

# From Waste to Value

## Valorising agricultural waste streams in Ethiopia

Final Report | Commissioned by the Embassy of the Kingdom of the Netherlands in Ethiopia



Compiled and Prepared  
July 2026

# Introduction

Waste Stream Mapping

Technical and Market Assessment

Policy and Regulation

Business Concepts of 5 Agricultural streams

Conclusions and recommendations

# Valorising agricultural waste streams in Ethiopia



## ETHIOPIA NOW

- Waste is used or discarded in an informal, often unhygienic and unsustainable manner
- 70% of organic waste is rotting in dumps, causing e.g. water contamination
- 25% of land is degraded, soils are highly acidic and depleted
- High reliance on expensive imported products like fertilizers or paper
- There are opportunities and small-scale activities to valorise waste streams

## THE PROJECT

- Explore innovative ways to turn waste streams into value-added products
- In line with circular economy principles, reducing agriculture waste
- Boosting local economic development
- Support private sector collaboration between ETH - NL



Embassy of the Kingdom  
of the Netherlands

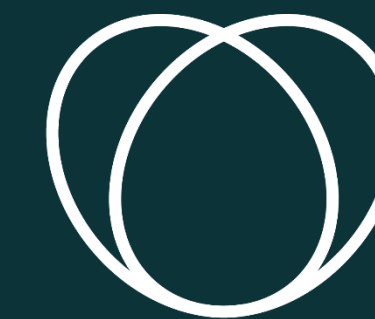
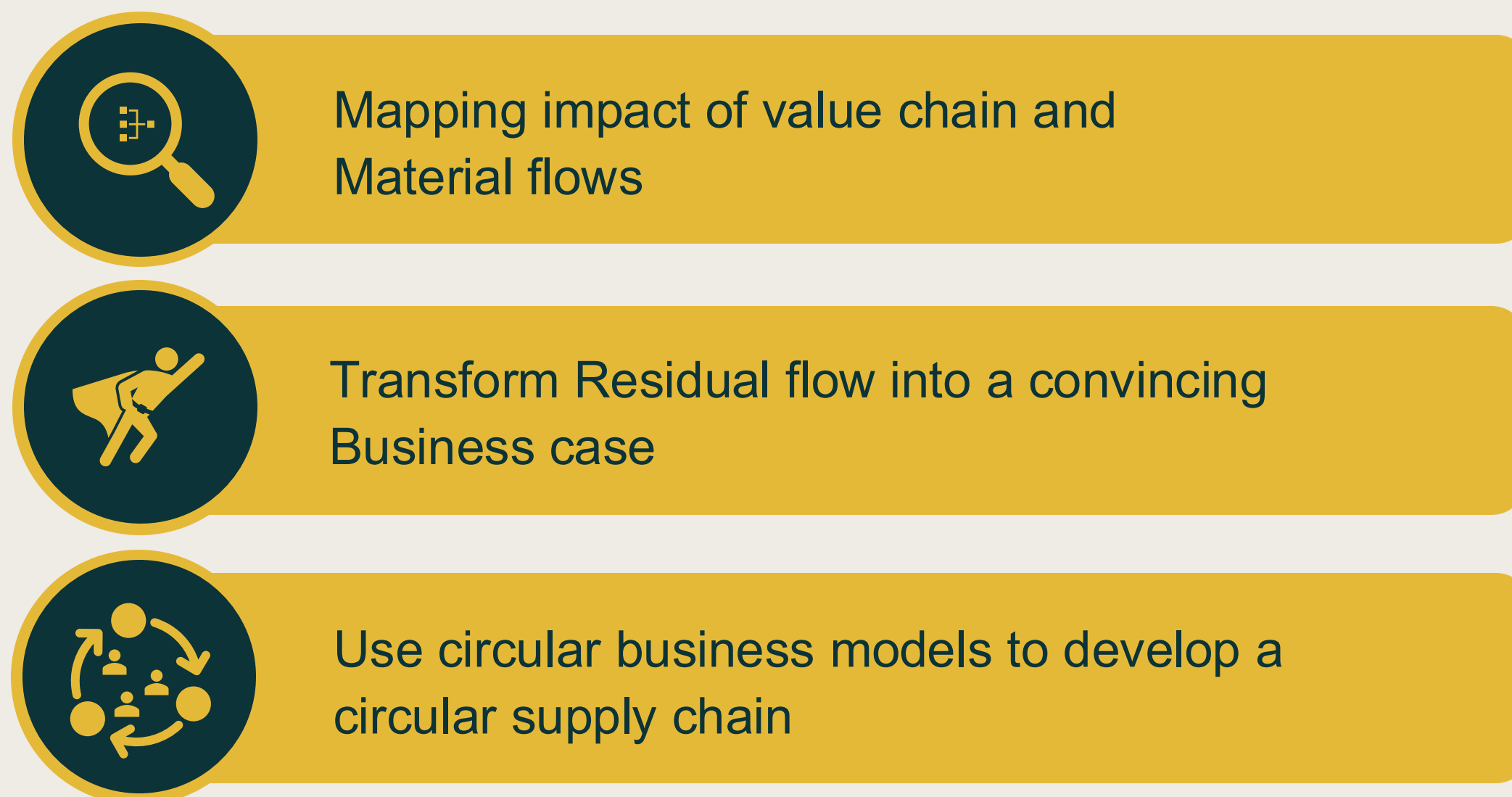
## ETHIOPIA FUTURE

- Import substitution by locally produced materials, food, (agricultural) products
- Job creation through the development of additional production and value chains
- Value creation (economic, social, environmental) by utilising waste as a value-stream
- Improved quality of soil leads to improvement livelihood of farmers and local community
- Alignment between policy creation and execution



- Making circular ventures a feasible reality
- We build ventures - Digisurfer, Caffè Inc, Ecostruct

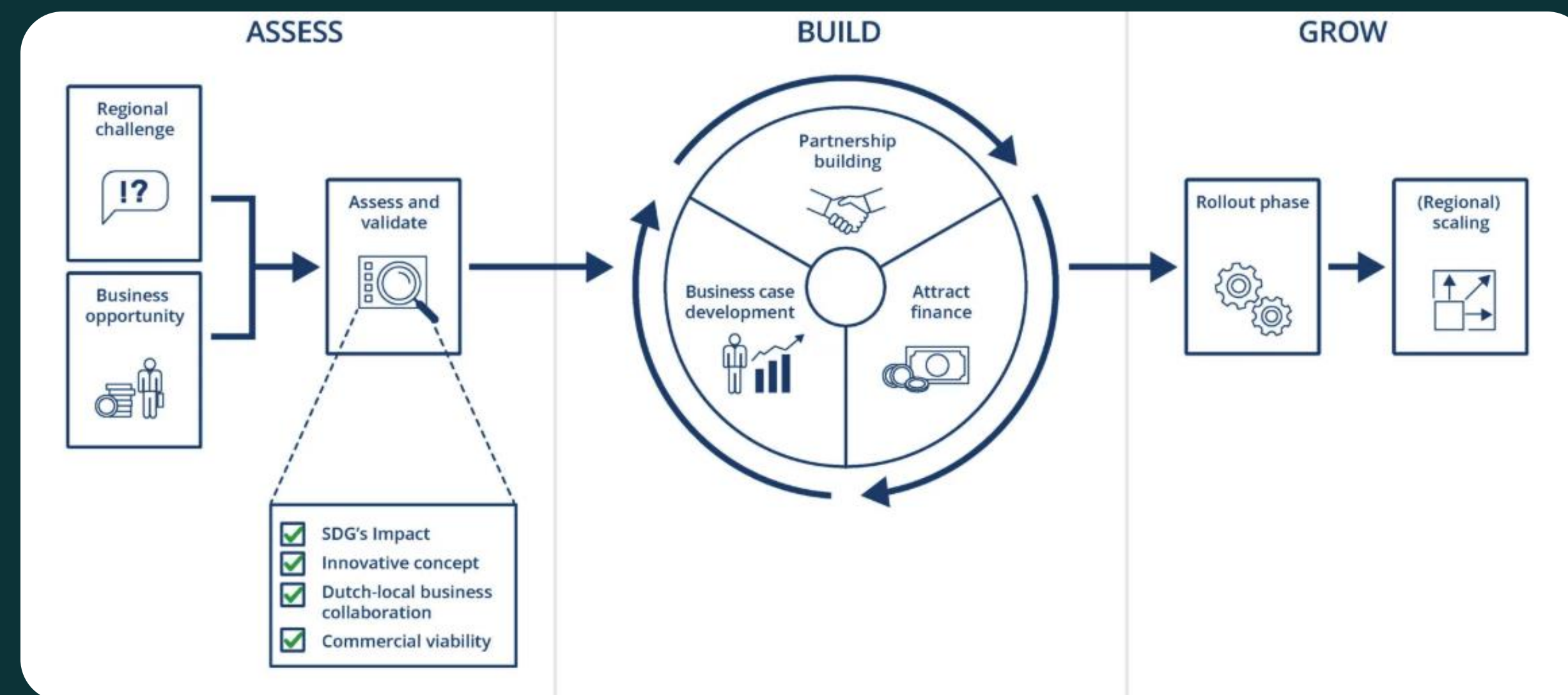
## Spaak Value Proposition



TRAIDE

- Dutch non-profit based in Ethiopia, Burundi and Rwanda.
- **Independent partnership builder** solving local development challenges
- Agriculture, water, green economy (circularity) and health
- Create private sector solutions with local private sector and international businesses

## TRAIDE Approach



Introduction

# Waste Stream Mapping

Technical and Market Assessment

Policy and Regulation

Business Concepts of 5 Agricultural streams

Conclusions and recommendations

# Methodology Waste Stream Mapping

| Sector                   | Crop/Agri Stream                                                                  |
|--------------------------|-----------------------------------------------------------------------------------|
| Coffee                   | Coffee                                                                            |
| Fruits and Vegetables    | Mango, Banana,                                                                    |
| Beer and Malt production | Barley malt, Beer processing residues                                             |
| Livestock sector         | Beef, Fish, Dairy processing, Poultry (Meet/Egg), Animal feed, Manure             |
| Pulses and Oilseeds      | Sesame seeds, Soya, Faba bean, Chickpea, Lentil, Field pea, Haircot bean)         |
| Edible oil processing    | Niger seed oil, Sesame oil, Sunflower oil, Soybean oil, Rapeseed oil, Avocado oil |
| Cereals                  | Wheat straw, Teff straw, Corn cobs, Sorghum Stalks                                |
| Floriculture             | Cut flowers and similar residues                                                  |
| Honey                    | Honey and Beeswax                                                                 |
| Herbs/Spices             | Herbs, Ginger, Turmeric                                                           |
| Vegetable canning        | Vegetable residues                                                                |
| Leather                  | Raw hides and skins (Goat, sheep, cattle)                                         |
| Textile                  | Cotton/Cotton lint                                                                |
| Wood processing          | Saw-mill waste                                                                    |

**Initial selection of streams based on:**

- Desk research on waste streams in Ethiopia (**volumes**, current use, upcycle potential and technology required, market potential)
- Interviews with Stakeholders per stream
- Technical expertise of Spaak team
- Contextual knowledge of TRAIDE team
- Grading criteria (explain on next page)

# Grading Criteria



## LOGISTICS

Connection between collecting, sorting, and transporting waste from farms or markets back to processing hubs.

