



Ministry of Foreign Affairs

Senegal Value Chain Study - Mango

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Senegal Value Chain Study - Mango

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Preface

A promising future in agriculture

Senegal is expanding its food production with great ambition to serve consumers and spur rural development. Products of Senegalese farmers find their way to not only domestic customers but also to export markets in West Africa and the European Union. Dutch growers realized long ago that local circumstances are very favourable for the production of high-quality, nutritious agricultural products. The relative proximity to Europe and accessibility of the wider Sahel region make Senegal an attractive partner for close cooperation.

Partly due to climatic conditions, agriculture in Senegal certainly faces challenges, such as water scarcity and soil salinity. Dutch modern technology and expertise can support (further) improvement of overall performance and sustainability of production, post-harvest handling and marketing. It goes without saying that this will benefit Senegalese farmers to produce in a more sustainable, and profitable manner. Dutch innovative technologies could improve, for example, the use of quality seeds, precision agriculture, storage and packaging.

This 'scoping study' has analyzed those value chains in Senegalese agriculture to which Dutch expertise and technology can have the most added value for improved overall performance. In the framework of the study, a number of specific business cases have been developed, which could enable Senegalese and Dutch partners to cooperate (more) successfully. The overarching objective is to build a sustainable partnership between Senegal and the Netherlands around agriculture.

I thank the consultants of Sense for their good work. For more information on the study or advice, please contact our agricultural experts through DAK-LNV@minbuza.nl.



H.E. Mrs. Joan J.J. Wiegman
Ambassador of the Kingdom of the Netherlands to Senegal

Préface

Un avenir prometteur pour l'agriculture

Le Sénégal développe sa production alimentaire avec une grande ambition de servir les consommateurs et d'accroître le bien-être en milieu rural. Au Sénégal les produits agricoles sont vendus dans les loumas, les marchés locaux, et sont également destinés à l'exportation en Europe et dans les pays de la sous-région. Depuis quelques années, des producteurs néerlandais ont investi le Sénégal pour la fabrication des aliments nutritifs de très bonne qualité et pour son personnel qualifié et engagé. Du fait de sa proximité géographique avec l'Europe et l'accès facile aux pays du Sahel, le Sénégal demeure une excellente destination pour les affaires.

Cependant, l'agriculture sénégalaise est confrontée à plusieurs défis qui l'empêchent de prendre son envol notamment l'amélioration de l'agriculture durable en plein champ, le renforcement des produits post-récolte, du contrôle de la qualité et de la commercialisation; l'utilisation efficace des intrants et réduction des pertes alimentaires dans la production agricole (gestion de l'eau, fertilisation des sols, utilisation des semences de qualité). De par leur expérience, les entreprises néerlandaises pourraient être un grand atout pour l'agriculture sénégalaise. En effet au vu de cette situation, les investisseurs néerlandais sauront contribuer à amélioration de la performance globale de la production et du marketing en utilisant des technologies modernes qui rendent l'agriculture plus attrayante pour les jeunes professionnels tels que les semences de qualité, l'agriculture de précision, le stockage et l'emballage des produits agricoles.

Cette étude de cadrage agricole a fourni une analyse de certaines chaînes de valeur stratégiques de l'agriculture sénégalaise où la technologie néerlandaise peut contribuer à de meilleures performances et à des positions considérables sur les marchés de consommation. Il a également développé des analyses de rentabilisation tangibles pour que les partenaires néerlandais et sénégalais coopèrent et créent conjointement des entreprises prospères. Pour de plus amples renseignements ou des conseils, vous pouvez communiquer avec nos experts en agriculture à l'adresse DAK-LNV@minbuza.nl

L'Ambassadeur des Pays Bas à Dakar
Son Excellence Mme Joan Wiegman

Executive Summary

Globally, the demand for mangoes and mango products has been increasing. Fresh mangoes are now available year round in Europe, with mango juice quickly becoming a key flavour in juice, dairy drinks, ice-creams, smoothies and assorted snacks.

South American producers dominate the overall volumes being imported by the EU. Much of the fresh fruit and juices enter via the Netherlands, before being redistributed across the region. Senegal, in contrast is a far smaller exporter, but it has become an important supplier of export grade mango to the EU in the EU summer months. At this moment in the supply calendar the traditional suppliers Brazil and Peru are not producing, which creates a production window with immense potential.

Within Senegal, the Centre- and Niayes region has emerged as the leading production zone for export grade mangoes in Senegal. It's a fairly organised sector, with professional exporters, who are close to the harbour and who enjoy drier conditions that allow for lower phytosanitary pressure. Production has been growing, but there are still opportunities to expand the production of export grade mango. This could be driven both by increasing the land under cultivation and the overall yields. While current yields are good when held up against the historic benchmark, Senegalese producers are increasingly lagging behind some of the more advanced counterparts in South Africa. Key to closing this yield gap will be developing knowledge and new techniques around pruning, orchard planning and the application of fertilisers.

An expanding fresh fruit sector comes with in-built challenges around sustainability. Larger areas will need irrigation, more pesticides will be applied and finally more fruit will need to be accommodated in cold storage. Managing waste will also become critical. Efficient fruit production sectors include mechanisms to secure maximum value for each grade of fruit. So, as fresh export production expands, productive commercial uses of the second and third grade fruit will need to be found. This includes a potential expansion of processing, which is in its infancy in Senegal.

This processing opportunity is very relevant to the Casamance. In reality this area produces more mango than the Centre and the Niayes. But the fragmented system of production; the challenges around fruit collection; the distance and complexity of getting fruit to port and a humid climate prone to fruit fly all make processing a far more feasible and appropriate idea for development.

Achieving these ambitions requires a better understanding of the processing opportunity in the Casamance. The varieties have been mapped, but more work will need to be done on understanding the market and opportunities to attract investment. From the perspective of export fruit production in -Centre and the Niayes, more will need to be done to counteract -and slow- salinisation caused by heavy irrigation and fertiliser use. The expansion of industrial production in the Centre and the Niayes raises a fundamental systemic question about the management of water resources in a water-poor area that relies on groundwater for irrigation. In the longer term, to ensure sustainable expansion of agriculture more will need to be done to enhance the land and water resource planning systems.

Résumé

Dans le monde entier, la demande de mangues et de produits à base de mangue est à la hausse. Les mangues fraîches sont désormais disponibles toute l'année en Europe, le jus de mangue devenant rapidement une saveur clé dans les jus, les boissons lactées, les glaces, les smoothies et les en-cas assortis. Les producteurs sud-américains sont en tête des volumes globaux importés par l'UE. Une grande partie des fruits frais et des jus entrent par les Pays-Bas, avant d'être redistribués dans toute la région. Le Sénégal, en revanche, est un exportateur beaucoup plus petit, mais il est devenu un important fournisseur de mangues de qualité export vers l'UE pendant les mois d'été. À cette période, les fournisseurs traditionnels que sont le Brésil et le Pérou ne produisent pas, ce qui crée une fenêtre de production avec un potentiel immense.

Au Sénégal, la région du Centre et des Niayes est devenue la première zone de production de mangues de qualité export. C'est un secteur assez organisé, dont les exportateurs professionnels sont proches du port et bénéficient de conditions plus sèches permettant une pression phytosanitaire moindre. La production a augmenté, mais il existe encore des possibilités d'accroître la production de mangues de qualité export. Cela pourrait se faire à la fois en augmentant les terres cultivées et les rendements globaux. Si les rendements actuels sont bons par rapport aux données historiques, les producteurs sénégalais sont de plus en plus à la traîne par rapport à certains de leurs homologues plus avancés en Afrique du Sud. Pour combler cet écart de rendement, il est essentiel d'acquérir plus de connaissances et d'élaborer de nouvelles techniques en matière d'égamage, de planification des vergers et d'application d'engrais.

L'expansion du secteur des fruits frais s'accompagne de défis inhérents à la durabilité. De plus grandes zones devront être irriguées, davantage de pesticides devront être appliqués et, enfin, davantage de fruits devront être stockés au froid. La gestion des déchets deviendra également essentielle. Les secteurs de production de fruits efficaces comprennent des mécanismes visant à garantir une valeur maximale pour chaque catégorie de fruits. Ainsi, à mesure que la production de fruits frais destinés à l'exportation augmente, il faudra trouver des utilisations commerciales productives pour les fruits de deuxième et troisième catégorie. Cela inclut une expansion potentielle de la transformation, qui n'en est qu'à ses débuts au Sénégal.

Cette possibilité de transformation est très intéressante pour la Casamance. En réalité, cette région produit plus de mangues que le Centre et les Niayes. Mais le système de production fragmenté, les défis liés à la collecte des fruits, la distance et la complexité de l'acheminement des fruits au port et un climat humide propice aux mouches des fruits font de la transformation une idée de développement bien plus réalisable et appropriée. Une meilleure compréhension des possibilités de transformation en Casamance est nécessaire pour atteindre ces objectifs. Les variétés de mangues ont été cartographiées, mais il faudra travailler davantage pour comprendre le marché et les possibilités d'attirer les investissements. Du point de vue de la production de fruits destinés à l'exportation dans le Centre et les Niayes, il faudra faire plus d'efforts pour contrer et ralentir la salinisation causée par l'irrigation massive et par l'utilisation excessive d'engrais. L'expansion de la production industrielle dans le Centre et les Niayes soulève une question systémique fondamentale sur la gestion des ressources en eau dans une région pauvre en eau qui dépend des eaux souterraines pour l'irrigation. À plus long terme, pour assurer une expansion durable de l'agriculture, il faudra travailler à améliorer les systèmes de planification des ressources en terres et en eau.

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1 Background and Method

The aim of this study is to provide insights into the Senegalese Mango value chain and to define critical interventions that are needed for the sector to flourish. These insights will be used to provide guidance to development and knowledge partners as they work in these intervention areas. Finally, these will be used by the private sector, who at a later stage might be encouraged to trade and deliver much needed equipment, inputs and expertise. Ultimately it is hoped that these interventions will play a useful part in fueling an improvement in the livelihoods and food security of the Senegalese people, while improving the lot of women and youth and the environment.

More specifically the study aims to (i) describe the market, production and enabling environment in the mango value chain in Senegal (ii) reveal the key issues, opportunities and bottlenecks in the value chain (iii) propose specific interventions that can help to address these bottlenecks & allow for the value chain to have greater impact (iv) identify areas where inclusive participation of women and youth in the economy can be stimulated (v) highlight opportunities for improved circular economy practices (vi) recommend areas where public, private and the knowledge sectors can make valuable, if not unique, contribution to these interventions

This study is to a large extent supported by knowledge obtained through a series of projects in the Senegalese Mango sector, and interviews with key stakeholders. The past projects included (1) the development of a supply chain strategy for a mango juice plant in 2017, for which all professional orchards in Centre Niayes and exporters were visited and interviewed, as well as a selection of farmers in Casamance. (2) analysis of the market for processed mango products in the EU, US and Gulf States and the perspective of Senegalese processing companies in 2018. (3) Benchmark study for mango cost of production in Senegal, Ivory Coast, Ghana and South Africa for HortiFresh/ GIZ, for which detailed cost of production analysis was done for large scale plantations and small scale plantations in Senegal, and finally advice regarding export promotion project for the sector to IFC (2019). We interviewed several key stakeholders to assess recent changes in the industry.

We must highlight that this research was carried out during the COVID 19 period, but after local constraints on travel were lifted. This has both advantages and disadvantages. A large number of interviews could be conducted telephonically, which made including a variety of perspectives and experiences from Senegal and the Netherlands far more possible. In some instances, the new “work from home” norm made interviewees more available.

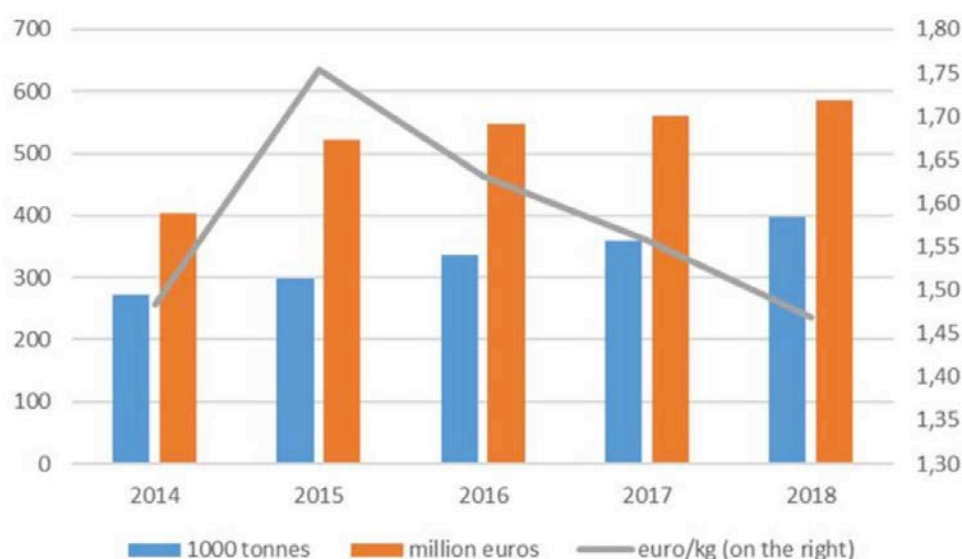
2 The Market

2.1 The Fresh Fruit Market in the EU

2.1.1 Overview

The volume and value of mango exports to the EU have been increasing steadily over the past decades, though export prices have been decreasing. Figure 1 provides an overview of the import volumes (source: CBI). This shows that the value increase is largely driven by large volume increases. Western Europe is still responsible for the bulk of consumption, with mango still being relatively new and expensive for Eastern Europe.

