

# **Circular bioeconomy business models – Recovering food products to reduce agricultural waste: Cases from Burkina Faso, India, Kenya and Vietnam**

Avinandan Taron, Solomie Gebrezgabher, Safietou Sanfo, Ramata Ouedraogo, Seyni Salack, Karim Diarra, Soumaila Ouedraogo, Kehinde Ojungobi, Sairam Muthuswamy, Trapti Malviya, Jack Odero, Dao Duc Liem, Manasi Tripathi



December 2022

## The Authors

Avinandan Taron, International Water Management Institute (IWMI), Colombo, Sri Lanka

Solomie Gebrezgabher, International Water Management (IWMI), Accra, Ghana

Safietou Sanfo, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Ramata Ouedraogo, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Seyni Salack, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Karim Diarra, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Soumaila Ouedraogo, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Kehinde Ojungobi, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL), Ouagadougou. Burkina Faso

Sairam Muthuswamy, Athena Infonomics, Chennai, India

Trapti Malviya, Athena Infonomics, Chennai, India

Jack Odero, Revolve, Research and Consulting Group (RRCG), Nairobi, Kenya

Dao Duc Liem, Center for Environment and Community Research, Hanoi, Vietnam

Manasi Tripathi, International Water Management Institute, New Delhi, India

Taron, A.; Gebrezgabher, S.; Sanfo, S.; Ouedraogo, R.; Salack, S.; Diarra, K.; Ouedraogo, S.; Ojungobi, K.; Muthuswamy, S.; Malviya, T.; Odero, J.; Liem, D. D.; Tripathi, M. 2022. *Circular bioeconomy business models - recovering food products to reduce agricultural waste: cases from Burkina Faso, India, Kenya and Vietnam*. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Initiative on Nature-Positive Solutions. 41p.

## About Nature-Positive-Solutions

Nature-Positive-Solutions is a One CGIAR initiative that aims to re-imagine, co-create and implement nature-positive solutions-based agrifood systems that equitably support local food and livelihoods, while simultaneously ensuring that agriculture is a net positive contributor to nature. For more details about the initiative <https://on.cgiar.org/3rHjbRO>

## Acknowledgments

This work was carried out under the CGIAR Initiative on Nature-Positive Solutions, which is grateful for the support of CGIAR Trust Fund contributors ([www.cgiar.org/funders](http://www.cgiar.org/funders)).



INITIATIVE ON  
Nature-Positive  
Solutions



**Disclaimer:** This publication has been prepared as an output of the CGIAR Initiative on Nature-Positive-Solutions and has not been independently peer reviewed. Responsibility for editing, proofreading, and layout, opinions expressed and any possible errors lies with the authors and not the institutions involved. The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by IWMI, CGIAR, our partner institutions, or donors.

## Summary


Agricultural waste represents untapped resources that can be used to produce large value-added products with many potential industrial applications. On-farm food waste comprises of harvest and post-harvest waste amounting to 1.2 billion tons per annum and measures up to USD 370 million. Production of food products and other outputs (like biofuel and compost) help in reduction of on-farm food waste and provide livelihood opportunities for the rural households. This reports highlights some innovative approaches across four countries which lead to reduction to food waste.

The report cover 6 cases located in Burkina Faso, India, Kenya and Vietnam. The two business models identified in Ouagadougou are – (i) **Waka group**, that repurpose mango residues in to sweet and bio-vinyl vinegar called MISSIM vinegar, and (ii) **SOFAB-SA** utilizes oilseeds (such as peanuts, cotton, and soybeans) with blue cheese bran or corn, salt, or any other micro-ingredient to produce feed for livestock. From India, two such case studies are included – (i) **Sai Shubhada agro industries** is located in Ahmednagar, (Maharashtra, India), and converts bagasse, [a pulpy and fibrous residue of the sugarcane processing] into organic jiggery, and (ii) **Arogyasangini Oil Mill**, Mill has embarked on the mission to re-introduce oil extracted from the safflower seeds. **Nadanya Greens** located in Mbale, (Vihiga, Kenya) is exploring the use of farm waste from livestock to produce feeds for fish reared through three fish ponds. **Xuan Tien Agricultural Cooperative**, located at Yen Chau (Son La province, Vietnam), converts mango which is otherwise wasted post-harvest.

## Business case: Burkina Faso

### WAKA Group: Bio and organic vinegar from mango residue

#### Business case

 The image on the left is a composite. The top part is a map of Africa with Burkina Faso highlighted in blue. The bottom part is a product advertisement for 'VINAIGRE DE MANGUE BIO MISSIM' by 'Groupe Waka'. It shows several bottles of vinegar on a white tray. Text on the ad includes 'Goût aigre-doux', 'Meilleur pour votre gastronomie', 'Disponible dans toute les alimentations', 'Service clientèle : +226 70 99 28 04', and a 'CERTISYS' logo.	Location:	Ouagadougou
	Waste input type:	Mango pulp residue and overripe mango
	Value offer:	Table vinegar "MISSIM"
	Organization type:	Private
	Status of the organization:	Operational since 2012
	Scale of Businesses:	Medium scale supplying to national and European markets
	Major Partners:	Trade partners, Certification body

#### Executive summary

The Waka group repurposes mango residues into sweet and bio-vinyl vinegar called MISSIM vinegar. The vinegar produced by the company is certified bio- and organic. The company has a large production capacity and exports vinegar to Europe. The company is located in the industrial zone, the capital of Burkina Faso, in a district reserved for various activities, mainly industrial. The proponent of the Waka company is a food technology engineer who first worked with a research and development NGO (Centre Ecologique Albert Schweitzer du Burkina Faso). The NGO developed the technique to produce vinegar as a research product. The NGO promotes technology transfer and allowed the promoter to take over the vinegar production center in 2012. Goup Waka employs 300 employees, 98% of whom are women. The company contributes to reducing unemployment and promoting the socio-economic empowerment of women in Burkina Faso.

Key performance indicators						
Land use	0,2 ha					
Capital investment:	USD 78,874					
Labor requirements:	300 women employed					
O&M cost:	Data not available					
Output:	25 cl bottle of vinegar					
Potential social and/or environmental impact:	The product is organic and quality certified, contributes to the preservation of consumer health and environment by minimizing waste; job creation					
Viability indicators	Payback period:	NA	Gross margin:	NA	Net profit (after tax)	NA

## Context and background

Burkina Faso produces large quantities of mango. Most of the fresh mango is sold directly to local consumers or exported. Only 20% of the production is transformed into value added products such as dried mango and juice. The commercialization and processing supply chain is very weak and losses are observed in the mango value chain. The Waka company uses the residues and rotting mangoes that are usually discarded, to produce vinegar known as MISSIM vinegar. The method used to repurpose mango residues into bio and organic vinegar is natural, less energy-consuming and adds value to the mango sector value chain.

## Market environment

The "MISSIM" vinegar is prized by the most affluent upper- and middle-class people and European market who appreciate the quality and value of organic products. The Waka group has a great market opportunity, as the middle class in developing countries is growing and so does the dissemination of knowledge on the benefits of consuming bio- and organic products.

## Business model

The Waka Group business model offers a certified organic and bio-product at a low and competitive price. Bio- and organic vinegar is increasingly popular, especially in Europe. The raw material is abundant and accessible; the production technology is natural, simple, and cost efficient. The company sells the vinegar using different packaging depending on the market segments. It uses 25 CL PET bottle for the local market while a 1liter glass bottle is used for the international market. With appropriate advertising, the company will be able to realize its great growth potential. The business canvas is shown in figure 1.



<b>Key Partners</b> <ul style="list-style-type: none"><li>• Trade partners in Burkina Faso and Europe</li><li>• Certification bodies</li><li>• Food stores</li></ul>	<b>Key Activities</b> <ul style="list-style-type: none"><li>• Supply of mango residues</li><li>• Production and sales of vinegar</li><li>• Product certification</li><li>• Partnership with food stores</li></ul>	<b>Value propositions</b> Organic table vinegar that respects quality standards and produced by the natural processing method	<b>Customer Relationships</b> <ul style="list-style-type: none"><li>• Distribution through food stores</li><li>• Retail outlet in front of the production center</li></ul>	<b>Customer Segments</b> <ul style="list-style-type: none"><li>• Middle-class consumers with a high level of education</li><li>• Export market</li></ul>
	<b>Key Resources</b> <ul style="list-style-type: none"><li>• Factory</li><li>• Production equipment (acetobioreactor, storage equipment)</li><li>• Human resources</li><li>•Transportation Equipment</li></ul>		<b>Channels</b> <ul style="list-style-type: none"><li>• Intermediate distribution in partner power supplies in Burkina Faso and Europe (Switzerland, France)</li><li>•</li></ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>• The premises (factory and administrative building)</li><li>• Costs of 6 annual certifications (nearly 7,887 USD)</li><li>• Workforce</li><li>• Advertising</li></ul>			<b>Revenue streams</b> <ul style="list-style-type: none"><li>• Sales of vinegar</li></ul>	
<b>Social &amp; environmental costs</b>			<b>Social &amp; environmental benefits</b> <ul style="list-style-type: none"><li>• Product that preserves the health and well-being of consumers (organic product)</li><li>• Employment opportunities for women and youth</li><li>• minimizing waste of resources, management of solid and organic waste through recycling and repurposing</li></ul>	

Figure 1: Business model canvas for WAKA group

## Value chain and position

The Waka company plays an important role in the mango value chain. The mango value chain starts with the production of fresh mangoes. A large part of mangoes are directly used for consumption in the country or exported. Another part is transformed into dried mango or mango juice and sold to the final consumer on the national and foreign markets (Figure 2). The Waka company is a strong link and intervenes in the transformation link of the chain. It recycles mango residue and transforms it into table vinegar for the national and international markets.

