to the end of the interview. Thank you very much for your time and attention.

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
&
GHANA CIRCULAR ECONOMY PROJECT, UNIDO

CIRCULAR ECONOMY STUDY ON SELECTED AGRICULTURAL AND AGRO-PROCESSING VALUE CHAINS IN GHANA

(BASELINE & CIRCULAR OPPORTUNITIES MAPPING SURVEY)

QUESTIONNAIRE FOR PROCESSORS

Consent note:
My name is……………………………………… I am from KNUST working on the Ghana Circular Economy Project in collaboration with UNIDO and HTU. You have been approached to help respond to some questions on your role and general operations along the agriculture & Agro-processing value chain because of your special position and activities in the chain. Any information you provide will be used solely for research purposes, and no information shared with us will be disclosed to any person or group without your prior consent or notification. While we don't promise any direct benefit to you from this interview, the findings have the potential of making a contribution to our understanding of the circular opportunities along the value chain that can be explored for enterprise development to create employment in the near future. There are no known risks associated with your participation in this research other than your time spent with us. Your participation is voluntary, and you have the right to withdraw from the interview at any point when you are not comfortable. However, your participation to the end would be very much appreciated.

Thank you.

Are you willing to participate in this study? 1. Yes|__| 2. No|__|
If YES, proceed but If NO, end survey.

Are there any questions you want to ask about the research? 1. Yes|__| 2. No|__|
If YES, please ask your question. If NO, proceed.

A. Screening / Identification Questions

No.	Question	Response
A.1	Questionnaire ID	
A.2	Name of Enumerator	
A.3	Name of Respondent	
A.4	Contact of respondent	
A.5	Date of interview	
A.6	Starting time of interview	
A.7	Region	1. Ashanti [ ] 2. Brong [ ] 3. Bono East [ ]
A.8	District/Municipality	1. Mampong [ ] 2. Techiman [ ] 3. Amanteng [ ] 4. Kintampo North [ ] 5. Sunyani West [ ] 6. Akuapim South [ ] 7. Ga West [ ] 8. Asuogyaman [ ] 9. Others
A.9	Community/Location	
A.10	Value chain Type	1. Cassava [ ] 2. Mango [ ] 3. Pineapple [ ] 4. Fish [ ]
A.11	Position in the organization	1. Owner-manager [ ] 2. Manager [ ] 3. Management staff [ ] 4. Worker [ ] 5. Other_
A.12	Type of processor	1. Home level processing [ ] 2. Cottage level processing [ ] 3. Industrial processing [ ]

SECTION 1: DEMOGRAPHIC INFORMATION

1. Sex of respondent	Female |__| Male |__|
2. Age of respondent	<36yrs|__| 36-49yrs|__| 50-60yrs|__| >60yrs|__|
3. Highest educational level	None|__| Basic|__| Secondary|__| Tertiary|__|
4. Marital status of respondent	Single, never married |__| Married |__| Separated/ Divorced/widowed|__|
5. Total Household size	|__|
6. Number of adults in the household (>18years)	|__|
7. Number of women in the household	|__|______
8. Religion	Christianity|__| Islam|__| Traditionalist|__| Others (Specify) |__|................
9. Primary occupation	Agro-processing|__| Farming|__| Salaried work|__| Trading|__| Other (Specify) |__|..................
10. Secondary occupation	Agro-processing|__| Farming|__| Salaried work|__| Trading|__| Other (Specify) |__|..................
11. Residential Status	Native|__| Non-native|__|
12. Member of Association/ Cooperative	Yes|__| No|__|
13. Total membership of your cooperative/group	|__||__||__|

SECTION 2: PROCESSING LEVEL INFORMATION

1. For how many years have you been engaged in this processing business? .... years
2. How many workers support your processing business? Total________; Females_________; Males_________; Youth (<36yrs)___

3. What is your total installed capacity (Mt)	|_____| Mt
4. What is your actual operational capacity (MT)?	|____| Mt
5. Which best describes the ownership structure?	Own business (sole) |__| Family business/Inherited|__| Partnership|_| Cooperative/Group ownership |_| Others|__.................................... |
6. What best describes your processing technology?	Fully Manual|__| >50% Manual [ ] >50% Mechanized [ ] Fully mechanized [ ]

