Sustainable Intensification of Mixed Farming Systems

CGIAR

Feed Value Chains

Sustainable Intensification of Feed Value Chains in Mixed Sheep-Barley Systems: Rethinking Waste Management - The Case of Atella

A Baseline Study

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The Sustainable Intensification of Mixed Farming Systems Initiative aims to provide equitable, transformative pathways for improved livelihoods of actors in mixed farming systems through sustainable intensification within target agroecologies and socio-economic settings.

Through action research and development partnerships, the Initiative will improve smallholder farmers' resilience to weather-induced shocks, provide a more stable income and significant benefits in welfare, and enhance social justice and inclusion for 13 million people by 2030.

Activities will be implemented in six focus countries globally representing diverse mixed farming systems as follows: Ghana (cereal–root crop mixed), Ethiopia (highland mixed), Malawi: (maize mixed), Bangladesh (rice mixed), Nepal (highland mixed), and Lao People's Democratic Republic (upland intensive mixed/highland extensive mixed).

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Abbreviations and Acronyms

BSG	Brewery Spent Grain
CSA	Central Statistical Agency
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
ICARDA	International Center for Agriculture in Dry Areas
KII	Key Informants' Interview
Qt	Quintal
WY	Waste Yeast

Contents

Introduction

Per capita consumption of animal products is a good indicator of the standard of living of a country's population. The per capita consumption of animal products in Ethiopia is one of the lowest in the world, approximately 9 kg of meat, 56.2 liters of milk and 4 eggs (FAO, 2019). Access to animal products is becoming increasingly restricted, especially for the low-income segment of society. Limitations in livestock production and productivity are attributed to the scarcity and inferior quality of feed (Assefa et al., 2013; Yadessa et al., 2016; Gebregziabhear, 2018; Tegegne and Feye, 2020; Bayissa et al., 2022). Consequently, production costs rise significantly. These elevated costs lead to increased retail prices for products such as meat, milk, and eggs, consequently diminishing their affordability by lowering the purchasing power of consumers (Negash, 2022). Additionally, escalating global feed prices and shortages of foreign exchange in the country have further intensified domestic feed prices. Utilizing agro-industrial waste for animal feed helps bridge the significant gap between feed demand and supply, while also mitigating the environmental impact of waste disposal. Agro-industrial waste recycled as animal feed needs to be nutritious, cost-effective, toxin-free, and well-received by animals. 'Eco feed' refers to agro-industrial by-products transformable into animal feeds through appropriate processing techniques like solid substrate fermentation/ensiling, cooking, and both wet and dry based methods.

In Ethiopia, agro-industrial by-products constitute one of the primary feed resources, accounting for about 1.53% of the overall feed usage, while other by-products (such as waste from animals, fruits, and vegetables) contribute 5.11% (CSA, 2020). Despite being good supplemental sources, the overall share of agro-industrial by-products in the country's feed use is quite low. In contrast, in North Shewa zone, by-products from alcoholic beverages are highly prized as supplements. Particularly in and around Debre Berhan town, the contribution of both local and industrial brewery by-products is significantly high.

North Shewa Zone is known for its mixed crop-livestock farming system and high market potential. The livestock system plays an important role in boosting the economy of smallholder farmers in the zone (Gebregziabhear, 2018). Livestock production in smallholder mixed crop–livestock farming systems is constrained by

feed shortages and scarcity of land for fodder cultivation (Tahir et al., 2018). Therefore, the use of alternative, non-conventional feed supplements such as agro-industrial by-products could provide practical and sustainable solutions to the prevailing livestock feed shortage crisis (Terefe, 2022).

North Shewa zone is predominantly known for the availability of alcoholic by-products. Referred to as 'Atela' in Amharic, these by-products are commonly purchased by farmers to feed their animals. Additionally, some households produce local drinks such as 'Areke' and 'Tella' specifically to generate the by-product 'Atela' for animal feed. The growth of brewery plants in North Shewa presents a chance for local farmers to utilize by-products like brewery spent grain and waste yeast for animal feed. Considering the large amounts of these by-products in the study area, it is imperative to develop a comprehensive management approach so as to mitigate waste of this industrial by=product and ensure efficient utilization of this by-product by the end consumers, which are livestock. The initial step looks at the entire value chain to identify existing opportunities and determine necessary interventions. Interventions may have the potential to enhance competitiveness by streamlining the entire "Atella" value chain instead of concentrating on a single segment. The aim of this study is to:

- Mapping the actors and core processes in the local "Atella" value chain.
- Identifying the market demand, supply, and distribution of "Atella".
- Identify leverage points and challenges in the local chain.