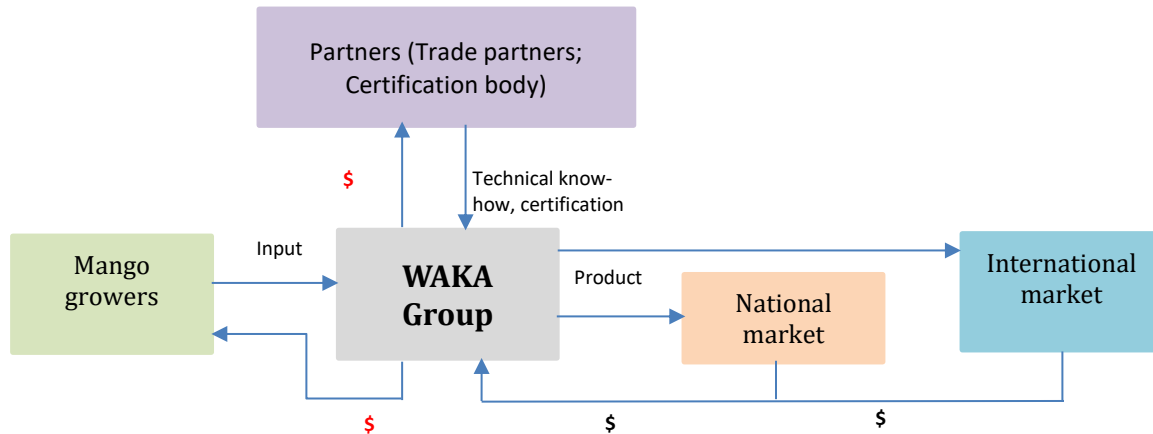


Figure 2 WAKA Group value chain

## Institutional Environment

The company is subject to national legislation on agri-food companies. It must conduct an environmental impact study showing that the production process is environmentally friendly. For the export of its products, it must obtain phytosanitary certificates attesting to product health safety.

## Technology and Processes

The production technology used to produce the vinegar is simple and natural. It consists of successive repurposing of mango residues into mango juice, mango wine, and at the end organic and bio-vinyl over a period of four weeks. It is a simple technology and does not involve any human or environmental risk.

## Financial analysis

Investment costs are made up of the cost of premises mainly factory and administrative building, the acquisition of production equipment (aceto-bioreactor), vehicle for transport of raw materials, and transaction costs, specifically costs related to the distribution of the final product. Initial financing was provided by a bank loan. Nowadays, the company has a large production capacity. It is looking for outlets and does not have a specific need for financing in view of current demand.



## Business case summary assessment -SWOT analysis

STRENGTH	WEAKNESS
<ul style="list-style-type: none"><li>• Bio product</li><li>• Basic commodity</li><li>• Certifications already acquired</li><li>• Good experience in the field</li><li>• Great production potential</li><li>• Product competitiveness</li></ul>	<ul style="list-style-type: none"><li>• Low product demand</li><li>• Weak marketing strategy</li><li>• Strong international market certification requirements</li></ul>
OPPORTUNITY	THREAT
<ul style="list-style-type: none"><li>• Strong worldwide recommendation towards organic consumption</li><li>• Scientific knowledge on the benefits of organic consumption</li><li>• Great accessibility of the raw material</li><li>• Large potential market</li><li>• Possibility of relatively easy duplication</li></ul>	<ul style="list-style-type: none"><li>• Socio-political and security unrest in the host country</li><li>• Possibility of appearance of new competitors</li><li>• Emergence of substitute products (cider vinegar, etc.) opportunity</li></ul>

## Socio-economic, health and environmental Impact

The company emphasizes increased opportunities for income generation, especially for women and youth, key agents of family well-being and economic development. It employs 300 people, 98% of whom are women and youth. Bio- and organic vinegar preserve the health and well-being of consumers. The Group waka also reduces waste through recycling and repurposing mango residues into vinegar, thus preserving the environment. It offers an alternative to the many canned vinegars consumed by most of Burkinabè.

## Scalability and replicability potential


The activity is likely to be easily expanded or replicated. The raw material is abundant, and the production process is natural, simple, and less expensive. There are no specific barriers to entry into the market in Burkina Faso, and fixed production costs are relatively lower.

## Reference

- <https://groupe-waka.com/uk/>
- <https://www.biolineaires.com/pourquoi consommer du vinaigre biologique/>
- <https://web.facebook.com/people/Groupe-AKA/100054910173155/? rdc=1& rdr>

## SOFAB-SA: Livestock feed production from agricultural residues and nontimber forest products

### Business case

 <p>The collage includes: a map of Burkina Faso in West Africa; two large white sacks filled with brown feed pellets; a blue bowl containing yellow feed pellets; and a person in a white shirt and blue pants carrying a large white sack of feed.</p> <p><b>SOFAB</b> the secret of the best breeders</p>	Location:	Burkina Faso
	Waste input type:	Agricultural residues- cereal bran rice low flour, cotton seed cake, baobab seed, non-timber forest products
	Value offer:	Feed for livestock
	Organization type:	Private
	Status of the organization:	2014
	Scale of Business:	Large
	Major Partners:	NA

### Executive summary

SOFAB-SA, created in 2009, is the largest livestock feed factory in Burkina Faso. It was born from the initiative of breeders who have organized themselves into cooperatives and requested the support of the government to set up a livestock feed factory unit. It employs 32 permanent workers and fifty to sixty nonpermanent workers and improves the development of the animal sector in Burkina Faso, with enormous economic gains for the country and rural households. The company contributes to improving livestock feeding in the country. The company has two production lines. The first line processes oilseeds such as peanuts, cotton, and soybeans and the second mixes the cake with, for example, blue cheese bran or corn, salt, or any other microingredient to make a tylored feed for a given type of animal. By producing 100,000 tons of livestock feed per year, SOFAB intends to reduce Burkina's trade deficit in the animal feeding sector by 15%. About 700,000 tonnes of cattle feed per year are imported into Burkina at a higher cost estimated at more than 8 billion CFA.

Key Performance Indicators				
Land Use	20 ha			
Capital investment:	About USD 10,686,480			
Labor requirements:	32 full-time workers and 50-60 part-time workers			
O&M cost:	Not available			
Output:	100,000 tons of livestock feed per annum			
Potential social and/or environmental impact:	Development of livestock sector, creation of jobs,			
Viability indicators	Payback period:	10 years	Gross margin:	Net profit (after tax)

## Context and background

Livestock plays an important role in the Burkina Faso economy. However, the vulnerability of pastoralists and breeders to food crises has increased considerably in recent years due to a combination of several factors. Among these factors is the fodder deficit in pastoral and agro-pastoral areas. The supply of livestock feed has become a central issue in the security and sustainable development of livestock farming. To overcome this challenge, breeders' initiative for the creation of SOFAB-SA was born in Koubri, a locality located about thirty kilometers from Ouagadougou. The overall goal of SOFAB was to produce low-cost livestock feed to sustainably improve the livelihood and well-being of livestock producers.

## Market environment

According to projections, the consumption of livestock products will increase by 216 % in the next 35 years, thus increasing the demand for livestock feed. SOFAB offers more than twenty quality products to breeders. The company's livestock feed allowed milk production to grow from 7 to 15 liters per day per cow.

## Business Model

The value proposition of SOFAB is to provide quality livestock feeds and to manage environmentally friendly agro-food residues. SOFAB serves as both the customer and the producer since most of the residues suppliers are the end users of the final product. The key activity is livestock feed production, while the key resources are land, equipment, livestock feed technology and the sourcing of cereals and agro-food residues. SOFAB has created permanent jobs for thirty-two individuals and fifty to sixty nonpermanent jobs and contributed towards developing sustainable livestock sector. SOFAB's customers are varied and include small or large breeders, public and private institutions, and NGOs. The company

has a shop in the capital for the flow of its products and several distributors located throughout Burkina Faso. The business canvas is shown in Figure 2.

<b>Key Partners</b> <ul style="list-style-type: none"><li>• Agricultural residue suppliers</li></ul>	<b>Key Activities</b> <ul style="list-style-type: none"><li>• Production of livestock feed</li><li>• Sale of livestock feed</li></ul>	<b>Value Propositions</b> <ul style="list-style-type: none"><li>• Animal feed tailored to the needs of livestock farmers (cattle, sheep, poultry, pig, horse)</li></ul>	<b>Customer Relationships</b> <ul style="list-style-type: none"><li>• Direct interaction</li></ul>	<b>Customer Segments</b> <ul style="list-style-type: none"><li>• Livestock farmers</li><li>• Institutions and private business</li><li>• Breeders</li></ul>
	<b>Key Resources</b> <ul style="list-style-type: none"><li>•Fruits from farmers</li><li>•Capital investments and O&amp;M costs</li><li>•Certification</li></ul>		<b>Channels</b> <ul style="list-style-type: none"><li>• Direct sales</li></ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>• About 10.6 million dollars</li></ul>		<b>Revenue Streams</b> <ul style="list-style-type: none"><li>• Sale of livestock</li></ul>		
<b>Social &amp; environmental costs</b> <ul style="list-style-type: none"><li>• Possible health risks to employees while working at the company</li><li>• Possible environmental burdens that threaten sustainability, including greenhouse gas emissions</li></ul>		<b>Social &amp; environmental benefits</b> <ul style="list-style-type: none"><li>• Increased income for livestock farmers by increasing livestock production</li><li>• Environmental-friendly approach by providing livestock feed services</li><li>• Improve the security and sustainable development of livestock and pastoral care resources.</li></ul>		

Figure 3: SOFAB business model canvas

## Value chain and position

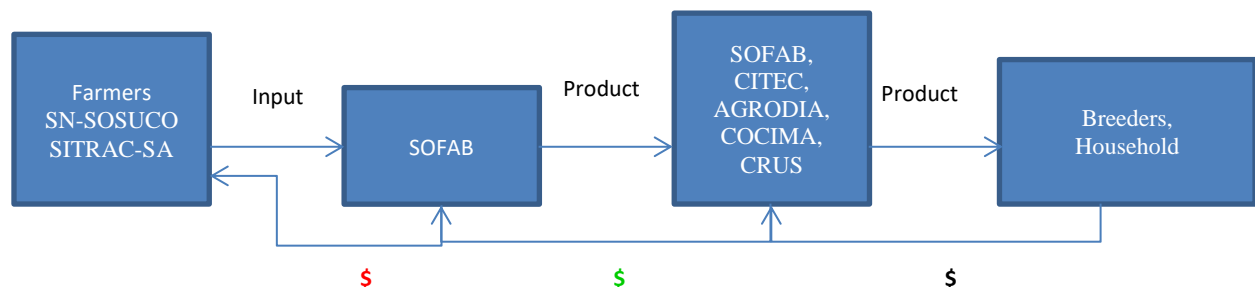


Figure 4: Livestock feeds value chain

The value chain (Figure 4) consists of a collection of cereal residues, baobab seed, and the production, and the commercialization of high-quality livestock feed. SOFAB, the largest livestock feed factory in the country, recycles and repurposes agricultural residues into higher-value products for livestock. By producing 100,000 tons of livestock feed a year, SOFAB aims to reduce Burkina's trade balance deficit by 15% in the livestock feed sector.