7. What variety of the target commodity do you usually process?	.... Code 1 (*codes below the table*)
8. What are the dominant sources of your raw material? (multi-selection)	Own farm|__| Contract producers [ ] Independent producers/farmers|__| FBOs/Cooperatives|__| Open market|__| Others|_....................................._|
9. Final product/intermediate product obtained from processing	Gari [ ] Starch [ ] fruit juice [ ] Dry Fruit chips [ ] Smoked fish [ ] salted fish [ ] Others______________
10. Main by-products from processing	Peels [ ] mango seeds [ ] Crowns [ ] Fish scales & intestines [ ] Waste water [ ]

Code 1: Cassava varieties; 1=Tek Bankye 2=Capevas Bankye 3= Bankye Esam 4=Debo 5=Kuffour Bankye 6=Akosua tuntum; 7=others (Specify....); ***Mango Varieties;*** 1=Keitt 2=Kent 3=Palma 4=Others (Specify..; ***Pineapple Varieties:*** 1=Sugar loaf 2=Smooth Cayenne 3=MD2 7= others (Specify..............................
Fish type processed: 1=Tilapia 2=Catfish 3=Others (Specify...

9. Processing inputs

Please provide information on the inputs used for your commodity (---------------------) processing in a typical business cycle

Input	Main source (codes)	Quantity	Unit price (GHC)	Total Cost (GHC)
xvi. Raw materials (main commodity- cassava, fruit, fish) (Mt)*				
xvii. Other raw materials (Ingredients/ additives)				
xviii. Water (litres)**				
xix. Fuel (Diesel) (Litres)				
xx. Fuel (Firewood) (Mt)				
xxi. Fuel (Biomass or crop residue) (Mt)				
xxii. Fuel (Petrol) (Litres)				
xxiii. Electricity (kWh)				
xxiv. Solar Energy used (MJ)				
xxv. Fuel for transporting raw materials (fresh produce) (litres)				
xxvi. Fuel for transporting other inputs (Litres)				
xxvii. Packaging material (Plastic bottles, gallons, etc)				
xxviii. Packaging materials (Bottles)				
xxix. Packaging material (others-sacks, papers, cartons, etc.)				
xxx. Fuel for transporting packaged processed products to customers (Litres)				
xxxi. Waste associated with transporting, processing, packaging, and transportation (Leftovers excluding by-products)				
xxxii. Waste in the form of by-products from the processing activities				
Other_1:				
Others_2:				
Others_3:				

Codes for sources of Raw materials: 1=own production; 2= Contract producers; 3=Independent farmers/producers;
4= FBOs/Cooperatives; 5=Open market; 6=others_______

****Code for water sources:*** 1=Rainfall; 2=Borehole; 3=stream/river; 5=others_______

10. Output from processing, Losses and Waste Generated during a typical processing cycle

Item	Quantity (kg)	Unit Price (GHC)	Market Value (GHC)
g. Total quantity of finished product obtained			
h. Quantity of finished product sold			
i. Quantity of semi-finished product obtained			
j. Quantity of semi-finished product sold			
k. Quantity of finished products consumed by household members or workers & quantity gifted			
l. Quantity used for animal feed			
m. Quantity lost (during processing, packaging, loading and transportation).			
n. Quantity of waste/debris generated after processing, packaging and loading			
o. Quantity of finished goods discarded due to contamination			
p. Quantity of finished goods discarded due to expiry			
q. Quantity of finished goods sold at reduced price due to quality deterioration			
r. Quantity of semi-finished goods discarded due to contamination			
s. Quantity of semi-finished goods discarded due to expiry			
t. Quantity of semi-finished goods sold at reduced price due to quality deterioration			

11. Marketing Outlets

vii. Indicate the main sales point of your commodity	Factory gate|__| Market within community|__| Market within district|__| Market outside the district|__| Market outside the region|__| Market outside Ghana |__|
viii.Indicate the main off-taker of your commodity	Distributor|__| Wholesaler|__| Retailer|__| Processors/Food Vendors|__| Institutional buyers ***(e.g., Hotels, schools, hospitals)*** |__| Others ***(Specify)*** ....
ix. Average distance covered to deliver finished product (Km)	
x. Means of transport to deliver finished product? (bicycle/ motorbike/tricycle(aboboyaa)/ public transport/Own truck/head carriage/by air/others)	
xi. Did you experience any challenge in finding buyers or off-takers for your commodity last year?	Yes|__| No|__|
xii. If ***"Yes"*** what was the main reason?	....