Figure 1: EU imports of fresh mango by volume and value from 2014 to 2018 (Source: CBI)



The biggest development over the past decade has been the growth of the ready-to-eat mangoes segment. They are ripened in controlled ripening rooms close to or in the final market so that they can be consumed within on or within a few days of purchase. These mangoes are sold at higher prices. The growth of the ready-to-eat market has had important consequences for suppliers, because for the importers require mango within one container to be uniform in the stage of ripeness. This is more difficult to achieve if you source from small farmers.

2.1.2 Product Market Segments

Within the market one can distinguish 4 clear segments. The top segment consists of exotic varieties that are 'tree ripened' and air freighted to the EU. Tree ripened means they are harvested closer to maturity and thus have more flavour. Where ripe mango has a sugar content of 14-18 brix, mango destined for export tends to get harvested at 6brix so that it can last 20 to 30 days in transport and distribution. Though the mango does ripen, it never comes close to the flavour of a mango harvested closer to maturity. The high segment consists of so called 'tree ripened mangoes', and fresh cut mango salads and organic mango. The normal segment are conventional mangoes of common varieties with the right appearance (minimum 40% red coloration, not noticeable skin blemishes etc.). Finally, the low segment consists of "off-sizes" (often too big) with external blemishes, and or limited shelf life because they are already too ripe. They are often sold to open-air markets where they are resold at discounted prices. They are also used by local processors of fresh cut fruit salads.

Figure 2: Segments in the EU mango market



2.1.3 Main Markets Within the EU

The Netherlands is by far the biggest importer in the EU and is central to the redistribution of mangoes around Europe. In 2019 the Netherlands imported just over 250 000 tons of mangoes, then re-exported 220 000 tons of that mango across the European region. With a consumption of 30,000 tons the Netherlands is per capita also one of the biggest consumers.

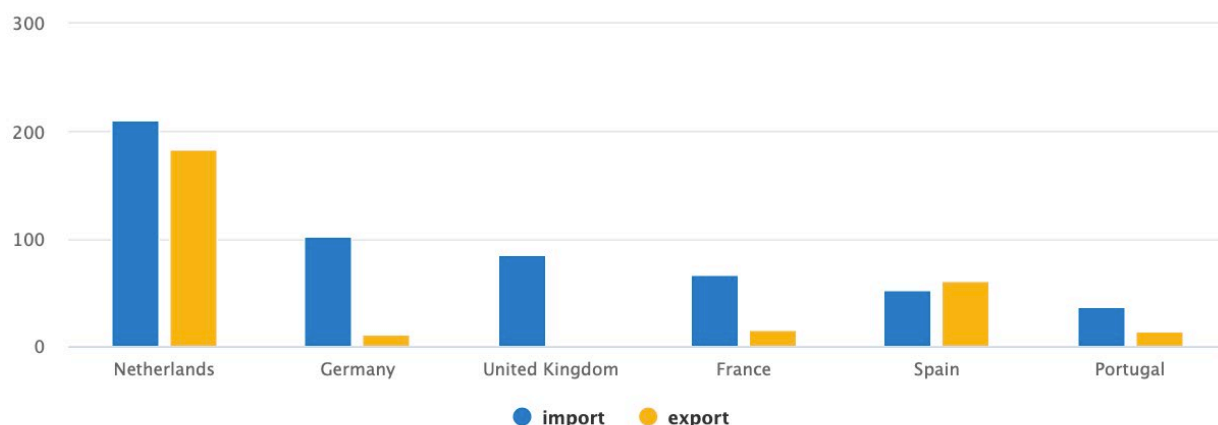
The UK is the second-largest importer of mangoes in Europe with over 86,000 tonnes of imports in 2018 but import volumes have been stabilising over the past three years. The stabilisation is a result of a maturing market and the devaluation of the British pound. The UK is a large consumer of air-freighted specialty mango from India and Pakistan. Brexit may put purchasing power further under pressure thereby reducing imports. It may also force UK importers to source directly from other countries. Finally, it is likely to force Irish importers to shift their supply from the UK to other EU countries.

With 66,900 tonnes of imported mangoes and limited exports in 2018, **France** is the third biggest consumer of mango. Mango is a popular fruit in France, but the general preference of consumers for local products will always compete with the import of mangoes. France has been a traditional buyer of West African mango due to the language and cultural links. For example, Ivory Coast exported 10,600 tonnes to France, which is more than mango giant Brazil.

Germany is the largest destination market for mango, with a consumption of 89,000 tonnes in 2018, up 55% from five years before and still growing. Germany is mostly supplied from the Netherlands.

Spain is the only country in Europe that produces mango. According to FreshPlaza it produced 34,000 tons, in 2018 up 30% from the year before in 2018. Local production based on the Osteen variety has increased local consumption. Spain is also becoming a trade-hub for mango with both imports from developing countries and exports to other EU countries increasing with 72% over the past five years. Most Spanish mangoes go to Portugal (24,400 tons) and France (16,000 tons). Spain can thus be an interesting destination to enter the Southern European market. Portugal is actually per capita the highest consumer of mango in the EU.

Figure 3: Imports and re-exports in the EU in thousands of ton, 2018



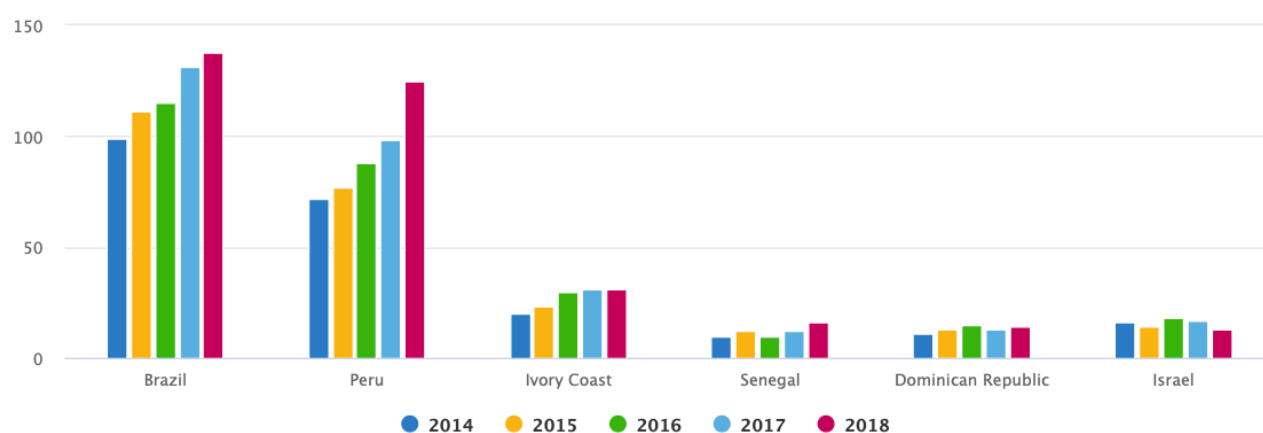
Source: ITC Trademap

Finally, **Belgium** is also increasingly a distribution hub for both air freighted and boat freighted mango, particularly for West African mango. Antwerp is an easy port to use for Dutch traders, and one of the major shipping routes from West Africa lands in Antwerp. Furthermore, it has a reputation for being far less strict on phytosanitary controls than the Netherlands. Many West African exporters who traditionally have issues with fruit fly control prefer to use Antwerp. Finally, SN Brussels airlines offered attractive rates on air freight and a very efficient handling at the airport. It is said that it's faster and cheaper to clear mangoes in Antwerp and truck them to Paris than to land them in Paris directly.

2.1.4 Supplying Markets and Seasonality

Most of the EU mango imports originated in Brazil and Peru. Collectively these countries supplied almost half of all fresh mangoes to the region in 2019. In contrast Senegal supplied a tenth of the mangoes that came from Peru. Figure 4 provides an overview of the main suppliers. Figure 5 provides an overview of the supply per season. Other regional suppliers to the EU are Mali and Burkina Faso, but their exports remain limited to about 9000 tons each. Their main challenge are the high transit time and logistical cost because they are landlocked. This doubles their transport cost compared to for example Ivory Coast which operates in the same time window.

Figure 4 EU Fresh Mango Exporters to the EU by Volume in thousands of tons from 2014 -2018 (Source: CBI.EU)



Seasonality plays a large role in the supply of mango. For the first quarter of the year South American producers Peru, Brazil and the Dominican Republic market their mangoes. From March producers in the Ivory Coast supply. By the middle of the year volumes from these mega-mango producers fall sharply. Senegal and Israel contribute only a portion of the volumes imported at the peak in February and March. Then from October the South American producers begin to market their mangoes & the cycle start again.¹

Part of the success of Brazil is that it is able to supply Mango all year round due to the large variety of tropical and sub-tropical climates in the country. Peru has been able to increase the length of their production season each year through a smart mix of varieties and techniques to speed-up or delay harvests. The Ivory Coast is the third biggest supplier, but exports only 5 weeks of the year. Figure 5 provides an overview of the production season in a number of producing countries. Though South Africa is mentioned, they no longer export meaningful volumes to the EU, because they have more lucrative markets in the Middle East and locally. Mexico and Ecuador are more oriented versus the US markets. India and Pakistan are too far for transport by boat; they only play in the premium exotic air freight segment.

Figure 6 provides an overview of the supply throughout the year of major players. Within this graph, Ghana is an odd one because its numbers are mostly based on fresh cut mango fruit salads prepared with local mangoes as well as mangoes imported from Ivory Coast, Senegal, South Africa, Burkina Faso and other countries. Fresh export in whole fruits from Ghana is less than 1000 tons.

¹ These combined volumes represent 80% of EU imports throughout the year

Figure 5 Overview of the Global Mango Season

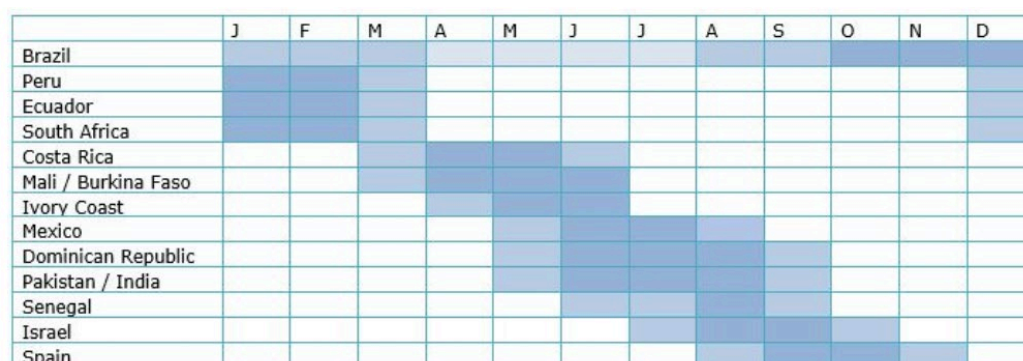
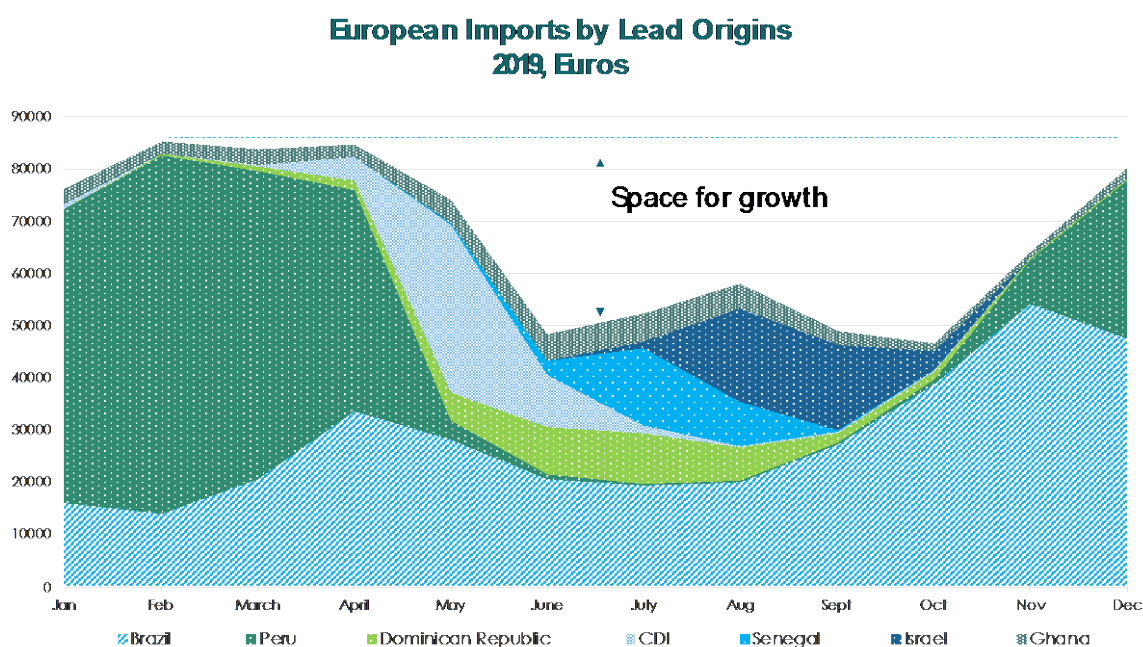


Figure 6 EU Sourcing Origins (lead markets, 2019, ITC Trade Map))



2.1.5 Varieties

The main mango varieties on the EU fresh market are Kent and Keitt. Tommy Atkins, once the dominant variety, is in decline because it is more fibrous. Osteen is gaining popularity as it is appreciated by consumers. It is the only variety produced in Spain and is increasingly being planted in other countries as a replacement for Tommy Atkins, since both are early season varieties. Palmer from Brazil is also common.