## Institutional Environment

At the institutional level, the Ministry of Agriculture, Animal and Fishery Resources implements the country policy on animal and plant production. Through the Environmental National Evaluation Agency, the Ministry of Environment, Energy, Water, and Sanitation validates environmental and social studies and ensures the supervision of the implementation of projects.

## Technology and processes

The SOFAB company plant has modern facilities. It is equipped with a 120-tonne weighbridge, a raw material cleaning machine, a laboratory, a dry extruder, and an input weighing-dosing device. The procedure to produce livestock feed pellets consists of first receiving and storing raw materials, cleaning feed materials, crushing, feed proportioning and batching process, feed mixing and finally feed pelletizing.

## Financial analysis

The initial investment plan for SOFAB was estimated at USD 6.15 million. The company was able to mobilize USD 5.3 million from the Burkina Faso Fund for Economic and Social Development. The business plan had omitted to consider some investments and the missing amounts became high with inflation rate. The total investments were about USD 10.7 million.

## Business case summary assessment -SWOT analysis

STRENGTH	WEAKNESS
<ul style="list-style-type: none"><li>• Expertise</li><li>• Local buy-in</li><li>• Plant allows out-scaling production</li><li>• Assured supply of agricultural residues</li><li>• Low O&amp;M and high revenue</li></ul>	<ul style="list-style-type: none"><li>• Requirement of skilled labor for the technology and research and development</li><li>• Much heterogeneity among the livestock feed production units</li><li>• Lack of regulation in the sector</li></ul>
OPPORTUNITY	THREAT
<ul style="list-style-type: none"><li>• Enormous potential of livestock and poultry feed market in the country</li><li>• Out-scaling &amp; up-scaling combination opportunity</li></ul>	<ul style="list-style-type: none"><li>• Increase of the insecurity in the country disrupts business opportunity</li><li>• Possible animal health risk may lead to investment needs</li><li>• Possible negative perception of health risk employees may force M&amp;O up</li><li>• Possible environmental burdens</li></ul>

## Socio-economic, health and environmental impact

By improving the local supply of animal feed, creating new job opportunities, and injecting money into the local economy, SOFAB has a significant economic development impact on the region, especially for farmers. It has also contributed to a decline in animal feed imports by 37 % in 2019 and an increase in the production of breeding products by offering quality products for better yield. SOFAB presents low environmental burdens, promises reduction of greenhouse gas emissions and sustainable land use.

## Scalability and replicability potential



The livestock and poultry feed market has enormous potential in Burkina Faso. The number of animal feed producers and agropastoralists is growing. The high demand for animal feeds is likely to make replication opportunities more attractive in any locality in the country. The key drivers for the success of this business are: i) partnerships with NGOs and breeders organized into a cooperative, ii) demand for end products –livestock feeds are internal, and hence no significant competition risks, iii) the big markets and the possibility of exporting in the subregion, and iv) positive government policy toward breeders.

## References

- <https://www.27avril.com/blog/agriculture/burkina-faso-sofab-sa-la-societe-de-fabrique-daliments-pour-betail-sinstalle-a-koubri>
- <https://burkina24.com/2013/04/12/burkina-une-usine-daliments-pour-betail-le-31-juillet-2013/>
- <http://news.aouaga.com/h/32997.html>
- <https://www.iedafrique.org/Le-paradoxe-de-l-elevage-au-Sahel-forts-enjeux-faibles-soutiens.html>
- <https://livestocklab.ifas.ufl.edu/media/livestocklabifasufledu/pdf-/pdfs-by-country-pre2019/BF ASFProd Mark 02082017.pdf>
- <https://www.fao.org/3/ca7019en/CA7019EN.pdf>
- <https://www.investirauburkina.net/secteurs-et-marches/industries/production-daliments-pour-betail-et-volaille-une-incroyable-opportunit-e-daffaires.html>

## Business case: India

### Sai Shubhada Agro Industries

 	Location:	Ahmednagar, Maharashtra
	Waste input type:	Bagasse and sugarcane juice
	Value offer:	Organic Jaggery
	Organization type:	Private Enterprise
	Status of organization:	August 2021
	Scale of businesses:	Micro business
	Major partners:	No partner

### Executive summary

Jaggery is vastly used as a sweetening agent for centuries in India. The requirement of this sweetening agent is proliferating at a fast rate due to growing awareness of the health benefits derived from jaggery. Analyzing the market scenario and considering the rise in demand for these sweetening agents, Sai Shubhada agro industries a newly established venture has ushered in this line of work.

The enterprise, Sai Shubhada Agro LLP is located in Ahmednagar, (Maharashtra, India), and is completing large-scale needs for items like sugarcane honey, jaggery cube, jaggery powder to the larger regional population. The business is focused on achieving outstanding responses for jaggery, owing to the perfect standards of safety as well as quality.

Sai Shubhada Agro is involved in the conversion of bagasse, (a pulpy and fibrous residue of the sugarcane processing) into organic jaggery. Sugarcane juice and bagasse extracted after crushing sugarcane are used as raw materials to prepare jaggery. Further, to reduce the fuel expenses of the business, the business uses the same bagasse as a fuel in cogeneration to produce steam and generate electricity. The cost recovery through the use of the residue for



energy production provides financial benefit to the enterprise and also reduces environmental burden of the waste. The key performance indicators are provided below.

Key performance indicators						
Land use	1 bigha (0.25 hectare)					
Capital investment:	USD 25-30,000 (INR 2-2.5 million) (Acquired Personal Loan)					
Labor requirements:	There are around 12 permanent employees in the enterprise and more helping hands are hired as and when needed					
O&M cost:	USD 0.47 (INR 38)/ kg					
Output:	USD 0.75 (INR 60)/ kg					
Potential social and/ or enviornmental impact:	<ul style="list-style-type: none"> <li>• Employed more than ten people in a year</li> <li>• The use of bagasse for fuel and jaggery production has led to a reduction on the dependence on conventional sources of energy and the recycling of waste</li> </ul>					
Viability indicators	Payback period:	NA	Gross margin:	NA	Net profit (after tax)	NA

## Context and background

India is the second-highest producer of sugarcane in the world after Brazil. The largest producer of sugarcane in India is the state of Uttar Pradesh, which produced over 177 million ton (around 45%) of sugarcane in 2021, followed by Maharashtra state producing 20% i.e. 101 million ton. It is to be noted that Sugarcane bagasse is one of the largest produced agricultural residues in the country. One of the uses of bagasse is the use of fuel in cogeneration to produce steam and generate electricity.

More than 70% of the jaggery production of the world is done in India. <sup>1</sup>As the major producer of jaggery, the country has been recognized as one of the leading traders and exporters of jaggery to the world. India exported 551,716.76 MT of jaggery and confectionery products to the world for the worth of USD 375.20 million during the year 2021-22. As Maharashtra is the 2<sup>nd</sup> largest state in the country to produce sugarcane, so does it produces more waste after processing it for sugar or jaggery. In view to the same, the idea gained traction when the large amounts of bagasse being produced in the area were being dumped in the waste grounds as it did not have any use. Sai Shubhada Agro Industries was set up with the aim of recycling this waste into something useful in August 2021.

<sup>1</sup> [https://apeda.gov.in/apedawebsite/subhead\\_products/jaggery\\_and\\_confectionary.htm](https://apeda.gov.in/apedawebsite/subhead_products/jaggery_and_confectionary.htm)

## Market environment

Jaggery is a popular product in households and is known for 'medicinal' benefits as it contains high value of calcium, magnesium, phosphorus, B-complex vitamin, iron, etc. which results in several health benefits. Additionally, it is one of the most common ingredients used in several traditional Indian cuisines as a sweetener or flavoring agent. As people become more conscious and aware of their food choices, the demand for organic products continues to rise. Consequently, the Indian organic food market is expected to exhibit a CAGR of 25.25% during 2022-2027.<sup>2</sup> The market in India for packaged jaggery has reached a value of USD 600 million. Looking forward, it is predicted that the market will reach up to USD 1.3 billion by 2027, exhibiting at a CAGR of 14.2% during 2022-2027.<sup>3</sup>

The bagasse generated from each of such industries making sugar/ jaggery is dumped unutilized and pollutes soil and nearby waterbodies. However, the waste can be used as a source of energy. As the market towards products providing health benefits is expanding, the production process needs to meet the demand generating more waste. Therefore, such businesses has a great potential in the future.

## Business Model

The business stands strong as it is involved in the production of a commonly used consumable product in Indian households. The materials needed in the production process: bagasse and biofuel are easily available and produced by the business itself out of waste (bagasse) which automatically reduces the cost of production. This makes the business financially viable. The factors mentioned below are key highlights related to the jaggery business (Figure 5).

