

# AGRO-LOGISTICS BUSINESS OPPORTUNITIES IN THE COLOMBIAN CARIBBEAN



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## INTRODUCTION

This document follows the report ‘Agro-logistics in the Colombian Caribbean: state of affairs, bottlenecks and opportunities’, both carried out with the support of the Netherlands Enterprise Agency and the Dutch Embassy in Bogotá.

This document elaborates on six of the thirteen preliminary business leads identified in the state of affairs report. For each business lead, the current situation and opportunity are presented. Challenges, risks and mitigation measures are also mentioned when especially relevant/specific.

Particularly, the report presents three business cases, one ‘business & knowledge case’ (given its higher potential when carried out in collaboration with a knowledge institution), one ‘showcase’ and a roadmap, both of which have the potential to become business cases when properly investigated and followed-up.

The opportunities identified are in line with the priorities of both the new Colombian government, to enhance internal (agricultural) productivity in a sustainable manner, and the priorities of the Dutch government for the country’s relationship with Colombia.

## 1. BUSINESS CASE: MANGO PROCESSING

### BACKGROUND

More than 100 local mango varieties are grown in Colombia, but only 16 are commercialized. These are classified in two groups: mango *criollos* and *mejorados*. The former category includes the *azúcar* and *común* (or *hilacha*), while the latter includes Tommy and Keitt varieties. In the Colombian Caribbean, the most produced varieties are the following:

- Bolívar: *mango común o de hilacha*, more fibrous than other varieties (but it still depends on each sub-variety).
- Cesar: *Tommy* (fibrous and juicy, more suitable to transport and resistant to degradation) and *Keitt*, but also *común* and *azúcar*.
- Magdalena: *azúcar*, suitable for fresh and processed consumption. It is harvested twice a year (May to August and December to January).

Magdalena is, amongst these, the main producing region, with an annual mango production of around 74,000 tons, cultivated across more than 5,100 hectares.<sup>1</sup>

### PROBLEM AND OPPORTUNITY

In the Caribbean region, large amounts of mango are lost, for lack of buyers and processors. In 2018 and 2019, only in the Ciénaga municipality and surroundings, roughly 8 tons per each hectare cultivated with mango (around 1000 ha) were collected and left to rot along the roads.<sup>2,3</sup> In the municipality of Aguachica, in the south of Cesar, a similar story repeated in 2021 with tons of mango *hilacha* (part of the mango *común* family) being lost after harvest and utilized for animal feed.<sup>4</sup>

Until 2018, mango production increased at a rate of 38–40%, while consumption of the fruit only grew 8-10%, in line with population growth.<sup>5</sup> One way to absorb part of these extra volumes is through agro-processing. Mango is suitable for a large variety of processes, amongst which drying and juicing; frozen mango cubes are also gaining market.

Mango juicing specifically, can result in different products: juice, puree, or pulp. FAO states that “juice is the fluid expressed from plant material by crushing, comminuting and pressing. It can be clear, cloudy or pulpy. Juice is classified as puree, if the resulting consistency is fluid that pours very slowly, or pulp if it pours even more slowly”.<sup>6</sup>

<sup>1</sup> UPRA, 2020

<sup>2</sup> El tiempo, 2019, available [here](#)

<sup>3</sup> Opinion Caribe, 2018, available [here](#)

<sup>4</sup> Noticiasrcn, 2021, available [here](#)

<sup>5</sup> Portal fruticola, 2018, available [here](#)

<sup>6</sup> FAO, available [here](#)

Mango puree in turn can be produced without removing the water (called ‘single-strength puree’) or by (partly) removing the water content, resulting in a ‘concentrated puree’. In this chapter we use the terminology ‘mango puree’ as the business case applies to both products. Naturally, by removing its water content, shipping of concentrated mango puree is more cost-effective.

Both types of mango puree are utilized as ingredients in several products such as natural juices, juice blends, soft drinks, dairy products (flavoured yogurt), baby food and healthy snacks (e.g. fruit and nut bars).

## MARKET SIZE AND DEMAND

### *Trade data*

The HS code 200989 refers to “Juice of fruit or vegetables, unfermented, whether or not containing added sugar or other sweetening matter (excl. containing spirit, mixtures, and juice of citrus fruit, pineapples, tomatoes, grapes, incl. grape must, apples and cranberries)”. No specific international HS code refers to mango juice or puree.

The biggest importer of fruit juices is the United States with USD 720 M. Germany and the Netherlands follow with USD 252 and 223 M. Within the EU, the other main importers are Austria (USD 146 M) and France (USD 121 M).

The majority of the USA’s fruit juice imports come from Thailand, Brazil and Indonesia. In 2021, Colombia was ranked as the 26th country that exported juices to the USA with a value of USD 4.8 M. Imports of juices into Colombia are limited to USD 1.3 M, also coming mostly from Thailand and Brazil.

Colombia exports between 20,000 and 30,000 tons of mango puree, mainly to the USA.<sup>7</sup> In the EU, the main market for this product is the Netherlands.

These numbers show large potential for both import substitution and exports of juices to the USA and other Western countries.

### *Market potential*

It is estimated that European imports of all types of mango purees account for 100,000 tons, with a stable annual market growth between 5 and 7% (2015–2024).<sup>8</sup> This is because of the increased popularity of mango as a flavour for fruit juices, smoothies, baby food and healthy snacks. The Netherlands imports almost half of the total volume of European imports, and re-exports 80% of it.

While the global market for mango puree is estimated to reach USD 2,110 M in 2026, thanks to a predicted annual growth 2019–2026 of 8.7%, North America is expected to witness the fastest growth in the same period.<sup>9</sup> This is especially true for the USA, where mango is gaining popularity as a component in orange juice blends.

### *Competitors in the region*

Currently, there seem to be only two large scale mango processing business in the region: Compañía Envasadora del Atlántico and FLP Procesados in the Atlántico department. In addition, Postobón sources half of their mango from Bolívar.<sup>10</sup> In this context, the lack of mango processing facilities in Magdalena – the department with the largest mango production amongst the five, and third department for mango production in the country – does surprise. Amongst fruit juice producers, in 2018 the largest exporters were FLP Procesados, Alimentos SAS, Gaseosas Posada Tobón (now Postobón), Natural Food Enterprise and Colombina SA.<sup>11</sup>

<sup>7</sup> CBI (a), 2021, available [here](#)

<sup>8</sup> CBI (b), 2021, available [here](#)

<sup>9</sup> Apeda, unknown, available [here](#)

<sup>10</sup> El Universal, 2022, available [here](#)

<sup>11</sup> Treid, 2019, available [here](#)



### Global competition

On a global level, Colombian mango puree would compete mainly with India (world leader in the market with exports for 250,000 tons annually) and Mexico (40–50,000 tons). In addition, Brazil (10–15,000 tons) and Perú (10,000 tons) are gaining market shares.