**Challenge:** Poor road infrastructure and long distances often lead to high transport costs and significant waste degradation.

**Favourable:** centralized production close to waste generation



## TECHNOLOGICAL FEASIBILITY

Bridges the gap between raw waste and value, with requirements ranging from simple drying for fertilizers to complex enzymatic conversion for biofuels.

**Challenge:** Low levels of technological development, advanced valorisation hindered by high machinery import costs, unreliable energy, and a shortage of technical expertise

**Favourable:** Low-tech streams that succeed with accessible, local tools and support of technological innovation within the country on tec

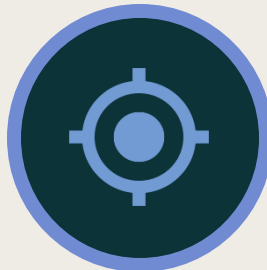


## MARKET POTENTIAL

Bridge between waste processing and profit. It measures the demand for products and ability to sell them

**Challenge:** cheap import undermines local margins

**Favourable:** multiple clients, high volumes, mass demand



## SOCIAL/ENVIRONMENTAL IMPACT

Evaluates how waste valorisation improves upon harmful current practices addresses health, `environment (biodiversity) and social value/impact through job creation and gender inclusion

**Challenge:** Valorisation process can create negative social/environmental impact

**Favourable:** Equality and direct visible and measurable environmental impact (biodiversity)



## (VALUE CHAIN) PARTNERSHIPS

Partnerships connect waste generators, such as industrial agro-processors and urban centres, with the private sector. Supportive government policy and international organizations (like GIZ or SNV) to provide funding and technological develop.

**Challenge:** Limited understanding of valorisation slows cooperation between industrial hubs, co-ops, and NGOs. C

**Favourable:** Partnerships stimulating access to market and finance



## IMPORT SUBSTITUTION / EXPORT POTENTIAL

Boosts local incomes and national competitiveness. It focuses on import substitution and export potential for niche products

**Challenge:** Meeting high quality standard for exporting & Import Dominance:

Large-scale synthetic fertilizer and feed importers have established supply chains

**Favourable:** Forex saving, SME-led growth



## DUTCH LINK

Advantage of leveraging Dutch expertise in circular agriculture, "Waste-to-Value" innovation, presence of Dutch companies in Ethiopia

**Challenge:** Technology mismatch and contextual factors

**Favourable:** Policy alignment and shared trade interest

Introduction

Waste Stream Mapping

# Technical and Market Assessment

Policy and Regulation

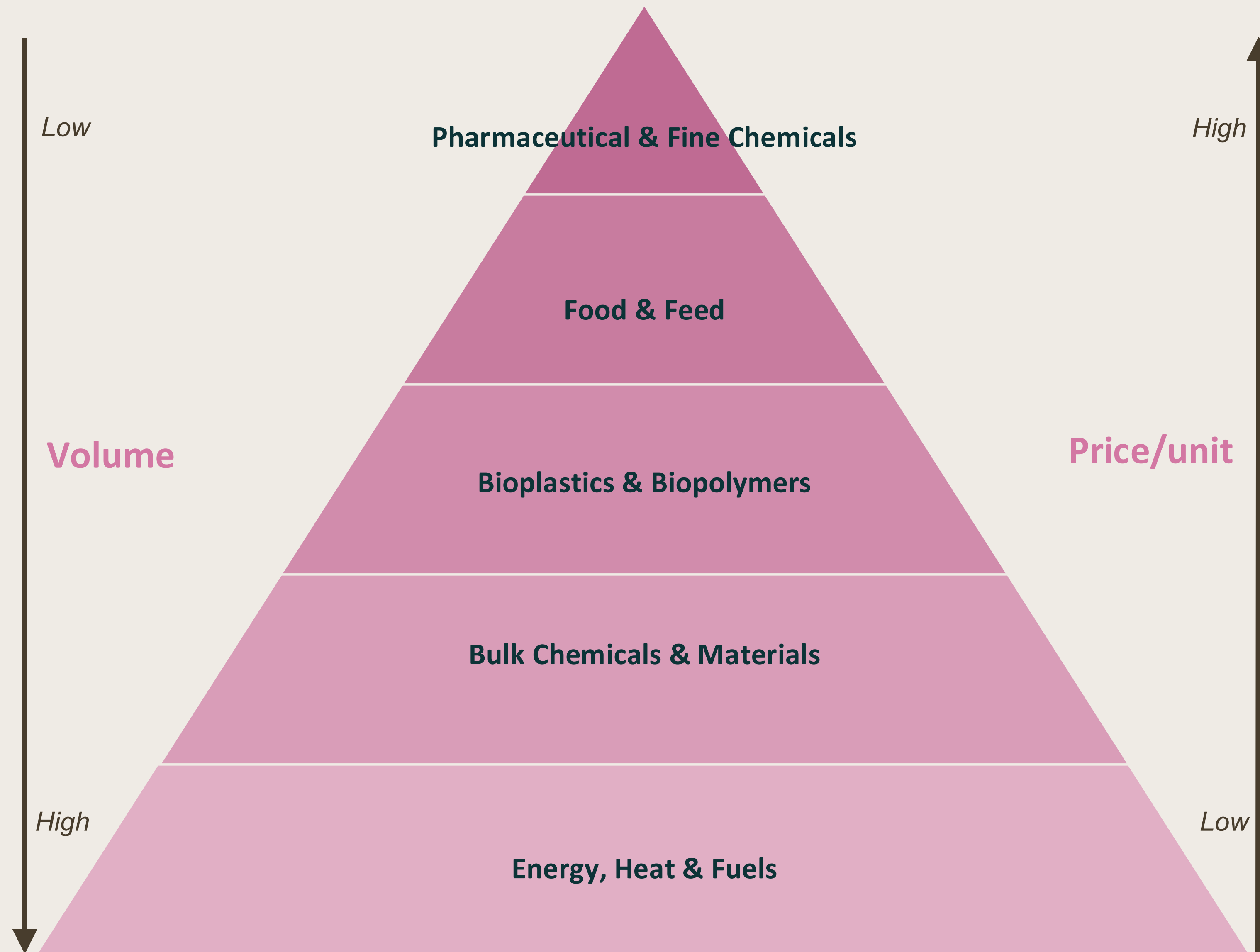
Business Concepts of 5 Agricultural streams

Conclusions and recommendations

# Biobased Value Pyramid

The biobased value pyramid is a tool/concept, introduced by the Dutch government (2007). It's a model for prioritizing high-value applications of biomass (such as pharmaceuticals and fine chemicals) over low-value uses (such as energy and fuel).

Please note that local trends and needs influence the value of an application and what to steer towards. In this project, the pyramid is used as a guiding tool in decision making for waste stream applications.





# Coffee | Grading Criteria

## ABOUT

Ethiopia is Africa's largest coffee producer with coffee being 30-35% of Ethiopian export revenue.

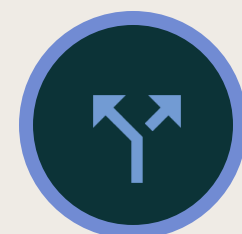
## RATIONALE

More than 50% of the coffee cherry - discarded during processing. Currently, they are openly burnt or landfilled, used as fertilizer or small-scale cascara production. The different waste streams in coffee production process can be upcycled into multiple high value products with e.g. biorefinery (Coffee Resurrect). Coffee will be one of the focus areas.



### VOLUMES PER YEAR

- Coffee production : 501 ktons/year (2024)
- For every 1kg of coffee cherry harvested, 0.9 kg waste is accumulated
- Coffee cascara- 312 ktons
- Coffee silverskin- 0,8kton
- Coffee grounds 29kton



### LOGISTICS

- Large processing sites for dry milling or washing stations
- Presence of dispersed processing in rural areas



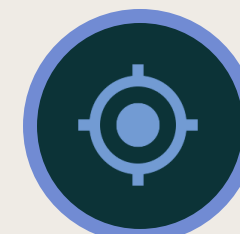
### TECHNOLOGICAL FEASIBILITY

- Potential for anti-oxidant rich beverages
- Bio-actives extraction
- Potential for food ingredient extraction



### MARKET POTENTIAL

Increasing interest in the Functional food and dietary supplement market



### SOCIAL / ENVIRONMENTAL IMPACT

- Soil acidity & toxicity
- Attracts oxygen from water - high impact on biodiversity
- Promoting production of local beverages and culture



### (VALUE CHAIN) PARTNERSHIPS

- Coffee Cooperatives in Ethiopia Caffe Inc (NL)
- Gallani Coffee (ET)
- PectCof/Dutch Gum (NL)



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Export of caffeic acid as ingredients for diet supplement
- Inputs for personal care products
- Export cascara



### DUTCH LINK

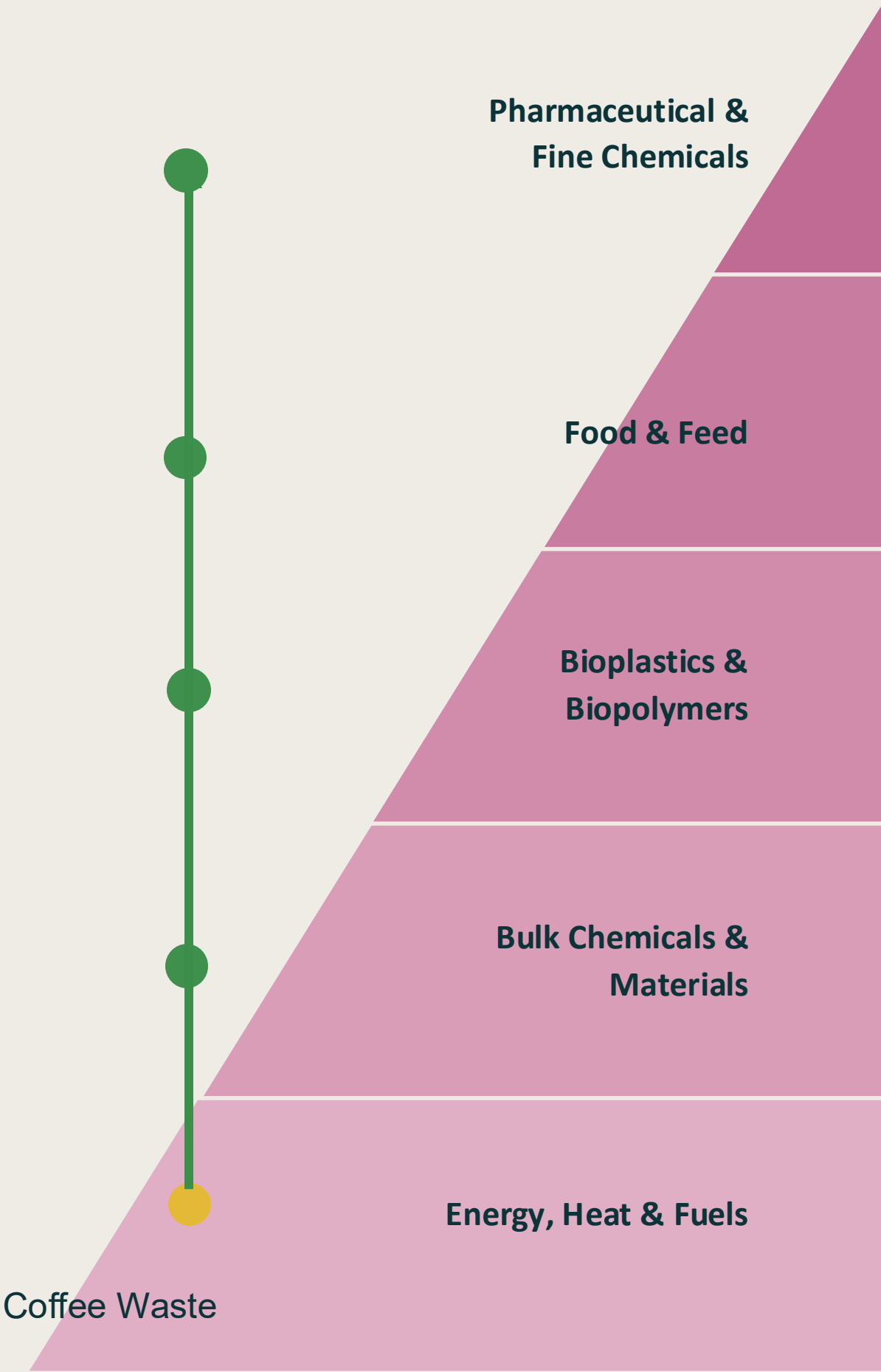
- Expertise in technologies for handling coffee waste
- Caffe Inc (NL) / PectCof/Dutch Gum (NL)
- Export cascara

