LOST POTENTIAL

MANGO LOSS AND WASTE IN SENEGAL
Feedback is an environmental organisation that campaigns to end food waste at every level of the food system. We catalyse action on eliminating food waste globally, working with governments, international institutions, businesses, NGOs, grassroots organisations and the public to change society’s attitude toward wasting food.

Initiative Prospective Agricole Et Rurale (IPAR) is a think tank based in Dakar, Senegal. IPAR’s mission is to contribute to social and economic development in Senegal and the sub-region by promoting exchange and debate based on rigorous strategic research and recommendations for inclusive policies, particularly in the agricultural and rural sectors. IPAR’s main activities include conducting pertinent, high-quality research to create and animate exchanges and debates as well as train relevant actors and reinforce their capacities, to create and animate exchanges and debates spheres.

Research conducted by Feedback and IPAR

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INTRODUCTION

Senegal is the second largest exporter of mangos in West Africa and the industry provides rural employment for thousands of people. As a country it has a long history of mango cultivation, yet it was only in the 1990s when exports of the tropical fruit really took off.

Despite the importance of mango production to the Senegalese economy, the full potential of this fruit is yet to be realised, as only 13% of the country’s mangos are currently exported, whilst much of the fruit is left unsold even to the local market. As a result, large volumes of this crop in Senegal are either lost or wasted. This represents a significant lost opportunity for rural development, as well as an opportunity for better nutritional and environmental outcomes.

This report draws on in-depth interviews with a range of stakeholders from across the mango industry to understand the main causes of food loss and waste (FLW) experienced in Senegal. These interviews have allowed Feedback and IPAR to put forward the first estimate of national FLW for Senegalese mangos and develop a proposed strategy for tackling this issue which is outlined in the penultimate section of the report.

Summary of findings
The following is a summary of the findings from this report:
• An estimated 65% of mangos in Senegal are wasted every year, equating to around 88,000 tonnes.
• The main causes of FLW are fruit fly, infrastructural challenges, weakness of cold storage methods, harvest management, cosmetic specifications, and local market saturation.
• Exporting companies select mangos from farms based on cosmetic appearance. The result is that farmers are left with large amounts of mangos on their trees which are unsold.
• Although there is a strong national demand for mangos in Senegal, the local market is often saturated, leading to low prices and mangos being wasted at later stages of the local supply chain.
• The region of Casamance suffers the greatest with the issue of food loss and waste, with estimates of 80% of production being lost or wasted in this area, despite growing the largest volume of mangos in the country. This is largely due to inadequate infrastructure connecting the region with ports.
Methodology
This report is the result of primary and secondary research conducted between January and October 2016. Field research was initially conducted in Germany where Feedback attended the *Fruit Logistica* exposition in Berlin in February 2016. At this event Feedback conducted interviews with nine Senegalese mango exporters to obtain initial data on experiences of food loss and waste on Senegalese farms.

After analysis of the initial findings from Berlin, Feedback spoke with a range of industry experts in Senegal and Europe to confirm the results received from the interviews. Feedback then began working with IPAR to reach various actors on the ground in Senegal.

A field trip was designed and executed in October 2016 during which Feedback and IPAR conducted a series of interviews with mango producers and exporters, as well as government and industry officials.

In total 17 interviews were conducted. Two of these interviews were conducted with producer organisations that represented collectively over 2,000 small scale producers to give an idea of scale of the wider sample represented by this research. The major limitation to this sample was geographical as field research was not conducted in the region of Casamance due to travel warnings at the time of study. Nonetheless, data was gathered from industry actors on the mango industry in Casamance for this report. Casamance is reported to be the most productive region of Senegal with regards to mangos as well as the region with the greatest volume of FLW. Not conducting research in this region is regrettable, but presents an immediate opportunity for future research.

The interview results in both field locations obtained a strong degree of consistency. These results were checked against existing literature and online sources. This comparison, which is documented in the report, suggests that the results, including estimates made, have a high degree of validity and representativeness. The design of the field trip to Senegal, ensured that industry and government representatives were interviewed after initial results were gathered, in order to seek validation by these institutions.

One recommendation of this report is for further research to be conducted, in particular to gain a more accurate picture of the total production and loss/waste of mangos in Senegal via a formal census. The results of this report are therefore presented in a way that should encourage replicability.
National production and exports

Estimates of Senegal's national mango production vary due to a scarcity of country-level data. The Senegalese Export Promotion Agency, ASEPEX, estimates that national production in 2015 was 125,000 tonnes. This volume is produced over 25,000 hectares of land, according to the Direction de la protection des végétaux. However, one exporter interviewed for this research suggested that this figure could be as high as 150,000 tonnes. Despite the significant availability of mangos, the country is reported to export only 10% of its production. In 2015 Senegal exported 16,397 tonnes of mangos, or 13% of total production. Whichever figures are taken as accurate it appears that exports of mangos are rising year on year as is shown in the table below.
Exported mangos generated 10 billion CFCA in revenue (approximately $16.5 million) for the Senegalese industry in 2015 (0.12% of GDP). Production and export volumes for 2016 are however expected to be lower than 2015. This is due to climatic conditions in 2015, including excessive rainfall that caused a delay in flowering of the mango trees which affected the fruit maturation process. The main market destinations are the Netherlands, France, and the United Kingdomvi.