SECTION 3: CIRCULAR OPPORTUNITIES

12. What proportion of the waste generated in your processing operations do you reuse or recycle back into your processing business? ___%
13. In which ways do you reuse the waste? 1. Composting/Farm Yard Manure [ ] 2. Mulching on own farm [ ] 3. Cooking/heating fuel [ ] 4. Animal feed [ ] 5. Others (________________) 6. Not Applicable [ ]
14. Are there other local uses for the waste generated from your business? Yes [ ] No [ ]
15. If yes, in which ways are the waste products being reused currently?
16. In which other ways do you think the waste products could be reused?
17. What technologies or approaches would be required to be able to reuse/recycle the waste from your processing business?
18. Describe the employment generation potential of the ways in which the waste products could be reused or recycled

19. Are there opportunities to reduce waste in your operations? Yes [ ] No [

20. If yes, in which ways?

21. What technologies or approaches are required to reduce waste in your operations?

22. Describe the socio-economic benefits that can be derived from reducing waste in your processing business?

SECTION 4: CONSTRAINTS ANALYSIS

Please, rank each of the following constraints associated with your processing business in order of severity (Scale: 1=Very Low; 2=Low; 3=Quite High; 4=High; 5=Very High)

Constraint	Rank
Limited access to quality raw material	|__|
Inconsistent supply of raw materials	
High costs of raw materials	|__|
Limited knowledge in improved processing methods	|__|
Limited access to improved processing technology	|__|
Limited access to labour	|__|
High labour cost	|__|
High cost of fuel	|__|
Limited access to market to sell produce	|__|
Limited access to market information	|__|
Limited knowledge about circular opportunities	|__|
Inadequate storage facility	|__|
High level of losses associated with processing	|__|
Limited access to distribution trucks/vehicle	
High rate of accidents during distribution	|__|
Others 1 (Specify)……………………………	|__|
Others 2 (Specify)……………………………	|__|
Others 3 (Specify)……………………………	|__|

SECTION 5: OTHER ISSUES

15. How would you describe the relationship between you and your raw material suppliers?
 1. Very weak [ ] 2. Weak [ ] 3. Quite strong [ ] 4. Strong [ ] 5. Very strong [ ]

16. Do you have any formal contract (written) with some of your raw material suppliers?
 Yes [ ] No [ ]

17. If yes, are contract terms respected by raw material suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

18. If yes, do you respect the contract terms with your raw material suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

19. Do you have any formal contract (written) with some of your offtakers?
 Yes [ ] No [ ]
20. If yes, are contract terms respected by offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

21. If yes, do you respect the contract terms with your offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

22. What are your main sources of finance for your processing business?Own funding [ ] 2. Family and friends [ ] 3. Credit from Banks [ ] 4. Credit from Cooperative Credit Union [ ] 5. Rotating Credit scheme/Susu [ ] 6. VSLA [ ] 7. Private money lender [ ] 8. Others______________________

23. Suggest three key things that you require to improve the efficiency of your operations?
 i.____
 ii. ____
 iii.____

24. Is there anything you want to tell me about your business that I have not asked about?
 ____
 ____

25. Do you have any questions for me?
 ____
 ____

End of survey

GPS location of respondent/facility	|__|__|__|__|__|__|__|
Ending time of Interview	|_hh_:_mm_:_ss_|
End note & Appreciation	We have come to the end of the interview. Thank you very much for your time and attention.