## ACTIVITIES

### Establishing a mango puree production facility

The very first step to establish a mango processing facility is to secure the necessary amounts of input material. The availability of fruits in this case does not concern; however, their transportation can prove difficult (see ‘Potential risks and mitigation’ section below).

The processing of mango into mango puree can be relatively easy, with steps such as:

1. Inspection
2. Chlorine bath
3. Inspection
4. Washing off of chlorine and debris
5. Steam treatment to loosen the skin (helps separating pulp from peel). Another, more labour-intensive, option is to cut the mangoes and scoop out the pulp.
6. Blending (cuts the fruit in bigger pieces, allowing to remove the seed)
7. Pulping/milling and sieving
8. Optional: heating to remove water content, if producing concentrated puree
9. Sterilization (with this step, the final product does not require refrigeration).

The same facility to be set up to produce mango puree can be used, with some adjustments (e.g. changing blades and hammermill), to process other fruits. It is not uncommon for mango processors to also work with passion fruit, tomato and guava. The table below shows the calendar of ‘high availability’ of this specific combination of fruits.<sup>12</sup> When wanting to source solely from the Magdalena department and surroundings, a slightly different combination of fruits may be more advantageous.

	J	F	M	A	M	J	J	A	S	O	N	D
Mango ( <i>de azúcar</i> )	X				X	X	X	X				X
Mango ( <i>común</i> )	X	X	X		X	X	X				X	X
Passion fruit						X	X	X	X	X		X
Tomato			X	X	X	X	X	X	X			
Guava		X	X	X		X					X	X

## POTENTIAL BY-PRODUCT

After deshelling mango seeds, mango seed oil (also referred to as butter) can be extracted by expeller pressing or cold pressing. After that, mango butter can be refined by using chemical components. Refined mango butter accounts for more than 80% of the total trade of such product.<sup>13</sup>

Although edible, mango seed oil is mostly utilized in the cosmetics industry, thanks especially to its antioxidants properties. In such industry, mango butter competes with the cheaper shea butter. However, within the growing trend for natural cosmetics, the use of “exotic” ingredients is also gaining relevance,<sup>14</sup> suggesting that mango butter demand will rise. This is especially true in the main markets for mango butter: the USA and EU.

Globally, the annual growth rate of the mango butter market predicted between 2021 and 2026 accounts for 4.3%. The FOB price of mango butter in 2020 ranged between 7 and 9,5 USD/kg.<sup>15</sup>

<sup>12</sup> Corabastos, unknown, available [here](#)

<sup>13</sup> Industry Search, 2020, available [here](#)

<sup>14</sup> CBI (b), 2021

<sup>15</sup> CBI (a), 2021

Producing mango butter as a by-product is certainly an option, however it does require specific machinery and substantial volumes to make it profitable. More research by interested investors is needed to assess the profitability of such by-product.

## FINANCIALS

As mentioned in the list of activities, the process of fruit puree or pulp production is quite straightforward. The initial investment needed to set up a processing plant are therefore not exorbitant. For obvious reasons, potential competitors are not allowed to disclose information on their investments or operations costs, and therefore other sources were used. Development organization and governments have conducted similar (pre-)feasibility studies to determine the profitability of a fruit processing plant. Both USAID, the Small and Medium Enterprises Development Authority of Pakistan and the Department of Agriculture of India performed (pre-)feasibility studies for fruit processing plants, which are used for this section.<sup>16</sup> These numbers have been validated by a connection who ran a fruit processing plant in Uzbekistan a decade ago.

### CAPEX needed

The initial investment to establish a processing plant as suggested vary from USD 20 M for a plant with a production capacity of 34,000 tons per year to USD 3 M for a facility with a capacity of 3,600 tons per year. Based on the availability of mangos and other fruits and the available investment capital, an investor can decide on the desired size of the facility.

### Financial Results

With an estimated world market price for mango puree ranging around USD 1,500/T,<sup>17</sup> it would be possible to get a good return on investment. The internal rate of return for these projects lays between 20 and 32% according to the pre-feasibility studies encountered, with a payback period of around four years.

## POSITIVE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACT

- Farmers argue that national incentives and campaigns to promote mango production have not been followed by concrete interventions and support that would secure the yields would be commercialized and/or processed for export. A new mango processor is therefore likely to gain public support.
- Mango production is also at high risk of fluctuations, with certain seasons characterized by overproduction of fruits, followed by a drastic decrease in their price. A stable demand of large volumes of fruits will therefore benefit mango producers.
- The value addition that comes from mango processing would be (partly) captured locally, contributing to sector development and development of regional the agro-industry, further leading to increased investment in infrastructure.
- In 2018 and 2019, tons of mango have been collected and left to rot on the side of the road, with phytosanitary risks for surroundings communities and cultivations. With the establishment of a mango processor, this situation would hardly repeat, at least in the sourcing areas.
- The investment would lead to increased local employment, both direct and indirect, respectively in the processing plant (operators, management, administration) and in the field (e.g. seasonal workers during harvest).
- When the product is (partly) exported, it would account for increased export and influx of foreign currency in the country.