### Regional production and exports

Senegal has three major areas of mango production. **Casamance** is the largest producer of mangos in terms of quantity (60% of national productionvii), followed by **Bas Saloum** and **Niayes** (combined 40% of national production). However, despite Niayes’ low productivity, most the country’s mango exports arise from this region and thus it is the highest earning area in the sector. There are three reasons for this:

1) The area of Casamance is situated south of the Gambia and the roads connecting this region with the country’s main ports are not well equipped for effective logistics.

2) Bas Saloum is further away from Dakar than Niayes, yet much closer than Casamance. However, this region has not benefited as greatly from capacity building programs compared to Niayes with regards to mango harvest management and quality control. This has limited the number of mangos that producers in Bas Saloum can export themselves, and means that they rely on exporters in Niayes to select which mangos can be exported.

3) Although Niayes produces a small quantity of mangos as a region, the exporters based here have trusted relationships with European importers. Niayes exporters purchase additional mangos from farms in Bas Saloum and Casamance to aggregate sufficient volumes to satisfy the demand that they otherwise could not supply.

Although estimates of relative productivity and exportation were provided as percentages, the stakeholders interviewed for this research were unable to give concrete data on the actual quantity of mangos produced in each region. The reason for this was twofold: firstly, no official census has been taken for mango production volumes; and secondly, whilst it is necessary to know how many mangos are exported, there is currently little incentive for producers to measure their overall production. For the purposes of this report the following estimates of regional production have been given based upon the answers provided by stakeholders interviewed for this reportviii. These estimates have later been used to calculate a national estimate of FLW.

<table>
<thead>
<tr>
<th>Region</th>
<th>% of National Production</th>
<th>Volume of Production (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>60</td>
<td>75,000</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>25</td>
<td>31,250</td>
</tr>
<tr>
<td>Niayes</td>
<td>15</td>
<td>18,750</td>
</tr>
</tbody>
</table>
Casamance (75,000 tonnes) - 60%
Bas Saloum (31,250 tonnes) - 25%
Niayes (18,750 tonnes) - 15%
% OF NATIONAL PRODUCTION
Feedback define **food loss** as food that is unintentionally removed from the supply chain, e.g. due to a breakdown in cold chain logistics, poor harvesting methods, or other infrastructural issues that can lead to spoilage. **Food waste** conversely, can be defined as mature food crops intended for human consumption that are either discarded or left to spoil as a result of the behaviour of stakeholders across the supply chain (farmers, brokers, exporters, importers, retailers, and consumers).

Like many fresh produce sectors, the mango industry in Senegal is affected by both food waste and food losses. However, Senegal provides a clear example of the interrelation between food waste and loss, as will be discussed in this section of the report.

**Farm-level food loss and waste**

Estimates of farm-level food loss and waste (FLW) varied between producers from 10 to 50%\(^\text{x}\) (Niayes and Bas Saloum regions); however, many producers suggested that losses could be as high as 80% in Casamance. Many producers in the Bas Saloum and Niayes regions reported working to an 80:20 rule, whereby they expected only 20% of each mango tree to be suitable for exporting, with the rest being sold to local markets, processors, or left in the field.

Sales to the local market depend on the price being high enough for producers to warrant picking the mangos. In cases where the market is saturated with an oversupply of mangos, many producers are forced to leave greater quantities of mangos in the field. There is a short window for mangos to be sold as they approach maturity - the longer mangos are left in the field, the higher their susceptibility to fruit fly damage. There is a very small processing industry for mango products in Senegal, which has a higher tolerance for damaged fruit to make various value added items\(^*\) such as syrups, dried fruit and juices. However, many producers (particularly small and medium producers) do not currently have access to these secondary markets.
Where producers are able to sell mangos to the local market, they reported a number of problems arising within the trading relationships between producers and market traders. Due to the informal nature of local market trade, producers often sold their mangos to traders without guarantee of payment or any type of contract. At times when the local market is saturated with mangos, producers based in Bas Saloum reported not being paid for their mangos as market traders claimed they had been unable to sell the product. Without formal contracts, means to record sales, or evidence of fruit being unsold producers had little power to make a claim against these buyers. Producers argued that due to the highly perishable nature of their products, they had little choice but to continue trying to sell as much as they could to these secondary markets despite the risk.

Export level food waste
There are three broad types of exporter in the Senegalese mango sector. Firstly, there are those who export only mangos that they have grown themselves. These tend to be larger industrial producer/exporter companies. Secondly, there are those who export their own fruit, whilst also sourcing from additional suppliers. Thirdly, there are those who export mangos on behalf of a wide range of producers. This third group are generally the commercial branch of producer organisations such as cooperatives, associations and federations. Whilst each of these groups are different in their business model and size, exporters as a whole tend to have lower volumes of waste than producers and minimal loss.

The larger industrial exporters have their own integrated supply base which incentivises them to maximise exportable yields to minimise risks associated with FLW. In addition, they benefit from relations with the emerging mango processing industry, largely due to their size and ability to supply stable volumes of mangos.