Methodology

The study was conducted in North Shewa Zone, Ethiopia from November 2022 to May 2023.

Description of the study areas

This study was conducted in two districts, Debre Birhan (DB) and Basona Worena (Basso) of North Shewa Zone in Amhara Regional State. Debre Birhan lies at a latitude of 09◦ 12' N latitude and longitude 38° 45' E with an average altitude of 2840 masll. The average temperature is 13°C and the area receives 1232 mm of rainfall annually. There are two breweries in this district, Habesha and Dashen. Basona Worena is classified in Agro-Ecological Zone 'moist *Dega*'. It lies between 2250 and 3200 masl, receives annual rainfall between 900 and 1050 mm annually and average temperature between 9–15°C. The soils are cambisols, vertisols and arenosols in the undulating lower parts of the district. Most of the area is cultivated, with some pasture areas at mid and high altitudes.

Data Collection and Sources of Data

Different methods were combined to generate data on the value chain. Participatory rural appraisals, focus group discussions, and key informant interviews were used to collect primary data. Secondary data were also collected from district offices. Relevant literature and documents were also reviewed to provide theoretical background.

Focused group discussions

Three focus group discussions (FGD) were conducted, one in each *kebele* (peasant association). FDGs were conducted in Gudoberet and Debele of Basso District and DB town. Ten participants took part in each FGD. A total of 30 participants, 12 women and 18 men, were included in the FGDs. Farmers included in FGDs were primarily those who utilize the local and industrial brewery by-products.

Key informant interviews (KII)

The key informants identified for this interview were Livestock Feed Experts, DB Employment Creation Office, Local Areke Manufacturers, Dashen S.C., Research Centers, Feed Cooperatives, Dairy Cooperatives and Farmers.

Method of Data Analysis

Thematic analysis approach

Data collected through FGD and KII were analysed using thematic analysis. Interviews were transcribed and examined in detail to identify common themes and patterns.

Value chain mapping

To get a visual representation of the entire chain in the district, chain mapping was used. Analysis of specific functions of each actor across chain was also described under the map. The map was used to show products and price flows along the chain at the local level.

Profit margin, added value, and value shares

According to Royal Tropical Institute (2008), calculating profit margins in the value chain is not straight forward. It requires information on costs and revenues of each individual actor in the chain. Once the costs and revenues of each actor in the chain are known, their financial position can be calculated in the following steps:

Gross income or operating profit: This is calculated by deducting variable costs from revenues.

Gross margin*:* This calculation is done by first dividing the gross income by the sales revenue. Following that, the result is multiplied by 100 to convert it into a percentage.

Added value: This is the difference between the price the actor pays for the produce and the price at which she or he sells it.

Value share: This is the percentage of the final, retail price that the actor earns. It can be calculated as the added value divided by the final sales price. Then multiply by 100 to convert it into a percentage**.**

Results and Discussion

The Actors and Core Functions in the Chain

Production

1. Brewery Spent Grain and Waste Yeast

There are two major beer companies in the zone, Dashen and Habesha. These companies produce various alcoholic and non-alcoholic beverages such as beer and malt under different brand names. The raw materials used to make these drinks are mainly barley, hops, yeast and water. The production process of these drinks includes a detailed brewing process such as malting, barley grinding, mashing, wort separation, boiling, yeast fermentation, stabilization, clarification, up to pasteurization and finally packaging. Based on these processes, high-quality and standardized alcoholic and non-alcoholic drinks are produced. A lot of waste is generated between the production process. The largest waste generated is brewery spent grain (BSG) and waste yeast (WY). These by-products are collected at the brewery's drop-off point and transported to surrounding farmers.

Brewery spent grain is the spent part of malt or barley. It is a by-product of the extraction of soluble sugars from the malt. Feeding BSG served as a replacement for forages (Allen and Stevenson, 1975). The second by-product is the WY. It is the second largest but least utilized by-product of the brewing industry (Huige, 2006). It is generated from the yeast used in the fermentation process. This yeast can be reused up to the 8^{th} generation. After repeated use, it is disposed of as waste. Due to its strong unpleasant odor and high tendency to pollute the ecosystem, this waste is not disposed of in the environment. Therefore, these wastes undergo a thermalization process. During this process, the waste is exposed to high-pressure steam to ensure the elimination of all undesirable microbes. After microbiologists from the beer

company's quality assurance department ensure this, the waste can be safely used as animal feed.