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
&
GHANA CIRCULAR ECONOMY PROJECT, UNIDO

CIRCULAR ECONOMY STUDY ON SELECTED AGRICULTURAL AND AGRO-PROCESSING VALUE CHAINS IN GHANA

(BASELINE & CIRCULAR OPPORTUNITIES MAPPING SURVEY)

QUESTIONNAIRE FOR TRADERS

Consent note:
My name is... I am from KNUST working on the Ghana Circular Economy Project in collaboration with UNIDO and HTU. You have been approached to help respond to some questions on your role and general operations along the agriculture & Agro-processing value chain because of your special position and activities in the chain. Any information you provide will be used solely for research purposes, and no information shared with us will be disclosed to any person or group without your prior consent or notification. While we don't promise any direct benefit to you from this interview, the findings have the potential of making a contribution to our understanding of the circular opportunities along the value chain that can be explored for enterprise development to create employment in the near future. There are no known risks associated with your participation in this research other than your time spent with us. Your participation is voluntary, and you have the right to withdraw from the interview at any point when you are not comfortable. However, your participation to the end would be very much appreciated.

Thank you.

Are you willing to participate in this study? 1. Yes|__| 2. No|__|
If YES, proceed but If NO, end survey.

Are there any questions you want to ask about the research? 1. Yes|__| 2. No|__|
If YES, please ask your question. If NO, proceed.

A. Screening / Identification Questio ns

No.	Question	Response
A.1	Questionnaire ID	
A.2	Name of Enumerator	
A.3	Name of Respondent	
A.4	Contact of respondent	
A.5	Date of interview	

No.	Question	Response
A.6	Starting time of interview	
A.7	Region	1. Ashanti [ ] 2. Brong [ ] 3. Bono East [ ]
A.8	District/Municipality	1. Mampong [ ] 2. Techiman [ ] 3. Amanteng [ ] 4. Kintampo North [ ] 5. Sunyani West [ ] 6. Akuapim South [ ] 7. Ga West [ ] 8. Asuogyaman [ ] 9. Others
A.9	Community/Location	
A.10	Value chain Type	1. Cassava [ ] 2. Mango [ ] 3. Pineapple [ ] 4. Fish [ ]
A.11	Position in the organization	1. Owner-manager [ ] 2. Manager [ ] 3. Management staff [ ] 4. Worker [ ] 5. Other_
A.12	Type of Trader	1. Wholesaler [ ] 2. Retailer [ ]

SECTION 1: DEMOGRAPHIC INFORMATION

1. Sex of respondent	Female |__| Male |__|
2. Age of respondent	<36yrs|__| 36-49yrs|__| 50-60yrs|__| >60yrs|__|
3. Highest educational level	None|__| Basic|__| Secondary|__| Tertiary|__|
4. Marital status of respondent	Single, never married |__| Married |__| Separated/ Divorced/widowed|__|
5. Total Household size	|__|
6. Number of adults in the household (>18years)	|__|
7. Number of women in the household	|__|______
8. Religion	Christianity|__| Islam|__| Traditionalist|__| Others (Specify) |__|................
9. Primary occupation	Trading|__| Agro-processing|__| Farming|__| Salaried work|__| Other (Specify) |__|..................
10. Secondary occupation	Trading|__| Agro-processing|__| Farming|__| Salaried work|__| Other (Specify) |__|..................
11. Residential Status	Native|__| Non-native|__|
12. Member of Association/ Cooperative	Yes|__| No|__|
13. Total membership of your cooperative/group	|__||__||__|

SECTION 2: TRADING LEVEL INFORMATION

1. For how many years have you been engaged in this trading business? .... years
2. How many workers support your Trading business? Total________; Females_________; Males_________; Youth (<36yrs)___
3. Which of the following best describes your typical training cycle? 1. Weekly [ ] 2. Biweekly [ ] 3. Monthly [ ] 4. Quarterly [ ] 5. Others_______________

