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CIRCULAR ECONOMY OPPORTUNITY MAP

Ghana Fish Value Chain

2026

Authors

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Circular Economy Opportunity Map
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MARCH 2026

Executive Summary

The fish value chain remains a vital pillar of Ghana's economy, food security, and rural livelihoods, supplying about **60%** of the country's animal protein and supporting an estimated three million people. However, the sector continues to face persistent challenges, including high post-harvest losses, inefficient use of resources, rising input costs, and rising environmental pressures. To address these gaps, a Circular Opportunity Mapping (COM) exercise was undertaken to identify where circular economy principles such as waste valorization, by-product utilization, energy efficiency, and regenerative production could be integrated to enhance sustainability and economic performance across the fish value chain.

Using a mixed-methods approach, the study drew on desk research, key informant interviews, focus group discussions, and structured personal interviews conducted with **252** value chain actors across four districts in the Ashanti and Eastern Regions. The sample included 88 producers, **63** processors, and 101 traders. Analysis combined descriptive statistics with lifecycle assessment and Material Flow Analysis to quantify resource inputs, product outputs, waste streams, and value leakages along the chain.

Findings show a value chain that is economically vibrant but constrained by structural inefficiencies and heavy dependence on traditional practices. The chain is strongly gendered, where production is dominated by men **(95.5%)** and processing **(90.5%)** and trading **(97%)** are overwhelmingly controlled by women, many of whom have limited formal education and operate micro-enterprises with few or no employees. Processing remains a critical value-adding stage but generates significant waste and consumes large quantities of fuelwood, with traditional smoking accounting for the largest share of resource use and emissions. Material

flow analysis reveals that approximately **76%** of raw fish becomes edible product, while about one-quarter is lost as by-products such as offal, heads, and bones. These waste streams remain largely underutilized despite their potential for conversion into fishmeal, fertilizer, collagen, and other high-value products.

Trading activities, by contrast, exhibit high efficiency, with almost 98% of fish sold and minimal spoilage recorded. Nonetheless, the broader chain experiences hotspots of inefficiency, particularly in energy use, waste handling, and limited adoption of improved technologies. Fuelwood consumption exceeds the weight of fish processed, highlighting a major sustainability concern. Water and electricity use remain low, reflecting both resource limitations and reliance on manual operations, while diesel consumption during transportation contributes to greenhouse gas emissions.

Overall, the study identifies significant opportunities for circular economy interventions that can reduce waste, improve resource efficiency, and strengthen economic resilience for the thousands of small-scale actors who depend on the fish value chain. Key recommendations include the promotion of improved smoking technologies and clean energy alternatives; development of by-product valorization enterprises; tailored capacity-building programs for women and low-literacy groups; strengthening of cold-chain and market infrastructure; and support for enterprise upgrading and social protection mechanisms. These measures, if pursued, can help reposition Ghana's fish value chain towards a more sustainable, competitive, and inclusive circular economy pathway.

The chain is strongly gendered, where production is dominated by **men (95.5%)** and **processing (90.5%)** and **trading (97%)** are overwhelmingly controlled by women, many of whom have limited formal education and operate micro-enterprises with few or no employees.

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1.0 INTRODUCTION

1.1 Background

The fish value chain plays a critical socio-economic and nutritional role in Ghana, contributing significantly to livelihoods, food security, and national GDP. Fish accounts for about 60% of animal protein intake among Ghanaians, while the sector supports an estimated 3 million people directly and indirectly across fishing, aquaculture, processing, and distribution chain (MoFAD, 2020). Despite its importance, the sector faces persistent challenges including high post-harvest losses, inefficient resource use, escalating input costs, environmental degradation, and climate variability. These challenges highlight the urgent need for innovative and sustainable approaches that enhance value creation while minimizing waste and environmental impacts.

Circular Opportunity Mapping (COM) provides a structured pathway for identifying where circular economy principles can be applied across production, harvesting, processing, and market systems. By focusing on strategies such as waste valorization, energy efficiency, by-product utilization, regenerative aquaculture, and closed-loop systems, COM supports a transition from linear "take-make-waste" models to regenerative and resource-efficient value chains. This approach not only aligns with global sustainability commitments but also creates economic opportunities for fishers, processors, traders, and small-scale enterprises by improving competitiveness and resilience.

In the Ghanaian context, circularity is particularly relevant due to high levels of post-harvest loss (estimated at 20–30% for artisanal fisheries) and the growing volume of under-utilized organic waste such as fish offal, scales, wastewater, and packaging materials. These waste streams hold significant potential for transformation into high-value products, including fishmeal, organic fertilizer, collagen, biogas, and sustainable inputs. Circular innovations are also essential to strengthen climate resilience in coastal and inland fisheries, reduce pressure on marine ecosystems, and support sustainable aquaculture expansion.

This Circular Opportunity Mapping exercise therefore aims to systematically identify actionable, context-specific entry points for integrating circular economy practices throughout Ghana's fish value chain. It will assess current material flows, value leakages, and environmental hotspots, while highlighting feasible circular business models that can deliver economic returns, reduce waste, and promote long-term sustainability. The exercise provides a foundation for policymakers, industry stakeholders, researchers, and development partners to design interventions that enhance the environmental, social, and economic performance of the sector.

1.2 Objectives of the Exercise

The specific objectives of the assignment were:

i. To map and analyze the structure of the fish value chain

ii. To quantify resource use and waste generation across the value chain

iii. To identify value leakages and inefficiencies in current practices

iv. To identify environmental and socio-economic hotspots

v. To assess existing waste management practices and recovery mechanisms

vi. To map feasible circular economy opportunities

vii. To rank and prioritize circular solutions based on feasibility and impact.