<sup>16</sup> Department of Agriculture Punjab, 2017, available [here](#)

<sup>17</sup> Based on:

– Apeda: Export price of mango puree EUR 1400/Mt

– Own source: National price (per kg) mango puree pasteurized 2022: EUR 1580/T

– Own source: National price (per 20kg) mango puree frozen Alimentos SAS 2022: EUR 1020/T

## POTENTIAL RISKS AND MITIGATING OPTIONS

- Difficulties in the transportation of raw material from producers to factory. Mitigation: investors could directly set up their own transport solution, with a fleet of vehicles and drivers. Else, they could incentivize and facilitate organized groups (such as cooperatives and producers' associations) to take up the task, possibly by setting up collection centres. On the longer run, investors could – directly or indirectly – support the maintenance of roads that connect the factory to supplier's fields and/or collection centres (with positive spillover effect for the whole area).
- By absorbing large volumes of mango produced in the area, the factory may (unintentionally) incentivize farmers to increase mango production. This is however unlikely, given the fact that mango producers already experienced mango cultivation promotion from the State and then suffered from the consequences. Mitigation (in case the risk actually becomes concrete): farmers interested in expanding their mango production may be redirected towards different cultivations, especially those with unmet demand and complementary seasonality. More directly, depending on these farmers' current cultivations, different product lines could be started to absorb such yields (provided there is an adequate demand).
- Lack of raw materials (e.g. other fruits) or demand for the factory to operate 12 months. Mitigation: source fruits from different departments. The extra costs incurred for transport of such products could be compensated by focusing on high quality (possibly organic) and niche fruits.
- Indirectly, the investment could lead to poor (field) labour conditions during harvesting season. Seasonal work is typically subject to unfavourable labour conditions, such as poor safety conditions, long working hours, inadequate pay. Mitigation: investors shall pay fair prices for raw materials, enough to secure the growers can hire seasonal workers with fair pay and conditions. In addition, investors could add clauses to their sourcing contracts to incentivize (and monitor) growers to ensure optimal working conditions.
- In 2021, fresh mango was granted green light to be exported to the USA. This could mean that part of the volumes of mango produced (and currently lost) in the Colombian Caribbean will be diverted to export. However, exporting fresh products to the USA comes with a series of strict regulations that many producers are not able to meet. In addition, not all mango varieties produced in the area are in high demand for the fresh export market (e.g. mango *común*), but are rather suitable for agro-processing.

## POTENTIAL FUNDING OPPORTUNITIES AND SUPPORTING ORGANIZATIONS

### *Potential funding opportunities*

- Dutch Good Growth Fund (former RVO, now Invest International): investors that want to invest in a factory and/or machinery in Colombia but cannot get funding from commercial banks, can get funded by the Dutch Government. Through the DGGF, they provide loans, participations, guarantees, export credit insurance and export finance.
- The [Fair Factory Development Fund](#) invests in food factories that allow for an increased local value addition and that benefit the community. They are an all-round shareholder.
- [FMO](#), the Entrepreneurial Development Bank, invests, amongst others, in agribusiness in Latin America across several phases of value chains, including processing. They provide long-term loans, equity, mezzanine and working capital finance.

Several other funds are available and could be suitable for such an investment. In addition, RVO and Invest International can support foreign investments in the feasibility study phase. Contact us for more information.

***Potential supporting organizations***

- Invest in Colombia is the national investment promotion agency. In addition, [Invest](#) in Santa Marta is the investment promotion agency of Santa Marta, the capital of the Magdalena department.
- ProColombia, part of Invest in Colombia, is in charge of export promotion.
- Holland House is the Dutch-Colombian Chamber of Commerce, they provide various services to (Dutch) companies interested in doing or setting up business in Colombia.
- Fedemango is the national association of mango producers. On top of providing technical assistance to mango growers, they help with commercialization and connect producers to buyers.



## 2. BUSINESS CASE: (ORGANIC) CASHEW PRODUCTION AND PROCESSING

### BACKGROUND

In Colombia, cashew grows spontaneously in the eastern regions (Llanos Orientales), and is cultivated in a total of 12 departments. Notably, in Vichada and Córdoba production areas are 4,300 and 2,050 hectares. The total area cultivated with cashew in the country is more than 8,130 ha.

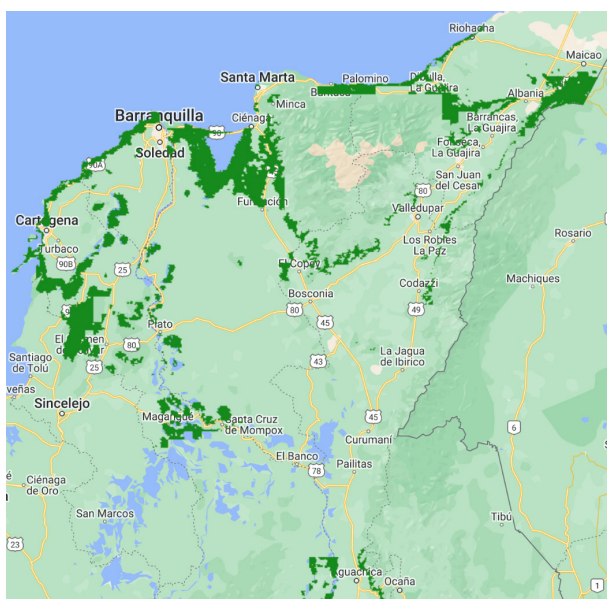
In the so-called *Caribe Seco* (dry Caribbean), Atlántico registers 100 ha, Cesar 70 and Magdalena 40 (no data is available for La Guajira, though it is known that production of cashew exists). These productions have a strong family connotation, with Atlántico also counting some commercial plantation. This seems to be the only plantation of the area with (low) technification, while the rest are classified as “without technology in cultivation and post-harvest”. In Vichada, production reaches 900 kg/ha, thanks to the use of clonal varieties. Other regions largely rely on seeds propagated from wild varieties, reaching a yield of only 50–300 kg/ha.

In 2016, Agrosavia selected three clonal varieties for production in the Vichada region, Corpoica Mapiria Ao1, Yopare Ao2 and Yucao Ao3, all oriented for export. In 2022, Agrosavia identified the dry Caribbean (Atlántico, Cesar, Bolívar, central Guajira and Magdalena) as the most promising region for cashew cultivation. In terms of associativity, producers of the region can join Asomarañon and Asomarcas (Caribe).