4. What is the total quantity you usually procure in a typical business cycle (Mt)	|_____| Mt
5. What proportion of the total quantity of procured commodity are you able to sell within the business cycle (%)?	|____| %
6. Which best describes the ownership structure of your business?	Own business (sole) |__| Family business/ Inherited|__| Partnership|_| Cooperative/ Group ownership |_| Others|__.................................... |
7. What variety of the target commodity do you usually sell?	.... Code 1 (*codes below the table*)
8. What are the dominant sources from where you procure commodity for sale? (multi-selection)	Own farm/processing center|__| Cottage level processing center [ ] Industrial processor [ ] Contract producers [ ] Independent producers/ farmers|__| FBOs/Cooperatives|__| Open market|__| Others|_.................................._|
9. Type/form of products you usually sell?	fresh Cassava roots/tubers [ ] Fresh fruits [ ] Gari [ ] Starch [ ] Cassava Flour [ ] fruit juice [ ] Dry Fruit chips [ ] Smoked fish [ ] salted fish [ ] fresh fish [ ] Others_________________________
10. Main by-products from your trading activities	Peels [ ] rotten fruits [ ] Crowns [ ] Fish scales & intestines [ ] Waste water [ ] Others_____

Code 1: Cassava varieties; 1=Tek Bankye 2=Capevas Bankye 3= Bankye Esam 4=Debo 5=Kuffour Bankye 6=Akosua tuntum; 7=others (Specify....); ***Mango Varieties;*** 1=Keitt 2=Kent 3=Palma 4=Others (Specify..; ***Pineapple Varieties:*** 1=Sugar loaf 2=Smooth Cayenne 3=MD2 7= others (Specify..............................
Fish type processed: 1=Tilapia 2=Catfish 3=Others (Specify...

9. Trading inputs

Please provide information on the inputs used for your commodity (---------------------) trading activities in a typical business cycle

Input	Main source (codes)	Quantity	Unit price (GHC)	Total Cost (GHC)
xxxiii. Raw materials (main commodity/ product traded) (e.g. cassava, fruit, fish, etc.) (Mt)*				
xxxiv. Fuel for transporting raw materials from source center to trading point (litres)				
xxxv. Fuel for transporting commodity/ product to Customers (Litres)				
xxxvi. Water (litres)**				
xxxvii. Packaging material (Plastic bottles, gallons, etc)				
xxxviii. Packaging materials (Bottles)				
xxxix.				
Other_1:				
Others_2:				
Others_3:				

Codes for sources of Raw materials: 1=own production; 2= Contract producers; 3=Independent farmers/producers;
4= FBOs/Cooperatives; 5=Open market; 6=Processor; others_______

*****Code for water sources:*** 1=Rainfall; 2=Borehole; 3=stream/river; 5=others_______

10. Output from Trading, Losses and Waste Generated during a typical trading cycle

Item	Quantity *(kg)*	Unit Price (GHC)	Market Value (GHC)
u. Total quantity of commodity sold			
v. Quantity of goods sold at reduced price due to quality deterioration			
w. Quantity lost during packaging, loading, and transportation during trading.			
x. Quantity of waste/debris generated after packaging, loading, transporting and trading *(Leftovers)*			

Item	Quantity *(kg)*	Unit Price (GHC)	Market Value (GHC)
y. Quantity of goods discarded due to contamination			
z. Quantity of goods discarded due to expiry			

11. Marketing Outlets

xiii. Indicate the main sales point of your commodity	Road side|__| Market within community|__| Market within district|__| Market outside the district|__| Market outside the region|__| Market outside Ghana |__|
xiv. Indicate the main off-taker of your commodity	Individual households|__| Distributor|__| Wholesaler|__| Retailer|__| Processors |__| Food Vendors|__| Institutional buyers *(e.g., Hotels, schools, hospitals) |__|* *Others (Specify* ....
xv. Average distance covered to deliver products (Km)	
xvi. Means of transport to deliver product? (bicycle/motorbike/ tricycle(aboboyaa)/public transport/ Own truck/head carriage/by air/ others)	
xvii. Did you experience any challenge in finding buyers or off-takers for your commodity last year?	Yes|__| No|__|
xviii. If ***"Yes"*** what was the main reason?	....