2.0 Methodology

Data for this exercise was collected as part of the general circular opportunities mapping survey which adopted a mixed-methods approach, combining desk research, key informant interviews, and personal in-depth interviews. The data for the circular opportunity mapping for the fish value chain was undertaken in the Ashanti and Eastern Regions of Ghana. In all, 252 actors comprising 88 producers, 63 processors and 101 traders were sampled for the study (Table 1). The fish value chain actors covered came from four districts with diverse fish production and post-harvest characteristics:

- Bosomtwe District – artisanal inland capture fisheries around Lake Bosomtwe
- Atwima Nwabiagya North District – smallholder aquaculture clusters and fish trading
- Kumasi Metropolis – major urban hub for cold storage, fish trading and distribution
- Asuogyaman District – capture fisheries and aquaculture activities along the Volta Lake

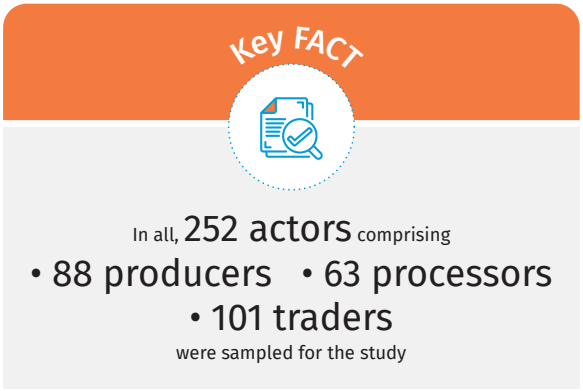
Table 1: Fish value chain actors sampled for the study

Actor type	Frequency	Percent
Producers	88	34.92%
Processors	63	25.00%
Traders	101	40.08%
Total	**252**	**100.00%**

A combination of purposive, stratified, simple random and snowball sampling techniques were employed to select key value chain actors for interviews. Using electronic questionnaires programmed on android tablets, data collection was done by trained enumerators through face-to-face personal interviews. This was supplemented with focus group discussions, key informant interviews and personal observations.

Field data collected was analyzed using basic descriptive tools such as tables and simple narrations. Lifecycle assessment was conducted using standard procedure. In addition, Material Flow Analysis (MFA) was conducted to quantify and visualize:

- Resource inputs (feed, water, energy, firewood, etc.)
- Process flows (fishing, handling, trading, processing, transportation, etc.)
- Output streams (fresh fish, smoked fish, dried fish)
- Waste/by-products (offal, scales, wastewater, damaged fish, wood/charcoal residues, etc.)



3.0 Results And Discussion

This section presents and discusses the key findings from data analysis.

3.1 Profile of Fish Value chain actors

Table 2 provides the socio-demographic characteristics of primary producers covered in the survey.

The demographic structure of the fish producers indicates a sector dominated overwhelmingly by men. Out of the 88 producers surveyed, 95.5% are male, with women representing only 4.5%. This aligns with broader patterns in many fishing communities, where men typically engage in capture fisheries while women are more involved in post-harvest activities. The low female participation suggests potential gender-based barriers or cultural norms influencing involvement in fish production.

Table 2: Characteristics of Fish Producers

Variable	Category	Frequency	Percent
sex	Females	4	4.5
	Males	84	95.5
	Total	88	100.0
Age	<36 years	26	29.5
	36-39 years	19	21.6
	40-49 years	23	26.1
	50-60 years	14	15.9
	>60 years	6	6.8
	Total	88	100.0
Education	None	3	3.4
	Basic	49	55.7
	Secondary	20	22.7
	Tertiary	16	18.2
	Total	88	100.0
Marital status	Single, never married	20	22.7
	Married	63	71.6
	Separated/Divorced/widowed	5	5.7
	Total	88	100.0

In terms of age distribution, the data show that the workforce spans a wide range of age groups, but is generally concentrated in the younger and middle-aged brackets. Nearly 30% of producers are under 36 years, and an additional 21.6% fall within the 36–39-year category. The 40–49-year group constitutes 26.1%, making it the second-largest segment. Only 22.7% of respondents are aged 50 years and above. This age structure reflects a relatively youthful but experienced workforce, which is important for sustaining productivity and adopting new practices or technologies in the sector.

Educational attainment among producers shows a predominance of individuals with basic education. Over half (55.7%) have completed basic schooling, while 22.7% possess secondary-level education. A notable 18.2% have tertiary education, and only 3.4% report having no formal education. This suggests that the majority of fish producers have at least foundational literacy and numeracy skills, which can support training uptake, recordkeeping, and engagement with extension services. The presence of tertiary-educated producers also signals emerging professionalization within the sector.

Marital status data indicate that most producers are in stable family structures. About 71.6% are married, while 22.7% are single. A small proportion (5.7%) are separated, divorced, or widowed. The high marriage rate may reflect the socio-economic stability often associated with long-term involvement in primary production activities such as fishing.

Overall, the demographic profile suggests that fish production in this context is a male-dominated activity undertaken predominantly by relatively young to middle-aged adults with basic to secondary education, and who are mostly married. These characteristics have implications for program design, extension delivery, labor dynamics, and gender-inclusive development interventions within the fishery sector.

The data on fish processors present a demographic profile that contrasts sharply with that of fish producers (Table 3). Fish processing is shown to be a female-dominated activity, with 90.5% of processors being women and only 9.5% men. This aligns with longstanding gender roles in many fishing communities, where women traditionally take the lead in post-harvest handling, processing, and marketing. Their strong presence in this segment underscores the importance of targeting women-centered interventions to support value addition and improve processing technologies.

The age distribution reveals that fish processing is carried out by individuals across a wide range of age groups, though the sector is dominated by mature and experienced actors. The largest segment (31.7%) falls within the 40–49-year range, followed by three equal groups (each 20.6%) within the <36, 36–39, and 50–60-year categories. Only 6.3% are above 60 years. This pattern suggests a workforce that is sufficiently mature to draw on long-term experience while still young enough to adopt improved processing practices and innovations.

Table 3: Characteristics of Fish Processors

Variable	Category	Frequency	Percent
Sex	Female	57	90.5
	Male	6	9.5
	Total	63	100.0
Age	<36 years	13	20.6
	36-39 years	13	20.6
	40-49 years	20	31.7
	50-60 years	13	20.6
	>60 years	4	6.3
	Total	63	100.0
Educational level	None	14	22.2
	Basic	40	63.5
	Secondary	7	11.1
	Tertiary	2	3.2
	Total	63	100.0
Marital status	Single, never married	7	11.1
	Married	46	73.0
	Separated/Divorced/ widowed	10	15.9
	Total	63	100.0

Educational attainment among processors shows a predominance of individuals with limited formal education. A significant proportion (22.2%) have no formal schooling, while the majority (63.5%) have only basic education. Secondary-level graduates account for 11.1%, and just 3.2% have tertiary education. This educational profile indicates that training programs, especially those on improved processing techniques, hygiene, safety standards, and recordkeeping, may need to be delivered using practical, visual, and hands-on methods to ensure effective comprehension and adoption.

The marital status distribution indicates that most processors operate within stable family settings. A large majority (73.0%) are married, while 11.1% are single. Additionally, 15.9% are separated, divorced, or widowed which is slightly higher than seen among fish producers and consistent with the fact that many women in rural and fishing communities often become household heads through widowhood or separation. This may also influence their reliance on processing as a livelihood activity.