In the case of those exporters who source mangos from outside of their own operations this lower frequency of FLW is because they select only the best fruit from the field. This reduces the amount of waste as a result of cosmetic specifications in their operations, whilst leaving the remaining fruit in the field. Exporters, particularly in the Niayes region, have benefitted from capacity building training, which has increased their skills in harvest management (amongst other areas). Exporters are trained to know the exact specifications of mangos (size, shape, colour) required by the import markets and so select only mangos that meet these criteria. This has given exporters an advantage in the sector as they have in effect become gate keepers for mango sales to Europe.

There is the potential for this concentration of knowledge to lead to abuse of this position particularly as the majority of mango producers claim to not have annual order programs or forecasts, meaning that mango harvests are left to the whim of the exporters. Without knowing what a ‘good’ or ‘bad’ mango looks like, producers are unable to question why a greater proportion of mangos are not exported. Therefore, whilst exporters tend to have lower volumes of wasted or lost mangos, these risks are unfairly shouldered by producers.
Although producers have had limited access to capacity building programs, there are several success stories relating to producer organisations receiving such training. Three producer organisations (two cooperatives and one federation) reported having received capacity building training to empower them to make their own selection for exports, thus increasing the volume of mangos sold to exporters. Through this training these organisations have now begun exporting directly themselves, further increasing their exportable yields and income for the producers, and also reducing FLW.

All stakeholders interviewed for this research believed there was a need for more research and data to obtain a better understanding of the volumes of mangos exported, sold locally, processed and lost in Senegal. Furthermore, the producers interviewed argued that there is a great need for further dissemination of capacity building programs to empower producers to maximise the exportability of their crops and reduce waste. Those producers who had benefitted from such training suggested that there is a need for trainer training amongst those in the industry to enable swifter dissemination of knowledge.

Causes of food loss and waste
The primary reasons for food loss and waste in the Senegalese mango sector are as follows:

Food Loss

Fruit fly
Fruit flies were recognised to be the major driver of losses in Senegal for mango production. This pest attacks fruit in its final stages of maturation and renders the fruit unsellable in a matter of days. Several efforts have been made to prevent fruit flies, for example by netting mango trees, but the major barrier to the success of these initiatives is the cost of the tools to the producers. It was argued that fruit fly prevalence could be reduced if less mangos were left in the field after the harvest selection, as the sheer quantity of mangos attracts more flies.
Infrastructure
Another major driver of food loss was a lack of access to markets caused by inadequate infrastructure. The roads between Casamance and Dakar are not appropriate for large vehicles to carry fruit on and so limited volumes of produce can be taken from the field to the market. Aside from fruit fly this was considered the single biggest issue causing food loss in Casamance. However, this is less problematic in the Bas Saloum and Niayes regions given their closer proximity to Dakar.

Cold Storage
A lack of adequate cold storage facilities at the farm level was identified as a challenge to being able to scale up the volume of mangos available for export. Furthermore, it was argued that the existing cold storage capacity at export pack houses also needed to be scaled up to enable a greater quantity of mangos to be stored properly to ensure sufficient shelf-life for exporting Europe.
**Harvest Management**
Producers identified the handling of crops as a minor cause of losses due to bruising of fruit and harvesting fruit prior to sufficient stages of maturation.

**Food Waste**

**Cosmetic Specifications**
Actors from across the mango sector argued that cosmetic specifications were currently too strict and preventing good edible mangos from being exported. In some cases, a proportion of the surplus ‘imperfect’ fruit could be sold to the local market, but many producers said that they were unable to sell all of their fruit despite it being of safe and edible quality. One producer’s cooperative interviewed suggested that if cosmetic specifications were relaxed to allow for a greater variance of different colour, shape and size mangos, they would be able to export 50-60% more of their product. They argued that, the “export potential is reduced because of cosmetic specifications”.

**Local Market Saturation**
Given the high availability of mangos present in Senegal's export sector the local market is reported to be often saturated with surplus fruit. As a result, the price for mangos on the local market is very low which presents two problems with regards to waste. Firstly, where it is not economically viable for producers and exporters to sell their mangos to local traders they will choose to throw them away instead. Secondly, where mangos are taken by local traders, the traders themselves can sometimes not obtain a good price for the mangos and so transfer this cost back to the farm by not giving a payment. Where the trader can't sell the product they let it go to waste as well. This market is largely informal thus no contract exists between producers and local traders, meaning that there is no guarantee of payment for the producer.

**National and regional FLW estimations**
The proportion of mangos lost or wasted in Senegal, like national production, is equally uncertain as there is no formal process for measuring the quantity of unsold mangos at the farm level.

In 2014, it was reported that 20-30% of Senegalese mango production was lost due to fruit fly, although this figure was followed by a suggestion that ‘only around 10,000 tonnes are exported and the rest is not commercialised and therefore lost’\(^\text{xi}\). The reason for this further loss (beyond the 20-30%) relates to the other reasons for FLW explained above. However, this figure seems high (suggesting that between 89-91% of mango production is lost or wasted\(^\text{xii}\)) and perhaps relates only to mangos ‘not exported’, and thus ignores mangos commercialised through the local markets.
In an interview for this research the Direction de la Protection des végétaux (DPV) estimated that up to 50% of mangos are lost nationally. However, other stakeholders interviewed suggested that the national average maybe as high as 70%.