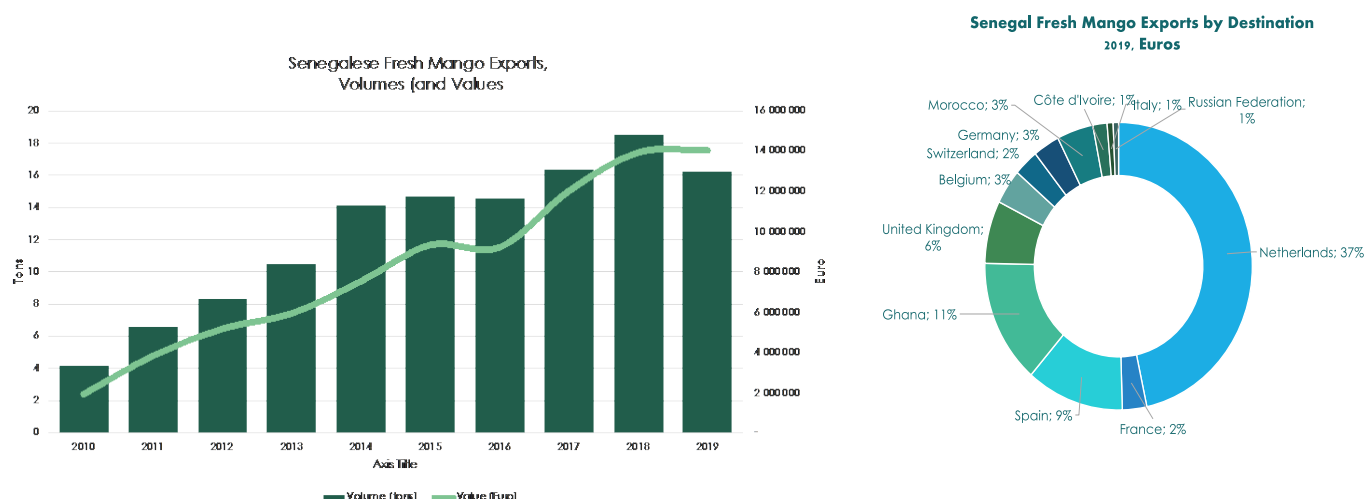
2.2 Senegalese Fresh Mango Exports

Buoyed by growing demand in Europe, exports from Senegal have been growing. In 2019 more than 14 000 tons of fresh mango left Senegal, largely for the EU. This was an almost doubling of volumes in a 5-year period. The vast majority of these mangoes were imported by the Netherlands, followed by Spain and France and a number of European countries.

The only real exception is a significant volume (11%) imported by Blue Skies in Ghana for fresh cut mango salads. They use Senegalese mango when the Ghanaian season has ended in order to

provide a year-round supply. The fruit salads are packaged directly in consumer packaging and flown out to the EU. However, due to Covid19 this business has taken a massive hit in 2020 because of the absence of passenger flights between Africa and the EU.

Figure 7 Senegalese Export Volumes and destinations (ITC Trade Map)



2.3 Local Market - Centre & Niayes

The local fresh market is mostly limited to informal traders who collect truck loads for the local fresh market. This is mostly to the open markets and small retailers, but even larger retailers tend to be supplied by small traders. The traders pay premium prices by West African standards, and this makes the mango too expensive for processing. There is one formal distributor with its own points of sale in the form of tents and small shops, Senfresh. This local fresh market is supplied from the Centre Niayes orchards, as well as Casamance and Mali. Opportunities are in better quality mango supplied over a longer season in more formal retail.

There are currently no professional processing factories that absorb meaningful volumes of mango and thus offer a good market for farmers. Though there are a few processors in dried fruit and juice that have tried, they did not reach the necessary scale to reach impact on the sector. Processing has remained at an artisanal level.

As the mango produced in Senegal is often organic by default, they are able to provide this to the market. In the 2020 season producers were able to achieve a 15% price premium over the conventional price. However, lower global supply means that this is in demand and is a useful product to build relationships with new importers.

2.4 Local Market - Casamance

The market available to the producers from Casamance used to be mostly limited to the local surroundings. There were traders sourcing for the Dakar fresh market and even for the Agrofruits juice plant when it was operational. However, the transport was complex and expensive. It involved crossing the border with the Gambia twice and crossing the river by boat. Often different

traders were responsible for segments of the route, leading to lots of loading and reloading and adding cost as everyone adds their margin. The cost of gathering in remote orchards, loading trucks, crossing borders and rivers, transport cost and roadblocks can easily triple or quadruple the cost of mango when it arrives in Dakar.

Since the opening of the Senegambia bridge in January 2019 the transport has become much easier and cheaper, improving market access for the Casamance. However, COVID19 has shown the risk of needing to cross borders to reach the Dakar market, as the bridge has been closed so far this year. Hence, it still makes sense to develop the port and transport by sea, in order to have an alternative and also introduce competition to road freight.

2.5 Regional Market

A small portion of Senegalese exports in 2019 went to Ghana (1784 tons) and the Ivory Coast (220 tons). The former presumably for the fresh cut fruit export to the EU and for dried fruit production, which is significantly larger in those countries than in Senegal.

There are also smaller volumes of mango transported from by road from Mali to Dakar. The season in Mali starts much earlier, and the farm gate price of mango is about 10% to 25% of the farm gate price in Senegal. However, the cost of getting this Mango to Dakar are high, as it needs to be moved from orchards with small trucks or tricycles before being packaged in boxes and loaded on large trucks. Sometimes mango is transported in bulk with large losses of fruit due to the rough roads. Fees for transport are high despite the fact that many trucks return empty to Dakar. Part of this is due to cost linked to about 13 roadblocks between Bamako and Dakar.

2.6 Market for Processed Products

2.6.1 Local Market For Juice

Juice production typically consists of 2 separate business models:

1. A juicing plant, which produces large volumes of a few fruits to be found in abundance around the plant in bulk packaging (210 liter drums). The minimum economic scale is 5 tons of fresh fruit per hour, which needs to run 24/7 for about 3 to 4 months to be profitable, and the typical investment is about 2,5 to 3 million USD.
2. A juice bottler, which purchases a large range of more than 10 different juices and concentrates and blends and bottles juice, and markets this to consumers via a dense network of distributors and wholesalers. A modern Tetra Pak plant is an investment of at least 4 million USD.

Figure 8 Typical Successful Juice Production Models



Figure 9 Local Juice Brand From Kiréne

However, in Africa most juice companies try to juice and bottle at the same time. This means they have a limited product range of expensive products in a packaging with limited shelf life. This is a major barrier to

being able to market juice products widely. They tend to remain very small niche players, incapable of absorbing meaningful volumes of fruit and competing with mainstream drinks such as coca cola.

Dakar and surroundings does provide a growing market for juice, which is served by imports and Kirène, a local bottler of soft drinks, juices and mineral water. They bottle large volumes in modern packaging lines under their own brand, Presseas. Their demand for mango puree is between 1000 and 1500 tons per annum, which is currently met by using their own stock produced 2 years ago. This volume is not sufficient to run a mango pulping plant, but Kiren failed to find sufficient export markets for its mango puree during the three years it operated.

2.6.2 Puree for Juice and other Applications(EU&US)

Mango pulp or puree as it is often called is used as an ingredient in food processing. Its biggest use is as a juice ingredient, but it is also used in marinades and sauces, desserts, dairy products and drinks, smoothies, marmalades & jams and baby foods.

Figure 10 Assorted Uses for Mango Concentrate



The standard for mango puree is 14-18 brix (sugar content), aseptic and packaged in an aseptic bag in 210 litre metal drums. Aseptic means the product is sterilised using steam and it can be stored at room temperature. A small percentage of the market is frozen puree, and this is mainly destined for use in dairy products. Dairy products need to be pasteurised at the end and using aseptic mango would mean the mango is heated twice which would reduce flavour and change the colour.

We estimate the current EU market for Mango puree at 42,000 tons per year (single strength equivalent), and slightly larger in the US. The biggest consumers of mango juice are in Western Europe and Southern Europe. In Eastern Europe it is less popular due to the price. There is still space for new suppliers on the market, but competition is fierce. You need to be able to match

existing suppliers on value for money. There is a strong demand for organic mango of which there is a shortage. It's difficult to farm Mango organically at a professional level.

The demand for mango puree is still mostly driven by the juice market, which is actually in decline as a whole in the EU and US. However tropical flavours such as Mango, and "not from concentrate" (NFC) juice are growing segments within this declining juice market. Fortunately, pulped mango, also referred to as single strength puree, functions as a concentrate but qualifies as NFC because there has not been any evaporation of water. In fact, to make mango juice, water needs to be added because the puree is too thick to drink. Most mango juices sold in the EU and US are blends with other cheaper fruits (e.g., apple, grape, pear, orange) and only a small percentage of mango (5% to 20%).

The juice value chain is dominated by importers and so-called compound houses who source, import, blend, standardise and market juice to juice bottlers. For example, they will blend various origins of mango juice to standardise the flavour throughout the year. Or they create multi fruit blends. Bottlers in turn purchase concentrates and NFC juices, blend and bottle. Importers and compound houses source concentrates and juices from juicing plants around the world, sometimes with assistance of agents, but their role is decreasing. Increasingly importers are also investing in their own plants or in strategic relationships with specific production plants in the land of origin.

The juice game is a blending game, where the goal is to reach the most flavour with the most interesting consumer story at the lowest price per litre. Some varieties like Alphonso are more expensive (\$1400/ ton normally, but between \$1100 and \$1600 depending on the season) because they provide more flavour, and thus can be used in lower concentrations in the blend compared to a cheaper Kent or Totapuri (\$550 to \$750 depending on the season, but usually around \$600 to \$650 CNF Rotterdam). Other varieties can deliver an interesting flavour profile and fit somewhere in between in terms of price, e.g., the Magdalena from Colombia, Chato de Ica from Peru or Amélie from Mali and Burkina Faso. The organic premium is around \$100 to \$150 per ton. The upper end of this range is typically achieved by the more valuable varieties such as Alfonso.

Major suppliers into this market are India, Mexico, Brazil, Thailand, Peru and Colombia. Mali currently has two factories for export and Burkina Faso one, but volumes are very small compared to the size of the market. South Africa also exports smaller volumes of Kent, Keitt and Tommy Atkins puree.

Kent and Keitt mango which are dominant varieties in Centre and Niayes are accepted on the market. But, for now does seem to compete directly with the cheaper Totapuri from India and Tommy Atkins from Mexico because Kent and Keitt don't have a particularly strong and specific flavour. We feel they should be able to fetch slightly higher prices because the colour is intense, and the sugar content is higher than other suppliers (18 brix compared to 14-16 brix from other suppliers). However, this has not yet been proven, and Kiréne was struggling to sell its puree at higher prices compared to Indian Totapuri. It may well take some time to build a reputation for this puree that allows it to capture this price premium. Proximity to the market would be a plus, particularly for NFC transport cost.

Non-exportable varieties from Casamance could produce interesting flavours but needs to be tested. Over the past decade Amélie from Mali and Burkina Faso has gained a reputation for supplying good juice that fetches premium prices. Amélie is a variety that is difficult to export fresh but is successfully dried and juiced. More premium varieties could obtain between \$800 and \$1600 per ton. However, at the start a lower price may be needed to get a foothold in the market. Assessing the potential sales price for the varieties in Casamance will require close cooperation with major importers.

2.6.3 Frozen Fruit

The market for frozen mango pieces (IQF mango) is still growing, and again non-exportable varieties could potentially be used. Once again organic is an interesting niche and route to market for new unproven producers. Frozen mango pieces have two main end-uses:

- As ingredients for the food industry, particularly for more luxury products where the impression needs to be given to consumers that real pieces of fruit have been used. For example, for yoghurts, ice-creams, smoothies, cakes, baby food etc. This industry mainly used 1cm cubes that in many cases are processed by adding sugar, boiling etc. This is a price sensitive segment where depending on the usage different buying criteria exist. For some applications firmer lighter coloured cubes are preferred, such as Ivory from China. For other applications a more colourful Kent or Keitt from Peru is preferred.
- As ingredient of fruit salads. Fruit salads made in restaurants and hotels often contain frozen fruit. In addition, the EU based producers of fresh cut fruit salads sold in supermarkets and convenience stores often switch between frozen fruit and fresh fruit depending on what is cheaper at the moment. This market mainly uses hand-cut chunks. Peru is a big player in this market.

In addition, a small portion of frozen mango is bought by consumers for home usage. The make smoothies or use these as toppings for yoghurt, desserts etc.

We estimate the total sales of frozen Mango in the EU market at 20,000 tons per year, and 45,000 tons in the US markets. The main competitors are Peru, Mexico, China and India, followed by new market entrants Thailand and Vietnam. The average market price fluctuates between \$900 per ton for Ivory from China and Totapuri from India to \$1400 to \$1600 for Kent from Peru and \$2000 for Alphonso. Within the EU the largest importers can be found in The Netherlands and Belgium.