---

<sup>2</sup> <https://www.imarcgroup.com/indian-organic-food-market>

<sup>3</sup> <https://www.imarcgroup.com/india-packaged-jaggery-market#:~:text=India%20packaged%20jaggery%20market%20reached,14.2%25%20during%202022%2D2027.>

<b>Key Partners</b> <ul style="list-style-type: none"><li>• No direct Partners are involved in the business</li></ul>	<b>Key Activities</b> <ul style="list-style-type: none"><li>• Collecting, transporting, crushing, filtration, weighing, and packaging</li></ul>	<b>Value Propositions</b> <ul style="list-style-type: none"><li>• There is significant value that gets added along the process. The fuel generated is an excellent alternative to reduce our heavy reliance on fossil fuels.</li></ul>	<b>Customer Relationships</b> <ul style="list-style-type: none"><li>• Word of mouth, online medium, relationship with the locals</li></ul>	<b>Customer Segments</b> <ul style="list-style-type: none"><li>• Wholesalers,</li><li>• Retailers</li><li>• Direct customers</li></ul>
	<b>Key Resources</b> <ul style="list-style-type: none"><li>• Equipment and technical know-how</li><li>• skilled labor</li><li>• Land</li><li>• Construction Materials</li><li>• Residues</li></ul>		<b>Channels</b> <ul style="list-style-type: none"><li>• The sales in local markets and through connected vendors along with sales from their own website</li></ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>• Production of a kilogram of jaggery costs USD 0.47</li></ul>		<b>Revenue Streams</b> <ul style="list-style-type: none"><li>• A kilogram of jaggery is sold at USD 0.74. Therefore, the profit stands at USD 0.33 on each kg</li></ul>		
<b>Social &amp; environmental costs</b> <ul style="list-style-type: none"><li>• Possibility of work-related hazards</li><li>• Potential greenhouse gas emissions during production and transportation of inputs and product</li><li>• Residue spillages</li></ul>		<b>Social &amp; environmental benefits</b> <ul style="list-style-type: none"><li>• Employment at the local level</li><li>• Management of waste and cost recovery</li><li>• Reduction in environmental costs</li></ul>		

Figure 5: Business Model Canvas of Sai Shubudha Agro Industries

## Value chain and position

The value chain of the business is simplified where the bagasse is transported to the processing unit after it has been collected from several farms and other processing units (where these are dumped as a waste material). The processing involves crushing the bagasse to make juice, which is filtered and concentrated to make molds of jaggery and packaging for sales (Figure 6). Usually wholesalers, retailers are used as intermediaries for marketing the products. Sai Subhudha also sales directly to customers.

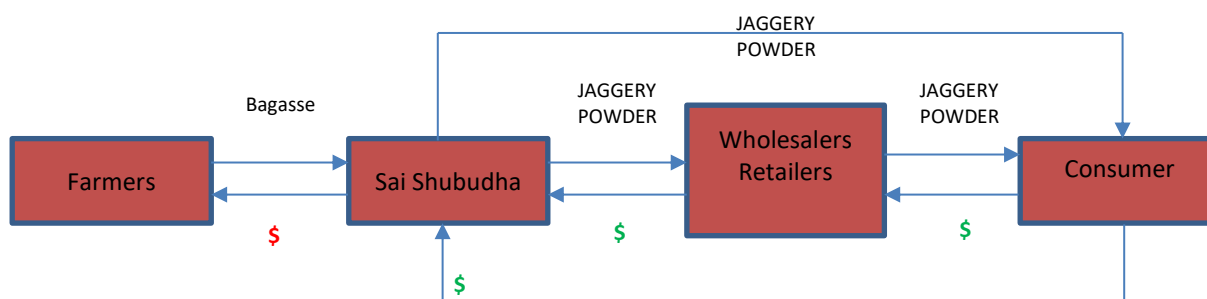


Figure 6: Value chain of Sai Shubudha Agro Industries

## **Institutional Environment**

The Food Safety and Standards Authority Act is a legislation that secures the laws relating to food and establishes science-based standards for food to manage its manufacturing, storage, distribution, sale, and import, to ensure that food is suitable for human consumption and other food-related concerns. Jaggery is classified under Sub-category “Sweetening Agent” now includes cane jaggery/cane gur as a sub-category under Para 2 of Regulation 2.8. Production of food (like jaggery) can be registered under Central FSSAI Registration license or the State FSSAI registration license. Registration of the jaggery business and obtaining a license may benefit a food business in a different ways. This includes legal protection, brand recognition, increased customer awareness, and help with growth of business. It is easier to obtain investments for the business and ensures good quality products for consumers. The consumers are assured about the quality through the FSSAI label on the product. This further signifies that the facility meets the required requirements for food safety and quality and avoidance of any penalty.

Ministry of New and Renewable Energy under Government of India (GoI) is presently implementing the National Bioenergy Programme (2021-26, Phase-I) with the outlay of Rs.8.58 billion (USD 105 million). This includes Waste to Energy Programme (Programme on energy from urban, industrial and agricultural wastes/residues). However, this is limited to the production of pellets and briquettes and excludes bagasse. Similarly, Biomass power & cogeneration programme is implemented with the main objective of promoting technologies for optimum use of country’s biomass resources (including bagasse) for grid power generation. Therefore, small business recovering energy from bagasse while can cost costs from restricting use of fuel and do not generate electricity fed to grid, are not under the ambit of financial assistance from GoI.

## **Technology & Processes**

The technology used by the enterprise in the process includes advanced and efficient tools and machinery which can produce more product in less time. These machineries are maintained and properly set to deliver quality outputs. The role of the labour is of utmost importance along with the technology involved in the operations of machines. The process diagram is shown in Figure 7.

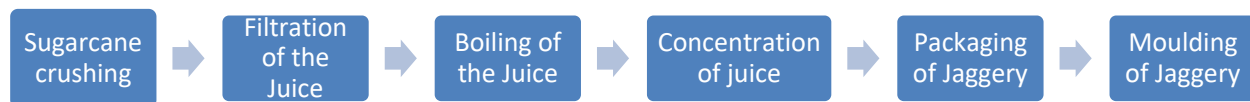


Figure 7: Process diagram of Sai Subhudha Agro Industries

## Business Model Summary Assessment – SWOT Analysis

Strength	Weakness
<ul style="list-style-type: none"> <li>Raw material is easily available and accessible</li> <li>Working on alternate fuel options is empowering</li> <li>Courage to take challenges due to availability of low cost fuel</li> <li>Organic jaggery is a nutritious product and always in demand</li> </ul>	<ul style="list-style-type: none"> <li>Non-availability of labour or non-willingness of the labour to come and work at the enterprise</li> <li>Other than the fuel, the cost of production is slightly higher</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>Steady expansion in the demand for organic products</li> <li>Creating local market along with regional expansion</li> </ul>	<ul style="list-style-type: none"> <li>GST is considered to be very high</li> <li>Logistics is an issue in the area</li> <li>Bank loans not very easily available</li> <li>Organic sugarcane is difficult to find as organic farming is not carried out by majority of the farmers</li> <li>Little support from government and other agencies with respect to policies and programmes</li> </ul>

## Socio-economic, Health & Environmental Impact

The business has been able to generate decent employment additionally for more than ten employees in the last one year. The adverse environmental impact due to considerable waste has also significantly reduced, as the business sustains on the idea of upcycling the waste, which is a residue of sugarcane processing. Health benefit of the product is in itself, jaggery acts as an antioxidant and helps in the reduction of stress. The production in general have created a balance on several factors of impact.

## **Scalability and replicability considerations**

The business model can certainly be scaled to other states with either large number of sugarcane processing units or in states within proximity to these units to factor in the transportation costs. The business can expand and start catering to markets all over the country. The model is also replicable if one can learn the technical know-how that is required.

## **References**

<https://www.tradeindia.com/sai-shubhda-agro-llp-33398107/> (accessed on December 15, 2022)

## Arogyasangini Oil Mill

 	Case name & location:	Arogyasangini Oil Mill
	Waste input type:	Safflower seeds
	Value offer:	Oil
	Organization type:	Private
	Status of organization:	Since 2021
	Scale of businesses:	Micro
	Major partners:	No partner

### Executive summary

The use of safflower seeds in India is limited. Safflower has been under cultivation in India for its brilliantly colored florets and the orange red dye (carthamin) extracted from them and seed. The seeds contain 24-36% oil, which leads to cold pressed oil extraction largely used for cooking purposes. The oil is as good as sunflower oil having enough amount of linolic acid (78%), which is very useful for reducing blood cholesterol content.

This specific case deals on the idea of converting safflower seeds into oil using a basic process combining manual and mechanical process. Arogyasangini Oil Mill has embarked on the mission to re-introduce oil extracted from the safflower seeds and its benefits to Indian households. The use of safflower oil is becoming increasingly common, especially amongst the health-conscious households preferring cold pressed edible oils in their food. The market potential is therefore high and it is a great opportunity such businesses.



Key performance indicators						
Land use	2000 sq. feet					
Capital investment:	USD 1250 (INR 100,000)					
Labor requirements:	4-5 Operative, for handling the machine					
O&M cost:	Raw material @ USD 0.74 (INR 60 kg)					
Output:	USD 4 (INR 330/ litre)					
Potential social and/or environmental impact:	Environment-friendly crop, uses safflower seeds that are produced in large quantities and later become waste					
Viability indicators	Payback period:	NA	Gross margin:	NA	Net profit (after tax)	NA

## Context and background

Recently, the world has witnessed the resurgence of usage of vegetable fats for food. Although it has been noted that safflower seeds rank the lowest in crops being harvested for oil, it is still quite popular, as it has many purposes like medicinal, for food and in some parts of the world it is also used to extract a dye called carthamin. It has a high linoleic content which makes it quite suitable for diet of people with high cholesterol<sup>4</sup>. A variety of safflower seed with even higher linoleic content makes that variety suitable for industrial uses like production of varnishes and biodiesel.