Overall, the fish processing segment is characterized by a predominantly female, mature, and largely basic-educated workforce, most of whom are married. These demographic characteristics highlight the importance of designing value-chain interventions, particularly in training, technology adoption, and enterprise support, that are tailored to women, sensitive to educational levels, and supportive of both household and livelihood realities.

The profile of fish traders covered in the survey is summarized in Table 4. The demographic profile of fish traders reveals a sector overwhelmingly dominated by women. Out of 101 traders, 97.0% are female, with men making up just 3.0%. This strong female presence reflects the traditional gendered structure of fish marketing in many fishing communities, where women play a central role in handling, pricing, and distributing fish products. Their dominance in this segment underscores the importance of women-focused market support programs, credit schemes, and capacity-building initiatives.

The age distribution shows that fish trading is primarily undertaken by mature adults with substantial life and business experience. The largest share of traders (34.7%) falls within the 40–49-year age category, followed closely by those aged 50–60 years (30.7%). Younger traders under 36 years constitute only 14.9%, while an additional 12.9% are aged 36–39 years. Traders above 60 years make up 6.9% of the sample. This indicates that fish trading is sustained by economically active adults who have likely built strong customer networks and market knowledge over time, with fewer young entrants joining the sector.

Table 4: Characteristics of Fish Traders

Variable	Category	Frequency	Percent
Sex	Female	98	97.0
	Male	3	3.0
	Total	101	100.0
Age	<36 years	15	14.9
	36-39 years	13	12.9
	40-49 years	35	34.7
	50-60 years	31	30.7
	>60 years	7	6.9
	Total	101	100.0
Educational Level	None	18	17.8
	Basic	67	66.3
	Secondary	13	12.9
	Tertiary	3	3.0
	Total	101	100.0
Marital Status	Single, never married	13	12.9
	Married	61	60.4
	Separated/Divorced/widowed	27	26.7
	Total	101	100.0

Educational attainment among fish traders shows a predominance of individuals with limited formal education. While 66.3% have basic education, a significant 17.8% have no formal schooling. Only 12.9% attained secondary education, and just 3.0% reached tertiary level. This

suggests that most traders rely heavily on practical experience, traditional knowledge, and interpersonal networks rather than formal training. It also reinforces the need for market development and training programs to be tailored using simple, practical, and demonstrative approaches to ensure accessibility and comprehension.

Marital status data presents a diverse household structure among traders. A majority (60.4%) are married, while 12.9% are single. Notably, the proportion of traders who are separated, divorced, or widowed is relatively high (26.7%). This group may rely on fish trading as a primary livelihood strategy due to the flexibility and income opportunities it provides. Their strong representation highlights the socio-economic importance of fish trading as a safety net for women who head households or face limited alternative employment options.

Overall, fish traders are predominantly women, mostly within the 40–60-year age range, with modest levels of formal education and varied marital backgrounds. These characteristics suggest a sector shaped by experience, resilience, and strong social networks—factors that development interventions should consider when designing programs to strengthen market access, business skills, and financial inclusion.

The key activities performed at this node of the value chain include:

a. Gutting, scaling, washing
b. Fuelwood procurement and preparation
c. Smoking on Chorkor or improved kilns
d. Drying on racks, mats, or solar dryers
e. Frying in oil for ready-to-eat products
f. Storage in cold rooms or freezers

3.2 Description of the Fish Value Chain

The fish value chain in Ghana comprises a diverse set of interconnected activities spanning capture fisheries, aquaculture, post-harvest processing, distribution, and retail markets. Ghana's fisheries sector includes marine, inland (freshwater), and a rapidly growing aquaculture sub-sector, collectively contributing significantly to food security, employment, and rural livelihoods.

The chain begins with input supply and production, where artisanal marine fishers operate along the coast, while inland communities depend on lakes and rivers such as Lake Bosomtwe and Lake Volta for capture fisheries. Aquaculture, dominated by tilapia and catfish production, is expanding in regions such as Eastern and Ashanti regions. After harvesting, fish enters the post-harvest handling and processing segment, where women play a central role in smoking, drying, salting, frying, and packaging. Processing is a critical stage in the fish value chain where women dominate and major value addition as well as waste generation occurs. The main processing pathways include:

i. Smoking (traditional and improved kilns)
ii. Drying and salting
iii. Frying
iv. Filleting, gutting, and packaging for fresh markets
v. Cold storage and freezing

g. Packaging for distribution.

It is important to note that traditional smoking using the Chorkor smoker remains the dominant processing method but is often associated with high fuelwood consumption, inconsistent product quality, and significant waste generation.

After processing, the processed or fresh fish moves through distribution and marketing

channels, including aggregators, cold stores, wholesalers, and retailers in major markets such as Kumasi, Accra, and other regional urban centers. Cold chain infrastructure in Ghana has improved but remains insufficient, contributing to losses and reduced product quality. The value chain also includes a set of support services, such as feed production, boat and gear supply, transportation, ice production, credit services, and regulatory oversight from agencies like MoFAD and the Fisheries Commission.

Despite its economic importance, the chain is characterized by post-harvest losses (20–30%), limited cold-chain capacity, inefficient processing technologies, environmental challenges, and underutilized waste streams (offal, scales, wastewater, wood ash, etc.). These gaps present both constraints and opportunities, especially for circular economy innovations aimed at improving resource efficiency, reducing losses, and transforming waste into valuable products.

3.3 Material Flow Analysis - Fish Processing Stage

Table 5 below quantifies inputs and outputs per processing cycle for the surveyed fish processors, based purely on the field data. The analysis of the processing stage in Ghana's fish value chain shows how raw fish is transformed and where losses occur along the way. Across 63 processors, about 19,454 kilograms of fresh fish are handled in a typical processing cycle. From this, around 14,772 kilograms become edible, processed fish that is ultimately consumed by people. This means most of the fish (roughly 76%) is successfully converted into food. However, a significant portion of the raw fish (about 4,864 kilograms) is in the form of by-products like heads, guts, and bones. These materials are typically discarded, even though some could potentially be repurposed for uses such as animal feed, fertilizer, or other value-added products. In addition, the analysis shows that spoilage during processing is relatively low, with only about 55.5 kilograms lost due to spoilage across all processors. This suggests that while spoilage is being managed fairly well, there is still room for improvement in how by-products are handled.

Overall, the data highlights a key opportunity in finding ways to make better use of the nearly 5,000 kilograms of by-products that are currently treated as waste. Doing so could improve both the sustainability and economic value of the fish processing sector.