This section of the report outlines estimates of FLW provided by various stakeholders in the mango growing regions of Niayes, Bas Saloum and Casamance. FLW have been aggregated due to a lack of data separating these two issues and due to the interconnected nature of waste (as a result of cosmetic specifications) and losses as described earlier. Furthermore, FLW has not been differentiated by mango variety (of which there are three principal varieties) although this would be a useful area of further analysis. After careful consideration of a range of regional estimates of FLW, a national estimate is provided for the purposes of developing an initial picture of the scale of mango FLW in Senegal.
Niayes

According to interviews with small holder cooperatives in Niayes, it is estimated that this region loses/wastes 45-50% of mango production per annum. It should be noted that this figure is an average and is not representative of all businesses in Niayes. For example, larger industrial producer/exporters (as explained above) and more advanced producer cooperatives have much lower waste due to greater access to training and direct trading relationships with importers. However, these are the exception rather than the rule at present.

Another note to highlight with regards to this estimate is that it refers only to production in Niayes. It does not include mangos sourced for exportation from producers in Bas Saloum and Casamance.

The diagram above depicts an average of 47.5% (8906.25 tonnes) of mango production being lost or wasted in Niayes, compared with an estimated 40% (7,500 tonnes) of mangos being exported. The remaining 12.5% (2343.75 tonnes) of production has been estimated to be either sold to local markets or in very small quantities to processors. Although cosmetic specifications are problematic for the stakeholders in Niayes, the main cause of this 47.5% is the fruit fly. It can be assumed that this figure refers largely to food loss caused by this pest, although as has been described above, addressing cosmetic specifications would have an impact on reducing both waste and losses.

Bas Saloum

An average of 40-60% of production in Bas Saloum was estimated to be lost/wasted by a local Government Development Agency that works to
develop the potential of the agricultural sector in this area, in particular with the mango industry.

The diagram to the right shows an average of 50% (15,625 tonnes) of mango production being lost or wasted in Bas Saloum compared with 20% (6,250 tonnes) being exported. Considering these two figures provided by stakeholders 30% is estimated to being sold to the local market (again with a very small proportion being sent to processors). Bas Saloum has a slightly higher average rate of FLW due primarily to the majority of production being graded by third party exporters who may impose excessively cautious measures. Producers in Bas Saloum also suffer from the problem of fruit flies.

Casamance

Although Casamance was not visited during the field trip to Senegal, each of the stakeholders interviewed reported losses between 70-80%. It is widely acknowledged that Casamance faces the most severe problems with FLW due to its remote location and insufficient infrastructure connecting its mango producers to Senegal's ports. Casamance is equally prone to pest damage from fruit flies, and would benefit greatly from capacity building programs to increase knowledge regarding export quality requirements and harvest methods. As with both previous regions discussed, Casamance would also benefit from cosmetic specifications being relaxed in order to increase the number of mangos available for exportation.

The diagram above shows an average of 75% (56,250 tonnes) of mango production in Casamance being wasted or lost. This figure echoes an estimate put forward by research conducted by a social impact investment company in 2013.

Estimates for export volumes and sales to local markets were not available for Casamance so an aggregated estimate of 25% (18,750 tonnes) has been calculated. To arrive at the given export (4.25%) and local market sales (20.75%) ratio, two assumptions have been made which are detailed in the appendix of this report. It is expected that like
Niayes and Bas Saloum, the number of mangos being sent to processors is negligible in Casamance.

**National estimate of FLW**

Given the range of FLW estimates per region provided by various stakeholders in Senegal, two scenarios can be estimated at present. Firstly, considering the lower estimates provided, a national FLW figure of 59% can be proposed (see scenario 1 below). Regarding the higher estimates given by stakeholders, a higher national estimate of 71% is arrived at (see scenario 2 below).

<table>
<thead>
<tr>
<th>Scenario 1 - low estimates</th>
<th>Production (tonnes)</th>
<th>FLW %</th>
<th>FLW (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>75,000</td>
<td>70%</td>
<td>52,500</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>31,250</td>
<td>40%</td>
<td>12,500</td>
</tr>
<tr>
<td>Niayes</td>
<td>18,750</td>
<td>45%</td>
<td>8,437.5</td>
</tr>
<tr>
<td><strong>Total national waste</strong></td>
<td><strong>73,437.5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total national production</strong></td>
<td><strong>125,000</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total national waste (%)</strong></td>
<td><strong>59%</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2 - high estimates</th>
<th>Production (tonnes)</th>
<th>FLW %</th>
<th>FLW (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>75,000</td>
<td>80%</td>
<td>60,000</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>31,250</td>
<td>60%</td>
<td>18,750</td>
</tr>
<tr>
<td>Niayes</td>
<td>18,750</td>
<td>50%</td>
<td>9,375</td>
</tr>
<tr>
<td><strong>Total national waste</strong></td>
<td><strong>88,125</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total national production</strong></td>
<td><strong>125,000</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total national waste (%)</strong></td>
<td><strong>71%</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These estimates require further testing and would benefit from finer-grain data. **However, if the scenarios are taken as representative for each region a midpoint average of the two scenarios produces an estimate of 65% of national production being lost or wasted. This is equal to 81,250 tonnes per annum.** This figure is within a 5-15% range of estimates given by a range of actors who estimated a national loss of 50-70% as suggested above.