Like mango pulping plants, frozen plants require a large investment of around 3 million USD. Typically, one needs multiple products to make a plant work. The fastest growing product category in frozen foods and vegetables are berries, such as blue berries, black berries, raspberries and strawberries. Morocco is a producer of frozen strawberries. Frozen beans and carrots and broccoli florets also have a stable demand.

2.6.4 Dried Fruit

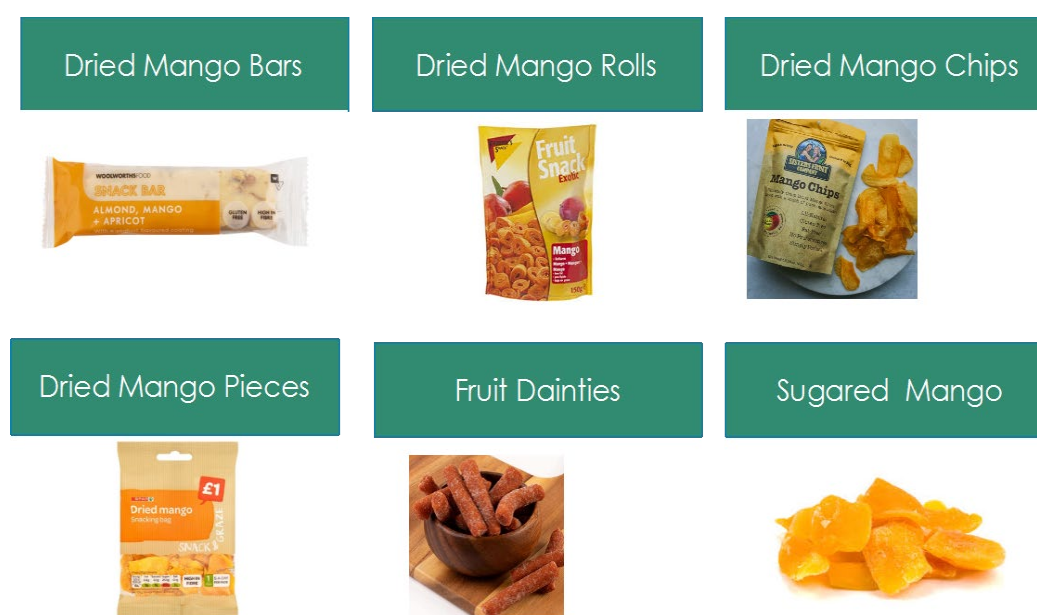
Dried mango is sold as a healthy snack in the EU and US markets. It is also consumed a lot by children, particularly in lunch boxes at school. Second grade and offcuts are used in small quantities in breakfast cereals. We estimate the market to be around 9000 to 10,000 tons in the EU and 9000 to 13,000 tons in the US. This seems a small amount, but one has to keep in mind that depending on the efficiency of the producer and the variety used, between 10 and 17kg of fresh mango is needed for 1kg of dried mango. Once you add in the labour cost and energy cost it

becomes a high value product, priced at about €7500 per ton CNF Rotterdam or \$7500 / ton landed in a warehouse in the US.

Dried mango has been the star of the dried fruit market, traditionally dominated by Mediterranean fruits such as raisins, dates, apricots, peaches, prunes and plums. Growth has been high over the past decades. There is still space for further growth in most of Europe with the exception of the UK, Germany and Switzerland where the market is more developed and better supplied.

There are actually six different types of dried mango product:

Figure 11 Assorted Dried Mango Products



1. Candied or sugared mango produced by placing mango in a sugar solution that draws out the moisture. This product group is still dominated by the Philippines but it's losing relevance overall as consumers increasingly prefer products with no added sugar. One needs access to cheap sugar to be competitive in this segment
2. Dried mango, usually in the form of strips, produced by air drying mango pieces in a special dryer with large fans and electric heaters, gas burners or hot water systems powered by coal, biogas or biomass. This is now the most popular category having shown solid growth. Traditionally dominated by South Africa and Mexico, but with Burkina Faso emerging as a new market leader in the EU.
3. Freeze dried mango, providing a very crisp product with a unique taste sensation is still a very small product group, mainly supplied from China. The production technology is complex and difficult to manage.
4. Dried mango rolls were developed in South Africa as a way to recover waste from overripe mangos and flesh still on the pip. The product has potential to grow but is difficult to manufacture.

5. Dried fruit dainties are made by extruding second and industrial grade dried mango. This product can easily be blended with other types of fruit and delivers a soft product with intense flavour. There is a lot of potential to grow this category in the EU.
6. Dried Mango bars are blends of mango and other fruits with cereals. They can be made using industrial grade dried mango, or with a mango pulp.

For Senegal like the rest of West Africa, dried mango (number 2) offers the best opportunities because it is a growing market where the dominant variety Kent does well. Dried fruit dainties and mango rolls would be important to utilise the expensive mangos properly and so make dried mango production competitive.

For dried fruit production the variety of mango is important. You need a fibreless variety that provides larger mangos (for processing efficiency), has a bright dark yellow or light orange colour when dried, and has sweetness as well as acidity. Some experiences with varieties include:

- Kent and Keitt (South Africa, Ghana, Ivory Coast) are best suited, because they are fibreless and generate great colour and flavour. They are also large mangos allowing for 12 to 14 kg of fresh mango for 1kg of dried mango.
- Brooks from Burkina Faso and Mali provides perhaps the best flavour, but the mangoes are smaller and suffer from fruit fly because it is a late variety.
- Amélie is more fibrous and acidic in flavour, which is actually preferred by about 30% of consumers. Unfortunately, many importers don't like it and think the consumers will not like it. It has been challenging to sell this variety, if it isn't organic.
- Palmer has been tried in Ghana but was not deemed suitable.
- Lippens has been tried in Burkina Faso but misses the acidity to give depth of flavour in the final product.
- There is no experience with Osteen, which has been planted recently as an early variety in Niayes.

Organic makes it easier to sell unknown varieties that are less attractive in flavour and appearance, because there simply is less choice for importers. This is increasingly in demand.

Figure 12 Assorted Organic Dried Mango Packs from the EU



A third distinguishing factor in the dried mango is the difference between conventional, unpreserved and organic mango. Conventional dried mango is usually preserved with sulphur,

which helps it to keep its bright yellow-orange colour but also prevents it from drying out. Unpreserved is conventionally farmed mango, but without sulphur added, while organic products is organically farmed unpreserved mango. The challenge is that many consumers want a beautiful product but not the sulphur.

The value chain is relatively simple. Most dried mango is produced in larger factories, that source mango from surrounding plantations. The product is sold to specialised importer-packers who either sell the product in stores and supermarkets under their own brand, or under the retailer brand. There are also a few exporters in Burkina Faso who source dried mango from many smaller factories who are not capable of direct export. In most countries there are larger producers who also source from other smaller producers and thus also act as an exporter- middleman. Most equipment for processing, including the specialised dryers come from South Africa, which has 3 manufacturers.

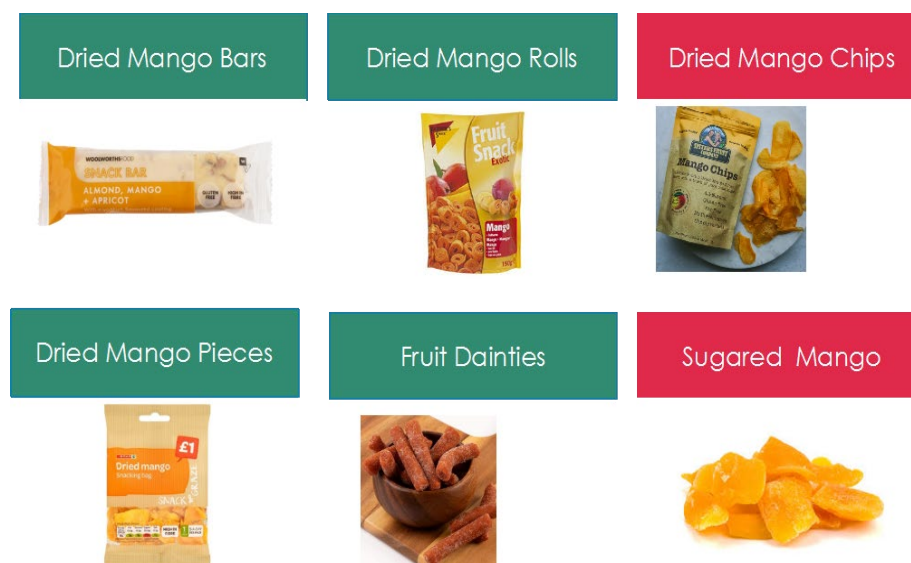
Dried mango is normally packaged in plastic bags of 2.5 kg, in cardboard boxes of 10kg, 22 tons per 40-foot container. Most retail packing is done by the importer, who sometimes uses a contract packer. This is to save on transport cost and being able to change pack sizes and designs on short notice.

The main suppliers to the market are:

- South Africa, the traditional market leader in the EU on conventional dried mango. Production has stagnated due to a lack of mango for processing, and South Africa has lost a lot of market share. Many South African companies are now involved in producing in West Africa.
- Philippines is the traditional market leader in candied mango.
- Mexico is the market leader for the North American market and is slowly trying to get into the EU market.
- Burkina Faso has become the market leader in the EU for both conventional and organic. Exports have increased from 150 tons in 2009 to 3500 tons in 2019 on the back of South African investors.
- Mali has remained a very small player in the sector, still exporting via Burkina Faso. The challenge has been a lack of good management of factories.
- Ghana has been a stable force in the market over the past decade with two large and professional factories producing about 1400 tons. The high prices of mango compared to neighbouring countries make it difficult for other producers to survive and existing ones to grow in Ghana.
- Ivory Coast is an upcoming player, with investments from South Africa and Ghana but still small.
- Ecuador, Kenya and Mozambique all produce very modest volumes sold in the EU.

They mostly use second and third grade mango.

Figure 13 Types of Dried Mango Products and their market potential (green=high potential)

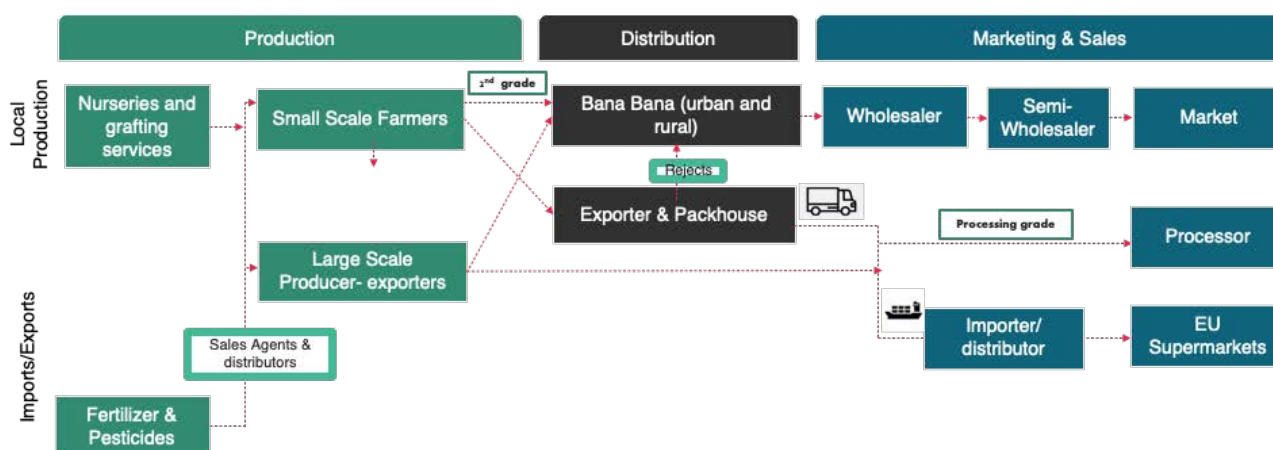


3 The Structure of the Value Chain

3.1 Overview

The value chain is relatively simple, with large scale producers exporting most of their fruit themselves to the EU importer. Small scale producers do this via an exporter. Second grade is sold to local traders, farmgate and at the packhouse (the sorting rejects). A very small amount goes to processing.

Figure 14 Value Chain Map for Mango in Senegal



3.2 Production Locations

We estimate the total annual production of Mango at 65,000 to 75,000 tons, coming from 3 distinctly different production areas. **The Centre and Niayes** areas produce around 25,000 tons, while the **Casamance** produces around 40,000 to 50,000 tons. Most of the 16,000 tons of fresh exports however come from the Centre and Niayes regions, while a large part of the mango available in the Casamance is not utilised. The **Senegal River Valley** is coming up as a new area, with one orchard established, and one of the largest orchards, Safina, said to move their due to salination of wells.

The main market for producers from the Centre and Niayes is the EU fresh market. Senegalese mango obtains premium prices due to the lack of competition in that marketing window of July till September and is able to provide good quality mangoes.