# Coffee | Flow



| Key waste streams | Biopyramid        | Current application Ethiopia | Upcycle potential                                                                                                                                                 |
|-------------------|-------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coffee husks      | Energy/heat/Fuels | Compost/burning              | <ul style="list-style-type: none"><li>Fibre-rich flour for bakery products</li><li>Bioactive extraction</li><li>Fertiliser</li><li>Pyrolysis to Biochar</li></ul> |
| Coffee pulp       | Energy/heat/Fuels | Fertiliser/landfill          | <ul style="list-style-type: none"><li>Extraction of pectin (gelling agent)</li><li>Infusion for beverages</li></ul>                                               |
| Coffee Parchment  | Energy/heat/Fuels | Compost/Burning              | <ul style="list-style-type: none"><li>Caffeine extract</li><li>Phenolic extract</li></ul>                                                                         |
| Silverskin        | Energy/Heat/Fuels | Burning                      | <ul style="list-style-type: none"><li>Caffeic acid extract</li></ul>                                                                                              |
| Coffee mucilage   | Energy/Heat/Fuels | Burning                      | <ul style="list-style-type: none"><li>Pectin extraction</li><li>Substrate for fermentation</li><li>Bioethanol fermentation</li></ul>                              |

| LEGEND    |             |
|-----------|-------------|
| Current   | <div></div> |
| Potential | <div></div> |





# Edible Oil and Oilseed | Grading Criteria

## ABOUT

Ethiopia's range of climate zones and altitudes enables it to grow a wide variety of oilseeds, making it the third major crop grown in the country (Linseed, Soybean, sesame, groundnut etc) and the 2nd largest export earning.

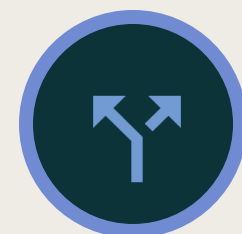
## RATIONALE

After extraction of oil, the hulls are burnt and the oil cake used for low-grade animal feed, they can be valorised to higher applications. Regarding avocado oil, there is traction on creating more value from the waste and relevant companies present in Ethiopia. That is why avocado oil is one of our focus areas.



### VOLUMES PER YEAR

- Hulls/Husks are 20-30% of the seed/oil cake
- Dependent on seasonality of the oil seed supply



### LOGISTICS

- Production of crops dominated by shareholder farmers (a secondary crop)
- Processing dominated by traditional and small crushing mills
- Monopoly of the largest traders



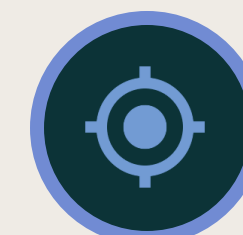
### TECHNOLOGICAL FEASIBILITY

- Techniques already existing on low end waste valorisation (e.g. press cakes to animal feed/ fertiliser)
- Higher end application technology still ongoing



### MARKET POTENTIAL

- Large volumes available for both High end and low end applications
- Further research needed on comparison with Animal feed as business case



### SOCIAL / ENVIRONMENTAL IMPACT

- Oilseeds are a mainstay of the rural economy, hence increased value could translate to increased value for the farmers.
- Protein and fibre-rich products can be incorporated as supplements for undernourished community



### (VALUE CHAIN) PARTNERSHIPS

- Strong collaboration potential with farmers supplying sesame and processors buying feed cake
- Collaborations active between avocado farms and avocado oil processors



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Export potential for high value extracts
- Potential to substitute fertiliser needs



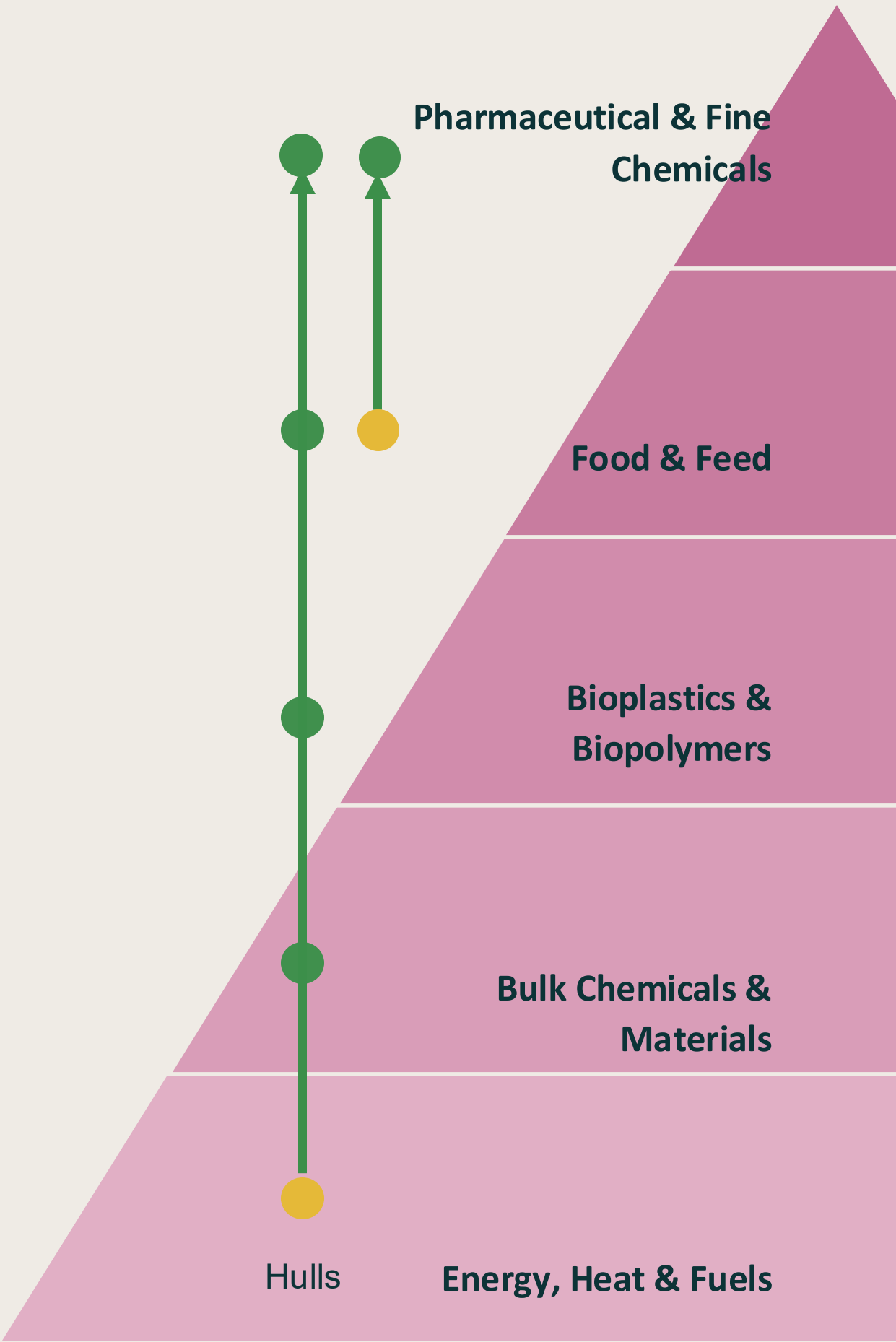
### DUTCH LINK

- Relevance for Dutch expertise in circular agriculture, feed optimization, oil processing efficiency, and bio-based value chains
- Various links with Dutch players in avocado oil

# Edible Oil and Oilseeds | Flow



| Key waste streams | Biopyramid             | Current application Ethiopia | Upcycle potential                                                                                                                                                       |
|-------------------|------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hulls             | Energy, Heat and Fuels | Burning                      | <ul style="list-style-type: none"><li>Extraction of phenolics</li><li>Extraction of cellulose</li><li>Production of Bio-bitumen</li><li>Pyrolysis for biochar</li></ul> |
| Oilseed cake      | Food and Feed          | Animal feed                  | <ul style="list-style-type: none"><li>Flour for Bakery</li><li>Substrate for fermentation</li></ul>                                                                     |



| LEGEND    |  |
|-----------|--|
| Current   |  |
| Potential |  |



# Brewery & Malt | Grading Criteria

## ABOUT

Beer and Malt production in Ethiopia is a rapidly growing sector. Production is seasonal and closely linked to agricultural cycles with large imports during off-season periods.

## RATIONALE

Large volumes of waste are generated during malt and beer production. These streams are currently used in low-value applications (mainly for animal feed) but often unknown the exact application. They have potential to be valorised into higher value products. An additional benefit is that the streams are generated centrally. These waste streams are therefore interesting to discover more in depth.