Arogyasangini Oil Mills, established in 2021 with an initial investment of USD 1,250 (INR 0.1 million). Although the business is limited to oil production, the entrepreneur intends to make the oil a household name, and aim to increase the income for the safflower farmers in the nearby areas, as recently the market price of safflower seeds has doubled<sup>5</sup>. Further, since in India, dye is extracted from the safflower florets there is a possibility for farmers to increase their income.

It is important to highlight that harvesting most of the varieties of safflower seeds grown in India is labour and time intensive because the flowers of most of the varieties are spiny. On one hand safflower seeds have a huge potential and on the other there are very India specific challenges to the harvesting. Nevertheless, given the uptick in new technologies, safflower seeds cultivation & harvesting for sesame oil is an avenue that needs to be explored.

<sup>4</sup> Resurgence-of-Safflower-Carthamus-tinctorius-L-Utilization-A-Global-View.pdf (researchgate.net)

<sup>5</sup> In most countries irrigated agriculture accounts for most freshwater use (as much as 70-80%), far higher than drinking water a (nariphaltan.org)

## Market environment

Safflower seeds oil has a huge national and international market, as it is a flavorful oil which can not only treat hypertension, and can be used in food preparation for people with high cholesterol, and aid in the preparation of frozen food. In terms of value, the global safflower oil market was estimated at USD 8.2 million by 2018. By type, the high oleic segment is expected to register a CAGR of 5.4% in the safflower oil market. Demand for safflower oil is estimated to grow at a CAGR of 6.9% through 2032.<sup>6</sup>

Further, it is quite interesting to notice that with the passage of time and more exposure to allergens there are increasing number of people who report nut oil allergies. Therefore, alternative oil has the potential to replace traditional nut oils like groundnut oil. Consequently, it also has the potential to cut into nut oil segment in regions across the world. India with China and Japan are the major markets for alternative food oil in Asia.

## Business Model

Most of the oil produced by the enterprise is sold directly to the people residing in the surrounding villages or known relatives. Therefore, word of mouth and trust plays a key role here. The raw material is mostly procured from the farmers. The value added in the process is 100% as the waste gets converted into a consumer good which attracts a lot of customers.

It is a traditional business model which relies heavily on community participation, which works effectively and efficiently for the business at the moment. However, if the model were to be expanded to reach more households in other regions & states it would need to expand its marketing prowess to include contemporary marketing techniques like online mode. The business canvas is shown in Figure 8.

---

<sup>6</sup> <https://www.futuremarketinsights.com/reports/safflower-oil-market> (accessed on December 12, 2022)

<b>Key Partners</b>  No direct partners involved	<b>Key Activities</b>  Cleaning, pressing of seeds for extraction, oil recovery, packaging and selling  <b>Key Resources</b>  Procurement of seeds from farmers	<b>Value Propositions</b>  The value added in the process is 100% as the waste gets converted into a consumer good which attracts a lot of customers.	<b>Customer Relationships</b>  Word of mouth, trust of the locals  <b>Channels</b>  Direct selling	<b>Customer Segments</b>  Surrounding villagers  Known people
<b>Cost Structure</b>  Around 2.5 kgs of oil gets produced from 10 kgs of seeds			<b>Revenue Streams</b>  Oil sold at USD 4 (INR 330) per litre  Raw waste is sold at USD 1 (INR 80) per kg	
<b>Social &amp; environmental costs</b>  • Possibility of work-related hazards • Residue spillages			<b>Social &amp; environmental benefits</b>  • Employment at the local level • Management of waste by reusing for other uses like livestock feed	

Figure 8: Business Model Canvas of Arogyasangini Oil Mill

## Value chain and position

The value chain for extraction of oil is very simple and straightforward. The seeds are collected from the farmers directly and taken to the mill for processing (Figure 9). For processing to happen, the shells are removed and cleaned. Subsequently, the seeds are pressed so that the oil can be generated. This is then packed and sold. Technical know-how plays an important role in the process. With very limited staff in the factory, the enterprise make sure all its members are trained to tackle the oil production process.

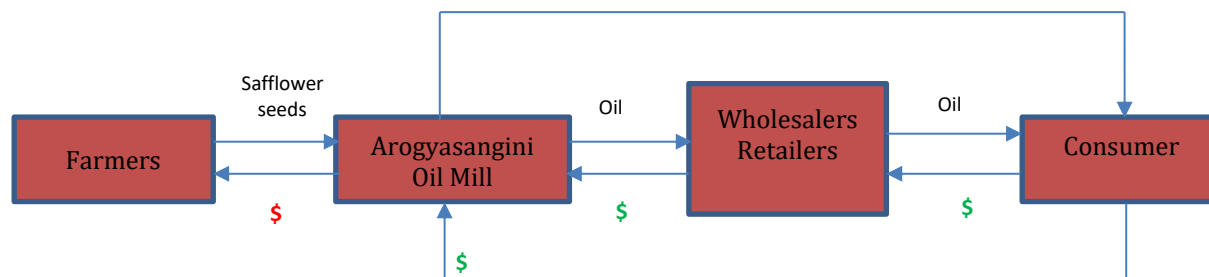


Figure 9: Value chain of the oil extraction from safflower seeds

There is a potential in the value chain to establish oil pressing centres in other regions in the country where safflower seeds can be easily procured. The enterprise can collaborate with

other willing partners in various safflower producing regions (Maharashtra, Karnataka, Andhra Pradesh, and Madhya Pradesh) of the country and educate them about the technical know-how of sesame oil production. This will not only aid in setting up of more centres, but also access markets across India.

## Technology & Processes

The model involves basic small machines for different processes. However, the basic machinery also requires capital investment and efficient people armed with the knowledge of operating this machinery.

To extract the oil from the safflower seeds, seeds are first collected, then removed from the shells, cleaned, roasted and then pressed mechanically to extract sesame oil. The process is a combination of manual labour and mechanical efficiency, which makes it an ideal business avenue (Figure 10).

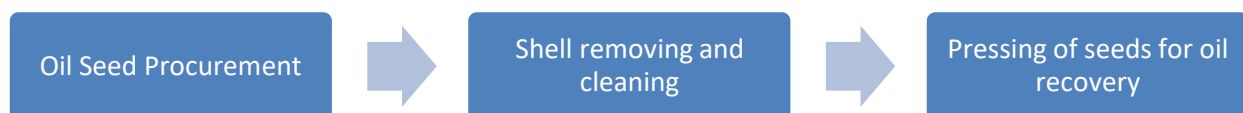


Figure 10: Process flow of the Arogyasangini Oil Mill

## Business Model Assessment - SWOT Analysis

Strength	Weakness
<ul style="list-style-type: none"> <li>• In demand product with locally available resources</li> <li>• Less input required during processing of these seeds</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of quality standards, as these seeds are waste products</li> <li>• Most of the seeds get affected by diseases due to lack of maintenance</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Government support and strategies in this regard</li> <li>• Catering to the very demanding market</li> <li>• Creating job employment</li> </ul>	<ul style="list-style-type: none"> <li>• Climate change and less facilities available regarding the same</li> <li>• Logistics and transportation</li> <li>• Market scale and shifting demand</li> </ul>

## Socio-economic, Health & Environmental Impact

Arogyasangini Oil Mills is alleviating the socio-economic conditions of the region by offering a reasonable price to the farmers for the safflower seeds. The financial incentive and the production of oil for use in regional households is also gradually reviving the interest of

farmers and consumers in safflower seeds and the oil. Since, most of the safflower seeds are used and negligible amount of it goes waste, it also helps in alleviating the burden of waste on the environment. Further, sesame oil is not just a simple, run-of-the-mill vegetable oil. It can easily be termed as a wonder oil for the overall wellbeing of the consumers.

### **Scalability and replicability considerations**

The model is both replicable and scalable. Since there are already few people involved in this business, this can be expanded to cover larger markets such as more states and households as sesame oil is a consumer good. To reach more households in other states, business could collaborate with online e-commerce platforms to sell the product and partner with online influencers to design and promote food recipes replacing conventional oils with the sesame oil.

The demand of oil is stable in the region. The replicability potential is high as it uses basic machines along with some manual labour. However, given the potential of oil to cut across diverse segments, the business model can be expanded to include other products containing sesame oil as one of the most important ingredients. To expand this business model to cater to other segments, investment of time and capital is required to gain more knowledge and collaborate with partners in other industries like pharmaceutical. Business model can also be expanded to include the extraction of dyes from the safflower seed, which again would require capital investment in terms of setting up of machinery and collaboration with partners from other industry to facilitate knowledge sharing and access to market.

## Business case: Kenya

### Nadanya Green: Composting from Goat and Chicken Droppings

	Case name & location:	NADANYA GREEN; Mbale, Vihiga
	Waste input type:	Goat and Chicken droppings
	Value offer:	Compost, energy and animal feed
	Organization type:	Private
	Status of organization:	Operational since 2017
	Scale of businesses:	Small scale
	Major partners:	N/A

#### Executive summary

Nadanya Green is a self-sustainable integrated farm tapping into solar power and recycling wastes from poultry and dairy goats' droppings to produce compost for a purely organic farm and feeds for pond-grown fish. Disposal of agricultural wastes is a constant challenge for farmers, especially when integrated farming is practiced on a relatively small piece of land. The farm practices goat farming, poultry farming, aquaculture and apiculture all of which generate a lot of waste but with limited disposal options. For this reason, Nadanya Greens is exploring the use of farm waste from livestock to produce feeds for fish reared through three fish ponds as well as generating compost manure for the farm's vertical gardens. The effort to convert wastes to agricultural input directly contributes to nature positive waste management, promoting sustainable smart farming and environmental conservation especially in the face of limited arable land.

Nadanya Greens produces fresh organic vegetables which is domestically consumed and the surplus sold off to generate income. Additionally, the firm has carved a niche for itself through aquaculture in an area that predominantly practices crop farming, thereby bridging the local gap of the highly in demand fish products. The farm directly employs two full time workers with the possibility of two more on casual basis when there's an increased

workload. The farm aims to further expand their business by expanding the land upon which the farm is set up to set up a piggery in what will hopefully see more people gain meaningful employment. Nadanya is also among many other things a model farm, set up as a conduit for learning and passing knowledge on smart agriculture tenets for prospective farmers.

