



Wageningen University & Research

Haiti Business Development and Investment Project

Final Report

Jan Brouwers, René Oostewechel, Yves-Laurent Regis



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Final report

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Institute: Wageningen Food & Biobased Research (part of Wageningen University & Research)

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Abbreviations

APHIS:	Animal and Plant Health Inspection Service (part of USDA)
DLT:	Distributed Ledger Technology
DM:	Dry Matter (of avocados)
HWT:	Hot Water Treatment
LSP:	Logistical Service Provider
MCI:	Ministry of Commerce and Industry (Haiti)
MPU:	Mobile Packing Unit
PauP:	Port au Prince
PDAI:	Business Development and Investment Project (French: Projet de Développement des Affaires et des Investissements)
POP:	Pre-clearance and Offshore Programs (procedure APHIS-PPQ)
PPQ:	Plant Protection and Quarantine
SAE:	Services d'Appui aux Entreprises
SOP:	Standard Operating Procedure
S&T-TMT:	Science and Technology, Treatment Mitigation Technology (procedure USDA-APHIS)
ToR:	Terms of Reference
US:	United States
USDA:	US Department of Agriculture
WB:	World Bank
WUR:	Wageningen University & Research
WFBR:	Wageningen Food & Biobased Research

Preface

This is the closing report of the technical support provided by Wageningen University & Research (WUR) for the Business Development and Investment Project in Haiti as agreed in the contract PPM-MCI-REF 12 (January 2020 – October 2021).

The first deliverables, a Training Report and a Recommendation Report, have been shared earlier with the commissioner, the Ministry of Industry and Commerce (MCI) in Haiti. The present report is the last deliverable: The Final Report. In addition, tailor made advice continues to be provided by the WUR team related to fruit export requirements and the design of the Mobile Packing Unit (MPU).

We believe these deliverables fulfil the intended goals of the technical support by WUR and are a good basis for the further progress of postharvest handling and preparing the pilot with the MPU in 2022.

We would like to thank the project team, especially Mick Pantal and Régine Napoleon from MCI and Emiliano Duch from the World Bank. Together, we had to overcome some challenges, such as changes in the project design, and travel restrictions due to COVID-19. We are also grateful to the partnership we experienced by all other project partners, including the pineapple, mango and avocado fruit producers we have encountered.

Solutions to challenges mentioned above have been found by adapting the design of the project, having close communication on project requirements, learning together from pilots, and maintaining a focus on how fruit small growers can be supported.

Any omission or misinterpretation in this report is entirely the responsibility of the authors and can in no way be attributed to other project partners or resource persons.

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1 Introduction

1.1 Project context

The majority of Haitian fruit producers are small growers mainly producing for the local market and for own consumption. Waste percentages are quite high, and the sector is not professionalized, resulting in a need to apply clear quality standards for fruit production, harvesting, storage and processing. Whereas mango and pineapple are exported, avocado does not have an export history, besides informal trade with the Dominican Republic.

Over recent years the Haitian government is assisting the small fruit growers. Through the Business and Investment Development Project (PDAI) the Haitian Ministry of Commerce and Industry (MCI) invests in a cold chain operation for fresh fruits including post-harvest and logistics services. The cold chain service will be available for avocado, mango and pineapple producers in the Centre, Artibonite, Nippes and Northeast Departments. The main goal is to implement a cold chain logistics service operating in Artibonite, Centre, Nippes and Northeast to achieve the overall goal of selling fresh fruits to the United States (US). The new cold chain should increase the competitiveness of the current fresh fruit sector, with the current fresh fruits producers in Haiti being able to serve higher value products to the US market.

For more background: <https://haitibusinessdevelopment.com/eng>

1.2 Project history

MCI has contracted Wageningen University & Research (WUR), through its research institute Wageningen Food & Biobased research (WFBR) to assist as the technical agent in advising on setting and implementing quality standards for harvesting, processing, storing and exporting fruits. A first contract was established in 2017 to design a packing house. The main idea at the start was to reduce waste and make the chain ready for export by introducing a packing house. However, it turned out that high costs and low operational capacity impeded this idea and the project was redesigned into a blockchain development to reach this goal.