This estimate is similar to that of the Kenyan mango industry, where 64% of mangos are reported to be lost for similar reasons. This is perhaps unsurprising as both countries have similar histories of fresh produce trade with Europe and efforts to tackle post-harvest losses in both countries are still relatively young, particularly with regards to infrastructure and post-harvest management. However, this is an important point of comparison as it is likely that there will be several learnings that could be shared between actors in both countries to address FLW in order to prevent duplicating
mistakes. Furthermore, having similar baseline data in both countries offers a unique opportunity to test various methods for FLW reduction. Such comparisons should however be taken with caution, given the difference in sample sizes between this study and the research conducted in Kenya.

The diagram to the left compares the estimated 65% FLW with the reported volume of exports (10%) and derives that an estimated 25% of national production is sold to the local market or processors. As with the previous estimates, the amount of produce sold to processors is likely to be a very small proportion of this 25%, as many of the stakeholders interviewed regarded the number of mangos going to this industry as negligible.
SOLUTIONS TO WASTE/LOSSES

The following solutions to waste and losses were proposed by various stakeholders in the mango export sector. There was a significant deal of agreement amongst different parties that the following solutions are required to prevent FLW. The solutions are listed in a specific order to demonstrate the stages required for a systemic approach to preventing FLW. As such, each stage is a pre-requisite for the stage which follows. Most producers require support to progress throughout this model to reduce FLW and increase on-farm incomes. However, some stakeholders have had more progress and therefore only the later stages will be of use to them.

Organisation of producers

The first challenge to reducing FLW in the mango supply chain relates to the dependence of unorganised producers on exporters and other intermediaries to harvest, market and sell fruit. This dependence leaves producers at the whim of these actors and vulnerable not only to exploitative practices, but also severely restricts the potential volume of mangos they can sell to the export market.

All the producers we met with at the different stages of this research agreed that the catalysing moment for their business in becoming a more effective actor in the export supply chain, and for reducing FLW, was when they joined other producers as part of various models of organisation. These models can take the form of associations, cooperatives or federations. Members of each of these types of organisation were interviewed for this study, each of which represented different numbers of small-scale producers, from 14 to over 1,500.

The shared principal underpinning each of these forms of organisation is that through bringing together a diverse pool of small-scale producers, many independent actors can aggregate larger volumes of produce to supply the demands of higher value markets. This increases the selling power of producers and is the first step towards empowering producers to maximise the total usage of their crop.

Capacity building

Once a number of independent small producers organise themselves and gain access to high value markets, they are also able to obtain training in order to further develop their businesses. Such training may come at a cost which can be shared equally amongst the various members, or may be provided for free.

"It is not enough to be organised – your capacity must be updated frequently"

PRESIDENT OF A MANGO PRODUCER’S COOPERATIVE (INTERVIEW 19 OCT 2016)
but only accessible to those existing as organisations, as was the case for the organisations interviewed.

Training can of course be applied to numerous areas of an organisation, but with regards to FLW, the capacity building in relation to harvest management and trade negotiations are the most critical. Being trained in harvest management empowers producers to be able to a) assess the stages of a fruit’s maturity to prevent over-maturation which made lead to loss and b) to grade their own fruit rather than relying on the will of separate exporters thus reducing the amount of exportable fruit left in the field. Training on trading negotiations allows producers to obtain greater countervailing power, or selling power, to ensure the contract through which they sell their produce are written on an equitable basis and serve both the interests of the buyer and seller, whether this is via an exporter or direct to an importer.

Exporters and farmers in Niayes reported to benefit from access to capacity building and industry training as a result of organising themselves. These businesses are now able to obtain better prices for their mangos; have developed direct relationships with importers in Europe and North Africa; and also contribute to a strong national reputation for the Senegalese mango industry. In comparison to businesses in Niayes, producers in the Bas Saloum region reported that they were at a disadvantage as they had not received training to build their capacity with regards to production and harvesting best practice.

14 small-scale mango producers in Bas Saloum expressed a strong desire to receive the same level of training that their counterparts in Niayes were receiving. Similarly, greater dissemination of training in the Casamance is required. ASEPEX and DPV reported some progress being made with regards to training in both regions but both agreed that there is a critical need for further investment in this training to improve its dissemination and effectiveness.
Shortened supply chains: direct producer – importer trading

The ultimate goal for all producers interviewed, after having organised themselves, was to be able to export their own produce direct to buyers in Europe. This was the principal driver for producer organisations to build their capacity through training, and was seen as a way not only to increase revenue for themselves, but also as a way to reduce the waste incurred through grading by having greater control over negotiations with overseas buyers. In addition to these benefits to the producers, buyers and consumers will ultimately benefit from a wider choice of products and brands, competitive pricing and ultimately increased innovation in the supply chain as a result of a greater diversity of exporting organisations selling mangos. Increased direct sales between producer organisations and importers also reduces the need for multiple intermediary actors, which could further reduce the overall cost of getting a mango from farm to fork.