Key performance indicators						
Land use	0.3035 Ha					
Capital investment:	41,667 USD					
Labor requirements:	Two permanent employees;					
O&M cost:	Salaries and wages - 290 USD Monthly Transport costs- 167 USD Monthly					
Output:	Compost, energy and animal feed					
Potential social and/or environmental impact:	<ul style="list-style-type: none"> <li>• Job creation / Source of livelihood</li> <li>• Environment Conservation</li> <li>• Knowledge transfer of environment- conscious agricultural practices.</li> <li>• Corporate social responsibility by educating two high school students; Free water and farm produce giveaways to the community.</li> </ul>					
Viability indicators	Payback period:	3 years	Gross margin:	13500 USD per annum	Net profit (after tax)	USD 7500 annually

## Context and background

Nadanya Greens is located in Mbale, Vihiga County, 400 Km. to the west from Kenya's capital Nairobi city. The farm was set up in 2017 and managed by a sole proprietor who is so passionate on smart agri-farming and sustainable agriculture that they left formal employment. Even though the farm sits on 0.30 ha, Nadanya Greens does a good job mixed agriculture doing crop farming, goat rearing, bee keeping and practicing aquaculture. Nadanya Greens establishment was inspired by the need to engage in affordable smart organic farming in rural Kenya to enhance food resilience in the backdrop of diminished rainfall for rainfed reliant agriculture due to global climate change.



## Market environment

Averagely one ton of agricultural waste is produced every month, with the bulk of the waste converted to animal feeds for the farm thereby limiting expenses that would have otherwise gone into purchase of costly feed. The farm equally converts and sells a mixture of sludge and chicken dropping with wood shavings at KES 200 for 90 KG bag to local farmers as disposal alternative and also a source of income.

## Business Model

Nadanya's business is hinged on a self-sustainable model leveraging farm wastes for cost recovery. The farm upcycles and reuses most of the waste product by ploughing them back into the farm to meet general costs of operations. Animal waste generated by livestock is used for the production of BSF at a rate of 1Kg per day, which is then provided to chicken and fish as an alternative to industrial proteins.<sup>7</sup> Additionally, the waste is also used to induce growth of planktons and algae in the fish ponds, a useful source of pure organic feeds for the fish. With significant costs being saved through this sustainable scheme, the farm is self-reliant freeing up costs to improve facilities on the farm. The farm also operates as a model farm generating revenue through consultancy fees made from prospective farmers along with sales of surplus organic fertilizers. In so far as regulation is concerned, the County Government of Vihiga pioneered county climate by-laws setting the pace for grassroots farmers with ambitions to practise climate-friendly agriculture. This means that there are numerous opportunities for the farm to thrive and secure expert as well as financial assistance to enhance its growth. The business canvas is shown in Figure 11.

---

7

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXjtzsof7AhV1gPOHHbmVAAEEQtwj6BAgTEAI&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D7GF0EhXEZS8&usg=AOvVaw1yxnpdhdhdy314W4e7uU4xq>

<b>Key Partners</b>  None	<b>Key Activities</b> <ul style="list-style-type: none"><li>• Conversion of wastes to animal feed</li><li>• Compost production from pond sludge and excess animal wastes</li><li>• Sales</li></ul> <b>Key Resources</b>  Land Semi-skilled work force	<b>Value Propositions</b> <ul style="list-style-type: none"><li>• Potential for biogas production to meet energy demands.</li><li>• Fish feed production</li><li>• Production of organic manure from compost</li></ul>	<b>Customer Relationships</b>  Direct sales	<b>Customer Segments</b>  Self-use and to farmers in the nearby region
			<b>Channels</b>  Own farm uses. Direct sales	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>• Initial investment costs (Land)</li><li>• Running costs (Employees)</li></ul>			<b>Revenue Streams</b> <ul style="list-style-type: none"><li>• Organic fertilizer sales</li><li>• Consultancy fees</li></ul>	
<b>Social &amp; environmental costs</b> <ul style="list-style-type: none"><li>• Used and untreated water drained in the river poses health hazards for users downstream.</li></ul>			<b>Social &amp; environmental benefits</b> <ul style="list-style-type: none"><li>• Conservation of the environment through alternative waste management pathways.</li><li>• Source of employment</li><li>• Corporate social responsibilities</li></ul>	

Figure 11: Business Model Canvas of Nadanya Green farm

## Value chain and position

Nadanya Green farm upcycles waste from livestock to produce animal feeds. This is necessitated by the rising cost of animal feeds and fertilizers driving the farm to adopt innovative pathways to sustain the farm and contribute to nature positive waste management. Upto one ton of waste generated in the farm is upcycled for composting activities or production of animal feeds. Surplus organic compost offers an additional income stream to the farm as it's sold in the surrounding community with majority of the clientele being smallholder farmers. Nadanya's proprietor offers an excellent solution for farmers with limited access to industrial fertilizer by bridging the gap with the more organic and sustainable alternative of natural compost. Additionally, the firm also lends its expertise through a consultancy based approach on creating a sustainable farm and waste reuse,

creating yet again another income stream. The value chain of the business is shown in Figure 12.

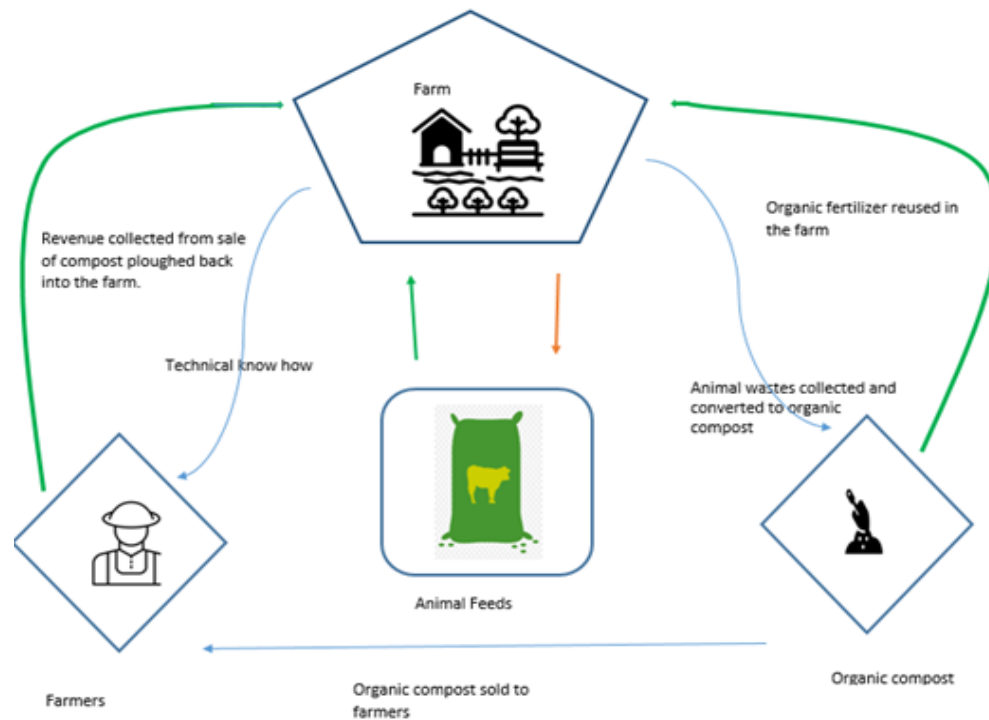


Figure 12: Value chain of Nadanya Green farm

## Institutional environment

The Vihiga County Climate Change Act (2019) received immense recognition for actively instituting climate-conscious regulations and policies within its pillars of governance. This act serves to build reformist policies that enhance the county's capacity to build resilience towards practical climate action championed by locals.<sup>8</sup> The initiative being the first among the 47 counties has seen Vihiga picked as a model county by the National Treasury and The Worldbank to advance positive climate action at the county level. Vihiga county has gone beyond setting up the regulatory framework to guide climate action activities, but has also set up a KES 35 million (291,666 USD) fund to help accelerate and finance climate action oriented ventures and projects by locals in all its 25 wards.<sup>9</sup> In so far as financial support is concerned, the Nadanya Green farm is yet to realize financial assistance from this fund. It

<sup>8</sup> <https://www.standardmedia.co.ke/western/article/2001446438/vihiga-county-recognised-for-its-climate-action-plans>

<sup>9</sup> *ibid*

remains unclear on what parameters are used to determine projects and activities that require support in promoting sustainable and actionable climate change.

## **Technology & Processes**

Animal feeds production and composting activities at Nadanya farm do not require any mechanized input. The proprietor of the farm outlines two key processes at Nadanya when it comes to value addition: Black Soldier fly (BSF) production & inducement of algae growth for fish feeds. Droppings from chicken and goats is mixed with farm soil and placed in three 90 KG bags, then slipped in each of the fish ponds. Water sips through the sack dissolving vital nutrients as sediments formed through soil particles settle at the bottom of the pond ultimately inducing growth of planktons and algae consumed by the fish. A 90 Kg bag of compost mixture lasts the farm up to 3 weeks per pond, saving Nadanya Green KES 6000 (50 USD) monthly on fish feeds. Similarly the production of Black Soldier Flies is reliant on local and simple technology to generate averagely 30 Kgs of BSF larvae monthly. Both processes (Algae & BSF production) are simple and non-technical and so does not require any specialized skills to carry out these activities.