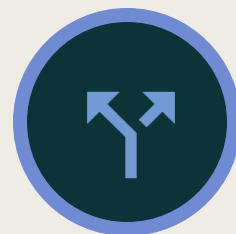


### VOLUMES PER YEAR

- Barley Malt : 150 -200 kTons/year
- Barely Beer: estimated 1.95 billion L (2026)

Waste streams:

- Rootles/husks : 8.8 – 12.5Ton/year
- Steepwater : 67,500 – 160,000 L/year
- BSF: 390 Kton /year



### LOGISTICS

- Waste streams are generated during malt and beer productions (hence available at a central location)
- Mos of these streams spoil quickly
- On site drying or processing is needed to reduce value degradation



### TECHNOLOGICAL FEASIBILITY

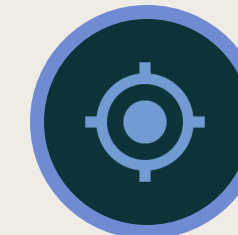
Established technologies:

- Anaerobic digestion for biogas
- Composting for biofertilizer
- Fermentation



### MARKET POTENTIAL

- Beer Malt: Wholesale: €1.09-1.63/kg, Total €164-328 million
- Barley Beer: €1.15 billion



### SOCIAL / ENVIRONMENTAL IMPACT

- Reduced water pollution (high-BOD wastewater)
- Lower GHG emissions (biogas vs fossil fuels)
- Improved soil health (fertilizer user)
- Increased local jobs and farmer income



### (VALUE CHAIN) PARTNERSHIPS

- Large players with financial means to invest in and have influence on their value chain (Nedamco Africa, Heineken)
- Malt processors and farmer cooperatives



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Reduces dependency on imported energy sources (biogas) and fertilizers
- Supports local circular value chains
- Supports rural development and agricultural productivity



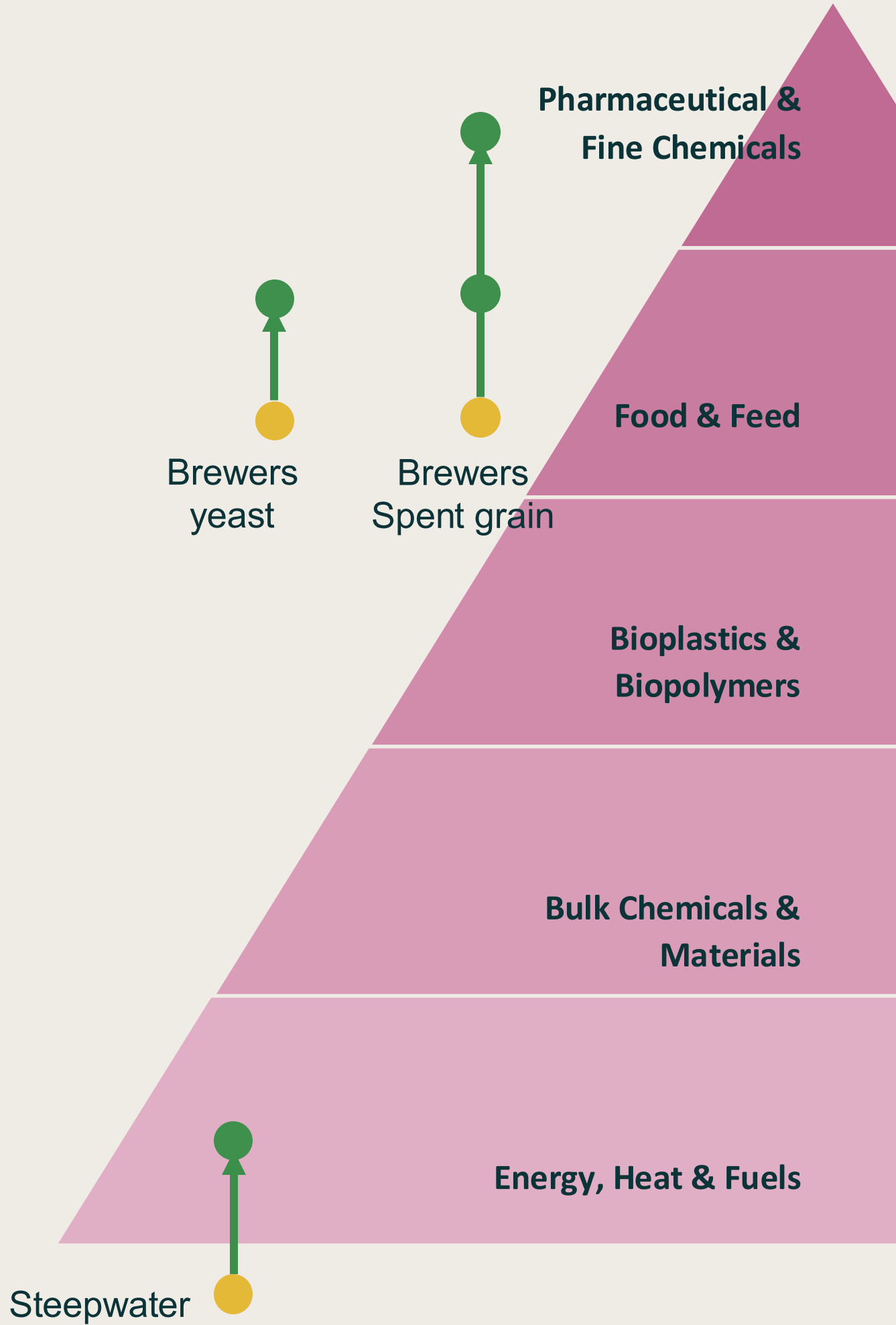
### DUTCH LINK

- Dutch beer brewers and malting companies in Ethiopia
- Dutch innovative startups upcycling to human food (BrouwBrood, MaGie Creations)

# Brewery & Malt production | Flow



| Key waste streams          | Biopyramid    | Current application Ethiopia           | Upcycle potential                                                                                                                                     |
|----------------------------|---------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Barley husk & rootlet      | Food & Feed   | Animal feed                            | <ul style="list-style-type: none"><li>Biofertilizer/ soil amendment</li><li>Bioenergy (biogas/combustion)</li></ul>                                   |
| Brewer's spent grain (BSG) | Food & Feed   | Animal feed                            | <ul style="list-style-type: none"><li>High Protein Flour for bread, bars, baked goods</li><li>Bioethanol</li><li>Substrate for fermentation</li></ul> |
| Brewers yeast              | Food and Feed | Animal feed                            | <ul style="list-style-type: none"><li>Protein/Vitamin B supplement</li><li>Skincare/wellness products</li></ul>                                       |
| Trub                       | Food & Feed   | Animal feed /silage with crop residues | <ul style="list-style-type: none"><li>Biogas (anaerobic digestion)</li></ul>                                                                          |
| Steepwater                 | -             | Treated and discharged                 | <ul style="list-style-type: none"><li>Biogas</li><li>Fertiliser</li></ul>                                                                             |



| LEGEND    |   |
|-----------|---|
| Current   | ● |
| Potential | ● |



# Fruits & Vegetables | Grading Criteria

## ABOUT

Ethiopia has a strong fruit and vegetable sector, generating large amounts of waste due to inefficient handling and challenges with storage and transportation. Potential in creating new products from the waste close to the source (the plantation).

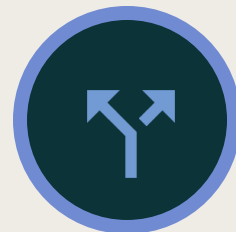
## RATIONALE

Fruit and vegetable waste is currently underutilized with high availability and multiple valorisation routes. These residues can be valorised into higher value products such as biopolymers, enzymes that can be used in pharmaceutical applications and protein for animal feed, contributing to the circular economy and reducing environmental impact. As there is some innovation occurring on this topic in Ethiopia there is momentum to focus on this stream.



### VOLUMES PER YEAR

- Approx 2.86 million tons of vegetables, 0.8 million tons of fruit per year
- There is a range for post-harvest losses from 15-70% with an average of 40% for vegetables due to poor handling, storage and transport.. Fruits have a postharvest loss of 37-55%.



### LOGISTICS

- Waste from fruits and vegetables is biodegradable and decentralized.
- Transportation, storage and cold chain gaps lead to high post-harvest losses
- Only 60% of the waste is collected in Addis Ababa.
- Efforts to improve exports (Ethio-Djibouti corridor) but still challenges.



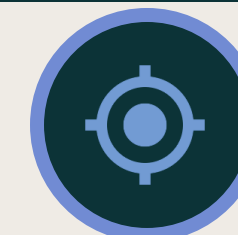
### TECHNOLOGICAL FEASIBILITY

- There is proven technology available (BSF, biogas/composting)
- Advanced applications (biopolymers and enzymes) require higher investment.



### MARKET POTENTIAL

- Market size : 8.38 billion euros/ year (2025)
- Opportunities for high value products for pharmaceutical industries
- Strong demand for advanced animal feed



### SOCIAL / ENVIRONMENTAL IMPACT

- Valorisation reduces methane emissions, open dumping and water pollution.
- Production of organic fertilizers improves soil fertility and reduces chemical use
- Creation of jobs and income in waste collection/ processing and product markets
- Improvement of food security
- Reduction of waste management



### (VALUE CHAIN) PARTNERSHIPS

- Combination of local farmers and cooperatives
- Fresh produce market and farmers (for waste supply)
- NGOs for funding
- Municipalities & Government (for waste collection and policy support)



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Substitutes plastic bag import by making paper bags
- Bio fertilizer and Bio actives as an export



### DUTCH LINK

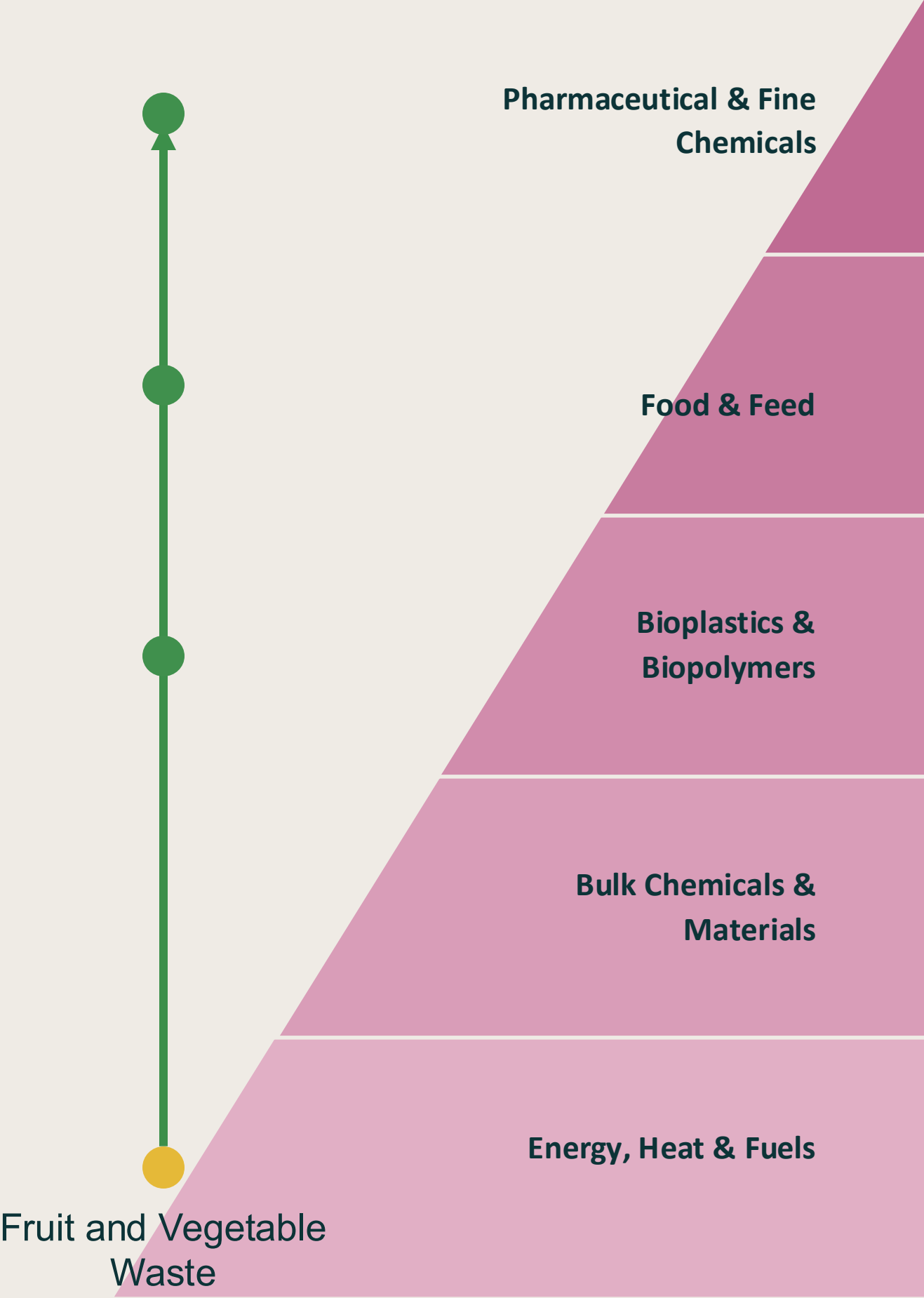
- Could benefit from partnering with e.g. LC Packaging
- Many Dutch innovators focusing on creating energy, new products and ingredients for human food.