A second contract was made over 2018-2019 to assist in designing blockchain together with exporting Haitian fruit companies. The main considerations were:

- There are many small fruit growers in Haiti. Main losses are directly at harvest and first stages of product handling.
- Farmers need to understand that they should pick mature fruits, but not yet ripe in order to prolong shelf-life;
- In the new design small growers should remain owner of fruit until final sale in US;
- Service provider organizes and pre-finances harvest until Port au Prince (PauP);
- Project reimburses the costs from harvest to packaging;
- Handling after arrival in Miami is assured by a broker;
- Financial handling of all steps is verified by financial operator applying blockchain technology;
- Flexibility is required: blockchain is new, Haiti has to deal with institutional weaknesses, and there is a need to learn from practice. Therefore learning was planned from a pilot in 2018 (WFBR Report 1838, see references)

The new objective was to test how technology can help build more inclusive value chains, combining blockchain and advanced logistic services for (1) full traceability from the producer at tree-level to the consumer; (2) transparency of cost along the value chain, and (3) direct payments and financing from final buyer to producer. Distributed Ledger Technology DLT (blockchain) enables farmers to keep ownership until final sale.

In this way it can improve farm income and enhance developments through investments at farm level in production and handling. Blockchain also results in a secure financial track-record for farmers, which opens opportunities to finance farmers based on track record, rather than on collateral. Such financing system is very scalable and with limited risks for the banks. However, any blockchain system can only be designed based on well manageable Standard Operating Procedures (SOPs). Therefore the focus by the WUR team was on designing and testing SOPs and helping to prepare the tender to select a block chain service provider (WFBR Report 1804, see references).

WUR analyzed the situation and described the optimal steps in the chain for the three fruits (mango, avocado, pineapple, see references SOP procedures). Requirements were described for:

- Time duration per step;
- Temperature management;
- Data registration; and
- Correct handling.

However, the involved Local Service Provider (LSP) did not want to change the present situation and allow small producers direct access to US markets. As a consequence, there was a need to redesign the project and see how wastes can be reduced already in the first stages of the supply chain and maintain export quality as required by the US Animal and Plant Health Inspection Service (APHIS, part of US Department of Agriculture). The idea was introduced to use "Mobile Packing Unit" (MPU): trailers with built-in packing units where processing is handled directly after delivery from trees. This is also a way to circumvent existing exporters that in many countries control the fruit export. In addition, the project partners decided to add pineapple in addition to avocado and mango in four different geographical areas in Haiti.

The MPU was designed by the WUR team and commented on by USDA-APHIS in order to meet strict US import regulations (including for mango for example hot water treatment and fruit fly control). A new phase started early in 2020 with a tender for a MPU designer. Over 2020 and 2021 the last assistance was contracted with WUR for helping in the design, tender and guidance for the MPU, including assisting the selected Spanish company Tecnove in designing the MPU. The main role of the WUR consultants over all contracts was to design the Standard Operating Procedures (SOPs), provide SOP training and advise/coach the MPU builder and project partners.

The present and third contract between MCI and WUR covers a period of 21 months over February 1st, 2020 till end October 2021. This additional contract had the purpose to strengthen the analysis of the study in 2019, revise all SOP steps in the three fruit chains, formulate recommendations for next harvest seasons, and monitor especially SOP revisions. This created important added value in terms of deepening the analysis, revise procedures and apply learnings in practice.

1.3 Deliverables and introduction to the Final Report

The following deliverables were agreed upon:

1. Provide training on SOPs for the three fruits and produce a Training Report (submitted to MCI March 2021, see references). Key observations from the training activities are summarized in Chapter 2;
2. Provide recommendations and produce a Recommendation Report (submitted to MCI July 2021, see references). Key observations are summarized in Chapter 3. These include incidental monitoring and ongoing coaching on fruit export; and
3. Produce the present Final Report before the end of 2021.

In addition, a new development in the ongoing project was the decision to stop the collaboration with the exporting fruits LSP and start operating with a Mobile Packing Unit (MPU). Key observations on the design, tender and preparations for the MPU pilot are summarized in Chapter 4. Over recent months trial exports have been monitored by the WUR team as an additional activity. Chapter 5 summarizes the main findings. Finally, Chapter 6 presents the conclusions of the Final Report.

There have been some deviations from the original planning due to external factors, all of which have been agreed upon in open discussions between MCI, World Bank and WFBR. The main change were the very strict travel restrictions due to the COVID-19 outbreak, which forced the Dutch consultants to assist the local representative, Yves Laurent Regis, online.

2 Lessons learned related to training

The planned activities related to monitoring additional pilot shipments was described in the Monitoring Report that was submitted in March 2020 (see references). In relation to these pilot shipments, training materials were developed, and training was provided to farmers and MCI staff over the remainder of 2020. In March 2021 WUR shared the Training Report, which described the training that was provided on pineapple, mango and avocado postharvest handling with the scope of harvest planning until loading for shipment in Port au Prince. Below the main elements are presented in relation to the training sessions on pineapple, mango and avocados.