### OPPORTUNITY

According to a study of Agrosavia published in 2022, the dry Caribbean is the region with more potential for the production of cashew, thanks to its climate and soil characteristics, specifically:

*The best conditions for commercial cultivation are obtained between 15° N and S latitude, with heights less than 600 m.a.s.l. (Lopes Serrano & de Paula Pessoa, 2016), where environmental conditions are often characterized by low fertility, sometimes a considerable level of soil salinity, and low or irregular rainfall (Bezerra et al., 2007). [...] The water requirement of the crop is between 800 mm and 1,500 mm per year, with a wet season of between six to seven months and a dry period of five to six months. [...] The optimum average temperature is 27°C, which can vary between 22°C and 36°C (Carr, 2014). In addition, the cashew is a plant that requires high light (>1800 h of sun per year), since its production is reduced in shaded or low light conditions. Cashew plants require deep soils, with good drainage. [...] The dry Caribbean is the region of the country with the greatest potential for cashew production, due to its climatic and soil conditions, as it has low rainfall, well-defined dry seasons for harvesting the crop, and well-drained soils.*



The map on the left shows a preliminary identification of suitable planting areas, based on the reported ideal altitude, annual rainfall and average temperature (suggested ideal average temperature is 27°C, we used a range of 24–31°C). For more details, the map is available at this [link](#).

In this business case we suggest the set-up of a total of 8,000 ha cultivated with cashew clonal varieties from Agrosavia. Furthermore, we suggest the establishment of a 40 tons/day processing facility. More details and calculations are presented in the sections below. By opting for organic agriculture, the volumes needed for the economic viability of this business case will be lower. However, given the lack of specific trade and productivity data for organic cashew, it is difficult to estimate a minimum volume of production/processing to make the business case economically viable.

Opportunities for sustainable and organic productions are emerging with the ever-growing trend to source from sustainable producers. Both consumers and policy makers are putting more emphasis on sustainability and traceability in the entire supply chain. The European Green Deal from the EU and the Sustainable Nut Initiative are two plans that contribute to these goals. Creating a vertically integrated supply chain and having control over the entire chain from farm to fork can be used to leverage these developments.

The challenge in this opportunity is the need for a large economy of scale. Many countries that produce cashew, especially in West Africa, ship raw cashew nuts to Vietnam and India for processing. To offer a competitive product fully processed in the country, large volumes are needed.

The opportunity proposed is certainly demanding, but at the same time it would give investors a unique position as frontrunners in the development of the Colombian cashew industry and its promising future. Colombia has the potential to jump from a country with extremely limited cashew production, carried out on a family-business level, mainly relying on wild trees and seeds saving, to one of the main producers of Latin America, with high yielding technified cultivations.

Should this not be possible, this investment is also suitable to be pursued separately. One could start a large-scale plantation (for a total of 8,000 ha or less, to start) and export to countries with larger processing volumes (the closest one being Brazil). The establishment of a processing plant would therefore be postponed to the moment when sourcing high volumes would not be a challenge anymore (either from Colombia only, or as a combination from Colombia and, e.g., African producers). By pointing at certified organic cashew, margins will be higher.

## MARKET SIZE AND DEMAND

In terms of market potential, it is reported that Colombia is not producing enough for its own consumption, as it imports 259 tons of shelled cashew nuts each year. Imports come 67% from Brazil, 20% from India and 9% from Vietnam. Around 70 tons of raw cashew nuts are exported to India.<sup>18</sup>

However, the export market does offer more potential than the local market. The USA is the biggest importer of shelled cashew nuts. The vast majority of their imports are coming from Vietnam (USD 1,080 M), and Brazil is ranked second with USD 40 M, corresponding to 5,718 tons. Other Latin American countries exporting shelled cashew nuts to the USA are Bolivia (USD 313,000 – 45 tons) and Perú (USD 220,000 – 16 tons).

European countries import almost all their cashew nuts from Vietnam and India. Several African countries are entering the market and are predicted to gain larger market share. This is because investments are being made into larger-scale capacities, that are often supported by international and governmental funds.

Because cashew production is often done without chemicals and fertilisers due to the high costs involved, it is estimated that around 70% of the cashew production in the world is organic by default, but merely a fraction is certified.<sup>19</sup> Therefore, the certified organic cashew market is relatively small compared to the total cashew market. The exact contribution of organic cashew is difficult to estimate, since trade database do not distinguish between organic and conventional trade. According to literature, estimations of the organic contribution vary between 2% and 3.5% of the world market.<sup>20</sup>

<sup>18</sup> Trademap.org accessed September 2022

<sup>19</sup> IFC, 2010, available [here](#)

<sup>20</sup> Cashew: Improvement, Production and Processing, 2016, available [here](#)

## ACTIVITIES

### Plantation phases:

- Starting material: Corpoica (now Agrosavia) developed three clonal varieties (suitable for cashew export) with slightly different characteristics.<sup>21</sup> The three varieties can reach, respectively, maximum yields (after 9 years<sup>22</sup>) of 1,888, 1,618 and 1,507 kg/ha, against a national average of 300 kg/ha, a national maximum (in Vichada) of 900 kg/ha and a global average of 600 kg/ha. The first of the three clonal varieties, Corpoica Mapiria Ao1 (or Mapiria) seems to be the most sought after in the Caribbean region.<sup>23</sup>
- Grafting and growing: the three varieties shall be grafted on criollo varieties. When ready (the plant shall count 6 green and healthy leaves), the plants can be transplanted in the field, with a density of 70–80 trees/ha. A density of up to 100 trees/ha is viable but not recommended. Cashew trees can be intercropped with tuberous and leguminous species.
- High yielding varieties will give fruits after 3 years from planting and present a moderately steep yielding. Other varieties may take 5 to 10 years.
- Harvest: the harvest is mostly done manually, although machines are available. Workers will then need to separate the cashew apple from the nut. This step is important as the nut can't be processed if pieces of fruits are still attached. The cashew nuts are therefore (sun) dried for 2–3 days, in order to reach a moisture content of around 10%.

### Processing phases:

- First quality control in the field: separating compliant and non-compliant nuts
- Transport to factory
- Grading: automated with machine (based on size)
- Cutting: in order to extract the kernel from the nuts. Now done by machine, this step can be dangerous if performed manually, as it could release harmful oils. In addition, there is a significant difference between daily volumes processed by machine vs manually.
- Drying: cashew kernels are dried for 8 to 10 hours at a maximum of 80°C, in order to reduce the moisture content to 3–4%. This process is often – incorrectly – referred to as 'roasting'.
- Peeling: can be done mechanically
- Grading
- Packing

## POTENTIAL BY-PRODUCT

### Potential cashew apple processing:

- Ideally separated neatly from the nut, cashew apples can be juiced within 24 hours, when conserved under 8°C.
- Although not mainstream, cashew apple juice is often consumed in African countries where cashew production takes place.
- The juice is then clarified and filtered, before being sterilized and undergo a thermic shock.
- When pressing cashew apples to extract juice, the fibrous part also gets separated. This can be immediately processed further or stored at –4°C. Cashew apple fibre can indeed be utilized as main ingredient in preparation such as vegetarian burgers.