2. By-product from Local Alcoholic Beverage ('Areke Atela')

'Areke' and 'Tela' are traditional alcoholic beverages widely consumed in the study area. These beverages are made by women. The women produce these alcoholic beverages either for home consumption or to support their livelihoods. The by-product of these drinks is used as a feed supplement in the region. The most consumed and marketed local by-product of local alcoholic beverages is the 'Areke' ('Areke Atela' in Amharic language). 'Areke Atela' was found to be the only by-product of the available traditional drinks that is widely marketed.

The North Shewa zone is famous for 'Areke' production. Most women engage in 'Areke making businesses to make a living. The production process of the 'Areke' is very rudimentary, labor intensive and requires the use of firewood. 'Areke' and the by-product ('Areke Atela') is sold to the market. The 'Areke Atela' is highly valued by the women. This is because they can generate additional profit from it. If 'Areke' unexpectedly turns out to be unfit for consumption, it is the 'Areke Atela' that compensates for the losses the women incur. The main ingredients for making 'Areke' include wheat, sorghum, maize, hops and water.

Support services and influencers

The support service providers identified in the chain are the Zone Agriculture Bureau, DB Agriculture Research Center (DBARC) and ICARDA. Technical support is provided to farmers. The technical support includes extension services by the Zone Agriculture Bureau offers advice and training on general feeding practices. The office also works to facilitate linkage between farmers and industries. ICARDA, DB University and DBARC support the system by working on research and development activities. DBARC is currently working to improve the nutritional content of the by-product and extend the shelf life of BSG by making silage out of it.

The Employment Opportunity Creation Office in DB was identified as an influencer in this chain. The office organizes unemployed youth in the district to distribute the waste from the beer company to farmers. These youth groups are supposed to

function as directed by the office. The sales price and the quantity they receive from the company are determined by the office.

Marketing and transportation

For Areke Atela, the livestock farmers themselves collect the by-product from the Areke producer's house and transport it to their farm, while for BSG and WY, the transport and marketing is carried out by a group of youth organized in a cooperative. There are 8 feed cooperatives who are responsible for this activity. Each cooperative is allocated a quota by the Employment Opportunity Creation Office in DB. These cooperatives transport the by-products by tanker and deliver them hot and fresh to the farmers. Each truck can transport up to 80 quintals of by-products at a go.

Storage and consumption

All by-products are used as feed supplements for livestock especially, dairy cows and sheep. These supplements are fed along with crop residues. Farmers mix crop residues with either the BGS, WY or 'Areke Atela' to make it palatable to animals. During the Focus Group Discussions (FGD) and Key Informant Interviews (KII), farmers reported that animals fed with these by-products exhibited notable improvements in both milk production and fattening. However, some adverse effects were also noted, such as miscarriages in pregnant animals and signs of addiction to the by-products in the animals. Additionally, issues related to the storage and handling of these by-products were mentioned. These by-products must be stored covered in a clean container, in a dry place and away from direct sunlight. In addition, the byproduct should be stored covered with clean water. The water needs to be changed every now and then. If all these safety measures are taken while maintaining hygiene, the by-products could last up to 8 days. After the 8th day, the byproduct tends to form mold. But most of the time these by-products don't last that long. It is consumed very quickly. In fact, there is a shortage of these nutritional supplements in the region. Farmers cannot access these by-products on immediate demand. The supply is limited. The causes of this shortage are the limited production of the beer industry and local Areke manufacturers. One reason for limited beer production is the seasonal demand for the product, so production fluctuates throughout the year. On the other

hand, production for Areke is limited due to the labor-intensive process of distilling the alcohol.