Table 5: Material flow at the fish processing stage

Flow Category	Value (kg per cycle)	Interpretation
Raw Fish Input (fresh fish for processing)	~ **19,454** kg (total across 63 processors)	Total fresh fish entering processing in the sample. This is the inflow of material - baseline for calculating yields and losses. (All data-driven; e.g. one processor input 800 kg in a cycle.)
Processed Fish Output (edible product)	~**14,772** kg consumed by people	Total edible product yield from processing (sum of fish sold plus fish consumed by processors' households). This is ~75.9% of input, meaning about 3/4 of input fish becomes food. A high yield indicates most of the fish flesh is retained for consumption (water weight loss from drying not counted as "waste").

Fish Waste (By-products) - heads, guts, etc.	~**4,864** kg (discarded)	≈25% of input weight ends up as waste (inedible parts removed during processing). For example, one processor with 800 kg input generated 200 kg waste - exactly 25%. These fish off-cuts are currently not reused (all respondents reported 0 usage for animal feed), representing a material leakage and a key circularity hotspot (opportunity for by-product utilisation).
Spoilage Losses (during processing)	**55.5** kg (estimated total)	Negligible "lost" fish reported during processing (~0.3% of input). This represents fish that spoiled or were discarded due to quality deterioration before becoming product. The data suggest minimal spoilage at processing stage - likely because fish is processed quickly (e.g. smoked) to avoid losses.

3.4 Material Flow Analysis - Fish Trading Stage

Table 6 shows flow for fish traders per trading cycle, based on the survey data. It highlights the volume of fish handled and where it goes (sold fresh, lost, etc.). At the trading stage of the fish value chain, the material flow analysis shows that a large volume of fish (about 57,529 kilograms) is brought in by traders per weekly trading cycle. The vast majority of this, roughly 56,624 kilograms, is successfully sold to consumers, which suggests a highly efficient turnover with minimal losses. Only a small fraction of the fish is lost during the trading process. Cleaning activities, such as removing guts and scales, account for around 9.6 kilograms of waste. Additionally, spoilage of unsold fish is quite low, estimated at just 5.6 kilograms per cycle. These figures indicate that traders are managing stocks well and are likely to move products quickly enough to avoid significant spoilage. It is also possible that traders procure quantities that fulfill weekly demand levels to avoid any significant losses or wastes.

Table 6: Material flows at the Trading node of the value chain

Flow Category	Value (kg per cycle)	Interpretation
Fish Procured (incoming stock to traders)	**~57,529** kg (total, excluding one data outlier)	Total fresh fish purchased by traders for resale. This is the inflow to trading. (One trader reported an unusually high volume with data inconsistency and was excluded for accuracy.) The typical trader in the sample procures a small quantity (median only a few kg or crates), but collectively this is the volume handled.
Fish Sold to Customers (outgoing stock)	~**56,624** kg (to consumers)	Approximately 98.4% of procured fish is sold to end consumers. Traders manage to sell almost all the fish they buy, which implies an efficient turnover. This includes fish sold at normal price and those sold at reduced price due to quality decline (≈442 kg were discounted, ~0.8% of total volume). The high sold percentage indicates very little physical waste at this stage - most of the fish fulfils its food purpose.

Fish Waste (Cleaning losses) - guts, scales	**9.6** kg (discarded)	Minor weight loss from cleaning or trimming fish. Only ~0.017% of the input becomes waste (e.g. when traders gut or scale fish for customers). This is extremely low in absolute terms (only a few kilograms in total). It shows that trading activities add minimal waste, since most fish is sold whole or with only small parts removed.
Unsold Spoilage Loss (thrown away)	**~5.6** kg (discarded spoiled fish)	Virtually no spoilage reported at trading stage - only ~5.6 kg (<0.03% of input) was recorded as fish lost or discarded due to poor quality (e.g. rot, damage). This suggests that traders either prevent spoilage by fast turnover or mitigate losses by price reduction or processing unsold fish. From a circular perspective, the distribution stage is very efficient in terms of material flow (almost all fish remains in the food chain).

In general, the trading node appears to be performing efficiently, with more than 98% of the incoming fish reaching consumers. However, even the small amounts of waste, especially the cleaning by-products could represent opportunities for better waste handling or reuse, such as composting or using the materials in animal feed formulation, which would make the value chain more circular and sustainable.

3.5 Resource Use and Efficiency in Fish Processing (Quasi-LCA)

Table 7 presents key resources or inputs employed per unit of fish processed, derived from the processor data. It quantifies usage of water, fuel, energy, etc., benchmarked per 1,000 kg of raw fish processed (i.e. per metric ton) for easy interpretation. This analysis is analogous to a simplified LCA, focusing on input intensity and potential inefficiencies in resource use.

Water Use (~1,100 L per 1,000 kg fish)

Water consumption in the fish value chain mainly for washing, cleaning, and brining is relatively moderate, averaging about 1.1 litres per kilogram of processed fish. While not excessive, the use of clean water is still a critical issue, especially in regions facing water scarcity. Opportunities may exist to reuse water for non-critical cleaning tasks or invest in basic water-saving technologies. As noted in FAO guidelines, good water management is essential in fish processing to maintain hygiene while minimizing resource use (FAO, 2016).

Table 7: Resource Use efficiency at the Processing stage

Input Resource	Usage per 1,000 kg Fish Processed	Interpretation (Efficiency & Impact)
Water (for washing, brining, etc.)	**~1,100 L** per 1,000 kg fish (≈1.1 L/kg)	Water usage is relatively low - about 1.1 litres per kg of fish. Many processors (≈30%) didn't use water (e.g. dry smoking without washing), while others used modest amounts. This indicates water is not a major input for most processing operations. Nonetheless, efficient water use is positive for sustainability (low water footprint).