2.1 Pineapple

With regard to pineapple it was quite challenging to maintain the process aligned with the SOPs, particularly on the following operational procedures:

- Leaving 4 - 7 cm of stalk attached to the bottom of the fruit at harvest;
- Handling the fruit by holding it at the stalk;
- Putting the fruit upside down on its own crown leaves;
- Grading in the field edge (under-/oversize, under-/overripe, damaged should not be harvested for export); and
- Harvesting only fruits in ripeness class 1 (just breaking) and class 2 (less than 20% yellow).

The lessons learned from the pineapple dry run were used to adapt the training to the context, refine the strategy and make the acquisition of new post harvesting skills profitable for the pineapple farmers.

2.2 Mango

Lots of visuals were used in the mango SOP training. This concerns photographs as well as showing for example the use of a stick thermometer and the stacking of field crates. Additionally, a quality chart was made for mango with clear photographs, depicting defects and diseases. The mango quality chart presents the guidelines for deciding on approval or rejection of mangos, as presented by farmers at Collection Points. Guidelines were presented following different quality elements and illustrated by visuals.

There are various criteria for rejection or approval of mangoes presented by farmers at Collection Points. Some defects are not accepted at all, others only to a limited percentage. In some cases, all fruits will be rejected, in other cases, a part of the presented batch will be rejected.

The main criteria concern:

- Ripeness stage;
- Shape;
- Defects; and
- Decay / diseases.

Special attention was given to the local production of a simple mango de-sapping rack. The WUR team produced a guideline on how to produce such a rack low-cost and with simple means that are available in the producer area, in order to enable farmers to produce these racks themselves.

2.3 Avocado

On 21 August 2020 a training was conducted on the postharvest handling of avocados, focusing on skin issues as well as on ripening. Several quality issues are also season related and were explained to farmers. Avocados are a typical fruit as they only ripen after harvest (or after they have fallen from the tree). However, they do mature on the tree and it should be judged before picking the avocado if the fruits are suitable for harvesting and shipment to an export market. This can be done by hand, by means of a penetrometer or by assessing the dry matter content (DM). The easiest way to assess ripeness of avocados is by hand and this was illustrated in the training with visuals. Also a penetrometer can be used, as was explained and shown during the training.

Avocados should not be harvested until they reach a degree of maturity at which they will ripen to acceptable consumption quality and deliver a positive experience to consumers. Avocados should also not be harvested too late as these fruits will be too ripe at arrival when exported. Harvest should be done when the fruit reaches 23% dry matter. Harvest maturity will vary from year to year and with location on the property for each variety. Rootstocks may also have an influence.

The avocado training provided detailed explanations on:

- Determining maturity (pressure);
- Determining maturity (dry matter of sample);
- Determining DM either by a conventional oven or a microwave oven; and
- Calculating DM.
- Quality- and packing requirements (uniformity)

In all training events visuals were used, as can be seen by the 4 annexes of the training report (see references):

- Annex 1: Training material Mango
- Annex 2: Mango Quality chart
- Annex 3: De-sapping rack design
- Annex 4: Quality issues avocado

2.4 Conclusions on training activities

From the training activities the following conclusions can be made.

Importance of correct handling during first steps: especially at harvesting stage it is important to pick the correct fruits: mature but not ripe yet. Correct application will avoid a large part of the current waste.

Usefulness of visuals: for farmers the use of visuals works well and should be maintained in future trainings.

Importance of installing a mindset of quality standards: Export fruits have to comply with the highest quality standards. Farmers have to be aware on the criteria for rejection/approval and apply these as of the harvest stage. If they do not apply the mindset of respecting quality standards no export will be possible of their fruits.

3 Recommendations

3.1 Coaching and recommendations

The WUR Recommendation Report (submitted July 2021, see references) summarized the recommendations and advices as provided by the WUR team over the past project period. These have been often tailor made and provided as part of tender procedures, Video Conferences, setting and clarifying SOP procedures for the three selected fruits, preparing and conducting tests with export of fruits, linking with the Block Chain process, advising MCI and WB, and assisting the selected service provider Tecнове in the design and preparation of the mobile packing unit.

Over 2020 – 2021 various types of coaching and recommendations have been provided by the WUR team. Some, like the SOP updates, build on earlier results. An overview is presented below in Tables 1 (end 2019 and 2020) and 2 (2021):

Table 1 Overview coaching / recommendations provided by WUR team over end 2019 and 2020