Mapping the Value Chain

The value chain was mapped by identifying and graphically representing the current value chain as identified during the study. The value chain map in Figure 1 shows the payment, information, and quantity flow of brewery by-products in the chain. It also presents the relationships and activities carried out by the various participants at each stage of the chain. These stages of the chain are production, collection, transport, marketing, and consumption. As shown in the chain map, Figure 21 the product flow begins at the beer factories and areke manufacturers and ends with the farmers. Beer factories sell their BSG and WY by-products in large quantities to cooperatives and farmers' associations. The beer factories sell about 91.06% and 8.94% to feed cooperatives and farmers' associations, respectively. About 78.8% of Areke Atela is supplied mainly to the surrounding farmers who keep dairy cows and raise sheep. The rest, 21.2%, is used by the Areke producers themselves to feed their sheep. There are no intermediate players in the chain for Areke Atela. Farmers purchase the by-product directly from Arke manufacturers. The beer company sells WY and BSG at a price of 0.15 ETB/Qt to young people organized in feed distribution cooperatives and directly to the surrounding farmers. These cooperatives are responsible for distributing the by-product to the community at a price of ETB 120/ Qt directly to farmers and livestock cooperatives in the area. Meanwhile, dairy cooperative members buy BSG for ETB 270 per liter. Most individual farmers purchase these products from traders at 500ETB/Qt. On the other hand, the price of Areke Atela ranged from ETB 2 to ETB 1.25 per liter depending on the availability of pastureland. During the dry season, the price of the Areke Atela tends to be higher, at ETB 2 per liter. When pasture is available (September, October, November), the price of the Areke Atela is only ETB 1.25 per liter.

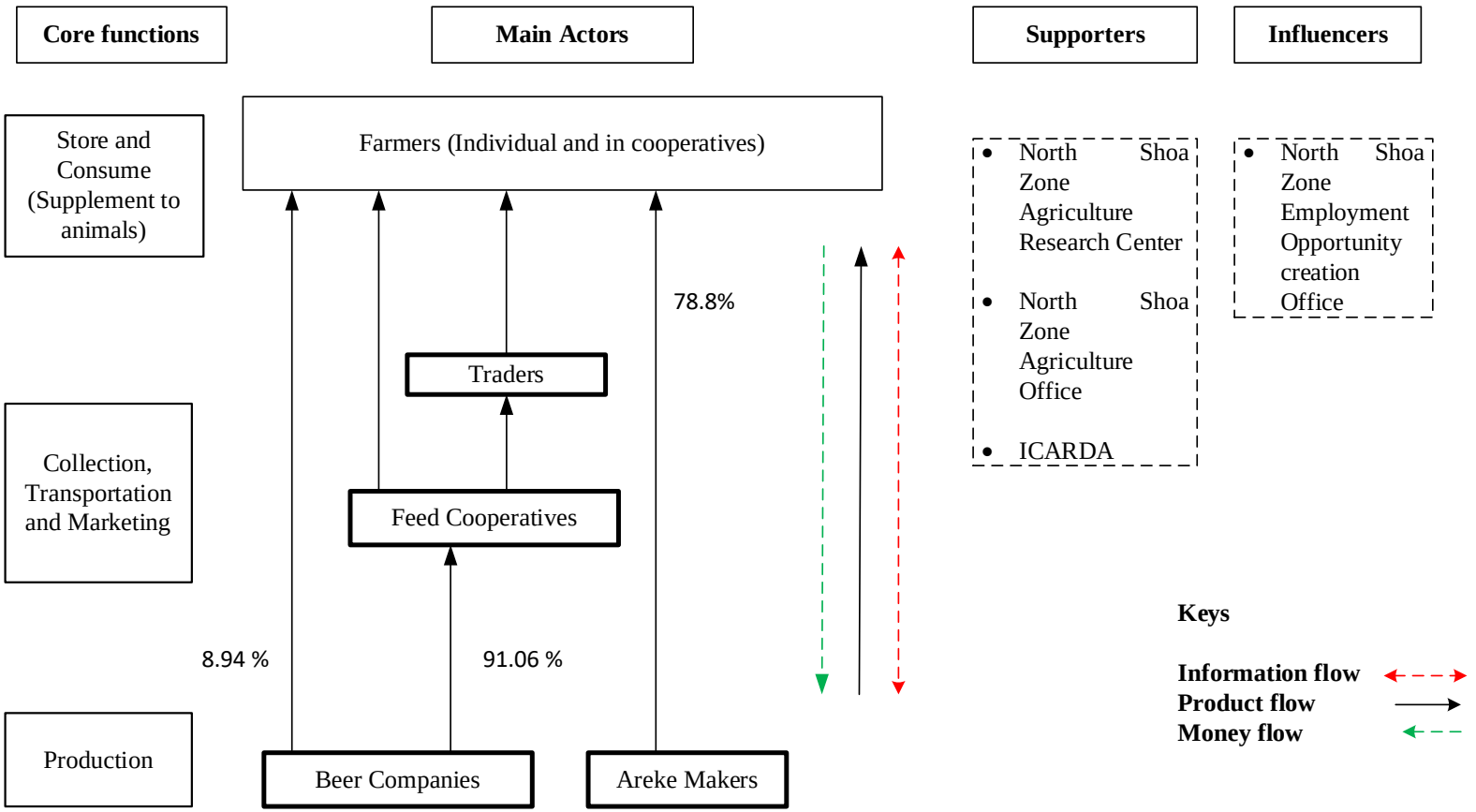

Figure 1: Value chain map of industrial and local brewery by-products

Market Outlets

Based on the flow direction of the by-products, five market outlets were identified in the study area.