Fuelwood (firewood for smoking)	**~1,313 kg** per 1,000 kg fish (≈1.31 kg wood per 1 kg fish)	Wood fuel usage is very high - on average, slightly more mass of wood is burned than fish processed. For instance, smoking 800 kg of fish might consume ~800-1,000 kg or more of wood fuel. This highlights an inefficiency and environmental concern: the process is energy-intensive, contributing to deforestation and emissions. Improving kiln efficiency or using alternative fuels is a key opportunity.
Electricity (for refrigeration, lighting)	**~92 kWh** per 1,000 kg fish (≈0.092 kWh/kg)	Electricity use is minimal overall. Only 8 of 63 processors reported using any electricity (e.g. for lighting or small equipment), and even then usage was low. Most small processors rely on wood/charcoal and manual methods, with little to no grid energy usage. This low electricity footprint suggests low modernisation, but also means limited cold storage or mechanisation in processing.
Diesel (Transport - raw fish)	~**48 L** per 1,000 kg fish (≈0.048 L/kg)	Diesel fuel used to bring raw fish to processing sites. Only about half the processors used motorised transport; others source locally or use non-motor means. 0.048 L/kg is an average - in practice some use motor tricycles or trucks, incurring fuel costs/emissions, while many use none. This indicates transport inefficiency is minor in terms of fuel per kg, given short distances (avg ~20 km) for raw material sourcing.
Diesel (Transport - products)	~**19 L** per 1,000 kg fish (≈0.019 L/kg)	Diesel used to deliver processed fish to market or buyers. Even fewer processors (only 17) used diesel at this stage - many rely on buyers coming to them or local sales. Fuel usage per kg is very low here. However, limited distribution may restrict market access. From an LCA view, transport energy for distribution is small relative to processing energy (wood).
Labour (manual work input)	~**12.6** man-days per 1,000 kg fish (≈0.0126 days/kg)	Human labour used per kg of fish. This roughly equals one person working 8 hours to process ~80 kg fish. Many processors are sole or family labour; about half reported no hired labour. The labour intensity (~0.013 days/kg) reflects traditional manual processing (e.g. hand cleaning, smoking). In circular terms, this indicates a high employment potential per ton of fish, but also potentially hard manual work concentrated among few individuals (often women).

Fuelwood for Smoking (~1,313 kg per 1,000 kg fish)

Fuelwood is by far the most significant input by weight, with an average of 1.31 kg of wood required per 1 kg of fish processed. This heavy reliance on firewood for smoking has two major implications: environmental degradation due to deforestation and air pollution from smoke. Similar concerns have been raised in studies on traditional fish processing in West Africa, which highlight the unsustainable harvesting of wood and the need for improved smoking technologies, such as the FAO's improved Chorkor oven (FAO, 2012). Transitioning to more efficient kilns or alternative fuels could drastically reduce wood use and associated emissions.

Electricity (~92 kWh per 1,000 kg fish)

Electricity use is mostly for refrigeration and lighting which averages about 0.092 kWh per kilogram of fish. While this is relatively low, it reflects the limited availability of electrical infrastructure in some areas. In regions where refrigeration is essential for preventing spoilage, access to stable and clean energy sources remains a key challenge. Off-grid solar cold storage systems could provide a viable solution, reducing dependency on unreliable or fossil-fuel-based electricity.

Diesel Use for Transport (~67 L per 1,000 kg fish total)

The survey results show that transport consumes about 67 litres of diesel per 1,000 kg of fish, 48 litres for moving raw fish and 19 litres for transporting processed products. While not a dominant input by weight or volume, diesel contributes significantly to greenhouse gas emissions. These transport-related emissions can be minimized through better logistics planning, use of more efficient vehicles, or transitioning to cleaner fuels. According to the IPCC (2014), transport emissions are a growing concern in developing food systems and should be addressed in sustainable supply chain strategies.

Labour (~12.6 man-days per 1,000 kg fish)

Labour input averages around 12.6 man-days per tonne of fish processed. This highlights the labour-intensive nature of the sector, which plays a vital role in local employment, especially for women and youth in Ghana. While this is not an environmental impact, it is a critical socio-economic factor. Strengthening occupational safety, fair wages, and training for workers could contribute to social sustainability in the value chain.

3.6 Summary of Opportunities

The LCA shows that the most resource-intensive and environmentally impactful stage is 'processing', particularly due to the use of 'fuelwood for smoking'. Water and electricity usage are modest but still important, especially in areas with limited infrastructure. Transport and labour play supporting roles, both in emissions and livelihoods.

To improve the sustainability of the fish value chain in Ghana, key areas for intervention include:

- Adopting energy-efficient and clean smoking technologies
- Implementing water-saving and reuse practices in processing
- Promoting renewable energy for cold storage and lighting
- Optimizing transport logistics to reduce diesel use and emissions
- Investing in skills and working conditions for labourers

Such changes align with broader goals of a circular and sustainable economy, supporting both environmental resilience and socio-economic development.

3.7 Social and Gender Profile of Fish Value Chain Actors

Table 8 summarizes social, labour, and gender-related indicators for the surveyed processors and traders. Understanding who is involved (women, men, youth), and the scale of their operations, helps identify inequities or imbalances in the value chain. The fish value chain in Ghana, particularly at the processing and trading nodes, is highly gendered and socially significant. Field survey results highlight important patterns in terms of gender participation, workforce composition, education, and challenges faced by actors in this sector.

Strong Female Dominance

Women play a central role in both fish processing and trading. Among surveyed processors, 90.5% were women (57 out of 63 respondents) and at the trading node of the value chain, female participation was even higher, at 97% (98 out of 101 respondents). This strong gender dominance reflects long-standing patterns in West Africa, where women are traditionally responsible for post-harvest handling, processing, and marketing of fish (FAO, 2015). These roles are not only a source of livelihood but also vital to household income, food security, and community cohesion.

Table 8: Social profile of the fish value chain in Ghana

Social Indicator	Fish Processors (63 surveyed)	Fish Traders (101 surveyed)	Interpretation
Female Respondents (% of sample)	90.5% (57 out of 63)	97.0% (98 out of 101)	The vast majority of actors in both processing and trading are women. Fish processing and trading in this context are female-dominated occupations. This highlights a gender dimension: women carry the bulk of the work (and risks) in the fish value chain. Any circular economy interventions (training, technology, financing) should strongly consider women's role and empowerment.
Average Workforce Size (persons per business)	2.7 total (mean); *Median* = 0 employees	1.4 total (mean); *Median* = 0 employees	Most operations are micro-enterprises. The median is 0 employees beyond the owner - meaning over half of businesses have no hired workers (the owner and perhaps family do all the work). A few larger processors (max 30 workers) and traders (max 30) exist, but they are rare. This fragmentation can imply limited capacity and difficulty adopting new practices individually, but also suggests potential for cooperative solutions.