<sup>21</sup> Corpoica Mapiria Ao1, Corpoica Yopare Ao2, Corpoica Yucao Ao3 – Corpoica, 2016

<sup>22</sup> Agronegocios, 2021, available [here](#)

<sup>23</sup> Agrosavia, 2022, available [here](#)

## FINANCIALS

### Plantation

- Land prices vary greatly across the country. Purchasing prices for agricultural land in the Colombian Caribbean could lay around 10–15,000 USD/ha.
- The costs of establishing a plantation are estimated around 704 EUR/ha.<sup>24</sup> These costs include the land preparations, the purchase and transplanting of seedlings, and other inputs like gypsum and fertiliser.
- Annual cashew production costs incurred are estimated at 71 EUR/ha.<sup>25</sup> Yearly topping up of fertiliser and labour costs for pruning, weed control and harvesting are included in this estimation.
- With an annual production of 1,500 kg/ha of unshelled cashews in a mature tree (from year 8), the production costs are estimated to be lying around 0.05 EUR/kg.
- Farm gate prices of unshelled cashews nuts are around 0,70 EUR/kg in West Africa (where the average yield is 300–400 kg/ha), showing the potential of professional production in Colombia. Thanks to the clonal varieties available, new cultivations in Colombia could directly enter the market with yields 5 times the African ones.
- Export prices of raw cashew nuts in shell lie around 1.50 USD/kg.<sup>26</sup> Even without local processing the margins look big enough to establish a plantation.

### Processing:

- A processing facility to shell the cashews would cost around EUR 8–10 M. This investment will cover the construction of a building and purchase of all the machinery needed to process 40 tons/day. This volume has specifically been suggested (by a contact with several years of experience in the cashew production and processing sector in West Africa) as a processing volume to be competitive on the international market. Such processing capacity would require the planting of 8,000 ha of cashew in Colombia.
- Operational expenses and processing costs are not shared due to disclosure agreements.
- The cashew kernel contributes up to 25% of the total weight of the cashew in shell. Therefore 75% of the weight is 'lost' by shelling the cashews. For 1 kg of kernels, 4 kg of cashews in shell should be processed.
- The world market price for cashew kernel (shelled cashews) is estimated at 9.50 USD/kg.<sup>27</sup> A margin of 3.50 USD/kg can therefore be earned by processing the cashews.<sup>28</sup>
- As mentioned, the biggest challenge is to get enough supply of shelled cashews to the processing facility to justify an investment of this kind.

<sup>24</sup> Purdue, 2018, available [here](#)

<sup>25</sup> Purdue, 2018

<sup>26</sup> Agronegocios, 2021

<sup>27</sup> Agronegocios, 2021

<sup>28</sup>  $9,50 \text{ USD/kg} - (1,50 \text{ USD/kg} \times 4) = 3,50 \text{ USD/kg}$

**POSITIVE SOCIAL,  
ENVIRONMENTAL  
AND ECONOMIC  
IMPACT**

- The value addition that comes from cashew processing would be (partly) captured locally, contributing to sector development and development of the regional agroindustry, further leading to increased investment in infrastructure.
- The investment would lead to increased local employment, both permanent (such as plantation managers and workers and factory operators, management, administration) and temporary, such as with seasonal workers during harvest.
- When the product is (partly) exported, it would account for increased export and influx of foreign currency in the country.
- With the right investor and (local) partners, the selected location could become the centre of excellence for Colombian cashew nuts, e.g. advancing in research on the clonal varieties and identifying best practices for crop management, to be replicated in other areas.

**POTENTIAL  
RISKS AND  
MITIGATING  
OPTIONS**

- Difficulty in accessing starting material. In September 2021, the clonal varieties from Agrosavia were not yet available at the Caribbean Agrosavia centre but needed to be taken all the way from Puerto Carreño in Vichada. We believe that setting up of a large-scale cashew production will bring sufficient traction for this problem to be solved by Agrosavia itself.
- Indirectly, the investment could lead to poor (field) labour conditions during harvesting season – when raw materials are bought from individual producers. Mitigation: investors shall pay fair prices for raw materials, enough to secure the growers can hire seasonal work with fair pay and conditions. In addition, investors could add clauses to their sourcing contracts to incentivize (and monitor) growers to ensure optimal working conditions. This however should be a marginal risk as the proposed case includes own production.
- Investing in a cashew production will virtually result in a monoculture. This is inevitable to an extent; however, the negative effects can be reduced. Mitigation: adoption of inter-cropping scheme, or regenerative agriculture practices, or agroforestry production model.
- Potential health hazard when deshelling cashew nuts manually. Mitigation: set up automated deshelling/cutting machine, in addition to strict safety protocols along the whole processing line (and in this specific case, for the handling of raw cashew kernels and the disposal of the shells).
- Cashew apple products are not attractive on the market. Mitigation: identify “trusted” businesses that are interested in pushing healthy products as they may suggest different products for which the demand may be higher, or ways to increase the attractiveness of such items.

***Potential funding opportunities***

- Dutch Good Growth Fund (former RVO, now Invest International): investors that want to invest in a factory and/or machinery in Colombia but cannot get funding from commercial banks, can get funded by the Dutch Government. Through the DGGF, they provide loans, participations, guarantees, export credit insurance and export finance.
- [FMO](#), the Entrepreneurial Development Bank, invests, amongst others, in agribusiness in Latin America across several phases of value chains, including processing. They provide long-term loans, equity, mezzanine and working capital finance.

In addition, investors could explore the carbon credit market. The demand for carbon credits keeps increasing, so much so that often it is possible to obtain pre-financing for investments that guarantee the planting of large amounts of trees.

Several other funds are available and could be suitable for such an investment. In addition, RVO and Invest International can support foreign investments in the feasibility study phase. Contact us for more information.