# Fresh Fruit & Vegetables | Flow



| Key waste streams                 | Biopyramid            | Current application Ethiopia       | Upcycle potential                                                     |
|-----------------------------------|-----------------------|------------------------------------|-----------------------------------------------------------------------|
| Banana by products                | Biopolymers           | Informal animal feed, open dumping | Biogas, Compost, cellulose for hydrogel production/ fibers            |
| Mango peels and seed              | Fine chemicals        | Disposed in landfill/ open fields  | pectin, seed oil                                                      |
| Pineapple                         | Fine chemicals        | Landfill                           | Bromelain enzyme, bioethanol                                          |
| Papaya                            | Fine chemicals        | Discarded mainly                   | Papain enzyme                                                         |
| Avocado seed/ oil                 | Fine chemicals        | Discarded                          | Antioxidants (for cosmetics)                                          |
| Vegetable trimmings               | Bulk chemicals & Feed | Informal composting                | Black soldier fly (BSF) larvae (animal feed) and frass for fertilizer |
| Mixed waste (fruits & vegetables) | Feed & food           | Uncollected, dumped                | BSF (animal feed or insect-based protein production)                  |

| LEGEND    |             |
|-----------|-------------|
| Current   | <div></div> |
| Potential | <div></div> |





# Cereals | Grading Criteria

## ABOUT

Ethiopia produces around 12 million tonnes of cereal residues includes Wheat straw, Corn cobs, sorghum stalks, Teff straw.

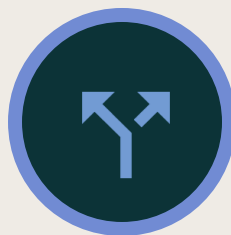
## RATIONALE

After extraction of oil, the hulls are burnt and the oil cake are currently used for low quality animal feed. With the nutritional value of these crops, we could aim for higher value applications of these residual streams.



### VOLUMES PER YEAR

- Hulls/Husks are 20-30% of the seed/oil cake
- Dependent on seasonality of the oil seed supply
- 45kton soybean defatted meal and 4kton hulls
- 30kton rapeseed meal and 4,5kton hulls



### LOGISTICS

- Production of crops dominated by shareholder farmers (a secondary crop)
- Processing dominated by traditional and small crushing mills
- Monopoly of the largest traders



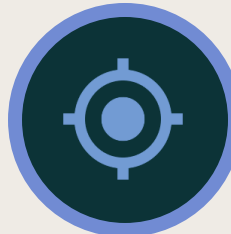
### TECHNOLOGICAL FEASIBILITY

- Mechanical grinding of seed cake to flour
- Infrastructure availability but major gaps in knowledge, equipment, and capacity needing external support



### MARKET POTENTIAL

- Potential for Flour/Food ingredients
- Crop residues can be used in the Biobased building material industry



### SOCIAL / ENVIRONMENTAL IMPACT

- Oilseeds are a mainstay of the rural economy, hence increased value could translate to increased value for the farmers.
- Protein and fiber-rich products can be incorporated as supplements for undernourished community



### (VALUE CHAIN) PARTNERSHIPS

- Government Initiatives promoting specific crop production
- Agricultural primary cooperative and cooperative unions play role in production, bulking, and marketing



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Could reduce dependence on building materials
- Animal feed



### DUTCH LINK

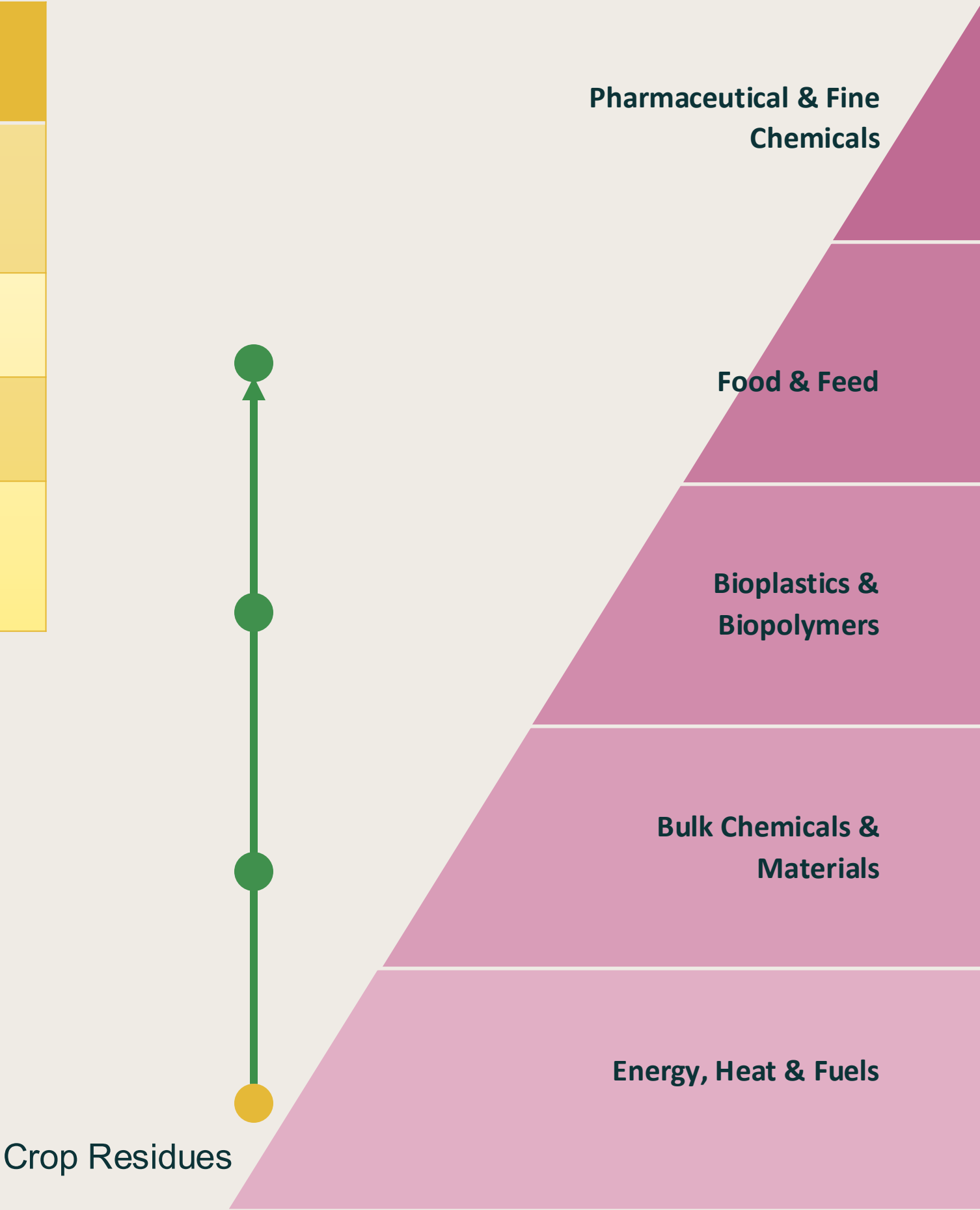
- Potential Dutch innovation that convert cereals into high value products
- No awareness of Dutch companies currently in this field in Ethiopia but Dutch agri-business presence is strong in poultry, dairy, and feed,

# Cereals | Flow



| Key waste streams | Biopyramid             | Current application Ethiopia | Upcycle potential                                                                                                                                                                           |
|-------------------|------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wheat straw       | Energy, Heat and Fuels | Burning                      | <ul style="list-style-type: none"><li>• Filler in bio composite materials</li><li>• Animal feed</li></ul>                                                                                   |
| Corn cobs         | Energy, Heat and Fuels | Burning                      | <ul style="list-style-type: none"><li>• Additive in construction</li><li>• Cellulose Extraction</li></ul>                                                                                   |
| Teff straw        | Energy, Heat and Fuels | Burning                      | <ul style="list-style-type: none"><li>• Additive in construction</li><li>• Cellulose Extraction</li></ul>                                                                                   |
| Sorghum stalks    | Energy, Heat and Fuels | Burning                      | <ul style="list-style-type: none"><li>• Filler in bio composite materials</li><li>• Use in construction application</li><li>• Extraction of cellulose for biopolymer applications</li></ul> |

| LEGEND    |             |
|-----------|-------------|
| Current   | <div></div> |
| Potential | <div></div> |





# Manure | Grading Criteria

## ABOUT

Livestock production generates large amounts of manure in Ethiopia. This waste is rich in nutrients and is currently underused or inefficiently managed. When distributed to the soil directly, there is a concern for antibiotics and hormones from the livestock management.

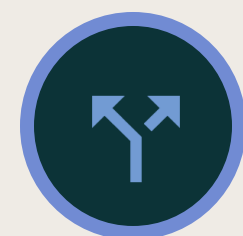
## RATIONALE

Manure is available in large quantities and rich in nutrients. Hence it creates the opportunity to convert the manure that is underused into energy (biogas) and improved fertilizers. Valorisation for this stream will provide a major social and environmental impact which provides an incentive for valorising this stream.