Social Indicator	Fish Processors (63 surveyed)	Fish Traders (101 surveyed)	Interpretation
Female Workforce (% of workers)	~61% (est.) of workers are female	~? (not directly measured)	Among employees reported, a large share are female (in processing, many who employ others hired women - one processor employed 29 women out of 30 workers). For traders, formal employees are very few, so workforce composition isn't well-defined. Overall, women not only own these businesses but also form the core of the labour force. This could point to inequities in job opportunities for men or simply the traditional gender roles in this sector.
Youth Involvement (% businesses with youth)	29% have ≥1 youth worker	27% have ≥1 youth worker	Only about one-quarter of businesses engage youth labour. "Youth" here likely means young workers or family members. The low involvement might indicate that fewer young people are entering these trades, possibly due to the laborious nature or lower income. Supporting circular initiatives (e.g. turning fish waste to products) could attract youth with new business models, addressing generational equity.
Education Level (respondent most common)	*Code 2* (e.g. basic education) - 64%	*Code 2* (basic education) - 66%	The typical education of respondents is low. (Code "2" was the most frequent education level for both groups - likely corresponding to primary or junior secondary level). Very few had tertiary education. This suggests knowledge and skills gaps that could be barriers to technology adoption and business expansion. Any capacity-building in circular economy should be delivered in accessible ways (local language, practical training).
Key Challenges Noted (qualitative)	Access to finance; Market access	Storage / cold chain; Finance	Although not fully quantitative, respondents often mentioned financial constraints ("need financial assistance") and marketing difficulties (low demand, many competitors) as challenges. Traders additionally face lack of cold storage leading to forced quick sales. These social-economic factors create an unequal playing field, where small operators (mostly women with limited capital) struggle to reduce waste or add value. Addressing these challenges is part of making the value chain more circular and inclusive.

Micro and Informal Nature of Businesses

The businesses surveyed are typically small-scale and informally structured. The average workforce per processing business is 2.7 people, but the median is zero, indicating many are family-run or operate without hired employees. For traders, the average workforce is even smaller, at 1.4 people, also with a median of zero employees. These figures suggest that most operations are run by individuals or rely on unpaid family labour, a common trait in informal economies. The lack of formal employment structures can limit access to social protection and economic resilience.

Women as Workers and Business Owners

Among processors, an estimated 61% of all workers are female, reinforcing the dual role of women as both entrepreneurs and labour providers. While data on the gender breakdown of workers in trading businesses wasn't directly measured, the high percentage of female ownership strongly suggests a similar trend. This highlights the importance of gender-sensitive interventions. Empowering women through access to credit, skills training, and infrastructure could yield far-reaching socio-economic benefits (World Bank, 2012).

Youth Involvement Is Present but Limited

Youth participation in value chain activities was relatively modest; about 29% of fish processing businesses reported having at least one youth worker and 27% of trading businesses had youth involvement. While youth are participating, they remain underrepresented. This suggests that the sector may not be sufficiently attractive or accessible to younger generations. Challenges such as low profitability, harsh working conditions, or lack of career progression may be factors. Efforts to engage youth could focus on modernizing the sector, introducing digital tools, or supporting entrepreneurship programs tailored to young people.

Low Formal Education Levels

Most respondents had basic levels of education. About 64% of processors and 66% of traders reported basic education likely up to junior secondary level. This reflects broader national patterns in informal sectors where formal schooling may not be a prerequisite for participation. However, it also points to the need for practical training programs that are accessible regardless of literacy levels such as visual guides, hands-on workshops, and peer mentoring.

Key Challenges: Financial Access and Infrastructure

Surveyed actors identified several major challenges: Processors cited access to finance and market as top concerns. Many operate with limited capital, restricting their ability to expand, improve product quality, or invest in equipment. Traders highlighted storage and cold chain limitations, as well as financial barriers. Inadequate cold storage contributes to post-harvest losses, reducing income and market competitiveness. These findings echo wider research on African fish value chains, where small-scale actors often lack the infrastructure and financial tools needed to improve efficiency and sustainability (FAO, 2021; WorldFish, 2020).

In general, the social dimension suggests that the fish value chain in Ghana is a female-dominated, small-scale, and informally structured with significant socio-economic importance. Women are the backbone of both processing and trading activities, yet face persistent barriers related to financing, infrastructure, and limited formal support.

While youth involvement and basic education levels suggest a foundation for future engagement, targeted interventions are needed to unlock the full potential of these actors. These should include:

- Gender-sensitive financial products and credit schemes
- Youth skills development and entrepreneurship support
- Low-cost, scalable cold chain solutions
- Literacy-inclusive training materials

Improving these conditions would not only enhance livelihoods but also contribute to food security and economic resilience in coastal and inland communities.

3.8 Key Hotspots for Circular Economy Opportunities

Based on the quasi-LCA and MFA above, several hotspots emerge in the fish value chain where inefficiencies or waste are significant. Table 9 below summarizes the main hotspots, supporting data, and potential solutions. The fish value chain in Ghana presents several critical inefficiencies that highlight clear entry points for circular economy interventions. These hotspots, ranging from waste generation and energy use to behavioural and financial barriers, are not only environmental concerns but also opportunities to improve resource use, reduce losses, and enhance livelihoods.

High Fish Waste in Processing: Untapped By-products

Processing generates substantial waste, with around 25% of the raw fish weight becoming by-products such as heads, guts, bones, and scales. Importantly, none of the surveyed processors reported repurposing these materials, meaning this biomass is entirely discarded. This represents a significant lost opportunity. In other contexts, fish by-products are used for animal feed, fertilizer, fish oil, or bioenergy (FAO, 2018). Ghana could similarly explore small-scale, decentralized systems for by-product valorization, especially in regions where agriculture and livestock farming could absorb these outputs. There is opportunity to introduce low-cost fishmeal or composting solutions tailored for small processors, and link with local farms to create a closed-loop system.

Excessive Firewood Consumption: Energy Inefficiency and Environmental Impact

The fish smoking process is highly energy-intensive, with a wood-to-fish mass ratio of roughly 1.3:1. Some processors burn hundreds of kilograms of firewood per batch, with large-scale operations using up to five tons of wood for five tons of fish. This heavy dependence on firewood contributes to deforestation, carbon emissions, and health risks from indoor smoke exposure. It is also economically inefficient. Studies in West Africa have shown that improved fish smoking technologies, such as the FAO's Chorkor oven or fuel-efficient kilns, can cut wood use by up to 50% while improving product quality (FAO, 2012). There is opportunity to promote adoption of energy-efficient smoking technologies, coupled with training and micro-financing to make these upgrades accessible to small processors.