## **Financial analysis**

Initial cost implications for setting up the farm, land purchase, and putting up farm structures including the three fish ponds was 41,667 USD. Financing for Nadanya Green was solely funded by the proprietor, who also disclosed that they made several attempts to secure financing from banks, grants, county support packages for sustainable and climate positive ventures to no avail. They admitted the gap in funding has greatly limited and slowed the uptake of nature positive initiatives for climate action in the country. Through upcycling of key wastes, the farm has maintained a steady revenue stream (sale of organic compost and consultancy) as well as cost saving resource recovery of upto 84 USD monthly, which translates to an annual gross savings of 1000 USD. Additionally, Nadanya Greens makes gross sales of up to 13500 USD annuals from selling of fish and chicken bred organically in the farm. This is the farm's largest revenue stream supporting key operations (6000 USD O&M costs). The owner indicated that the farm should be able to break even three years from now (2025) if it maintains its current operational capacity. Nadanya Green is exploring other financing avenues including through the Agricultural Finance Corporations for possible credit to further contribute to the circular economy by setting up a biogas facility.

## Business Model Assessment – SWOT Analysis

Strength	Weakness
<ul style="list-style-type: none"><li>• Steady supply of waste</li><li>• Low operation and maintenance costs</li><li>• Local buy-in</li><li>• Strong regulatory framework to guide the business</li></ul>	<ul style="list-style-type: none"><li>• Limited land use for expansion</li><li>• Threat of vandalism and theft</li><li>• Limited technology to upscale project</li><li>• Limited financial assistance</li></ul>
Opportunities	Threats
<ul style="list-style-type: none"><li>• Prospective biogas generation</li><li>• Opportunity for replication, in locations with limited land use and a sustainable farm.</li></ul>	<ul style="list-style-type: none"><li>• Possible human health risk may lead to investment needs</li><li>• Possible negative perception of health risk employees may force M&amp;O up</li><li>• Contamination of the river since it is source of waste</li></ul>

## Socio-economic, Health & Environmental Impact

Nadanya offers great social and economic gains in its community. Firstly, through the farm, livelihood is realized, albeit not extensively. The farm directly employs two farm assistants and the owner, providing and sustaining their livelihood. Moreover, Nadanya's proprietor also goes further to share their technical understanding and know-how on waste reuse to prospective sustainable smart farmers, extending the social-economic impact of the venture in the community. The Climate Action Act (2019) of Vihiga prescribe policies that promote afforestation and sustainable land use to help build climate resilient farms, and Nadanya through its waste reuse program is able to positively impact the environment as envisaged by this act.

On environmental impact, animal waste pose a great danger to the environment and consequently to humans if not properly managed. If left unattended, waste is washed up to rivers, contaminating communal water sources posing serious health hazards as well as degrading the environment. All this is mitigated to a great degree through nature positive waste reuse as a form of waste management by the farm, although not entirely as untreated water from the fish pond is often drained into the rivers.

## Scalability and replicability considerations

The Nadanya Green project offers an excellent blueprint for smart sustainable farming with nature positive impact on the environment. Vihiga envisions practical local effort for climate oriented activities through the Climate Change Act (2019) and Nadanya Green's success offer valuable insight and lessons for the business to be replicated in other areas. Several counties

in Kenya established climate related legislation along with concomitant financial assistance to integrate smart farming at grassroot levels following the successful implementation the act in Vihiga County. This type of support, dissemination of technical know-how on nature positive agricultural waste management especially through the circular economy can be replicated anywhere in the country and still find unprecedented success. However, significant bottlenecks still exist in fully unlocking the potential of smart farming and reuse of agricultural waste. There remains a huge gap in terms of the fundamental understanding of the business and nature of operations thereby limiting favorable policies and financial product designs to support these ventures.

## References

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXjtzsof7AhV1gP0HHbmVAAEEQtwJ6BAgTEAI&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D7GF0EhXEZS8&usg=AOvVaw1yxnpdhdhdy314W4e7uU4xq>

<https://www.standardmedia.co.ke/western/article/2001446438/vihiga-county-recognised-for-its-climate-action-plans>

## Business case: Vietnam

### Xuan Tien Agricultural Cooperative

	Case name & location:	Xuan Tien Agricultural Cooperative, Yen Chau, Son La, Vietnam
	Waste input type:	Mango fruit residues
	Value offer:	Consumables (Soft dried mango/ fresh round mango, Taiwan mango)
	Organization type:	Agricultural Cooperative
	Status of organization:	Established June 2017 and operational since 2018
	Scale of businesses:	Small <ul style="list-style-type: none"> <li>• Fresh round mango 300 tons/year</li> <li>• Fresh Taiwan mango 600 tons/year</li> <li>• and 10 tons/year dried mango</li> </ul>
	Major partners:	<ul style="list-style-type: none"> <li>• Department of Agricultural &amp; Rural Development (DARD)</li> <li>• Agriculture Extension Department</li> <li>• GREAT project,</li> <li>• Sweden Project for Small Enterprises development.</li> </ul>

## Executive summary

Xuan Tien Agricultural Cooperative was established in 2017, according to the Cooperative Law 23/2012/QH13 of National Assembly in the mango specialty area - Yen Chau district. This is a mountainous region (northwest of Vietnam) and a center of mango for Son La. Traditionally round mangoes variety that were not sold in market ended up disposed or composted. However, with the establishment of the cooperative, it allows to easily procure the mango that is not sold in the market due to its strategic location. By purchasing and using this low quality mango, Xuan Tien has had a significant positive impact on both the social economic and environment, reducing the pollution associated with improper disposal of



rotten mangoes mainly in waterbodies in high production season. The intervention of the cooperative helps in increasing the incomes of local mango farmers by introducing a stable procurement price. It also has a social impact due to creation of local jobs.

Key performance indicators						
Land use	0.03 ha shop-showroom					
Capital investment:	USD 20,000					
Labor requirements:	From 7 to 10 persons according to the season (10 part time workers)					
O&M cost:	46,000.00 USD per month (approx. 550,000 USD annually)					
Output:	300 tons fresh round mango 600 tons fresh Taiwan mango 10 tons dried mango from about 30 tons fresh mango					
Potential social and/or environmental impact:	<ul style="list-style-type: none"> <li>• Jobs</li> <li>• Increased income for more than 38 cooperative members in the local area as well as nearby farmers</li> <li>• Reduced water pollution due to indiscriminate waste disposal in nearby waterbodies</li> </ul>					
Viability indicators	Payback period:	Under 2 yrs	Gross margin:	USD 37,000	Net profit (after tax)	USD 37,000

## Context and background

Mango is a key development product for mountainous northern-west Son La province, which is mainly grown in Yen Chau, Mai Son, Muong La and Song Ma districts at a suitable altitude of 600-1000m. Mango area in Son La increased quickly from about 7,000 hectares in 2013 to 20,000 hectares today with an output of 75,000 tons/year and the plan is going to 30,000 hectares by 2030. Son La mango has been exported to a wide range of countries such as the US, UK, Australia, New Zealand, UAE and China, of which China is the largest customer. Some of mangoes have met VietGAP, GlobalGAP and Organic Standards, but most (about 70%) are still on low quality and difficult to sell. The provincial and district authorities have selected mango as key development plan, on one hand due to the high value of mango, on the other hand due to the suitability of mango with hot weather in Yen Chau. In the recent years, the areas of mango plantation has rapidly expanded, but the rate and volume of low quality is still high. Thus, utilizing low quality mangoes including fruit wastes and residues into the new food systems will play a very significant role is a very important for Son La. Xuan Tien Cooperative is situated in the Yen Chau district, mountainous north –west of Vietnam, which is center of mango for Son la and North Vietnam. The location allows it to easily and cost-effectively purchase the mango variety that cannot be sold as well as low quality mango and convert the mango into dried mango used as food consumables. This intervention is key in

providing addition income to the local mango farmers, local jobs and reduce water pollution since the unsold fruits ended up in local streams causing water pollution.

## **Market environment**

Vietnam is the 13th largest mango producer in the world with a total planting area of 87,000 hectares in the country. In 2021, Vietnam's total mango production reached 893.200 tons, 6.5% higher over previous year. Son La currently is one of leading province in the country in terms of volume and quality of mango. In 2021, despite the Covid-19 pandemic, the export value of Son La mango reached 3 million USD. Dried mango has a growth rate of up to 179.6%/year due to long-term preservation. According to a study by the Institute of Policy and Strategy for Agriculture and Rural Development, due to the impact of Covid-19 (2019-2021), the domestic mango price has decreased by 8%/year while the export mango price has increased by 3 %/year.<sup>10</sup> The top 3 importers of dried mango are Russia with 637 shipments followed by United States with 485 and China at the 3rd spot with 285 shipments.<sup>11</sup> Therefore, there is a potential for the dried mango in the global market although it is reported that freight and labor costs has increased costs and reduced profits.

## **Business Model**

Key value propositions of Xuan Tien Cooperative are the production of dried mango and fresh round mango in the high season (Figure 13).