### VOLUMES PER YEAR

- Total volume: 29.598 kt (Dry)/year (20.245 cattle, 3.663 donkeys, 2.299 goats, 1.852 sheep, 773 poultry, 766 horses)
- Urban and regional nutrient volumes from manure:
- Addis Ababa: (approx. 5.200 farms) : 0.5-2.6 Gg/year N, 0.2-0.8 Gg/year P, 0.9-3.7 Gg/year K
- Jimma (approx. 500 farms): 0.04-0.22 Gg/year N, 0.02-0.07 Gg/year P, 0.07-0.3 Gg/year K



### LOGISTICS

- Manure is difficult to collect and it has a recovery range from 30%–68%
- Transportation is necessary from urban livestock to crop farms
- Logistics is a barrier for large scale



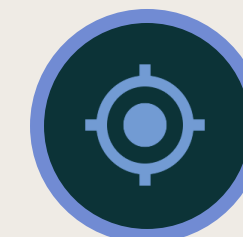
### TECHNOLOGICAL FEASIBILITY

- Anaerobic digestion is an established technology
- Small-scale digesters
- Lack of storage systems and lack of technical experience



### MARKET POTENTIAL

- Energy from manure from livestock in Ethiopia can supply 81% of Ethiopia's electricity (2019)
- Recycling manure to fertilizer can save 1.2–5.0 million euros in Addis Ababa due to reduction of fertilizer imports
- Farmers can have additional income



### SOCIAL / ENVIRONMENTAL IMPACT

- Reduction of indoor pollution (from biomethane)
- Lower GHG emissions
- Reduction of water and soil pollution
- Improvement of soil fertility and crop yields
- Job creation



### (VALUE CHAIN) PARTNERSHIPS

- Combination of small local farms and larger cooperatives
- Bioenergy companies



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Potential import substitution for fertilizers



### DUTCH LINK

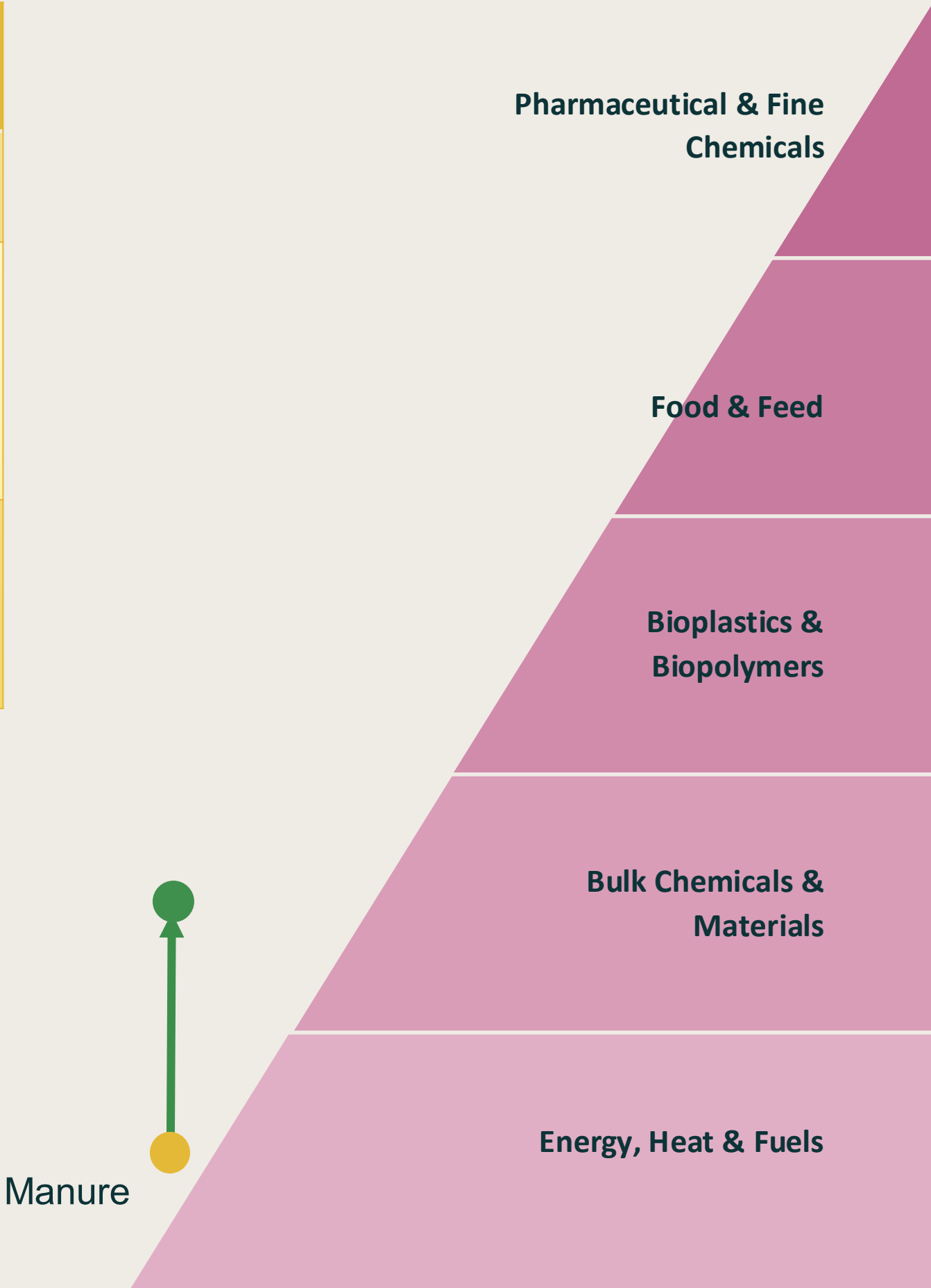
- Small scale biogas/biodigester technology innovations biodigesters
- Presence in poultry sector (de Heus)

# Manure | Flow



| Key waste streams                     | Biopyramid                 | Current application Ethiopia                           | Upcycle potential                                                                                                                                                            |
|---------------------------------------|----------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manure                                | Bulk chemicals & Materials | Applied directly to fields (low efficiency fertilizer) | <ul style="list-style-type: none"><li>Biofertilizer (processed, higher efficiency) for soil improvement &amp; nutrient recycling</li></ul>                                   |
| Manure                                | Energy, Heat & Fuels       | Used as cooking fuel                                   | <ul style="list-style-type: none"><li>Biogas ( 40-75% methane) through AD (anaerobic digestion)</li><li>Electrcity &amp; Heat (CHP)</li><li>Bio-natural gas (fuel)</li></ul> |
| Processed Manure (Digestate after AD) | Bulk chemicals & Materials | Mostly Underused                                       | <ul style="list-style-type: none"><li>High-quality biofertilizer</li><li>Nutrient recycling (N,P,K)</li></ul>                                                                |

| LEGEND    |             |
|-----------|-------------|
| Current   | <div></div> |
| Potential | <div></div> |





# Cotton & Textile | Grading Criteria

## ABOUT

Cotton and textile production in Ethiopia is a rapidly growing sector. The value chain includes farming, processing and textile production and waste is generated at different stages.

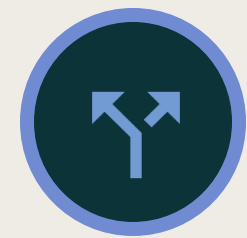
## RATIONALE

Most cotton and textile waste is underused and available in large quantities, creating opportunities to convert them into higher- value products such as recycled materials, fertilizer or energy. However, as most waste streams are being utilized and it's not a focus point of the embassy, the momentum for this project to focus on cotton waste is not there.



### VOLUMES PER YEAR

- Raw cotton production: 71.000 tons/year (2025)
- Lint cotton (primary product) 37% of production
- Cotton seed: 58%
- Ginning waste: 5%
- Fabric cut-offs: 28.5% of production



### LOGISTICS

- Waste is generated in different stages : ginning and textile production
- Cotton is processed in ginneries where fibre, seeds and waste are separated
- Waste (e.g. leaves and stalks) is collected and used locally (e.g. as fertilizer)
- Farmers often sell through middlemen but cooperatives help get better prices and market access)



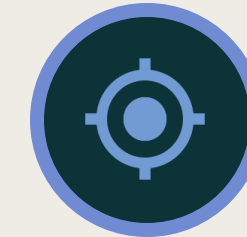
### TECHNOLOGICAL FEASIBILITY

- Use for fertilizer is technical feasible through established technologies.
- Established technologies for recycling textile waste into fibres and yarns



### MARKET POTENTIAL

- Cotton seeds have a strong market potential for the production of edible oil, which can provide an additional revenue for ginneries
- Sustainable branding for textiles , rising demand for sustainable cotton
- Textile industry value: 105 million euros (2021)



### SOCIAL / ENVIRONMENTAL IMPACT

- Using waste as fertilizer improves soil quality
- Reduction of need of chemical inputs
- Cooperatives help farmers improve their income
- Textile industry has poor waste management (e.g. landfilling, wastewater pollution)



### (VALUE CHAIN) PARTNERSHIPS

- Farmers
- ETFAMA (Ethiopian Textile and Garment Manufacturers Association)
- Desta PLC
- ETIDI (Ethiopian Textile Industry Development Industry)



### IMPORT SUBSTITUTION/EXPORT POTENTIAL

- Lint is mainly exported to international markets
- Seeds and waste streams mainly used locally



### DUTCH LINK

- Clothing and textiles, is among the export products of Ethiopia to the Netherlands
- Bottom Up! (Solidaridad, MVO, DIEH, CmiA, Cotton made in Africa) - NL initiative to support sustainable practices)