***Potential supporting organizations***

- Agrosavia is a public agricultural research institute. They developed the clonal varieties of cashew that would be ideal for a technified production. Hence, they are crucial for the set-up of the plantation.
- Invest in Colombia is the national investment promotion agency. In addition, there are regional counterparts in [Atlántico](#), [Bolívar](#) and [Magdalena](#).
- ProColombia, part of Invest in Colombia, is in charge of export promotion.
- Holland House is the Dutch-Colombian Chamber of Commerce, they provide various services to (Dutch) companies interested in doing or setting up business in Colombia.
- Asomarcac is the cashew associations of the Caribbean. They provide technical services to cashew growers, with the goal of organizing cashew production and transformation and industrializing the sector.
- Asomarañon is the national association for cashew growers, with ambitions to bring Colombia on the global spotlight in the sector.



### 3. BUSINESS & KNOWLEDGE CASE: SOLUTIONS FOR INCREASED EFFICIENCY IN SMALL SCALE PRODUCTIONS

#### BACKGROUND

Seventy percent of the fruit and vegetable consumed by Colombians is produced by small-holders. For this reason, solutions that can help increase their efficiency and sustainability are important.

Farmers are dealing with ever-growing prices of agricultural inputs. In addition, climate change is affecting cultivations across the world, with impacts on, amongst others, growing cycles and irrigation needs.

Finally, more than one third (40.5%) of the total losses and waste of food in Colombia occurs at farm level. While the most desirable solution is to reduce this percentage, there are opportunities that would help recover (part of) the value of the produce lost.

#### OPPORTUNITY

The proposed activities are set to make agricultural production more affordable, sustainable and efficient. For the reasons above, these are specifically proposed for implementation by small/medium farmers, but could nonetheless be suitable for larger agricultural productions.

#### POTENTIAL ACTIVITIES

**Training and piloting (at cooperative or community level) of production of organic fertiliser by use of fresh manure.** Chicken manure is especially suitable for the purpose: because of its high NPK levels, limited volumes are needed. Small and medium-scale farmers often raise a few chickens that are let free to range around the farm. When possible, chicken dropping could be collected, such as from their coops, and transformed into different types of fertilisers. One option is “manure tea”, that does not require the drying of manure and can be integrated in fertigation systems. Another option is composting manure together with organic waste.

**Adoption of smart farming solutions.** Farmers that focus on a limited number of crops, including those that are part of an outgrowing scheme, can benefit from the use of digital solutions. For instance, [SmartFarmingTech](#) provides on- and offline agronomic support, also supported by satellite data, two-way SMS services, and at the same time data collection and analysis. [Cropin](#) provides several digital solutions to monitor and manage farms, not only focusing on the production activities but also farm/farmer records; to connect growers to agri-business and extension officers, and to support ‘farm to fork’ traceability. Differently, [Yielder](#) is a platform where farmers can, amongst other functions, access databases from knowledge centres, communicate amongst each other and access trainings.

Often, these types of apps are financed by the buyer of the products, in case of an outgrowing scheme, or by international associations/donors. However, these are often so successful that – by word of mouth – individual farmers end up downloading the app, for a small price. In the case of SmartFarming, the development of an ad-hoc app for a specific crop in a specific country/region requires an investment of EUR 10–15,000.

**Distribution of soil humidity sensors.** With very diverse irrigation practices and climates, it is difficult to give accurate advice to farmer when and how much to irrigate. Most farmers irrigate according to their own experience based on visual soil characteristics, and we found, through research performed in Mozambique, that they often tend to over irrigate.

Previous own research (in Mozambique) tried to address this through the introduction of soil humidity sensors. Soil sensors measure the moisture level at different depths and give out three results (with different coloured lights): too humid, good humidity, too dry. By using the sensors, farmers are able to assess the humidity of the soil at root level, which allows them to only irrigate when actually needed.

**POTENTIAL  
FUNDING  
OPPORTUNITIES,  
SUPPORTING  
ORGANIZATIONS  
AND RECOM-  
MENDATIONS**

The use of soil sensors offers benefits such as water savings, optimizing resources for agricultural production and financial savings from a more efficient use of diesel-powered irrigation pumps. Overall, this means that agricultural productions can be made generally more sustainable. Currently, soil humidity sensors are sold in Mozambique for around EUR 100.

Ideally, these solutions would be integrated with local and/or Dutch actors, such as growers' association and their extension services, or knowledge institutions. These could be, for instance, SENA, Agrosavia, PUM, Nuffic. In Mozambique for instance, the soil humidity sensors were part of a Nuffic training.

MASSIF, a Dutch Government fund managed by FMO partners with local financial institutions to provide access to finance to, amongst others, "small businesses in rural areas and agricultural value chain to improve the livelihoods in these communities". A partnership with such fund could be explored to support farmers in having access to the proposed technologies.

Our recommendation is to deepen this research by utilizing the PADEO approach. This means identifying a specific chain where smallholders have an important role but still experience issues and bottlenecks, and determine its boundaries. Then, a deep dive into the bottlenecks experienced is needed. This will allow to identify key change point (or 'hotspots'). Once identified the hotspot, specific solutions shall be identified and brought in.

## 4. BUSINESS CASE: ORGANIC WASTE TRANSFORMATION

### Current situation

Currently, 34% of food produced in Colombia and destined to human consumption is lost or wasted, of which mainly fruits and vegetables (62%), root vegetable (25%) and cereals (8%). More than one third (40.5%) of the total losses and waste occurs at farm level, followed by losses in the distribution phase (20.6%), the post-harvest and storage phase (19.8%) and the consumption phase (15.6%).<sup>29</sup>

Losses incurred in the distribution phase include the food not sold, or spoiled, at municipal markets and distribution centres. In certain cases, such as in Granabastos (Atlántico), this is recovered and composted to be utilized as fertiliser in the green areas of the market itself. Precise data on markets' and distribution centres' organic waste quantities is unfortunately not available.

While integrated solutions to prevent and reduce losses should be universally undertaken, and while food loss at each stage requires specific interventions, there are solutions that allow to recover part of the value of the food lost.

### Opportunity: waste to energy & agri-input

Organic waste can indeed be processed and result in products with different values. A “popular” solution is anaerobic digestion of mixed organic waste, that results in an energy component, typically biogas (that can be then converted to electricity and residual heat) and a leftover product, a de-facto fertiliser. A handful of Dutch companies specialize in the treatment of different organic waste streams at different scales. Some of them, especially those with international focus and/or experience, are reported in the table below.