3.2.1 Mango Quality

The quality of mango in the North is high due to low rainfall and thus low disease pressure, a lot of sun and a short transit time. Exporters are only an hour from port and Senegal is close to Europe. Mango can also be transported by road via Morocco to Europe, which increases reliability of transport & frequency of delivery. Road transport can depart daily. Port shipments weekly. Finally, a large share of the mango marketed from Senegal is sold as Organic. Small farmers tend to produce fruit organically by default. Low rainfall and lower disease pressure makes organic production possible. Furthermore the orchards tend to be isolated, which limits spread of diseases.

Mango quality in the South is lower, because of higher rainfall and limited pest control, and the near continuous spread of fruit trees over the region. Even if a plantation is treated, pest and diseases can easily invade the orchards from nearby trees that are not managed. The region is not only a large mango producer, but also a cashew producer. Mango and cashew trees belong to the same family and therefore suffer from similar pests and diseases. The widespread cashew trees are hosts for mango pests and diseases.

Figure 16 provides the number of producers per region, with indicative production volumes and farm sizes. Over the next paragraphs we will describe the producers in the regions in more detail.

Figure 15 Map of Production Regions and Volumes

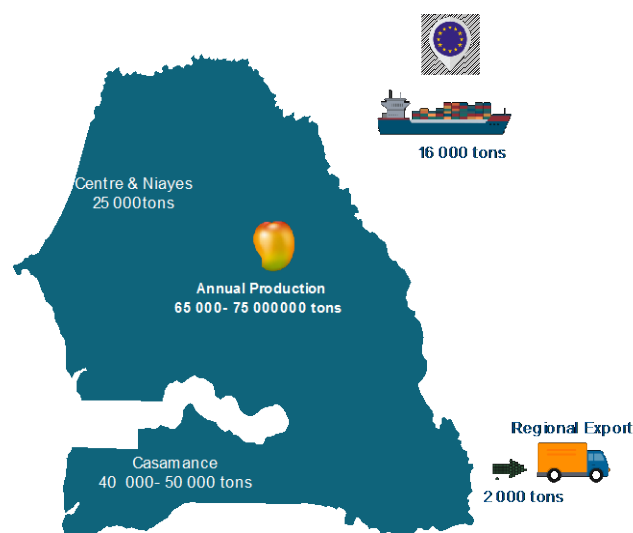


Figure 16 Overview of production regions

	#of Farms	Farm Size	Total Production	Export Volumes	Exporter Traders
Large Plantation	9	50-100ha	25 000	50%-70%	10
Centre Niayes	500-800	1-10 ha (usually 2-3ha)	7 000-10 000 tons per season		
Casamance			40 000-50 000 tons	1 000 tons	

3.3 Large plantations in Centre and Niayes

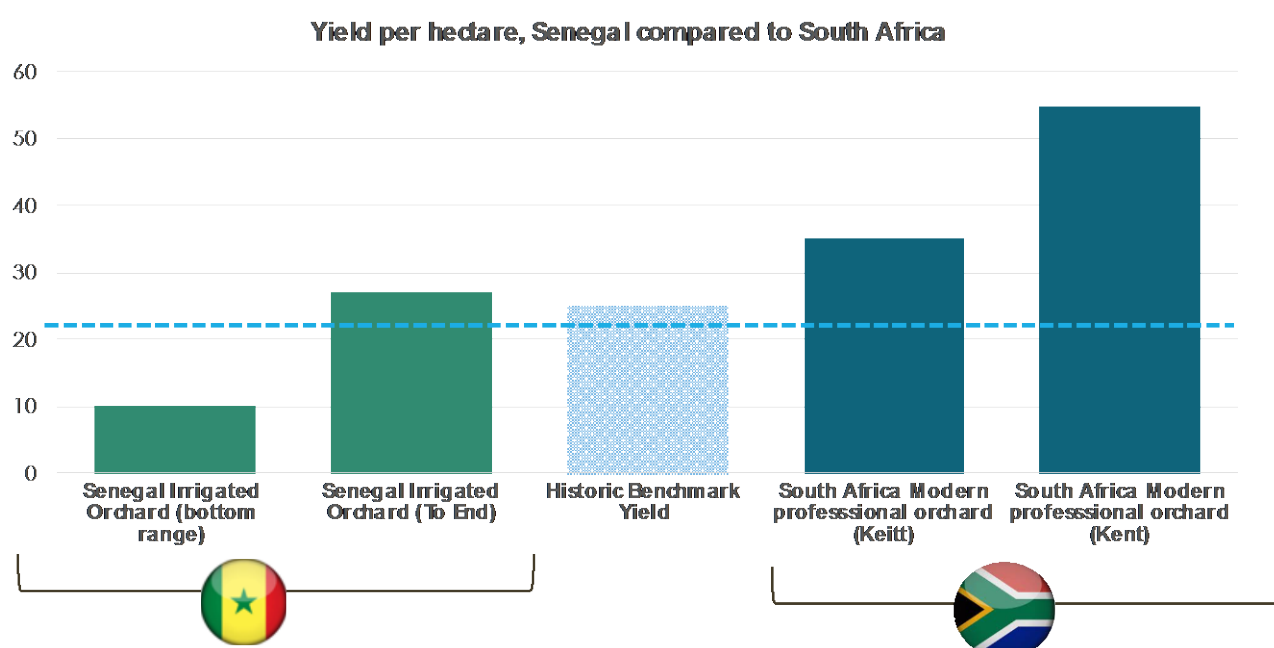
There are about 9 irrigated professional mango orchards from 50 ha to 300 ha in size who export directly from their own packhouses. The total yield is 10-27 tons per ha of which about 50% to 70% is export grade. The planting density in the orchards is 3x6 meter with 500 trees per ha in rows, that are pruned every year and receive a strict schedule of preventative spraying against pests and diseases and also receive fertiliser. The dominant variety is Kent, followed by Keitt. Osteen is just introduced as an early season variety.

Though for West African standards these are very professional high yielding plantations, there is still a lot of space for improvement. Firstly, several plantations struggle to reach the theoretical yields of 25tons/ ha for Kent, despite large investments in agricultural practises and irrigation.

Secondly, the plantations have converted most of their Keitt to Kent because they struggle with fruit fly once the rains come. However, this is also a matter of proper diseases control. Removing Keitt shortens the season and makes it more difficult to utilise infrastructure such as packhouses properly. Keitt is also a higher yielding variety, though it has larger fruit and thus the export grade is relatively lower.

Thirdly, even the 25 tons per ha is an outdated maximum. For example farms in the Hoedspruit area in South Africa with a comparable climate achieve on average 30 tons for Kent, but the better ones do 35 tons on Kent, and 35 to 40 tons with a maximum of 45 on Keitt. This is done with a planting density of 1000 to 1500 trees per ha, and even more precise management. For example for each block leaf samples are analysed and a specific fertiliser is developed for that block, that is added to the irrigation system. They still farm Keitt despite the rains.

Figure 17 Comparison of yields between Senegal and South Africa



The difference in yields between Senegal and South Africa can also be caused by differences in genetic material (tree quality). Farms in Senegal tend to produce their own trees, from material selected from their own farms. In South Africa trees are ordered from specialised nurseries.

An issue is that generally boreholes are used for irrigation. The usage of groundwater for irrigation is officially not allowed, and is most likely not sustainable. Pumping from wells that are often more than 100 meters deep also costs a lot of diesel. Salination of boreholes is also an issue.

Commercial plantations in the Niayes area are still expanding, and every couple of years a new plantation is added. But the expansion is modest. Some plantations may move to the Senegal River Valley in future.

3.4 Small Producers in Centre Niayes

We estimate that there are between 500 and 800 small scale farmers in Centre and Niayes that farm between 1 and 10ha each, but on average 2 to 3 ha. We estimate their total production at between 7000 and 10000 tons of mango, of which roughly half is exported. There are 10 exporters-traders who source from these small-scale farms and have their own packhouse. Rejects are sold via informal traders on the local fresh market.

The small farmers can roughly be divided in two categories:

- Owner managed mango farms. For most owners, the mango is one of their farming activities. Green beans, which are planted after the mango season, are often more important for farmers.
- Small plantations owned by formal sector workers in Dakar. These farms have farm managers employed who tend to live on the farm. They tend to be poorly paid and supervised, and are more caretakers than farmers.

The small farms are not irrigated and have a low planting density of around 120 to 160 trees per hectare. Compared to small scale farmers in other countries in West Africa, small scale farmers in Senegal invest a lot in orchard maintenance, and they have a very high percentage of export grade (50% versus 10%).

The trees are pruned annually, which keeps them very small. The orchard floor is cleaned of fallen fruit and weeds annually. The orchards are mostly organic with yields of about 5-8 tons per ha, of which 50% is exportable. Most orchards do use bait traps for fruit fly. These farmers do not use any foliar or chemical fertiliser. At most they may add some manure to each tree and usually not every year. As a result they require only flexible staff – usually 2 workers- who are hired in to carry out specific tasks for short periods throughout the year. Even harvesting is often carried out by the buyer of the fruit.

Nevertheless there is a lot of improvement possible. We believe the plantations would benefit from a higher planting density, investments in soil improvement such as mulching of pruning wood, and keeping a short grass layer instead of barren soils, and supplementary irrigation. Farmers believe higher planting density would require more water which is not available, but we believe that this would reduce the exposure of much of the soil to direct sunlight, which would dramatically reduce evaporation. Furthermore increasing the organic matter would improve the retention of moisture in the soil.

Another issue is the quality of trees used. Most farmers plant trees from seed directly in the orchard and then employ a grafter who comes to the orchard. The rootstock nor grafting wood is certified and standardised, nor is the grafting always done properly. Also not all trees survive the grafting, which leads to open spots.

Some small plantations are slowly being expanded, while others are disappearing due to urbanisation in the greater Dakar area.

3.5 Casamance

The Casamance produces about 40,000 to 50,000 tons of fresh mango. Only 1 000 tons from this is allegedly for export via exporters in Dakar. Only one third seems to be traded for the local fresh market in Casamance cities and around Dakar. However, with the Senegambia bridge this is likely to increase. About two thirds is either consumed close to source or not sold because of poor quality (fruit fly infestation, other pests and diseases or overripe), or because it concerns undesirable or unknown varieties for which no market exists.

The region is traditionally divided in 3 areas:

- Basse Casamance in the West, from the coast to Ziguinchor, also referred to as Ziguinchor.
- Moyenne Casamance in the middle, also referred to as Sedhiou.
- Haute Casamance in the East, also referred to as Kolda.

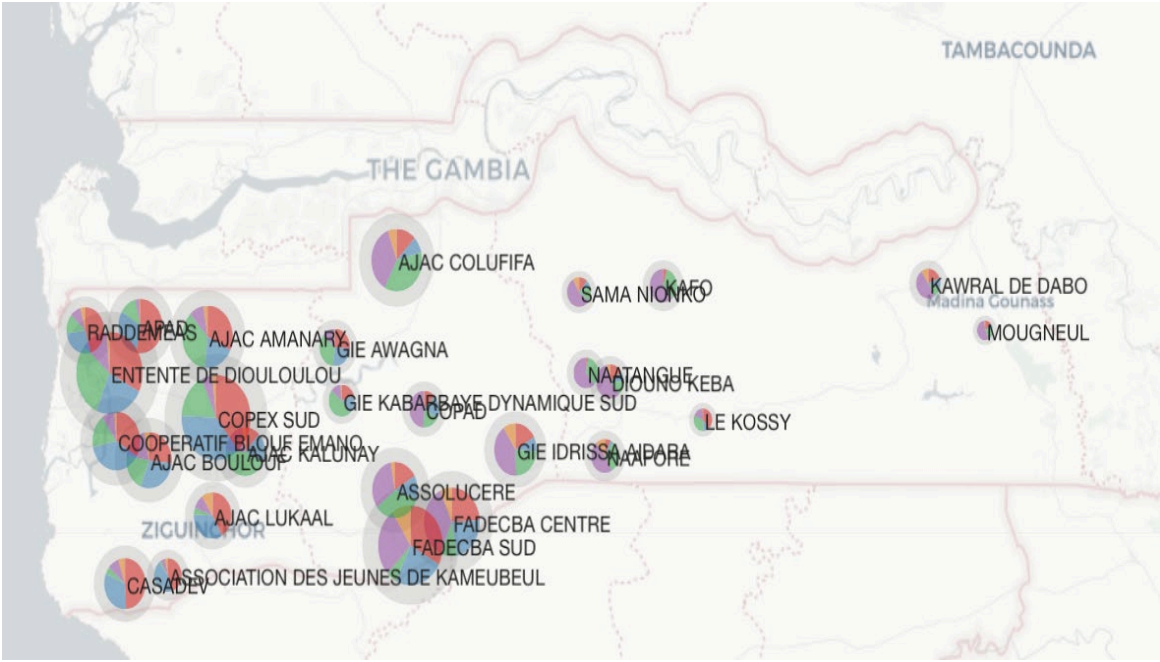
The IFC Comango project has gathered a large amount of statistics over the past years with regards to the number of trees, farmers, plantations and the varieties. Figure 18 shows the number of trees per variety per area, while Figure 19 shows the production zones on the map, with the size of the circle indication the total production and the colours the share per variety.

Comango has recorded 9852 plantations with 414,000 trees. This means an average of only 42 trees per plantation. This is caused on the one hand by the small size of plantations, with many 'plantations' actually containing just a few trees, while even 'proper' plantations are small. A study in Basse Casamance found that 75% of farms is less than 2 ha, and the average was 1.72 ha. The planting density is also low. The study found that in Basse Casamance 71% of plantations were actually intercropping systems, with crops being farmed in between mango trees. The average tree density was between 30 and 62 trees per ha depending on the area. Even the 31% proper plantations are likely to have a low planting density due to their age. Only 14% is younger than 20 years. At that time 10x10 and 8x8 spacing was the norm, giving 100 to 125 trees per ha. Professional plantations in Centre Niayes work with 500 trees in a 3x6 spacing, whereas in South Africa high yielding plantations use 1000 to 1500 trees per ha.