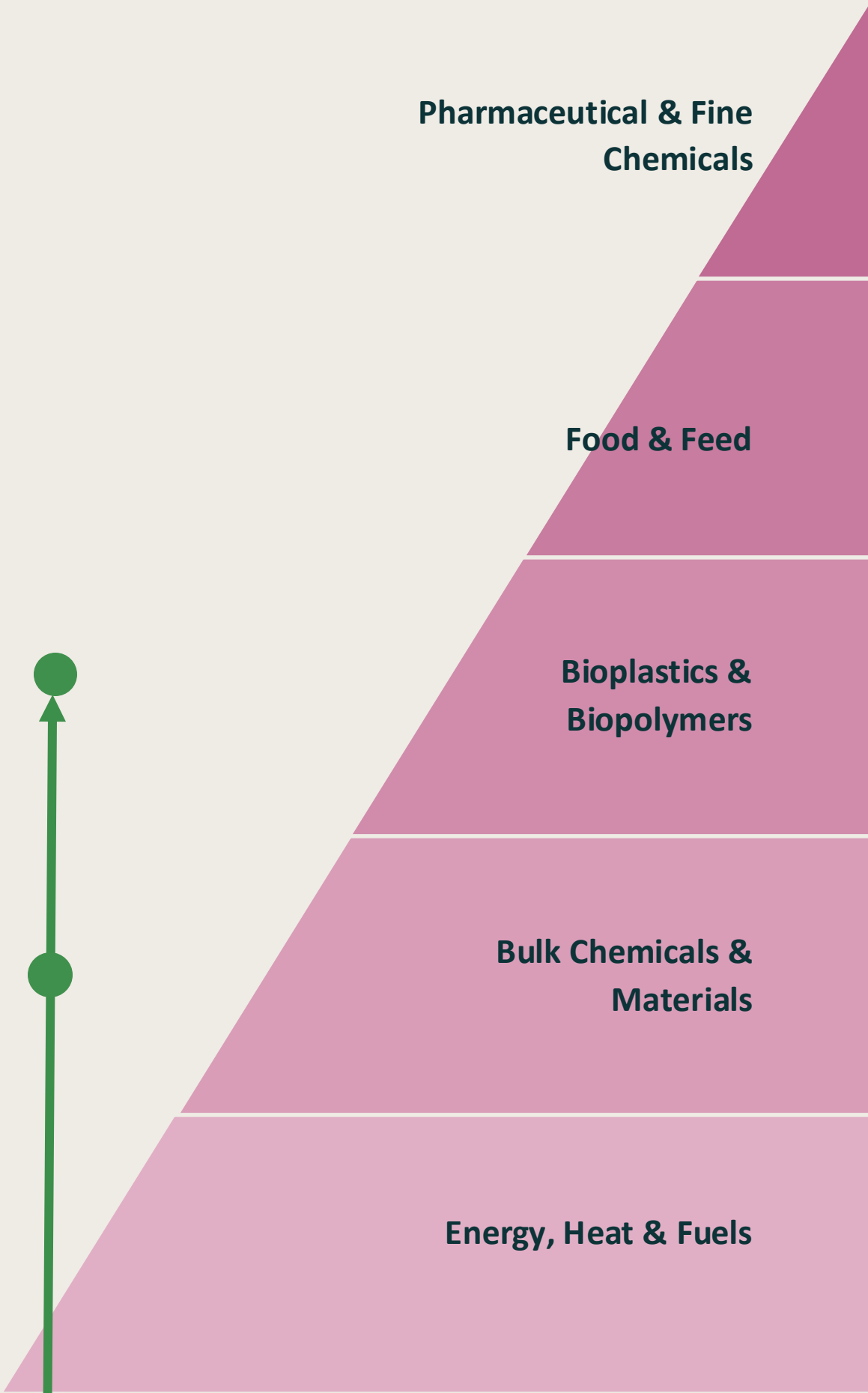
# Cotton & Textile production | Flow



| Key waste streams       | Biopyramid                 | Current application Ethiopia | Upcycle potential                                                                              |
|-------------------------|----------------------------|------------------------------|------------------------------------------------------------------------------------------------|
| Cotton seeds (58%)      | Food & Feed                | Edible oil, animal feed      | <ul style="list-style-type: none"><li>Biochemicals, biodiesel</li></ul>                        |
| Ginning waste (5%)      | Bulk chemicals & Materials | Fertilizer                   | <ul style="list-style-type: none"><li>Bioenergy</li><li>Compost</li></ul>                      |
| Textile waste           | Bulk chemicals & Materials | Not managed                  | <ul style="list-style-type: none"><li>Recycling fibers and yarns</li></ul>                     |
| Dye sludge & wastewater | Energy, Heat & Fuels       | Discharged                   | <ul style="list-style-type: none"><li>Wastewater treatment</li><li>Resource recovery</li></ul> |

| LEGEND    |  |
|-----------|--|
| Current   |  |
| Potential |  |

Discharged/  
Not Managed



Introduction

Waste Stream Mapping

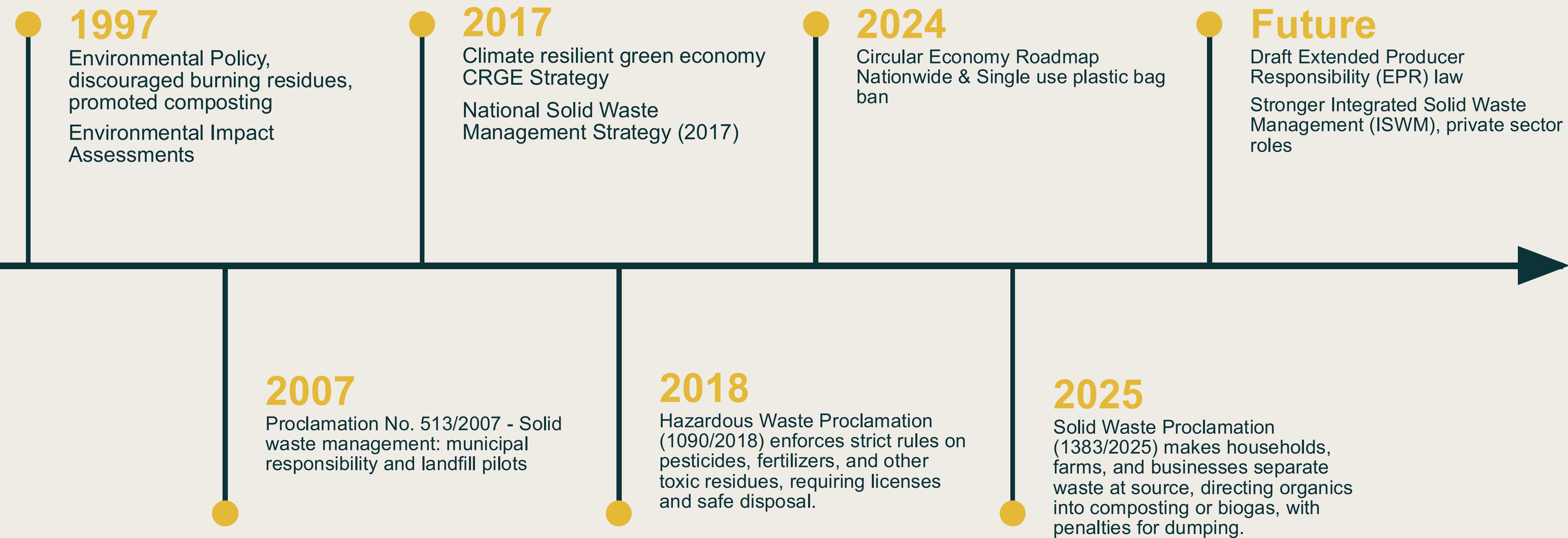
Technical and Market Assessment

# Policy and Regulation

Business Concepts of 5 Agricultural streams

Conclusions and recommendations

# Policies shaping practices



# Analysis

## Regulatory Barriers

- No clear, product-specific national certification and testing protocols, and quality control remains fragmented, project-dependent, or absent
- Institutional overlap between multiple agencies (MoA, EPA, energy bodies) with unclear mandates
- Subsidy misalignment: chemical fertilizer import heavily subsidised; organic / biofertilizers grey area
- Zoning gaps: the absence of dedicated zones or clear land-use pathways for agro-waste valorisation

## Current Incentives

- *Ethiopia's Investment Incentive Reform 2026: Key Legal Shifts from Regulation 517/2022 to 586/2026*: positions agri-waste projects as “environmental protection, renewable-energy, and agro-industrial processing” activities --> eligible for reduced corporate-income-tax (5%–15%) and customs/VAT exemptions for imported capital goods
- Ministry of Agriculture, the ATI and Agricultural Transformation Council launched a tax-reform policy providing a framework for duty-free import of essential equipment
- Subsidised rural biogas pilots and PPP frameworks with recycling/waste-to-energy tax incentives
- IPDC is rolling out waste-management and recycling norms for parks

## Implications & Opportunities for Valorisation

- Policy alignment with National Circular Economy Roadmap
- Lack of knowledge & awareness of regulations by e.g. farmers and business (interviews)
- Disconnected policy-practice
- Weak and scattered enforcement of existing waste-policy framework
- Collaborate with IPDC focusing on valorizing agricultural waste streams

# Regulations Vs. Standards

- Influence market access and export readiness
- Proof of compliance needed for investors & development finance institutions
- Support creating a common practice of valorisation of waste streams
- Strengthens credibility

| REGULATIONS                                                                                | STANDARDS                                                                                                          |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Official rules issued by a government or regulatory authority                              | Agreed technical or quality benchmarks for products, processes, or services                                        |
| Legally binding — businesses and individuals must comply                                   | Typically voluntary, demonstrate good practice and consistency                                                     |
| Set mandatory requirements for safety, quality, environmental protection, or market access | Used to show compliance and build market confidence                                                                |
| Non-compliance can lead to fines, sanctions, or market exclusion                           | Can be adopted by any organisation without legal obligation                                                        |
|                                                                                            | <b>A standard becomes binding when a law, regulation, contract, or certification scheme explicitly requires it</b> |

*The regulations and standards per waste stream can be found in the specific Business Concept Note*

# What does this mean for the business cases?

- Momentum is building under the National Roadmap Circular Economy, Green Legacy initiative and Ethiopia's role as COP32 host
- From piloting to scaling is a challenge
- Different context per waste stream per location
- Collaborate with government on structural & logistics support for valorisation
  - Ethiopian Investment Commission (EIC) and Industrial Parks Development Corporation (IPDC)
  - Ministry of Agriculture (MoA) and Agricultural Transformation Institute (ATI)
  - Environment, Climate, and Green-Industry bodies (EPA, MoE, Climate-change units)
  - Municipalities for local implementation and support
- Importance of awareness & advocacy



*"Pushing for enforcement of the law, and stimulating awareness with customers will support our business model"*

Bethelhem Dejene, CEO Zafree Papers

Introduction

Waste Stream Mapping

Technical and Market Assessment

Policy and Regulation

# Business Concepts of 5 Agricultural streams

Conclusions and recommendations

# Valorising Coffee Husks into Cascara



## THE PROBLEM

- **Low farmer income:** ~USD 1.37/day (below living wage)
- **Environmental pollution & degradation of soil:** Methane emissions, pollution of water systems, inhibits plant growth due to plant-toxic

## PROPOSED SOLUTION

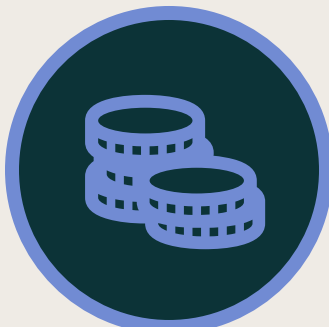
Valorisation of husk via low-tech opportunities

| Product       | Process                               | Market                                                                                         |
|---------------|---------------------------------------|------------------------------------------------------------------------------------------------|
| Cascara Tea   | Drying and Grading coffee cherry husk | Beverage ingredient for specialty tea, ready-to-drink beverages, and functional drink markets. |
| Cascara Flour | Drying and milling the husk,          | High-fibre food ingredient for bakery, snacks, health food, and cereal applications.           |

## BIGGEST CHALLENGES

- **Supply chain:** Dedicated cascara collection, transport & storage infrastructure largely absent
- **Seasonality:** Only available 2-5 months after harvest (from Nov-Feb)
- **Quality & compliance:** Strict EU Novel Food Regulations
- **Market creation:** Cascara relatively unknown to European consumers

## IMPACT



Generates direct additional income for smallholders from a by-product currently earning them nothing