Many overseas buyers require assurance that quality controls can be maintained and also that sufficient volumes can be supplied. Therefore, both previous stages are required prior to direct trading relations being established.

ASEPEX expressed concern that although direct trading relations between producer organisations and importers are beneficial, unless the capacity of the producers are strengthened with regards to marketing and negotiations there is a risk that producers could be exploited by overseas buyers. They noted that exporters have experienced situations in which produce has been rejected at the final destination without evidence being provided to back up the claims. In these cases, the price paid for produce is often deducted, but rather than contesting these issues exporters choose to accept the claims for fear of losing business. This is global phenomenon that testifies to the imbalance of power within the food economy, in which those closest to the later stages of the supply chain have significantly greater power than those near the production stages. In other countries some producers and exporters have taken to hiring third party surveyors or insurance companies to deal with rejections claims, however this was not common practice in Senegal as exporters perceived that such a decision would affect their competitiveness. To ensure that the benefits of shorter supply chains are maximised for the producer, training must therefore be provided to ensure producers and buyers operate under equitable contractual terms.

“Once you get organised you can get your voice heard, and you will not be exploited. Getting organised means you can get around the intermediaries”

PRESIDENT OF A MANGO PRODUCER’S COOPERATIVE (INTERVIEW 19 OCT 2016)
Relaxation of cosmetic specifications

All of the stakeholders interviewed for this research agreed that the cosmetic specifications enforced for mango exports were unnecessarily strict and restricted the total volume of mangos that could be sold. One producer’s cooperative that exported its own produce argued that if cosmetic specifications were relaxed they would be able to export 50-60% more mangos to the European market. ASEPEX further argued that relaxing cosmetic specifications is a necessary ‘requirement’ if Senegal is to increase the volume of mangos it can export and reduce national FLW.

Mangos are judged upon their size, shape and colour with regards to cosmetic specifications. There are of course criteria to be met with regards to flavour (judged by a sweetness index) and health and safety, yet these additional criteria are regarded by the industry as a major block to maximising export volumes. As is mentioned in the previous section of this report, the effect of these restrictions means that as much as 80% of mangos can be left behind in the field. Whilst some of these mangos will be sold to local markets or processors, a great deal of them will ultimately be affected by fruit fly or other issues and will rot in the field.

Cosmetic specifications are determined by the ultimate purchaser, which more often than not is a retailer. Cosmetic specifications set by European retailers set a very low tolerance for fruit exports which is ultimately taken as an industry standard. Different categories of product quality exist, but each of these, the stakeholders argue, are too strict.

The reason the relaxation of cosmetic specifications is placed at this stage is that producers argued that only after organising, receiving training, and establishing direct relations with importers, would this measure achieve a maximum impact. The rationale for this is that although relaxing the cosmetic specifications of mangos would increase the number of mangos that can be exported, the industry is currently set up to operate with smaller volumes that could be potentially sold. Therefore, alongside the relaxation of cosmetic specifications, producers argued that there would be a simultaneous requirement to build larger cold storage facilities to house greater volumes of mangos. Demand would also need to increase to match the newly available volume of mangos, either through existing fresh produce channels or through the establishment of various processing industries.
Development of processing industry

Even after the previous four stages have been achieved by a large part of the mango industry, there will ultimately still be a percentage of mango production that is lost due to not meeting the requirements for local and export markets. Despite this, many of these mangos could be valorised through processing facilities to create a range of products such as: chutneys and jams; dried mangos and mango powder; syrups, juices and other drinks; vinegar; and confectionary. These products would generate additional income for producers by maximising the total sold crop, whilst also generating further jobs for rural communities.

An exporter based in Niayes reported sending 40% of their unexportable mangos to a juice processing facility near their facilities whilst the remaining 60% was buried to prevent the spreading of fruit flies. The exporter had been unable to sell their mangos to the local market as it was often saturated with the surplus production from other producers and exporters in the area, and therefore did not offer satisfactory prices. Now
the exporter can sell 400 tonnes of mangos per year that would have been previously wasted to a juice making business.

The cooperative interviewed in Niayes benefited from a similar relationship with two juice making companies and was able to sell an estimated 35,000 tonnes of surplus mangos per year to these processors (70% of their surplus production). Both of these juice making companies are industrial facilities that required large volumes of mangos to be delivered. However, smaller processing operations are feasible, as are decentralised models. One small processing business was interviewed that has been processing fruit into jams, juices, and syrups for 12 years\textsuperscript{xvii/xviii} and sell their produce to the local market. The business is run by women and employs women across three generations.