Market channel I: Beer Company ➔Consumers (Farmers organized as cooperatives)
Market channel II: Beer Company ➔Feed Cooperatives ➔Consumers (Farmers organized as cooperatives)
Market channel III: Beer Company ➔Feed Cooperatives ➔Consumers (Farmers organized as cooperatives)
Market channel IV: Beer Company ➔Feed Cooperatives ➔ Traders ➔Consumers (individual farmers)
Market channel V: 'Areke' makers ➔Consumers (individual farmers)

Profit Margins for BSG

The profit margins of BSG value chain actors varied along the chain (Figure 2). The feed cooperatives shared the highest profit margin (54.81%), followed by the traders (45.16%) and the beer company (0.03%). Each of the actors in the value chain adds value to the product as the product flows from one actor to another. The actors transported and delivered the product from the beer company. The total value added to the BSG chain was ETB 500 per quintal. The Beer Company earned 0.03% of the final sales price, while feed cooperatives and distributors earned 54% and 45.97%, respectively.

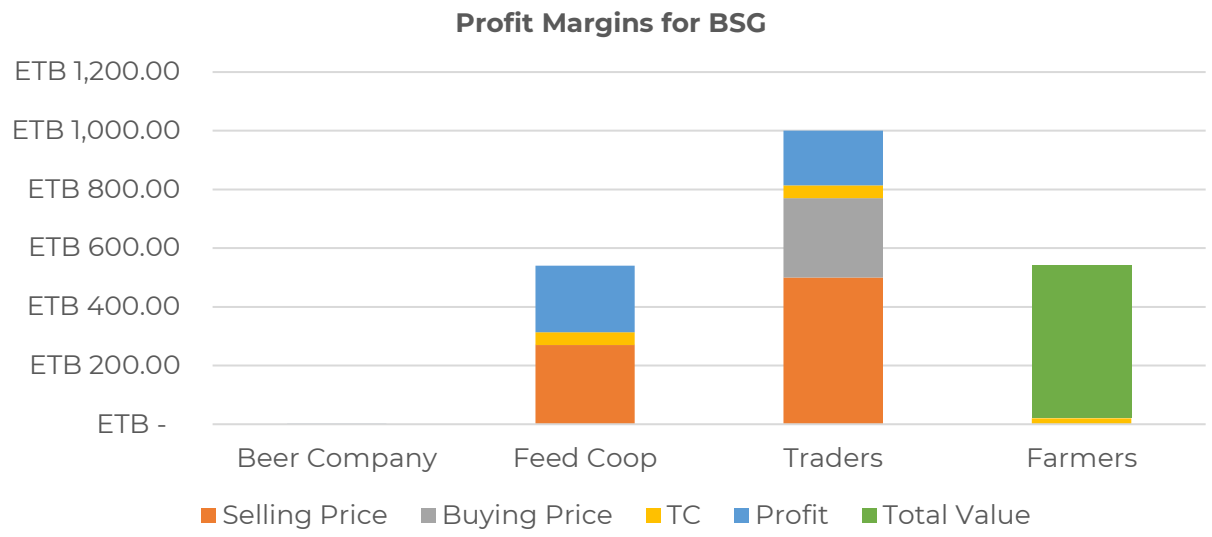

Figure 2: Distribution of Profit Margin for BSG

Based on the three market channels, feed cooperatives received the highest share of value in all market channels (Table 1). The feed cooperatives received the highest share from Channel III (99.94%) and the lowest share from Channel IV (53.97%), which is due to the participation of local traders in this channel. The retailers received a value-added share of 46% from the chain.

The 'Areke' by-product Market

The Areke by-product from the local traditional alcoholic beverage, passes through only one marketing channel. The by-product is called 'Atela' in Amharic. On the market. Channel V only involves the Areke manufacturers and farmers. There are no intermediate products in the channel. Areke manufacturers deliver the by-product directly to farmers. These Areke manufacturers have loyal customers for the by-product. Figure 3 shows the value of Areke against other livelihood activities.