Figure 18: Break down of production volumes per variety per area in Casamance (Source: comango.org)



Figure 19: Mango Production in the Casamance (source: comango.org)



As such there are 3-4 types of orchards:

1. Semi-professional orchards with about 125 trees per ha that may receive some pruning, spraying and fertilisation. They usually have Kent and Keitt varieties, and a small part of their production may be exported via Dakar. The maximum size is 5ha. There are not so many of these.
2. Small traditional mango orchards that receive no maintenance.
3. Intercrop orchards, which seem to be the majority of orchards.
4. Village orchards and backyard orchards, which just have a limited number of very large trees.

There are at least 35 different varieties of mango in Casamance, but there are 5 main varieties that account for ranging from fibrous to non-fibrous local varieties and grafted Kent and Keith mangoes. Kent and Keitt account for 64% of mango in Ziguinchor, 34% in Sedhiou and 13% in Kolda.

Sierra Leone, Diourou and Papaye are the three other common varieties. Due to COVID 19 we have not been able to taste and inspect those varieties, and thus we do not know if they are suitable for processing, and if so what type of processing and what processing yields can be achieved with them.

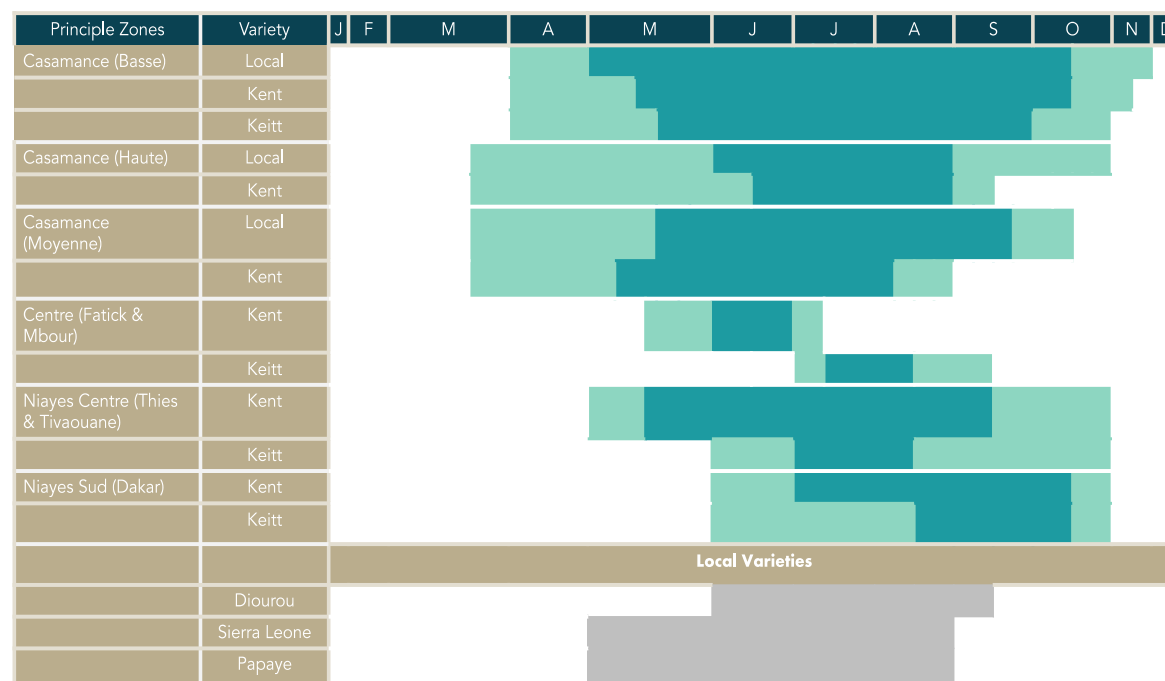
Finally, all the other varieties account for 7% and 23% and 32% in the areas respectively. Hence, the further east one goes, the smaller the percentage of Kent and Keitt and the higher the other varieties.

3.6 Mango Production Season

Senegal has a relatively long production season due to the different regions in which mango is produced with their different climates, and the different varieties. Figure 20 provides an overview

of the season. The darker shaded areas indicate high season when volumes are higher and prices lower. The lighter low season areas are not suitable for processors because mango will be too expensive. The season lasts basically 6 months.

Figure 20: Production Season for various Mango Varieties in Senegal



3.7 Processing

3.7.1 Mango Puree and Juice

Between 2015 and 2017 Agrofruits, part of beverage company Kirène purchased between 1000 and 3500 tons per annum to produce mango puree for usage in their own Presseas and Minute Maid juices and for export. But it struggled to source enough mango at economic prices and export the juice produced that could not be absorbed in the own factory. Making the plant economically feasible requires it to process at least 5000 tons of fresh mango per year, and export most of the 3000 tons of puree produced.

On the sales side, Kirène struggled. They invested in Coca Cola certification, but the company never honoured their promises of buying the puree. The company had no experience in business to business marketing. Finally, the company struggled to sell the product at a higher price than the cheaper Totapuri from India. Though one would expect the Kent and Keitt from Senegal - high in sugar - to be a better product, it is unclear whether it can actually fetch a premium. And in the Centre and Niayes region it is not possible to purchase mango at a price that will allow it to compete with India.

A big issue is that small producers in Centre and Niayes have no interest in selling to processors who cannot match the price for non-export grade on the local fresh market, which is often more than 200 FCFA/kg. Export orchards on the other hand are interested in selling their rejects to large processors, instead of dealing with too many individual, often unreliable traders. Kirène sourced mango at 125 FCFA/kg for conventional and 150 FCFA/kg for organic, but even at this price that is

considerably lower than the local fresh market, it cannot compete with India. Furthermore, at these prices it cannot secure the 5000 tons in Centre and Niayes it needs to break even.

Making the plant profitable would require the business to source large amounts of mango in Mali and Casamance, which would increase volumes and bring down the average price per kg. It would also lengthen the season to at least 5 months, which would make it competitive. However, this would require an investment in supply chain development including trucks and sorting warehouses, which Kirène was not willing to make.

Agrofruits stopped production and is now thinking about moving the line to Casamance or Ivory Coast. It does not seem to make sense to base an industrial juice line around Dakar.

Agrofruits stopped production and is now thinking about moving the line to Casamance or Ivory Coast. It does not seem to make sense to base an industrial juice line around Dakar.

3.7.2 Other Processing

There are a handful of other mango processors, including about 2 drying factories around Dakar but they never reached any serious production volumes despite some of them having acquired professional drying equipment from South Africa. Fruit prices are simply too high to be competitive for a small start-up company.

Finally, Blue Skies exports fresh export rejects from Senegal to Ghana by air. These are cut for the EU fresh fruit salad market. Given the number of flights between Senegal and the EU it would make sense to export directly from Senegal to the EU, and this could be an opportunity to be explored post Covid.

3.8 Pricing in the Value Chain

Small farmers receive between 275 and 350 CFA farm gate for export grade, but on average closer to 300 CFA. By the time this is sorted, washed and packed in boxes in refrigerated containers and on the ship the price is 800CFA. This seems a large margin, but about 10% of mangos are still rejected at the packhouse level. Packaging has high labour cost and packaging cost, and transport to the ship also needs to be added. Senegal does receive a higher than usual FOB price for mango due to quality and less competition in this window.

Farmers are still able to sell second grade mango to local bana-banas for very high prices between 175 to 225 CFA. When the mango puree plant was operational, they purchased for 125CFA for conventional and 150CFA for organic mango. This price was not interesting for small scalars who only need one or two bana-banas to sell their crop. It is only the large plantations who do not want to deal with many traders every single day who are interested in selling this price, which is still high in the region for processors.

Figure 21 Prices in the mango value chain in Centre and Niayes

	Export	Local	Industrial processing
Farm Gate	275 – 350 FCFA	175- 225FCFA	125/ 150 FCFA
Exporter/ packhouse FOB	800 FCFA	800 FCFA	

Pricing in Casamance is much less transparent. Roadside prices at which mangos are sold vary between 25 and 50CFA/ kg depending on location, variety and season. This is however the price paid to a trader harvester. A series of traders is involved before the mango arrives in Dakar. It could be that with the new bridge transport cost are lower and higher farm gate prices are possible. However, competition between farmers and traders is high, so farmers do not have a good bargaining position.

3.9 Actors in the Value Chain

3.9.1 Direct Actors

Figure 14 provides an overview of the value chain. In Centre and Niayes, small scale producers sell export grade to exporters, some of which are cooperatives, some are larger farms and some specialised exporters without a farm. The exporters sell to importers in the EU, who in turn sell to retailers and supermarkets. Commercial plantations export directly to the EU.

Non-export grade is sold to small traders who in turn supply retailers, mostly in Dakar. Processors when active source rejects from packhouses at large plantations and those servicing small farmers. Some traders also come to the packhouses for rejects.

In the Casamance the value chain is longer and more complicated. There are harvester traders who negotiate a price with owners, harvest the mango with their team and then sell the mango onwards to traders who transport it to urban market. Mango is also harvested by households themselves and other people and sold on the roadside to consumers and other traders who in turn transport this to major towns.

3.9.2 Indirect Actors

There are only a few nurseries supplying to farmers, and those are not very professional. There are no specialised maintenance service providers, only independent grafters who are paid per tree by farmers and nurseries.

3.9.3 Professional Organisations

Professional organisations are a common feature of the agricultural sector. However, there are relatively few in the mango sector that are fully operational.

The mango "interprofession" is intended to support producers to lobby for additional support and develop technical skills, access to market etc. It's supported by USAID, but isn't fully operational.

Market access is a key issue that's being addresses by a PPD working platform. Its goal is to increase the access of local producers to the EU and to ensure that fruit fly is controlled so that

this access isn't jeopardised. In the Casamance various producer associations are involved in initiatives that relate to fruit fly control especially.

3.9.4 Banks and Microfinance Organisations

Larger mango farmers are able to access financing (working capital and asset finance) through the La Banque Agricole (formerly **CNCAS**). Most small-scale farmers who are not able to self-finance, get financing elsewhere. Where they are interested in pursuing financing from the banking system, they tend to turn to micro-finance organisations. PAMECAS, the Union Financiers Mutualiste are some of the MFI's extending loan products to small scale farmers. These institutions offer unsecured lending, at 16% interest per year with a payback period of 3 years for investments in equipment or working capital for inputs. The MFI's are also able to access funding from the Priority Investment Guarantee Fund (FONGIP).

3.9.5 Input Supplier Financing

Solar pump irrigation for small scaler producers is in part prefinanced by suppliers. They provide zero interest financing to MFI's, who then offer loans to small scale producers. These loans are typically attract a 165 interest rate and are paid off over a 3 year period. MFI's have become more adept at providing financing and business planning advice. This ensures that the farmers take out loans for optimal amounts so that they get the required returns to be able to pay back these loans. The MFI's are also far more adept at managing their default rates. So they play an important role in small scale finance.

3.9.6 Agricultural Insurance in Senegal

There aren't any specific agricultural products specifically crafted for mango producers. In fact, agricultural insurance has only recently been developed in Senegal. Most of the focus to date has been on the grain chains. Nevertheless, the National Agricultural Insurance Company of Senegal has been working to offer insurance products in all agricultural sectors with the exception of livestock and fishing. Risks of crop failure due to flooding or (index insurance), to damage caused by birds, wildlife, etc. are some areas that are covered. However, uptake of these products is still low.

3.9.7 The Knowledge Sector

Knowledge and skills development are two important supporting activities in the agricultural sector. A sound structure would have a good combination of proactive research and development, which is then enriched and disseminated to professional education, vocational training and extension services. Despite mango being an important export product for Senegal, it doesn't get much specific attention from a knowledge development perspective. As a result the general agricultural knowledge system applies.

Some practical skills are being developed with the assistance of exporters and donors. But this is fairly limited to fruit fly control. As a result, much of the general framework for research and development and extension services is described below.

3.9.8 Research and Development & Professional Skills development

Agricultural research and development falls under the remit of the Senegal Institute of Agricultural Research (ISRA). It falls under the Ministry of Agriculture and Rural Equipment's (MAER) but operates as an autonomous unit. The Institute of Food Technology and the Universities of Dakar, Thiès, Saint Louis and Ziguinchor all contribute to knowledge development in the agricultural

sector. But there's relatively little work being done to improve techniques for mango farming or tree development.

Generally, international research teams provide additional resources for Senegal. For example, the Institute for Research on Development in France provides funding for students carrying out research in developing countries. Their local partner IRD- Senegal focusses on environmental sustainability amongst other themes.

3.9.9 Extension Services

Some mango exporters provide some support to the small scale farmers they work with. This is especially linked to phytosanitary controls. Some producer associations in the Casamance have been working on fruit fly control. But the structure of production in that area make this a tricky model.

All other extensions services are linked to the state system. While there are not very active in mango, the system is outlined below as it could provide insights in to the potential partners who could be engaged for a project around extension services.