The producers from Bas Saloum suggested that there was a significant need for investment in processing facilities in each of the three regions to add value to unexportable mangos that currently cannot be sold to the local market. This desire was further explained by a producer’s organisation in Niayes\textsuperscript{xix} that represents 1200 mango producers, operating over a total of 100 hectares\textsuperscript{xx}. They proposed that the development of a larger processing industry for mangos would provide a solution to the issue of fruit flies that currently cause the country to lose much of its mango production. It was argued that during periods of increased fruit fly prevalence, the mangos could be harvested before reaching full maturity and processed to create different products. Examples of value-added products that can make use of mangos prior to full maturation, include canned fruit, juice and jam\textsuperscript{xxi}. These products would be storable and therefore have a greater shelf-life. Furthermore, the markets for value-added products may offer wider opportunities for producers, for example North Africa is reported to be the world’s largest market for the consumption of mango puree\textsuperscript{xxii}.

Some efforts are being made to invest in processing facilities. One local government official working in regional development reported that a cold storage and processing facility was due to be built in Bas Saloum, which is expected to export 150 tonnes of mangos during its pilot in 2017\textsuperscript{xxiii}. The local economy is expected to benefit from the
facility by receiving 50% more income for their mangos then they currently receive from exporters based in Niayes\textsuperscript{xxiv}. There is however, a significant need for more initiatives like this to be invested in to reduce mango FLW across the country.

An additional idea put forward by several producers was for small-scale on-site processing facilities, or even mobile processing facilities to be designed to allowed even greater decentralisation of this value chain. This idea would need further investigation and testing, but this would empower producer organisations to diversify their product ranges, whilst also offering a guaranteed outlet for surplus mangos.
CONCLUSIONS AND RECOMMENDATIONS

This report set out to understand the major causes of FLW in Senegal's mango sector. The interviews conducted achieved this objective whilst also providing valuable insights that have enabled an initial estimate of FLW in the industry to be proposed, and for a strategy for FLW reduction to be developed.

In concluding this report, the following two areas of recommendation are proposed as a means to identify the necessary next steps to tackle FLW in Senegal's mango industry:

Further research: food waste and loss estimates

All of the stakeholders interviewed for this report suggested that there is a strong need for a national census on mango production to enable accurate forecasting of mango availability on an annual basis. Such a census would also enable a more detailed estimate of FLW to be established. This data would allow for business models to be developed, particularly for processing facilities, to understand the true potential of the mango sector.

Further research is of particular need in the region of Casamance to understand how mango exports could be increased to bring greater socio-economic development to this rural area of the country.

Other potential areas for additional research include investigating the best methods for post-harvest produce management capacity building, comparisons of Senegal's agricultural and export industries to other African countries', and investment vehicles and strategies to develop businesses that use surplus mangos (and other surplus produce) as production inputs for new value-added products.

Food waste and loss solutions

Four key solutions to reducing the FLW of mangos were proposed by the producers and exporters interviewed for this research, namely: organising small scale producers; building the capacity of producer organisations to export directly; relaxation of cosmetic specifications; and the development of a processing industry for value added products. These solutions have been framed as part of a holistic strategy for FLW reduction as it is clear from this research that the greatest impact will be achieved by addressing each cause of food waste in sequence.

Various stakeholders must be included in this strategy to ensure it is effective:

- The Direction de la Protection des végétaux and ASEPEX should prioritise widespread dissemination of capacity building programs for post-harvest management and marketing in the Bas Saloum and Casamance regions. This will require investment and would benefit from international cooperation with agencies already working in this field.
• A great deal of work is already being done to reduce mango FLW in Kenya as part of The Rockefeller Foundation’s YieldWise initiative. TechnoServe is one such project supported by Yieldwise. The project has found that smallholder farmers are willing to adopt and utilise new technologies, that NGOs are able to deploy ready-to-implement tools to organise smallholder farmers, and that NGOs have the scale to aggregate smallholder farmers in value chains; the project is continuing to look into the long-term effects on food waste and loss of these steps. Feedback and IPAR recommend that knowledge is exchanged between stakeholders in Kenya and Senegal to benefit both industries and to serve as a testing platform for piloting different models of FLW reduction. The Rockefeller Foundation could support this exchange by holding workshops at regional conferences on this subject.

• European retailers must relax their cosmetic specifications. Retailers indirectly set industry standards for fruit and vegetables by applying unnecessarily strict cosmetic specifications. Retailers should review these specifications and ensure that fruit is judged on its edibility, safety, and taste not on how it looks.

• Senegal provides a strong investment opportunity for the development of value-added processing facilities. Feedback and IPAR recommends that Senegalese entrepreneurs develop business models for the transformation of surplus mangos into different value added products. Again, investment will be required for these businesses to be realised. There is potential for a range of initiatives to be developed, and stakeholders expressed interest in both large industrial facilities as well as small-scale mobile processing machinery.
APPENDIX

Calculations for report estimations

Regional Production

<table>
<thead>
<tr>
<th>Production (% Total)</th>
<th>Production (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>60% 75,000.00</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>25% 31,250.00</td>
</tr>
<tr>
<td>Niayes</td>
<td>15% 18,750.00</td>
</tr>
<tr>
<td>Total National Production:</td>
<td>125,000.00</td>
</tr>
</tbody>
</table>

This calculation contains a critical assumption (assumption 1) on which the major estimates from this report are based (areas highlighted in orange).