Table 1: Distribution of added value share of the actors between market channels

Actors	Beer Company		Feed Cooperative		Traders		Individual farmers	Farmers in cooperatives
Unit	ETB/Qt	%	ETB/Qt	%	ETB/Qt	%	ETB/Qt	ETB/Qt
Channel I	0.15	100	-	-	-	-	-	0.15
Channel II	0.15	0.125	119.85	99.87	-	-	-	120
Channel III	0.15	0.06	269.85	99.94				270
Channel IV	0.15	0.03	269.85	53.97	230	46	500	-

Where, ETB = Ethiopian currency and Qt (quintal) = 100 kg

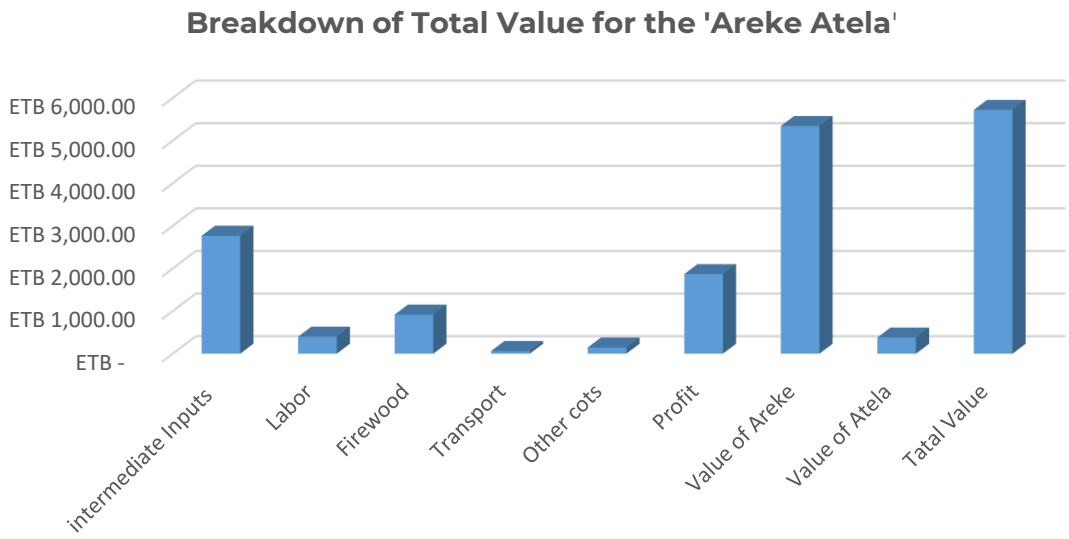

Figure 3: Break down of the value of Areke Atela

Conclusion and Implications

The study focused on the Atella feed value chain in the North Shewa Zone of the Amhara Region in Ethiopia. It aimed to map the actors and core processes in the local chain, identify the distribution of added value, and highlight leverage points and challenges. The findings revealed that the use of agro-industrial by-products, particularly alcoholic beverage by-products, as animal feed could provide practical and sustainable solutions to the prevailing livestock feed scarcity in the region. The local production of brewery by-products, such as brewery spent grain and waste yeast, presented an opportunity for farmers to optimize the value chain and enhance their competitive advantage.

Implications:

Livestock feed scarcity: The shortage and poor quality of feeds in Ethiopia have contributed to limited access to livestock products and increased production costs. The study suggests that recycling agro-industrial wastes, such as brewery by-products, as animal feed can help bridge the feed gap, reduce production costs, and improve the affordability of livestock products for consumers. This has implications for food security and the livelihoods of smallholder farmers.

Sustainable waste management: Using agro-industrial by-products as animal feed addresses feed scarcity and has environmental benefits. Proper processing techniques can transform these waste materials into eco-friendly feed options. Promoting waste recycling through value-chain approaches can contribute to sustainable waste management practices and reduce the impact of waste disposal on the environment.

Economic opportunities: The Atella feed value chain presents economic opportunities for local farmers and entrepreneurs. By optimising the value chain and exploring the potential of brewery by-products, farmers can diversify their income sources and create employment opportunities. This is particularly relevant for educated youth who can develop entrepreneurial skills in the processing and utilisation of agro-industrial by-products.

Policy and intervention: The study highlights the importance of recognising prevailing opportunities and identifying the challenges in the value chain. Policymakers and

stakeholders can use this information to develop targeted interventions and support mechanisms to enhance the competitiveness and resilience of the Atella feed value chain. This can include investment in processing technologies, capacity building for farmers, and promoting market linkages.

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