Table 9: Hotspots along the fish value chain

Hotspot Issue (Inefficiency)	Data Evidence	Circular Economy Opportunity
High Fish Waste in Processing (offal/by-products)	~25% of raw fish weight becomes waste (heads, bones, guts) with 0% currently repurposed. No processor reported using these by-products for anything (all "quantity used for animal feed" = 0).	By-product valorisation: Develop uses for fish waste - e.g. process into fish meal or pet feed, compost for agriculture, or even biofuel. This would close the loop by converting waste into valuable products, reducing environmental pollution and potentially providing new income for processors.
Excessive Firewood Consumption (energy inefficiency)	Wood fuel usage ~1.3:1 (wood mass to fish mass). Many processors burn ~hundreds of kg of wood per batch (e.g. 5 tons fish required ~5.0 tons wood fuel in total). This contributes to deforestation and high CO_2 emissions.	Efficient energy systems: Introduce improved smoking ovens or alternative fuels (e.g. agro-waste briquettes, solar dryers). More efficient combustion or drying technology can drastically cut wood use per kg of fish, saving costs and reducing environmental impact. This improves sustainability and could yield carbon credits or other green benefits.
Limited Reuse/ Recycling Mindset	87% of processors and 93% of traders indicated no reuse of waste (survey question on reuse interest: only ~8 processors and 7 traders showed interest). Packaging materials (polythene, sacks, etc.) are used (some data on packaging inputs) but no mention of recycling.	Awareness & training: Implement training programs on waste recycling and reuse (e.g. turning fish scales into collagen products, reusing packaging). Encourage a culture of "waste-to-value". Since interest is currently low, education and demonstration projects are needed to show the economic benefits of circular practices.
Financial & Scale Constraints (many micro-operators)	~50% of businesses have no employees; median throughput is very low (few tens of kg). Many cite lack of capital and low demand as issues. These small-scale actors find it hard to invest in new tech or infrastructure (e.g. cold storage, waste processing).	Cooperative models & financing: Form cooperatives or clusters so processors/traders can share resources (e.g. a communal cold room or fishmeal grinder) and access microfinance. By scaling collectively, they can achieve circular solutions (like collective waste collection for processing) that are not feasible individually. Empowering mostly female entrepreneurs with credit and group support will improve social equity and circularity.

Hotspot Issue (Inefficiency)	Data Evidence	Circular Economy Opportunity
Quality Deterioration in Trade (economic loss)	~0.8% of traded fish (≈442 kg) had to be sold at reduced price due to quality loss. While physical waste was near-zero, this implies some value loss from sub-optimal handling (likely due to lack of ice/cold chain).	Cold chain & processing: Invest in low-cost cooling (ice boxes, solar freezers) or training in fish processing for traders. This can maintain fish quality longer, allowing traders to sell at full price or process excess into dried products. Though current spoilage is small by weight, better quality preservation adds economic value and resilience, key goals of circular economy (doing more with what we have).

Limited Culture of Reuse and Recycling

There is a widespread lack of reuse or recycling practices among actors in the value chain. According to the field survey, 87% of processors and 93% of traders reported no reuse of materials or waste. Only a small fraction expressed interest (~8 processors and 7 traders). While packaging materials like polythene and sacks are used, none is recycled. This suggests not only infrastructure gaps but also low awareness or motivation around circular practices. In other sectors, even basic interventions like reusing containers, sorting waste, or composting organic material have been shown to reduce operating costs and environmental impacts (UNEP, 2021). There is good opportunity to launch awareness campaigns and demonstration projects on simple reuse and recycling options tailored for informal businesses.

Financial and Scale Constraints among Operators

The fish sector is dominated by micro and informal businesses with about 50% of businesses having no employees. The median throughput is just a few tens of kilograms, meaning limited economies of scale. Many operators cited lack of capital and low, inconsistent demand as key barriers to investing in better infrastructure or technology. Because of their size and resource limitations, many of these businesses cannot independently afford solutions like cold storage, solar drying, or waste processing equipment. There is opportunity to encourage cooperative models or shared infrastructure (e.g. communal cold rooms, shared processing hubs) and improve access to microcredit or government-backed green financing schemes.

Quality Deterioration in Trade: Hidden Economic Losses

Although physical waste during trading is low, the data shows that around 0.8% of fish (≈442 kg) was sold at a reduced price due to quality deterioration. This indicates value loss, likely due to lack of cold chain infrastructure or proper handling. In tropical climates like Ghana's, post-harvest quality declines rapidly without proper icing or cold storage, especially during transport and market display. According to FAO (2021), post-harvest losses in African fisheries are often underreported when measured only in physical waste, while quality degradation and value loss are widespread and economically damaging. There is an opportunity to improve access to affordable cold chain technologies (e.g. solar-powered ice machines or coolers) and provide training on hygienic handling and storage.

In general, the fish value chain in Ghana faces several inefficiencies, but these also present clear circular economy opportunities. The most pressing issues include:

- Unused fish by-products in processing
- High firewood consumption
- Lack of reuse and recycling practices
- Financial and structural barriers
- Product quality losses during trade

Addressing these hotspots will require a combination of technical solutions, behavior change, and enabling finance mechanisms. Importantly, interventions must be designed to suit micro- and small-scale actors, who dominate the sector and are most vulnerable to shocks and inefficiencies.

3.9 Current Circularity Gaps along the Fish Value Chain

Table 10 below highlights the major circularity gaps that exist across the fish value chain and outlines practical opportunities to address them. At the input supply stage, inefficiencies in the use of materials and the prevalence of plastic waste remain major challenges. These gaps present opportunities to promote local production of fish feed, which can reduce import dependency and carbon footprints, as well as encourage plastic recovery and recycling within fishing communities.

Table: 10 Summary of Circularity Gaps by Value Chain Stage

Stage	Main Circularity Gaps	Key Opportunities
Input Supply	Inefficient materials, plastic waste	Local feed production, plastic recycling
Production	Wastewater, sludge, bycatch	Aquaponics, sludge composting
Landing/Handling	Post-harvest losses	Ice hubs, offal recovery
Transport	Spoilage, packaging waste	Cold-chain leasing, reusable crates
Processing	Offal/scale waste, fuelwood use	Fishmeal, collagen, efficient kilns
Packaging/Storage	Single-use plastics	Biodegradable packaging
Distribution	Cold-chain breaks	Centralized hubs, cold transport
Retail/ Consumption	Market waste	Composting, biogas, waste segregation
Waste Disposal	Dumping, pollution	Biorefineries, circular enterprises

During production, the key issues include the generation of wastewater, sludge, and bycatch. These streams, often treated as waste, can instead serve productive purposes. Emerging solutions such as aquaponics, which integrate fish farming with vegetable production, and sludge composting offer pathways to convert waste into valuable resources while minimizing environmental impacts.

At the landing and primary handling stage, significant post-harvest losses occur, especially where infrastructure and handling practices are inadequate. Improving access to ice hubs and establishing systems for offal recovery can reduce losses and create new resource streams for secondary products such as fishmeal. In the transport stage, spoilage and packaging waste, particularly single-use materials, undermine efficiency and environmental performance. Circular opportunities include leasing cold-chain services, which make refrigeration more affordable, and promoting reusable crates to cut down on disposable packaging. Within distribution, cold-chain interruptions remain a major cause of fish spoilage and quality degradation. Establishing centralized cold hubs and promoting cold-transport services can ensure product integrity and reduce losses.