Whilst estimates for the total production of Casamance were obtained during this research (60% - 75,000 tonnes), estimates for Bas Saloum and Niayes have been extrapolated from the following information:

- Mango production in Bas Saloum and Niayes equates to 40% of national production (50,000 tonnes);
- Mango production in Bas Saloum is greater than that in Niayes;
- Bas Saloum experiences 40-60% FLW, and Niayes experiences 45-50% FLW.

Based upon this information an assumed 70/30 split in production (after Casamance) between Bas Saloum and Niayes has been given in order to produce regional production quantities.

This calculation is also based upon ASEPEX's official estimation that the national volume of production is 125,000 tonnes per annum. As stated earlier this report, this figure may be as high as 150,000 tonnes.

Regional contributions to national exports

<table>
<thead>
<tr>
<th>Exports (% Reg. Production)</th>
<th>Exports (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>4.25% 3,187.00</td>
</tr>
</tbody>
</table>
Regional sales to local market/processors

<table>
<thead>
<tr>
<th>Sales to Local market/processors (% Reg. Production)</th>
<th>Sales to Local market/processors (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>20.75%</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>30%</td>
</tr>
<tr>
<td>Niayes</td>
<td>12.5%</td>
</tr>
<tr>
<td>Total National Domestic sales</td>
<td></td>
</tr>
</tbody>
</table>

A third assumption is used in this calculation (assumption 3) and is highlighted in green. This assumption is based upon assumption 2 using the following information:

- Casamance produces 75,000 tonnes of mangos;
• Casamance experiences an average loss/waste of 52,500 tonnes (75% production);
• Casamance exports 3,178 tonnes of mangos (4.25% production);
• The remaining 20.75% of production (15,562 tonnes) is therefore assumed to be sold to local markets, with a negligible amount being sold to processors.

Regional and National FLW high and low estimates

<table>
<thead>
<tr>
<th></th>
<th>FLW Low estimate (% Reg. Production)</th>
<th>FLW High estimate (% Reg. Production)</th>
<th>FLW low (tonnes)</th>
<th>FLW high (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casamance</td>
<td>70%</td>
<td>80%</td>
<td>52,500.00</td>
<td>60,000.00</td>
</tr>
<tr>
<td>Bas Saloum</td>
<td>40%</td>
<td>60%</td>
<td>12,500.00</td>
<td>18,750.00</td>
</tr>
<tr>
<td>Niayes</td>
<td>45%</td>
<td>50%</td>
<td>8,437.50</td>
<td>9,375.00</td>
</tr>
</tbody>
</table>

Low and High estimates of National FLW:
- 73,437.50 tonnes
- 88,125.00 tonnes

Estimate of average National FLW: 80,781.25 tonnes

Estimates for regional FLW were given by a number of stakeholders during this research. The results of these estimates provided a low and high scenario for regional levels of FLW. These figures have been added together to produce low and high estimates of national FLW. This provides an estimated range of 59-71% of national mango production being lost or wasted. Taking an average from this range provides a national estimate of 65%.

National production, export, domestic sales and FLW comparison

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Total production</td>
<td>125,000</td>
<td>100%</td>
</tr>
<tr>
<td>Total exports</td>
<td>16,937</td>
<td>14%</td>
</tr>
<tr>
<td>Total domestic sales</td>
<td>26,719</td>
<td>21%</td>
</tr>
<tr>
<td>Total FLW</td>
<td>80,781.25</td>
<td>65%</td>
</tr>
</tbody>
</table>

This chart compares national production volumes alongside exports, domestic sales (including processors) and food loss and waste.
ENDNOTES & REFERENCES


iii www.freshplaza.com/article/159838/Adding-value-to-Senegalese-mangos

iv 02/16 Field research at Fruit Logistica

v www.africanews.com/2016/05/02/senegal-s-plans-to-boost-mango-exports/

vi www.freshplaza.com/article/159838/Adding-value-to-Senegalese-mangos

vii 21/10/16 Interview with DPV

In order to calculate estimates for regional production tonnage, two assumptions must be made. Firstly, a national production of 125,000 tonnes, as given by ASEPEX must be assumed. Secondly, whilst the total production contribution of Casamance was provided by stakeholders (60%), the relative contributions for Bas Saloum and Niayes were not readily available. Nonetheless it is widely accepted that Bas Saloum produces a greater volume of mangos than Niayes. Therefore, an assumption has been made that Bas Saloum produces 25% of national production, and Niayes 15%. Based upon these assumptions the following regional annual production estimates are generated:

ix 02/16 – Field research at Fruit Logistica, Berlin 10/16 – Field research in Senegal

x Intracen.org/news/Senegalese-mangos-to-receive-export-boost/

xii The article in footnote 12 estimates Senegal's national production at around 90,000 to 120,000.


xviii This business also processes cereals such as rice for the local community. This process is an example of a zero waste operation: any discoloured rice which is not sellable due to aesthetics are kept by the workers to cook themselves.

xxi In order to produce regional and national estimates of FLW.

xxiv The facility plans to pay 300 FCFA per kilo of mangos, compared to the 200 FCFA received by farmers for mangos sold to exporters in Niayes.