Cascara sold to EU markets, retain value in Ethiopia beyond raw coffee bean exports



Cascara diverted from open disposal annually, reducing methane emissions & soil acidification

# Valorising Residues from Avocado Oil Processing



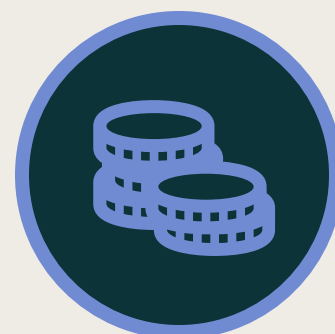
## IMPACT



Preventing soil acidification & water contamination



Biochar and fertiliser produced restore degraded land for small-holders farmers



Residues exported as powder and cosmetics oil generate foreign exchange & create jobs

## THE PROBLEM

- **Waste:** avocado oil processing residues dumped in landfill
- **Feed deficit:** shortage and high prices
- **Foreign exchange shortage:** structural need for new export revenue streams
- **Soil degradation:** nutrient depletion and reducing productivity

## PROPOSED SOLUTIONS

- Cosmetics most challenging technology
- Off-takers challenging in each of the pathways
- USD 2–6M /yr estimated revenue avocado powder

| Avocado Powder                                                                                                                                                                                                  | Cosmetics Oil                                                                                                                                                                                        | Animal Feed                                                                                                                                                                                                                                                                         | Biochar / Fertiliser                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Food-grade requires oil pressing using clean (treated) water</li><li>• Mechanical skin/pit removal needed before drying</li><li>• High investment requirement</li></ul> | <ul style="list-style-type: none"><li>• Extraction method, oil yields, and refining standards not yet validated for Ethiopian conditions</li><li>• Potentially high investment requirement</li></ul> | <ul style="list-style-type: none"><li>• Persin in skins/pits requires mechanical separation and controlled inclusion levels</li><li>• High moisture creates mould risk; sun-drying is weather-dependent</li><li>• Transport costs high; sensitive to distance from source</li></ul> | <ul style="list-style-type: none"><li>• Smallholder price sensitivity limits direct sales</li><li>• Drying logistics before processing into biochar</li><li>• Business case depends on complementary revenue streams</li></ul> |

# Restoring Soil Health with Manure & Sludge



## THE PROBLEM

- **Mismanaged organic waste:** Poor management or disposal into landfill/rivers of both chicken manure & sludge
- **Soil Nutrient Depletion:** Negative balance for N,P,K due to insufficient organic matter in soil
- **Import dependence:** Ethiopia imports nearly 2 million tons of fertilizer annually, rising cost of imported fertiliser

## PROPOSED SOLUTION



- Available technology: mix & blending equipment; compotower technology by the Big Dutchman; drying & curing infrastructure; screening & packaging systems
- Compost remains commercially viable when produced near farming clusters and waste sites

## BIGGEST CHALLENGES

- Feedstock Supply: Consistent fertilizer production depends on reliable volumes of brewery waste and poultry manure throughout the year
- Lack of suitable technology or expertise to convert organic waste into a standardized fertilizer product suitable for the market.
- Off-takers and market adoption

## IMPACT



Reduced dependence on imported fertilizer



Circular use of nutrients by returning organic material back into agricultural production



Job creation in waste collection, processing, logistics, fertilizer production, and distribution.

# Creating Paper Pulp from Banana Stems



## IMPACT



Creating locally sourced & sustainable packaging opportunities in Ethiopia



From sourcing of the banana stem: 1100 temporary/field jobs when producing 40 tonnes/day

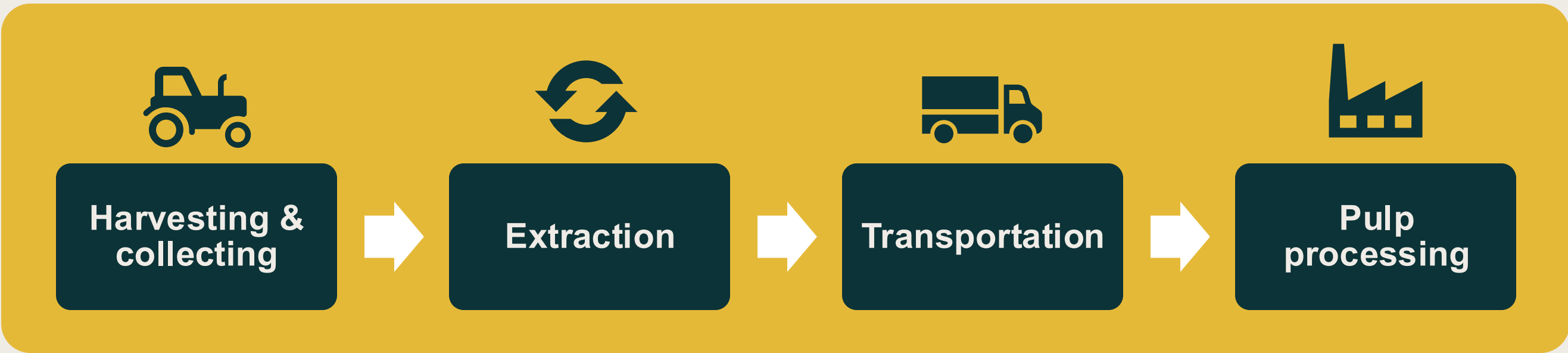


CO2 prevented per tree-based virgin pulp: 1.5 metric tonnes CO2/tree

## THE PROBLEM

- **Mismanaged plastic waste:** 7–10 kg of **plastic** waste pp/py of which 91% is improperly managed
- **Soil Degradation & Air pollution:** burning or rotting of banana stems
- **Deforestation:** 35% to 42% of all wood harvested worldwide used for paper and paperboard
- **Missed economic opportunities:** 28.3% of mothers part of labour force, most pulp & paper is imported

## PROPOSED SOLUTION



- Creating pulp from the banana stem: scaling factory to 40ton/per day
- Demand for pulp based products is growing in Ethiopia & Africa
- TRL 9: Pulp mill equipment is off-the-shelf technology
- Target market: Local paper and carton factories, export to other African countries and/or EU

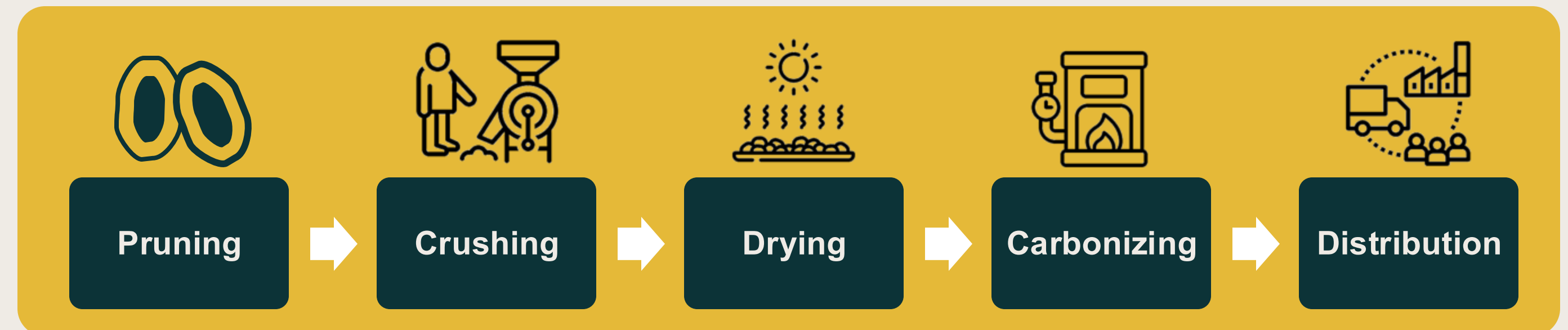
# Valorising Mango Pruning Waste into Biochar



## THE PROBLEM

- **Biomass overshoot:** Large quantity of abandoned fruit trees that will be pruned and produce a large amount of biomass in the coming decade.
- **Soil Degradation:** Agricultural soils (mainly coffee plantations) in the surrounding area lack organic matter

## PROPOSED SOLUTION

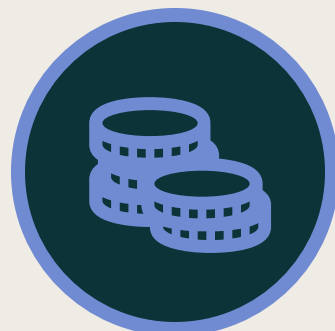


- Pyrolysis facility, 13% biochar yield from wet feedstock
- Syngas by-product makes process largely energy self-sufficient; sellable
- Localised operation: biochar bagged in 1m<sup>3</sup> big bags, delivered by truck to local farms

## BIGGEST CHALLENGES

- **Unfamiliar market for biochar:** Finding the right partners for offtake, educating farmers on usage. Long term: obtain government support for biochar use.
- **Carbon offset Scheme:** Approval required by verified issuer

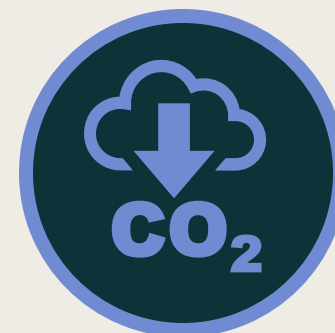
## IMPACT



Generate profitable business for pruning (continuous agricultural practice)



Produce green energy locally for powering mango processing



Store carbon and improve local soils

Introduction

Waste Stream Mapping

Technical and Market Assessment

Policy and Regulation

Business Concepts of 5 Agricultural streams

# Conclusions and recommendations

# Conclusions from the business cases

## Business case essentials have shown:

1. Willingness + Active lead partner
2. Logistics influences business case: tap in on existing logistics
3. Policy enforcement in Ethiopia could result in waste processing costs, stimulates the business cases of valorisation
4. Replace import dependent cases: from business and impact perspective
5. Dutch technology, expertise and clients can bring added value to make these cases succeed



This Photo by Unknown Author is licensed under [CC BY](#)

# Recommendations for the embassy

## OVERALL

- Creating Introduction for Dutch off-takers, Dutch investors
- Funding opportunities for pilot projects
- To stimulate valorisation practices initiate a database where information, inspiration and standards & regulation regarding valorisation of the most important value streams can be found.

## POLICY/DIPLOMACY

- Advocate against the chemical fertilizer and stimulate local production (meets biodiversity & climate resilience focus)
- Centralized overview of rules, standards, regulations for valorisation
  - Lobby within local governments to push for better regulations and subsequent enforcement to stimulate use of organic fertilizer
  - Influence policy and standardization regulation development within Biochar sector

# Contact



**Spaak Circular Solutions B.V.**

**Livio Bod**

Innovation Lead

✉ [Livio.bod@spaakcs.nl](mailto:Livio.bod@spaakcs.nl)



**TRAIDE Foundation**

**Maud Hartstra**

Partnerships Lead - Ethiopia

✉ [Maud.hartstra@traide.org](mailto:Maud.hartstra@traide.org)