Who	What (input)	What (output)	Input volumes	Technology
<b>Waste Transformers</b>	Organic waste	Biogas, electricity, heat, liquid organic fertiliser	0.3 to 3 tons/day	On-site containerized anaerobic digester (modular, min 350-600 kg)
<b>Safisana</b>	Faecal sludge, organic waste	Energy, organic fertiliser, irrigation water	Min 15 tons/day	Anaerobic digester
<b>DutchPowerGroup</b>	Organic (agricultural and biomass) waste, municipal waste	Energy, fresh water, heating/cooling	60 to 100 tons/day	Modular incineration technology (grate firing technique or fluidized bed technology)
<b>HoSt</b>	Agricultural waste, agro-processing waste, municipal waste	Biogas, fertiliser	n/a	Anaerobic digester; thermophilic and mesophilic after-digester for sludge treatment
<b>Dorset Group</b>	Digestate, poultry manure, biomass, sewage sludge, liquid manure	Materials are dried and possibly pelletized	n/a	Mostly drying, but they also offer a solution to use, all year long, the residual heat at biogas installation

The initial proposed idea was to link these medium-scale waste transforming opportunities to distribution centres and local markets. This is also because they work best when fed a mixture of organic materials, rather than a “mono stream”. The electricity generated would then be utilized to power the technology itself and/or the infrastructure to which it is linked. It is also possible to utilize the electricity generated to power fridges/cooling chambers, that would overtime allow to reduce the amounts of food spoiled.

<sup>29</sup> DNP, Política para la prevención y reducción de las pérdidas y desperdicios de alimentos, 2020. Available [here](#)

Depending on the installation site and owner, the fertiliser could be distributed – or sold for a low price – to farmers in the area. Producers' associations could play a role in this. However, given the difficulties in connecting rural to urban areas, this may reveal tricky. Another (rather ambitious) option for this is that of organizing a return-chain, also thanks to the intermediaries that do have the means to reach remote locations.

## Opportunity: waste to material

While the transformation of waste into energy, biogas and fertiliser is always a viable option, upscaling waste into biobased materials often requires specific inputs.

Nowadays, different agricultural residues can be turned into different materials, for instance [bagasse](#) (residue of sugar production from sugarcane), [areca palm leaves](#), [wasted mango](#), [pineapple leaves](#), [abacá banana leaves](#) that are turned into packaging materials, vegan leather and technical fabric. Opportunities are also available for using organic waste to produce, after an enzymatic digestion process, insulation panels.

## Recommendations

Anaerobic digestion systems are a great solution to integrate in places where there is a constant flow of (mixed) organic waste. They entail a considerable investment, that is however balanced by substantial cost savings and revenues from the fertiliser sale. On the financial side, the factors to be considered when evaluating the business case are (1) the cost of waste disposal, (2) the cost of electricity and (3) the cost and cost/price of fertiliser. Experience of organizations such as the Waste Transformers suggests that a strong private interest is crucial for driving the initiative. Once identified an interested private party, the business case can be verified and compiled by having access to precise information on the factors mentioned above. In addition, international funds and development agencies may play a role when the technology installation benefits the surroundings communities.

Regarding the upcycling of (mono) waste streams into bio-based materials, our recommendation is to complete a comprehensive waste streams analysis in the region. In this way, it will be possible to identify already existing solutions for the specific streams, or encourage and support research institutes in the search for a suitable upgrade process.

## 5. SHOWCASE: TERTIARY ROADS IMPROVEMENTS

### Current situation

Literature review and interviews carried out in the last months highlighted the shared discontent towards the state of roads in the regions, and in the country, especially tertiary roads. Tertiary roads are managed largely by municipalities (100,748 km or 70.8%) but also by the INVIAS (27,577 km or 19.4%) and departments for the remainder (13,959 or 9.8%). Country-wide, 94% of the tertiary road network is classified as in a 'bad state'.

### Dutch technologies

**Hitech Roads** is a Dutch company that developed a solution that allows to have stronger roads on a thinner road basis. A powder additive is combined with conventional cement and the correct ratio of water, water-resistant layers are formed, that also allow for a higher bearing capacity. Road construction times short of 70%, while costs reduce up to 30%.<sup>30</sup> Hitech Roads is not new to Latin America, as they already implemented projects in Argentina, Bolivia and Colombia too.

**Road Rapid** is a product of Verduisie BV that makes dirt roads water repellent, and at the same time hardens them, making them suitable for the passage of heavy vehicles. The results are immediate, and the strength of the road increases over the few months after the procedure. The road will only require light preventive maintenance. Road Rapid is suitable for soil with "at least 15% of clay, loam or clayey silts [...] and a pH degree which does not exceed 8".

With a different purpose, but nonetheless notable technology, the Chaplin TKI<sup>31</sup> and Chaplin XL<sup>32</sup> projects consist of testing roads where part of the bitumen in the asphalt composition would be replaced with lignin. Lignin can be extracted from wood waste and works as a binder in asphalt. The projects have been carried out by a consortium of companies, public parties and knowledge institutes, notably WUR, UU and TNO. The Chaplin projects are a flagship of the **Circular Biobased Delta**, a foundation that aims to accelerate the transition to a CO2 neutral economy. The first results of the test roads proved that it is possible to substitute bitumen for lignin up to 50%, with CO2 savings of 35-70% for top layers and 25-50% for underlays. It is important to notice that the test only considered Dutch road and climate conditions. Further testing in different regions may show different results.

### Potential funding opportunities

The former Drive and Develop2Build funds from RVO could be looked into. However, they have been transferred to Invest International and could therefore be subject to different conditions than those published on the RVO website. The Building Prospect fund by FMO could also serve the purpose. Building Prospect is already funding a PPP in Cartagena aiming at substituting the diesel-fuelled buses with a new natural gas-fuelled fleet.<sup>33</sup>

In Colombia, natural and juridic persons that met certain criteria (mainly in terms of amount of profits) are allowed to invest up to 50% of their income tax in the realization of infrastructure, construction or systems with a social impact. This system is called *obras por impuestos*, "construction for taxes". These projects are subject to certain requirements, such as being executed in areas most affected by armed conflict, in areas subject to territorial development program or in areas part of the "orange development plan" (that focuses on the promotion of culture, creativity and urban renovation). Road infrastructure are part of the potential projects. Therefore, partnering with a company that fits the criteria for *obras por impuestos* could be an opportunity to showcase innovative road technologies.