Extension Services are designed to be coordinated and developed by **ANCAR**. This state funded agency has extension staff in each of Senegal's 45 districts and 190 counties. However, a chronic shortage of funds means that there's been a high vacancy rate in the organisation since 2017. To support ANCAR, Special Regional Development Agencies (**SRDR's**) were established by the government. They operate in particular zones and on particular themes. For example, the Senegal River Development Agency (**SAED**) was created in in the Senegal River Valley to support the development of irrigated agriculture there. The Agency's advisory service employs 85 field extension staff equipped with motorbikes and 12 supervisors. Extension activities include participatory diagnosis, needs assessment, implementing activities and monitoring and evaluation. SAED receives funding from the government and is currently managing seven donor- financed projects funded by the African Development Bank, the French Development Agency, the Japanese International Cooperation Agency, the Korea International Cooperation Agency, the Kuwait Fund, the Saudi Fund for Development and the World Bank.

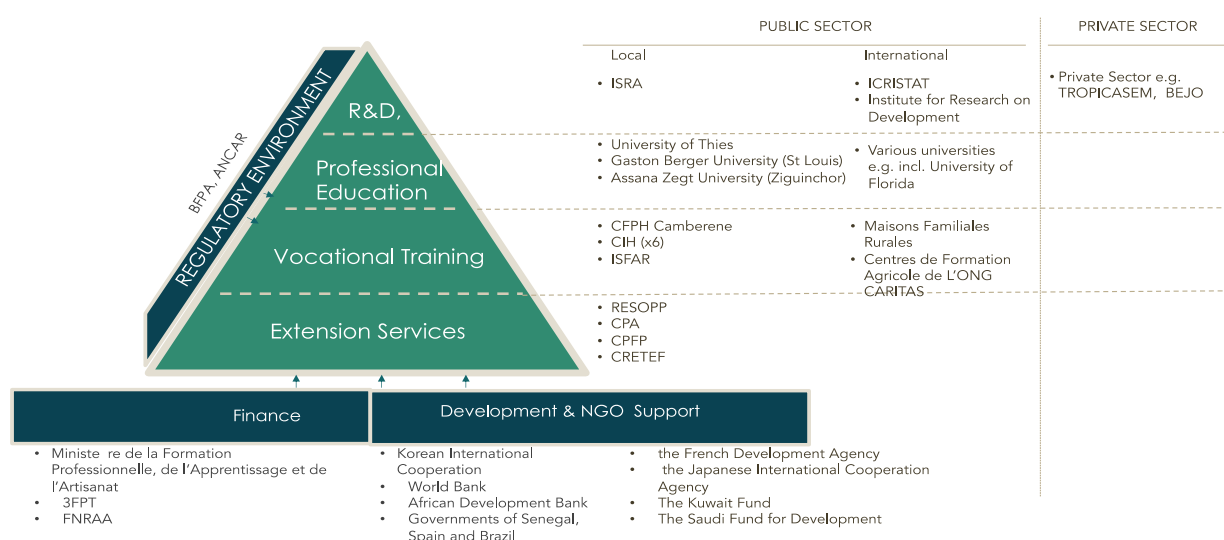
Another relevant agency is **ANIDA**. Founded in 2006, the National Agency for Agricultural is tasked with creating large, modern farms in "community agricultural domains," primarily to serve as employment opportunities for rural youth and to promote agricultural development. Twelve such domains are in operation and include over 100 farms. ANIDA employs 70 extension agents, who are supervised by 12 extension managers. Donors include the African Development Bank and the governments of Senegal, Spain and Brazil. In addition to extension services, these organizations provide a range of support including infrastructural development and supply of inputs.

Some professional and cooperative organisations provide training for their members. For example, RESOPP. This is a is a federation of farmer cooperatives, which offers training services to its member cooperatives as well as non-members. To realise this goal, they have training facilities in 8 out of the 15 regions in which Senegal is divided.

The Centre Polyvalents de Formation des Producteurs (**CPFP**) and the Centres Régionaux de Formation Technique et Professionnelle, (**CRETEF**) provide training on agricultural techniques and innovative techniques for farming amongst other topics. These are targeted at producers.

The small scale of production and especially commercial enterprise related to these specific vegetables suggests that this is a small and relatively unimportant activity area for these extension services providers. However, should outgrower schemes become popular as a mode, local shoppers begin to look for these vegetables more often, or this be seen as a means to develop a more varied diet in Senegal, then this will need to be rectified.

Figure 22 Overview of knowledge and skills development actors in Senegal



3.9.10 Finance (Agricultural Knowledge Sector)

The system design has created clarity on the intended financing mechanism for R&D. This should be funded by the National Agro-Food Research Fund of Senegal. This is a government agency established in 2004 that mostly funds research but has recently started funding dissemination of knowledge. The National Fund for Agro-Sylvo Pastoral Development (FNDASP) provides funding to support for the dissemination and large-scale adoption of technologies. They also fund projects that will expand the availability of certified seeds for priority sectors by promoting sustainable seed systems.

These are not specifically targeted at mango. Also resource constraints mean that these funds are fairly limited.

4 Issues and opportunities

4.1 Space to expand fresh exports to the EU

The market for fresh mango is still growing in the EU, and Senegal is well positioned to grow. The mango from Senegal is well appreciated by consumers and importers for its flavour. Importers appreciate the professionalism of the exporters, particularly those with their own plantations. The quality is high because the plantations are only an hour from port, and the boats go directly to Europe in 6 days. This provides longer shelf life, or more flavour because mangos can also be harvested later when more mature. There is also the alternative of being able to transport mango

by road to Spain. Finally, Senegal has a unique time window on the market where competition is still limited (see figure 2).

Despite all these advantages, the export from Senegal to the EU is still relatively small with about 15,000 tons over 3 months. In comparison, Ivory Coast exports 30,000 to 35,000 tons over a 6-week period. Compared to that peak in the market there is still space for another 10,000 to 15,000 tons from Senegal, particularly in the late season when Niayes is usually harvesting. We see a continued modest expansion of plantations with a new player coming in roughly every 2-3 years, and existing plantations gradually expanding. There is however potential to accelerate this pace. One way would be to focus more on productivity increases of both commercial and small holder farmers.

An expansion of production would also increase the supply for second grade mango for processors and the local market, potentially lowering the prices for processing grade and making that activity more profitable.

The Senegal River Valley is actually the best placed for expansion of mango production, because it would fit in the later window and has a sustainable source of irrigation. There is also space for small scale producers in Casamance and Centre and Niayes to fit into these value chains if they further professionalise.

Another opportunity for expansion is the introduction of an early season variety like Osteen. A few plantations have planted test plots. It is a variety that is well appreciated on the EU market, and if it performs well it makes sense to plant this on a larger scale.

4.2 Low Productivity of Orchards And Unsustainable Water Sources

The majority of Senegalese commercial plantations are still yielding way below their potential, with some sitting at 15 tons, while the best one yield 25 tons. Major gains are possible by introducing precision farming, consultation from experts and higher density orchards. Small scale orchards particularly should be able to achieve productivity gains by better soil and water management and increasing the density, as well as fertilisation.

A key issue is the source of water for irrigation. Most plantations pump groundwater from boreholes, which may lower the water table, plus the emissions and cost of diesel are high. It is important to look at how this can be made more sustainable. Solar irrigation has been used in many African countries and multiple locations in Senegal to expand access to irrigation. This is affordable technology, with low requirements for technical skill and is especially well suited to small scale producers. Salination of boreholes is also an issue that needs to be tackled. This requires better water and land management, more rigorous implementation of existing policy around water-use from boreholes and the development of new more precise techniques to minimise water use.

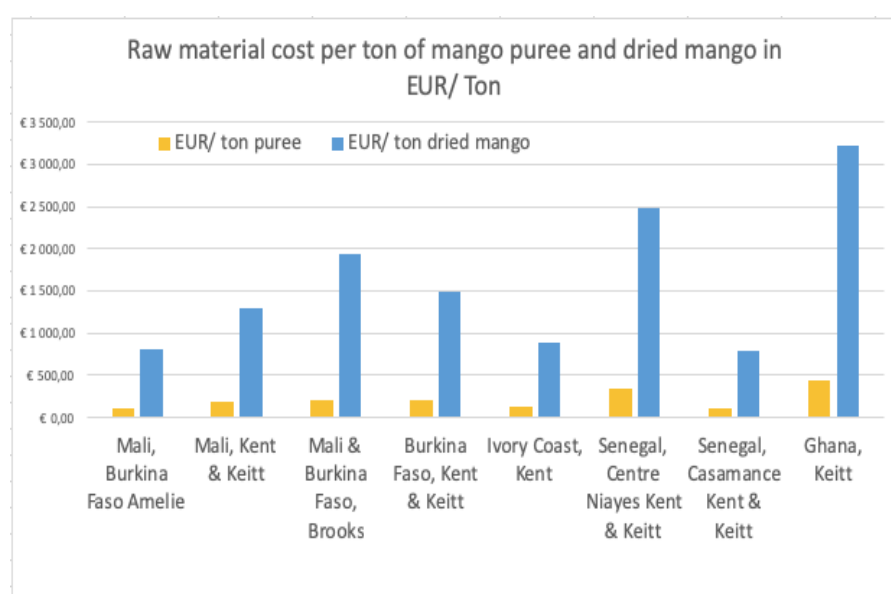
This has been the topic of intervention for a few donor agencies. However, the causes of salinisation and solutions are fairly area specific. Salinity levels in Saint Louis is different than in Podor or in the Centre Niayes. The solutions along the Senegal River Valley would also be different in Podor than in borehole fed irrigation amongst small scalers in the Centre Niayes. As a result, there is still much to be won.

4.3 Lack Of A Competitive Processing Sector

There are currently no professional processors in Senegal with a significant production and export volume. The main reason is that processing in Centre Niayes is not competitive, because there is too little 'processing grade' mango available and the prices are too high. High prices are in turn caused by the lack of supply and the strong domestic demand.

At the current processing grade price of 125 FCFA/kg, processors cannot compete with the fresh market who is willing to pay 225 FCFA/kg farmgate. And even 125 FCFA is still too high for juice, IQF and Mango-puree to be competitive. In comparison, the farm gate price for Kent in Ivory Coast is 30 to 50 FCFA, 70-80 FCFA in Burkina Faso and about 60 FCFA in Mali. Amélie in Mali is as low as 30 FCFA/kg. Because 1.72 kg of fresh mango is needed for 1 kg of mango puree, and 13 kg for 1 kg of dried mango, this price difference is further amplified. Figure 23 compares the cost per ton of puree and ton of dried mango of different varieties across West Africa.

Figure 23 Comparative Cost of Mango Puree vs Dried Mango



From this figure it becomes clear that only Ghana has higher prices. Interestingly, both Ghana and Senegal do not export mango puree currently, while Burkina Faso and Mali have one and two exporting plants each.

Ghana exports around 1400 tons of dried mango coming from 2 plants, but the only reason this is economically feasible is that these are very efficiently run factories that have been established a long time ago, and that they can utilise their equipment for a large part of the year by drying pineapple and coconut. This is an option that Senegal does not have. Furthermore, one has to take into consideration that over the past decade there has not been a single new export drying plant in Ghana. Whereas Ivory Coast and Burkina have had many new plants.

Furthermore, we have seen across West Africa that establishing a successful processing plant for export requires a strategic partnership and investment from either importers or established processors from other countries. Those partners are more likely to invest in Ivory Coast, Mali or Burkina Faso at the moment. For example, Sense and IFC convinced Westfalia-Mpak (market

leaders in dried mango with large plant in South Africa and Burkina Faso) to visit Senegal for a scoping mission, but they decided to invest in Mali instead.

A significant expansion of the fresh mango export could however result in an increased supply for processing and drive down prices in the future.

4.4 Challenging roadmap for Fresh exports from the Casamance

Casamance does have much more mango and at a significantly lower price than Centre-Niayes zone. The informal, disorganised structure of production has made it difficult for this region to win share of the export market. Firstly, logistics need to be improved so that the mango can be harvested, collected and readied for road or sea freight to Dakar. This is not a small task as farmer. A “producer” might be a resident with a single mango tree in their yard.

The commercial aspect of this collection will need to be better organised, with collectors brought into the chain in a coherent way. They will need financing for tricycles, packaging crates, working capital etc.

Another important barrier to tackle would be fruit fly and phytosanitary control. This is challenging in modern organised orchards. But it will be more difficult in Casamance, which has a more humid climate than Centre Niayes. Farmers use a zero-input model of production, which raises the question of whether they can be convinced to participate in a program to control phytosanitary pressure.

Finally, marketing mangoes from Casamance is made more difficult because buyers are often unsure of whether the mango they’re buying meets the agreed quality standards. At the moment they travel to the region to check quality. But this is not sustainable and erodes some of the cost advantage of sourcing from this area. Finding a mechanism to reduce this uncertainty would be beneficial. Vertical integration with an exporter or producer in the Centre Niayes would be helpful, but there’s a difficult case to be made when compared to investing in the Senegal River Valley. An intermediate stage packhouse that grades mangoes and arranges outbound logistics could be considered. But again, the business case for a commercial investor could be tricky when compared to investing elsewhere in Senegal.

4.5 Processing in Casamance

The processing opportunity in the Casamance is by comparison far more straightforward than for fresh market exports. There is a fair amount of Kent and Keitt at affordable prices. Furthermore, there are other varieties, Diourou, Sierra Leone and Papaye, that may or may not be suitable for drying, juice or freezing. What they are suitable for will require explorative production trials. These can assess how they perform when compared to better-known processing varieties like Kent, Totapuri, Amelie etc.