The processing stage generates substantial volumes of offal and scales, while the use of fuelwood in traditional smoking contributes to deforestation and emissions. These issues can be addressed by converting by-products into fishmeal, collagen, and other value-added products, alongside the adoption of efficient kilns to reduce fuel consumption.
Circular challenges continue at the packaging and storage stage, which is dominated by single-use plastics. A shift towards biodegradable or reusable packaging alternatives would reduce pollution and improve sustainability. At the retail and consumption stage, a significant amount of market waste, including spoiled fish and organic waste, is generated. Solutions such as composting, biogas production, and improved waste segregation can turn these waste streams into useful resources.

Finally, the waste disposal stage is characterized by dumping and environmental pollution. Advancing biorefineries and supporting circular enterprises that upcycle organic and inorganic waste can create new economic opportunities while reducing environmental burdens.

4.0 Summary, Conclusion And Recommendations

This section provides a summary of key findings, conclusions and recommendations for stakeholders' consideration.

4.1 Key Findings and Conclusion

The results show a fish value chain that is socially vibrant, economically significant, and deeply shaped by gendered roles. However, the chain is seriously constrained by inefficiencies, resource-intensive practices, and underutilized opportunities for circularity. At the production stage, men dominate (95.5%), reflecting established cultural norms around fisheries in Ghana. Producers are generally young to middle-aged and possess at least basic education, indicating a workforce capable of learning and adopting improved practices. By contrast, fish processing (90.5% women) and trading (97% women) are overwhelmingly female-driven activities. These segments are largely managed by mature actors with limited formal education and are typically operated as micro-enterprises with few or no formal employees. This pattern underscores both the economic importance of women in the value chain and the need for tailored, accessible capacity-building interventions.

The structure of the value chain itself spans input supply, harvesting, landing, processing, distribution, retailing, consumption, and waste handling, mirroring Ghana's broader fisheries system that integrates marine, inland, and aquaculture production. Processing remains a central node because it adds value but also generates the most resource consumption and waste. Traditional smoking dominates, relying heavily on fuelwood and producing large quantities of fish by-products that currently have no secondary use. Material flow analysis reinforces these observations. At the processing stage, about 76% of raw fish becomes edible product, with roughly 25% ending up as by-products such as heads, guts, and bones. Spoilage is minimal, but waste volumes remain high and underutilized. At the trading stage, the system operates with remarkable efficiency where almost 98% of procured fish is sold, with very little spoilage or cleaning waste. This suggests that losses at the distribution node are negligible compared to upstream processes.

The quasi-LCA further highlights resource-use hotspots. Fuelwood consumption is exceptionally high, slightly more than the weight of fish processed, thereby posing environmental and economic sustainability concerns. Water and electricity usage are generally low, reflecting both resource limitations and the traditional nature of operations. Diesel use for transportation is modest but still contributes to emissions. Labour inputs are significant and predominantly provided by women and family members, underscoring the value chain's role in rural employment but also the prevalence of manual, physically demanding work.

Overall, the results reveal a value chain with strong gendered participation, high labour intensity, and relatively efficient market turnover, but also notable inefficiencies in energy use, waste management, and technology uptake. These gaps present clear opportunities for circular economy solutions that enhance sustainability while supporting livelihoods.

4.2 Recommendations

The following recommendations are proposed based on the findings from the study.

1. Promote Improved Smoking Technologies and Clean Energy Alternatives

Given the extremely high fuelwood-to-fish ratio, the sector urgently needs efficient smoking kilns, such as improved Chorkor smoker, Ahotor ovens, or hybrid clean-energy systems. Subsidies, financing schemes, and community-based demonstrations should be prioritized to accelerate adoption. This would reduce deforestation, lower emissions, improve product quality, and decrease production costs for processors.

2. Develop By-Product Valorization Pathways to Reduce Waste

With nearly 5,000 kg of fish by-products generated per processing cycle, interventions should support the conversion of offal, heads, scales, and bones into animal feed ingredients, organic fertilizer, fishmeal, or artisanal products. Training, small-scale processing equipment, and private-sector partnerships can help transform these waste streams into viable economic opportunities, strengthening circularity and income diversification.

3. Tailor Capacity-Building Programs to Women and Low-education Groups

Because processors and traders, who are mostly women, generally have basic or no formal education, capacity-building must use practical, hands-on, and visual methods. Topics should include hygienic handling, business management, recordkeeping, resource-efficient processing, and occupational health and safety. Women-focused cooperatives and producer groups can serve as platforms for scaling training and improved finance access.

4. Strengthen Cold Chain, Transport Efficiency, and Market Infrastructure

Although trading losses are minimal, expanding cold storage access through solar-powered systems, community cold hubs, or off-grid solutions could reduce pressure to sell quickly and allow traders to reach higher-value markets. Improved transport logistics and linkages with organized supply chains would reduce diesel use, enhance product quality, and stabilize incomes across the value chain.

5. Support Enterprise Upgrading and Social Protections for Micro-Businesses

Given that most processors and traders operate with no hired labour and limited assets, policies and programs should strengthen their business resilience. This includes access to microcredit, group savings, digital payment systems, health and safety training, and simplified regulatory processes. Enhancing working conditions and providing social protection mechanisms for predominantly female actors will contribute to more equitable and sustainable value chain development.

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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 *because of quality deterioration*** 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%.
Proportion/Percentage loss in value (price*) of commodity during harvesting	
Proportion/Percentage loss in value (price) of commodity during post-harvesting on-farm (i.e. during gathering and loading, etc.)	
Proportion/Percentage loss in value (price*) of commodity due to Rodents or insect attack	
Proportion/Percentage loss in value (price*) of commodity during storage	
Proportion/Percentage loss in value (price*) of commodity during processing	
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	|__|
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 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 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 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)				
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)			
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? xvii. (bicycle/motorbike/ tricycle(aboboyaa)/ public transport/Own truck/head carriage/ by air/others)	
xviii. Did you experience any challenge in finding buyers or off-takers for your commodity last year?	Yes|__| No|__|
xix. 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

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 [ ]

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

27. 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 [ ]

28. 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[ ]

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

30. 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 [ ]

31. 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 [ ]

32. 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_____

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

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

35. Do you have any questions for me?
_____
_____

End of survey

GPS location of respondent / trading point	*I__I__I__I__I__I__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.*

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

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