<sup>30</sup> NWP, 2021, available [here](#)

<sup>31</sup> WUR, 2021, available [here](#)

<sup>32</sup> UU, 2020, available [here](#)

<sup>33</sup> FMO, 2016, available [here](#)

## Challenges and recommendations

On a regular basis, any road maintenance or construction to be performed in Colombia goes through a public tendering procedure. Exception exists when projects are directly assigned to a specific executor.<sup>34</sup> Getting involved with public entities can be a long process and it generally benefits from local presence in the country, including a strong local network that can identify upcoming projects and facilitate the procedure. For these reasons, participation in public tenders from foreign companies can reveal difficult.

Further research is recommended to gain a better understanding of public tendering procedures for the maintenance or construction of roads in Colombia, and to assess the interest (and resources) for innovative technologies from the different entities in charge of the tertiary roads system. We also recommend assessing the interest from private parties that may be in need of private roads' renovations. This could, ideally, serve the purpose of demonstrating such technologies in the local context and gain traction for their adoption.

<sup>34</sup> Gobierno de Colombia, unknown, available [here](#)



## 6. ROADMAP TOWARDS INTEGRATED TRANSPORT AND LOGISTICS BETWEEN COLOMBIA AND DUTCH CARIBBEAN

### Current situation

Despite the close proximity with the islands of the Kingdom of the Netherlands, and the admissibility for exports of all Colombian fresh fruits and vegetables to both Aruba and Curaçao, trade between the islands and Colombia is still relatively small.

Aruba and Curaçao import most of their food, and they do so largely from USA and NL. Until a few years ago, the islands were mainly importing their fresh fruits and vegetables from Venezuela, an option that – at the moment – is not viable.

Currently, islands are suffering from rising prices of both products and shipping, in line with the global trend of the past two years. In addition, Aruba and Curaçao confront even higher shipping costs, given that they offer limited (re) export products, hence ships that arrive on the islands go back rather empty.

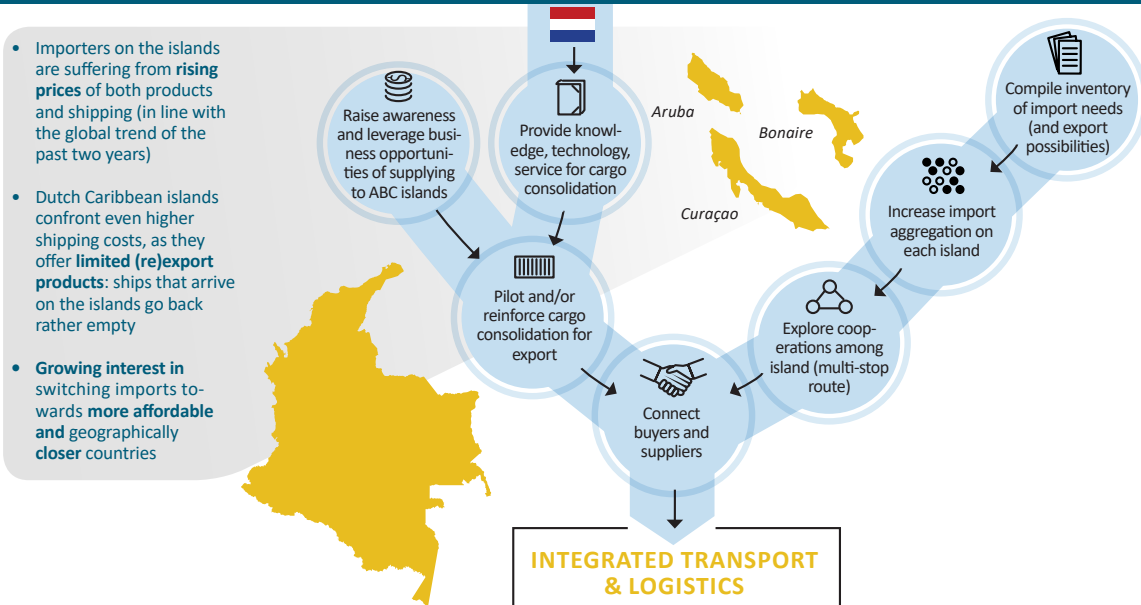
Aruba and Curaçao do not hide their interest in diversifying their imports, also by increasing purchases from Colombia. There are however some challenges that may discourage either (or both) sides to move forward in this:

- On the demand (buyers and importers on the islands) side:
  - Limited collaboration amongst importers on each island: despite importing similar products, buyers do not seem to coordinate and consolidate their purchases, with the results of purchase orders being fragmented and low in volume. Consolidation of cargo is not a popular practice and often seemed with limited enthusiasm.
  - Limited cooperation across the islands: this is also due to the fact that consolidated imports and subsequent re-exports from one island to the others is not convenient, as there are import duties between the islands (products are only free of duty if produced on one of them).
  - Scepticism around investing resources to build stable relations with Colombian exporters. This happens mainly for two reasons: on the one hand, certain importers do not feel the need to invest in such relationships, as they plan on resuming imports from Venezuela once possible. On the other hand, importers lament that they are not being granted proper attention by Colombian suppliers, as volumes requested are limited. For this reason, they often prefer directly hiring someone in Colombia to identify a supplier and then buy, sort, pack and ship their orders.
- On the offer (suppliers and exporters in Colombia) side:
  - Little consideration because of low volumes: Colombian exporters prefer focusing on large scale market rather than scattered demand from multiple islands, eventually missing out on substantial opportunities. However, it shall be considered that Aruba, Curaçao and Bonaire count a local population of 281,000 and more than two million tourists annually.
  - Lack of knowledge on how to consolidate cargo: the large majority of Colombian exporters are not specialized in cargo consolidation. Most exporters sell entire containers and therefore do not know how to approach a different type of demand that requires shipping mixed containers.

## Roadmap

In the following image, we envisioned a roadmap towards a more efficient and integrated transport and logistics between Colombia and the Dutch Caribbean islands. It should be clear that, for this result to be achieved, both the offer and demand side need to engage proactively, be willing to collaborate and be part of the dialogue. The role of the Netherlands in this case is therefore narrowed to the provision of knowledge, technology and/or services for the consolidation of cargo, that we believe is the first step to a more integrated and sustainable trade among the parties.

### ROADMAP towards integrated transport and logistics between Colombia and Dutch Caribbean





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