---

<sup>10</sup> <https://kinhtenongthon.vn/xuat-khau-xoai-say-tang-gan-180nam-post50279.html>

<sup>11</sup> <https://www.volza.com/p/dried-mango/import/coo-vietnam/>

<b>Key Partners</b> <ul style="list-style-type: none"><li>• Farmers selling mango to Cooperative</li><li>• MARD / DARD</li><li>• Big companies exporting dried mangoes</li></ul>	<b>Key Activities</b> <ul style="list-style-type: none"><li>•Marketing</li><li>•Technical support from DARD</li><li>•Training to farmer</li><li>•Hiring to make dried mango</li></ul> <b>Key Resources</b> <ul style="list-style-type: none"><li>•Fruits from farmers</li><li>•Capital investments and O&amp;M costs</li><li>•Certification</li></ul>	<b>Value Propositions</b> <ul style="list-style-type: none"><li>• Recovery of on-farm agricultural waste to food consumables</li><li>• Reduction in water pollution from improper disposal</li></ul>	<b>Customer Relationships</b> <ul style="list-style-type: none"><li>• Direct with consumers, distributors</li></ul>	<b>Customer Segments</b> <ul style="list-style-type: none"><li>• Big companies</li><li>• Wholesale market</li><li>• Consumers</li></ul>
			<b>Channels</b> <ul style="list-style-type: none"><li>• Direct with distributors and export companies</li><li>• Directly through own shop</li></ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"><li>• Investment (Land, shop)</li><li>• Operational cost (mango, transportation, fuel, hiring drying)</li><li>• Marketing (leaflet)</li><li>• Training to farmers</li><li>• Depreciation</li></ul>		<b>Revenue Streams</b> <ul style="list-style-type: none"><li>• Revenue from sale of mangoes USD 450,000</li><li>• Revenue from sale of dry mangoes USD 43,000</li></ul>		
<b>Social &amp; environmental costs</b> <ul style="list-style-type: none"><li>• Operational hazards</li><li>• Spillage of the residue</li></ul>		<b>Social &amp; environmental benefits</b> <ul style="list-style-type: none"><li>• Job creation for 10 persons part-time to peel mango</li><li>• Social benefit thru stable mango price for farmer (stable income for farmer)</li><li>• Environmental benefit thru processing low quality fruit, which was disposed previously in garden in the high short season.</li></ul>		

Figure 13: Business Model Canvas for Xuan Tien Agricultural Cooperative

## Value chain and position

Xuan Tien cooperative sources fruits directly from 38 households linked with the cooperative and from about 500 farmers in a rounding area during high season. These are direct purchases from the farmers. The cooperative also receives support from partners such as the DARD and GREAT project in cultivation techniques. The cooperative has one showroom in headquarter, for direct contact with consumers and is also associated with several supermarkets. The residue (mango peels) obtained during the processing of dried mangoes and composted and returned to mango plantation farmers. The value chain is shown in Figure 14.

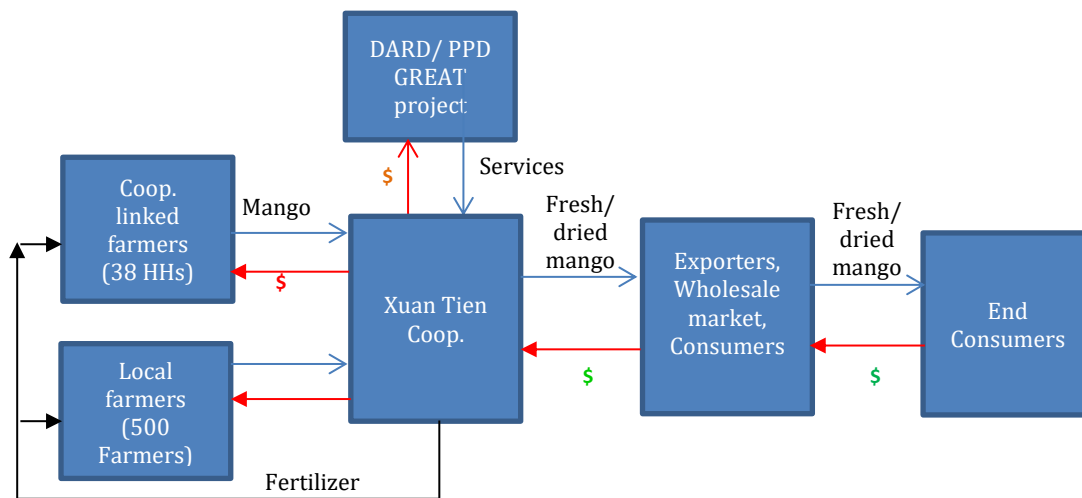


Figure 14: Value Chain of Xuan Tien Cooperative

## Institutional environment

The Vietnam Government issued Resolution 53/NQ-CP dated July 17 2019, on "solutions to encourage and promote enterprises to invest in agriculture effectively, safely and sustainably", which clearly states: By 2030, Vietnam will be among the top 10 countries in the world. Vietnam is a deep processing center of world agriculture".

With the desire to contribute to reducing the waste from soften mango, improving income for farmer and improving quality of processed agricultural products, then Xuan Tien Cooperative has received much support from local authorities on food safety regulations and packaging labels. However, to promote further for online selling, the cooperative still faces several difficulties.

## Technology & Processes

The production process of round mango and dried mango follows the following steps – (i) farmers harvest and transfer mangoes to the cooperative (ii) at the cooperative the mangoes are sorted by type and quality, (iii) based on the type the mangoes are packages or are used for drying and further packaged (Figure 15).

The cooperative has only one shop to gather mangoes from farmer, this shop allocates on the national road No. 6 and it is very convenient for transportation and contact with customers in the Capital Hanoi.

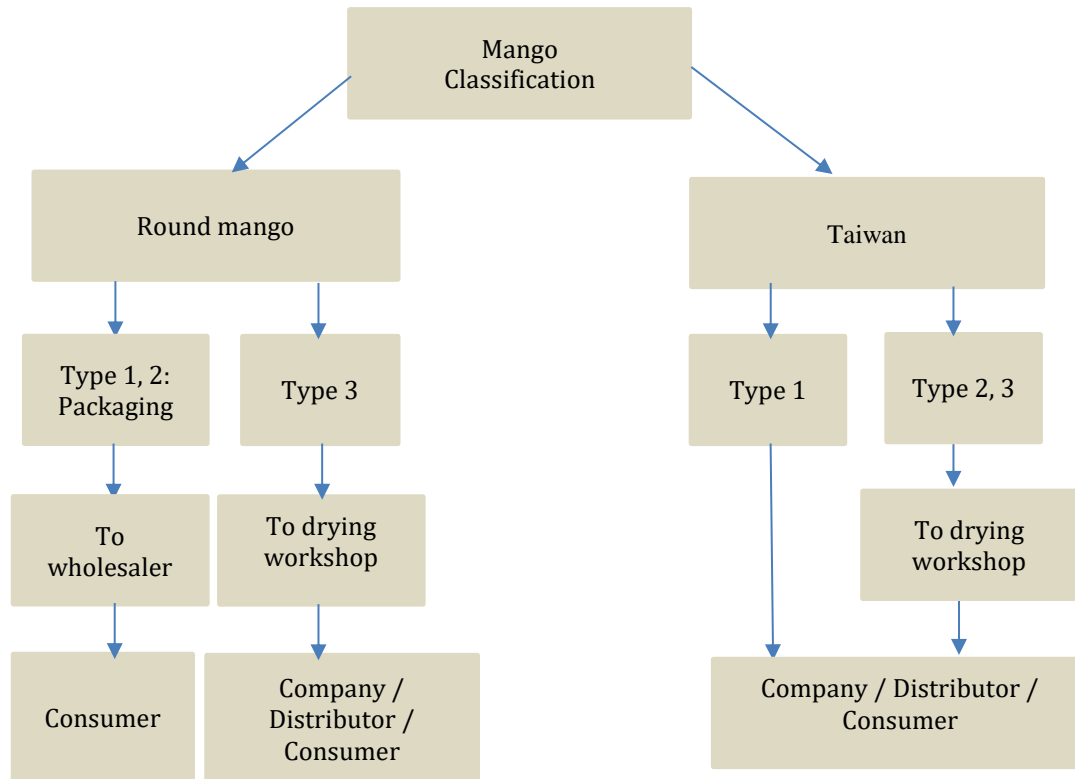


Figure 15: Process flow Diagram of Xuan Tien Cooperative

## Financial analysis

The major investment of Xuan Tien Cooperative is the shop and the premises of the operations and has been contributed by cooperative member valued about 20,000 USD (460 million VND). This also serves as the collection center for all cooperative members. The main production costs of Xuan Tien Cooperative are the cost of raw mango, (depending on the season, about USD 1,740 to 221,000/month), the cost for hiring dryer (it is about USD 2.6/1kg), and transportation cost to wholesale market. Total monthly operating and maintenance costs varies between USD 11,000 -25,000. The business shows that the payback period is 2 years and since the government does not tax agricultural cooperative (only the registration fee), the gross profit margin is the same as net profit margin and relatively stable in near future.

## Business Model Assessment - SWOT Analysis

Strength	Weakness
<ul style="list-style-type: none"><li>• Low investment especially for infrastructure</li><li>• The round mango is local fruit and adapted with micro-climate region</li><li>• Engaged in social impact (farmer income improvement)</li><li>• Local buy-in</li><li>• Traditional expertise in the process of drying mangoes</li></ul>	<ul style="list-style-type: none"><li>• Market segment is not big</li><li>• No machines and depending on hiring machine</li><li>• No specialization in online marketing and sales</li></ul>
Opportunities	Threats
<ul style="list-style-type: none"><li>• Potential of expansion if online marketing and sales is promoted by local government.</li><li>• The online payment system is convenient and if initiated would provide opportunity for cooperative</li></ul>	<ul style="list-style-type: none"><li>• High cost for fertilizer</li><li>• Steep competition of businesses who enter the market with better processing technique</li><li>• Recent increases in labour costs and shipment</li></ul>

## Socio-economic, Health & Environmental Impact

The operations of the cooperative have improved the incomes of local mango plantation farmer by stable mango price in the peak season. By keeping the stable mango price, the local farmers stay with mango plantation and invest more into traditional farm. Besides, it creates employment for local youths and women to peel mango, drying and packaging in high season. In addition, through Xuan Tien VietGap educational programs for local farmers, small holders have learned to use good inputs and take care their tree properly to improve fruit quality and yield. Finally, as the waste from rotten mango on the field is not there, it reduces methane emission that results from rotting mango in waterbodies.

## Scalability and replicability considerations

The key drivers for the success of this cooperative are low investment of cooperative on infrastructure, the speciality of round mango and the local buy-in, all those issues help cooperative in having cost-effective operation. Using the traditional techniques and serving export market provides an opportunity for scaling up. However, increase in labour price, shipment costs and steep competition in the market are some of the growing challenges for scaling up such business proposition.

*Case descriptions are based on primary and secondary data provided by case operators, insiders, or other stakeholders, and reflect our best knowledge at the time of the assessment Dec 2022. As business operations are dynamic, data can be subject to change.*