SECTION 3: CIRCULAR OPPORTUNITIES

23. What proportion of the waste generated in your trading operations do you reuse or recycle back into your processing business? ___%

24. In which ways do you reuse the waste? 1. Composting/Farm Yard Manure [ ] 2. Mulching on own farm [ ] 3. Cooking/heating fuel [ ] 4. Animal feed [ ] 5. Others (________________) 6. Not Applicable [ ]
25. Are there other local uses for the waste generated from your business? Yes [ ] No [ ]

26. If yes, in which ways are the waste products being reused currently?

27. In which other ways do you think the waste products could be reused?

28. What technologies or approaches would be required to be able to reuse/recycle waste from your trading business?

29. Describe the employment generation potential of the ways in which the waste products could be reused or recycled

30. Are there opportunities to reduce waste in your operations? Yes [ ] No [ ]

31. If yes, in which ways?

32. What technologies or approaches are required to reduce waste in your operations?

33. Describe the socio-economic benefits that can be derived from reducing waste in your trading business?

SECTION 4: CONSTRAINTS ANALYSIS

Please, rank each of the following constraints associated with your trading business in order of severity (Scale: 1=Very Low; 2=Low; 3=Quite High; 4=High; 5=Very High)

Constraint	Rank
Limited access to quality raw material	|__|
Inconsistent supply of raw materials	|__|
High costs of raw materials	|__|
Poor road network linking supply centers to destination markets	|__|
High cost of fuel	|__|
High cost of transportation	|__|
Limited access to trucks/vehicles to transport commodities	|__|
Limited access to market information	|__|
Limited knowledge about circular opportunities	|__|
Inadequate storage facility	|__|
High level of losses associated with trading	|__|
High rate of accidents during distribution	|__|
Others 1 (Specify)......................................	|__|
Others 2 (Specify)......................................	|__|
Others 3 (Specify)......................................	|__|

SECTION 5: OTHER ISSUES

26. How would you describe the relationship between you and your raw suppliers?
    1. Very weak [ ] 2. Weak [ ] 3. Quite strong [ ] 4. Strong [ ] 5. Very strong [ ]

27. Do you have any formal contract (written) with some of your suppliers?
    Yes [ ] No [ ]

28. If yes, are contract terms respected by suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

29. If yes, do you respect the contract terms with your suppliers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

30. Do you have any formal contract (written) with some of your offtakers?
    Yes [ ] No [ ]

31. If yes, are contract terms respected by offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases 4. Yes, in few cases [ ] 5. No, in all cases [ ]

32. If yes, do you respect the contract terms with your offtakers? 1. Yes, in all cases [ ] 2. Yes, in many cases [ ] 3. Yes, in some cases [ ] 4. Yes, in few cases [ ] 5. No, in all cases [ ]

33. What are your main sources of finance for your trading business?
    Own funding [ ] 2. Family and friends [ ] 3. Credit from Banks [ ] 4. Credit from Cooperative Credit Union [ ] 5. Rotating Credit scheme/Susu [ ] 6. VSLA [ ]
    7. Private money lender [ ] 8. Others______________________

34. Suggest three key things that you require to improve the efficiency of your operations?
    i.____
    ii. ____
    iii.____

35. Is there anything you want to tell me about your business that I have not asked about?
    ____
    ____

36. Do you have any questions for me?
37. ____
    ____

End of survey

GPS location of respondent / trading point	|__|__|__|__|__|__|__|
Ending time of Interview	*|_hh_:_mm_:_ss_|*
End note & Appreciation	*We have come to the end of the interview.* *Thank you very much for your time and attention.*

In partnership with Canada

Ghana Circular Economy Centre

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Republic of Ghana

About Ghana Circular Economy Centre

The Ghana Circular Economy Centre (GCEC) project supports Ghana's transition to a resource-efficient and inclusive circular economy by promoting innovation, strengthening policy and institutional frameworks, and building capacity across key value chains, including plastics, agriculture and agro-processing (cassava, mango, pineapple and tilapia), and textiles.

The project is implemented by the United Nations Industrial Development Organization (UNIDO) in partnership with the Ministry of Environment, Science and Technology (MEST), with funding support from Global Affairs Canada.

The GCEC serves as a national hub for knowledge generation, stakeholder engagement, and the piloting of circular solutions to advance sustainable industrial development, improve resource efficiency, and create decent jobs.

Host Institution

HO TECHNICAL UNIVERSITY

Value Chain Leads

KNUST
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY OF CAPE COAST

The Or Foundation

CAPE COAST TECHNICAL UNIVERSITY

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