Setting up processing in Casamance will require significant investments in post-harvest logistics in order to secure a steady supply. In the current system orchards are so small and the value chain is so fragmented that it will be challenging to get a consistent stream of mango to a plant. It may require a plant to set-up decentralised collection hubs and invest in crates, trucks and picking teams. This is not impossible, various juice plants in Mali and Burkina Faso have gone the same

route. There are also initiatives from donor agencies currently working to map these varieties, organise farmers and improve logistics. However, there is a lot of work to be done.

The most important benefit is that the phytosanitary challenges are lower for processed mango. The region could also offer organic by default product, which achieves higher prices. Buyers of organic product are also more open to new suppliers and are more forgiving of poorer quality. Developing the processing sector here allows the producers to benefit from a natural competitive advantage- rather than aiming for a market that is very profitable, but potentially difficult to win in, with greater risk. It allows the actors in the chain to organise & potentially find solutions for improving phytosanitary control. These can be used in future initiatives to expand fresh mango exports. Processing could thus be a stepping-stone to developing competitiveness for is a lower risk roadmap to being able to compete in the fresh export market at a later stage. The development impact could be significant. Stimulating mango drying in the Casamance could provide hundreds of jobs for women in factories as well as impact thousands of families/small scale farmers.

4.6 Genetic Material & Nurseries

There seem to be no professional nurseries in Casamance. Both commercial and small-scale farms would benefit from professional nurseries that can provide high quality trees. This is an activity that requires limited investments and can provide employment to youth and women. It is typically a small-scale production model that requires relatively small plots of land. The infrastructure required is also relatively small. But it does require precision farming techniques and good control of production & marketing so that “fakes” are not allowed to creep in to the system. Working to improve genetics so that the trees are naturally high yielding clones as system-wide benefits that can be reaped for decades.

4.7 Long Earn Back-Period for Investments

Because investments in a new orchard and packhouse are substantial and it takes 4 years from planting decent size grafted trees to a first sizable crop, it takes 8 years to earn back the investment. This is a long timeframe for any investment, particularly in Africa.

4.8 Diversification: Opportunity and Need

It is very challenging to run a profitable mango orchard with export packhouse if you only use the packhouse for mango. It is not without a reason that several plantations, e.g., Safina, van Oers and Soleil Verte, combine mango with green beans. The seasons are complimentary, allowing the same packhouse and trained staff to be used for a longer period. The other advantage is also that green beans are an annual crop that can provide cash flow and income while a mango plantation is still in development. It also spreads the risk and helps to make more efficient use of permanent staff.

It makes sense to also explore other diversification opportunities that would utilise the packhouse, for example sweet melons, sweet corn and strawberries for export, or premium packaged vegetables for supermarkets in Dakar.

4.9 Orchard Maintenance Services

One way to improve productivity of small-scale farms is to stimulate the development of orchard maintenance services. In addition to knowledge, proper maintenance often does not happen due to a lack of labour and equipment. Professional orchard maintenance services are private businesses who employ teams of skilled workers led by a trained agronomist who perform services such as pruning, fertilisation, pest and diseases scouting, preventative spraying and treatment etc. The teams have professional equipment such as mist-blowers, chainsaws, pole-pruners, wood chippers and brushcutters. With the support of the HortiFresh program these services are currently being developed in Ghana and Ivory Coast.

This activity seems to be a good opportunity for youth employment. From a development program perspective, it's cheaper to train and equip 100 professionals than 2000 farmers.

4.10 Solar Irrigation

Irrigation is essential in Senegal. Yet, the use of diesel to power pumps means that the cost of irrigation is high. Solar powered irrigation is being used in vegetable crops amongst small scale producers. This creates potential to adopt these systems for commercial mango orchards. Where large commercial open field crops are limited in the adoption of this technology by the large scale of their operations, mango orchards are generally more compact. Drip irrigation fed from water harvesting tanks that are in turn are fed by solar powered pumps is thus possible- especially along the Senegal River Valley where farmers are close to the river. Professional service providers already exist.

5 Environmental Sustainability (Circular Economy)

5.1 Water Usage

There are limited environmental issues with the mostly organic small scale producers in Centre and Niayes as well as Casamance. The bigger issue is with the commercial plantations in centre and Niayes because they use groundwater for irrigation, which may not be sustainable. However, at least this water is used for a high end export crop as opposed to for example onions and potatoes. Furthermore because water is used for a permanent crop soil salinations are limited. Water usage is also lower because irrigation is precise with driplines at the base of the trees. There is less surface evaporation because watering takes place in the shade of the tree.

5.2 Pesticide Usage

Commercial farmers use pesticides and fungicides to control pests and diseases. However, compared again to potatoes and onions the environmental impact is less. Firstly all chemicals used need to meet strict EU requirements, and therefore there is limited use of forbidden pesticides. Maximum allowed pesticide residues also mean that usage needs to be limited. A lot of the fertilisation takes place with foliage fertiliser, which means run off of fertiliser to streams and leaching into ground water is also more limited.

5.3 Energy Usage

Transport by refrigerated containers uses a lot of energy, but the transport and transit times are shorter compared to other suppliers to the EU. Transport to road via Morocco to Spain does have high carbon emissions.

6 Socio-Economic Development (food security, employment, women and youth)

6.1 Livelihoods

For small scale farmers mango production is often just one of several activities or crops, and one that does not require high investments in terms of inputs, labour and time. Mango is usually not their primary crop. Often farmers will interplant with cash crops such as legumes, okra, eggplants and chilli-peppers, and mango revenues are reinvested in these crops that offer quicker returns.

Nevertheless, it is a very financially attractive business. Figure 23 contains a profit and loss statement of a small scale mango farmer in Les Niayes with 1,8 ha producing 5,25 tons/ha. 50% is sold to exporters at € 0,45/kg and 50% to local market traders at €0,23. With very few inputs used, gross margins are 92% and net margins before tax are 74% representing a very healthy € 1314 /ha.

Figure 24 Profit and loss for small farmers in Senegal

Profit and loss							
REVENUES		tons	price/kg	Revenue per Ha	Per Kg	TOTAL FARM	
Grade 1		2,625	0,45 *	1 181	0,225		2 126
Grade 2		2,625	0,225 *	591	0,1125		1 063
Grade 3		0	0	-	0		-
TOTAL REVENUES				1 772	0,3375		3 189
VARIABLE COST							
Variable Cost: inputs		Unit	Cost/ Unit	No. Units per ha	Months	Cost/ ha	Per Kg
Foliage fertiliser	kg	18	1	3		18	0,003
Fruitfly spray	Kg	12	1,00	1		12	0,002
SUB TOTAL: INPUTS						30	0,006
Variable Cost: labour		Unit	Cost/ Unit	No. Units per ha	Months	Cost/ ha	Per Kg
Pruning	working day/ year	37,5	1	2		37,5	0,00714286
Spraying	working day/ year	15	1	2		15	0,00285714
weeding	working day/ year	15	1	1		15	0,00285714
removing fallen fruit	working day/ year	7,5	2	3		15	0,00285714
fence maintenance	working day/ year	15	2			30	0,00571429
SUB TOTAL: INPUTS						113	0,02
TOTAL VARIABLE COST						143	0,03
GROSS MARGIN		92%				1 629	0,31
FIXED COST for the entire orchard							2 933
Fixed staff		No. of staff	Salary/mont	no. months	total cost	Cost/ ha	
Workers		2	15	3	90	50	0,01
SUB TOTAL FIXED STAFF						50	0,01
Other fixed cost		% of capex	capex				
Insurance		0%	2 625			-	-
Maintenance		0%	2 625			-	-
Depreciation			278			-	-
Working capital interest					-	-	-
Phone cost					108	60	0,01
Fuel/Water					108	60	0,01
Certification					-	-	-
Electricity					198	-	-
travel					263	146	0,03
TOTAL FIXED COSTS					198	316	0,06
PROFIT BEFORE TAX		74%				1 314	0,25
							2 364

The situation in Casamance is different, for a number of reasons:

- They mostly lack access to the lucrative export market.

- They fetch far lower prices on the local market, because there is much more supply and it requires multiple traders and a longer transport route crossing borders to reach the Dakar market.
- The planting density is far lower for most farmers because they have mango trees in an open field as opposed to some horticultural crops in-between the mango trees. Yield per ha are much lower.

This means that for Casamance, Mango is even more of a side income for which no real investments are made. Most farmers do not prune or fertilise or spray. They don't typically invest in labour & so rely on family labour. It is simply a bonus income, that comes at a time when farmers have limited other income, ahead of the planting of the major crop when the rains start. It also acts as a diversification strategy providing an alternative source of income.

Commercial plantations on the other hand are a labour intensive business, requiring treatment throughout the year, plus casual labour during the harvest and pruning after the harvest. A 100ha plantation would have 10 permanent employees, 10 workers during the season in the packhouse and another 90 people harvesting.

6.2 Food security

Food security- and developing some degree of self-sufficiency- is a particularly pressing theme in Senegal. Fruit is an important part of a healthy diet, and there are few fruits produced in Senegal. It is pretty much limited to Mango, some banana and water melons, as well as sweet melons for export. From this perspective having local production of fruit decreases imports and has a positive impact on health.

6.3 Inclusive Development

Mango farming in Senegal is mostly limited to men. Establishing an orchard requires secure land rights and an up-front investment which usually places it outside the possibilities of women. Nevertheless experience suggest women are usually better in managing horticultural crops. Fruit farming is also an activity that often attracts a younger crowd keen to set up professional orchards, even if they need to start out small. There is thus a challenge in looking into how youth and women can access land to establish orchards.

Professional orchards as well as extension services to smaller farmers, professional nurseries, orchard maintenance services and sale and servicing of small scale irrigation systems are all activities that are of interest to youth. They are more modern technology driven activities that can be grown gradually and do not require large investments up front.

Women are involved in retail of mangoes, but not so much in trading (bana banas). In other West African countries mango processing is the domain of women, with usually about 50% of entrepreneurs and over 90% of the factory staff being women. Hence developing this activity in Senegal and particularly Casamance would offer great opportunities for women.

Women tend to be over-represented in the more detail-oriented activities in packhouses. This bodes well for their ability to find employment. This is reflected in the employment statistics

shared by industrial fruit and vegetable growers. At Grand Domaine du Senegal (GDS) 22% of their staff is female. Van Oers, employs more than 4000 women during the harvest period. Furthermore, this is an area where women are generally not in competition with men. Industrial production is this a meaningful way to create better inclusivity of women in the workforce.

7 Options for Intervention

7.1 SWOT Analysis

<p>Strengths:</p> <ul style="list-style-type: none"> – Unique export window for EU – Close to EU market – Good climate for mango – Presence of professional plantations – Relatively advanced small scale farmers 	<p>Weaknesses:</p> <ul style="list-style-type: none"> – High price of mango, in particular export grade – Low yields per ha for commercial plantations compared to peers – No professional processing sector – Domestic trade poorly organised – Largest production region, Casamance, is poorly connected to the market – Domestic trade is not well organised – Dependent on groundwater from boreholes, high cost of pumping – Production of trees is not professionalised – Fresh export is very dependent on one variety, Kent
<p>Opportunities:</p> <ul style="list-style-type: none"> – Exports can be doubled: space in the market – Expansion of orchards in Senegal River Valley – Processing in Casamance if varieties are suitable – Space for women and youth in services of small scale farmers and nurseries – Solar irrigation – Lengthening the season with new variety Osteen 	<p>Threats:</p> <ul style="list-style-type: none"> – Unsustainable use of groundwater – Urbanisation is taking productive land out of the mango zone – Fruit fly and other diseases make Keitt less feasible

7.2 Bottlenecks & Interventions

Bottlenecks	#	Interventions	Fit with Dutch Knowledge, Strategic interests etc.	SDG Goals
Space to expand fresh exports to the EU.	1	Support investment in orchard expansion in existing and new production areas. (investment promotion, access to finance, technical proficiency and market linkages with the NL and other EU countries.	****	1,2,8
A yield gap with major exporting countries & unsustainable water usage.	2a	Support knowledge development in the mango sector that focusses on yield improvements and sustainable practices. This includes introducing precision farming techniques, water management, enhancing knowledge around new productive zones along the Senegal River, and new models of energy.	**	1,2,8
Unsustainable water use, with high use of non-renewable energy for irrigation.			***	12
Processing opportunity in Casamance (potential roadmap to fresh exports).	3	Explore the feasibility of a processing opportunity in the Casamance (juice, dried fruit, frozen cubes).	***	1,2,8
		Post-harvest logistics development – infrastructure, organisation of farmers or collectors.		
		These interventions lay the foundation for an expansion of existing fresh mango exports.		
Lack of a competitive processing sector, which could become problematic when production of fresh ramps up.	4	Explore the feasibility of a processing opportunity in the Niayes (juice, dried fruit, frozen cubes).	***	1,2,8

No availability of new Genetic material & nurseries in the Casamance	5	Explore new nursery models for the Casamance. This will require a cleared understanding of the end markets- fresh, processed etc. and whether there is a case for investing in commercial orchards or paid trees.	**	1,2,5
Orchard maintenance services.	5	Expand support of commercial orchard maintenance services (investment promotion and technical support).	*	1,2,8,4

Sustainable Development Goals



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