Month	Type of recommendation or coaching	product
2019	Draft Standard Operation Procedures (SOPs) were provided for Mango, Avocado and Pineapple, test with users and update SOP versions in the course of 2019 (three versions each for Mango, Avocado and Pineapple).	PDF files with SOP for each fruit
End 2019	Draft Postharvest Standard Operation Procedures for Mango, Avocado and Pineapple, test with users and update SOP versions (two versions each for Mango, Avocado and Pineapple).	PDF files with SOP for postharvest SOPs for each fruit.
February-March 2020	Design a de-sapping rack for mango.	Design with clear instructions for making a de-sapping rack
March 2020	Produce proposal for mango quality chart	Mango quality chart
April 2020	Advice on Collection Point planning (outside the Blockchain system)	Excel file for planning
April 2020	Formulating mango audit for harvest, transport and handling.	Format for Mango Audit
May-June 2020	Advice on ripeness and dry matter test avocado.	DM guidelines
August-September 2020	Advice on the avocado shipment to Florida (blockchain test)	Guidelines for avocado shipment to US
17+ 30 September 2020	Explaining SOP's and answering questions to potential bidders in pre-bidding conference for LSP tender	Clarity on SOP requirements for potential bidders
September 2020	A condensed Avocado SOP was made in September 2020 to assist the tender procedure with six potential avocado service providers.	Updated avocado SOP
October 2020	Participation in online meetings with USDA-APHIS staff (Barth, Kohl, Yu, King, Henning, Abad). These meetings were based on the mango SOP and derived requirements for a mobile packing unit that would meet USDA APHIS requirements. With adaptations of USDA feedback, these meetings were used to fine tune the design requirements presented in the ToR for the MPU.	ToR for MBU updated on USDA-APHIS requirements
December 2020	Formulating the Terms of Reference for an off-grid mobile HWT Packing Unit for mango and other tropical fruits. (required to meet USDA-APHIS requirements).	preparation of tender procedure for the design and implementation of the mobile packing unit.

Table 2 Overview coaching and recommendations provided by WUR team over 2021

Month	Type of recommendation or coaching	product
April 2020	Advice for Tecnove on approval procedures with USDA / APHIS.	Selected MPU service provider Tecnove informed on USDA-APHIS approval procedures
May 2021	Advice on height of containers, quarantine of the packing section and especially about the supply time of the hot water basins.	Updated design principles for MPU are available
June 2021	Advice on procedures for forced-air cooling.	Clarity on procedures for forced-air cooling
June 2021	Guidelines for anthracnosis treatment procedures on avocado like HWT.	Clarity on procedures for anthracnosis treatment procedures on avocado
August 2021	Checking on progress with design MPU.	MPU design monitored
September 2021	Designing a format for a pre-shipment quality report.	Format for pre-shipment quality report
September 2021	Buying and applying penetrometer for avocado quality control.	Penetrometer is available and staff able to use penetrometer
September 2021	Advise on avocado sizing.	Clarity on sizing of avocados
October 2021	Replying to forced air cooling questions avocado LSPs.	Cooling requirements are clear for LSP exporting avocados
October 2021	Recommendations on avocado export (ongoing till end 2021), on applying thermal pallet covers to safeguard cold chain disruptions at the airport and during air transport.	Clarity on how to apply thermal pallet covers
October 2021	Quality control sample Hass avocado from Thiotte, (Southeast department).	Quality control report for Hass sample
October 2021	Participation in online meeting with representatives from HBC group and ETS JB Vital S.A to review critical steps of avocado SOP and address their concerns on the disruption of cold chain at the cargo service during airport security clearance.	Clarity on handling cold chain procedures during airport security clearance

4 Additional LSP and Mobile Packing Units

In the course of the mango season in the summer of 2020, it became clear that the project depends on one Logistical Service Provider (LSP) for the export of its fruit to the US. It also became clear that the LSP 'Haiti mango consortium' had conflicting interests as it consists of a group of mango exporting companies that each have an interest to export their own mangoes (as a trader) as well as mangoes for the project farmers (as a service provider). In a tight market and with logistical difficulties due to the COVID-19 pandemic and political unrest in Haiti, it turned out that their interest to export their own mangoes prevailed.

The awareness of this fact resulted during the second half of 2020 into two new initiatives within the project strategy:

1. A tender for new LSPs avocado export
2. The development of Mobile Packing Units (MPUs)

4.1 Tender for new LSPs (Avocado Export Project)

A tender was launched for the Avocado Export Project. It aimed to hire up to six service providers to provide the necessary training, technical assistance and processing and logistics services for avocado producers in the Centre and Artibonite Department and export to the US market (with USDA quality levels required for West Indies seedling avocados).

The following tender procedures were made:

1. The project supported the partnership between each Service Provider and small farmers, providing up to US\$ 150,000 in working capital to cover the following advances: (i) advance to farmers for the fruits received, (ii) advance for the service provider for the packing, cooling and transport, and (iii) advance to the farmer and service provider for the final invoice (factoring).
2. The total final expenses incurred by the farmer to carry out the sale of the avocados are eligible for a matching grant.
3. The farmer and the service provider will share the profits in a percentage that must be proposed by the bidder (> 50% for the farmer).

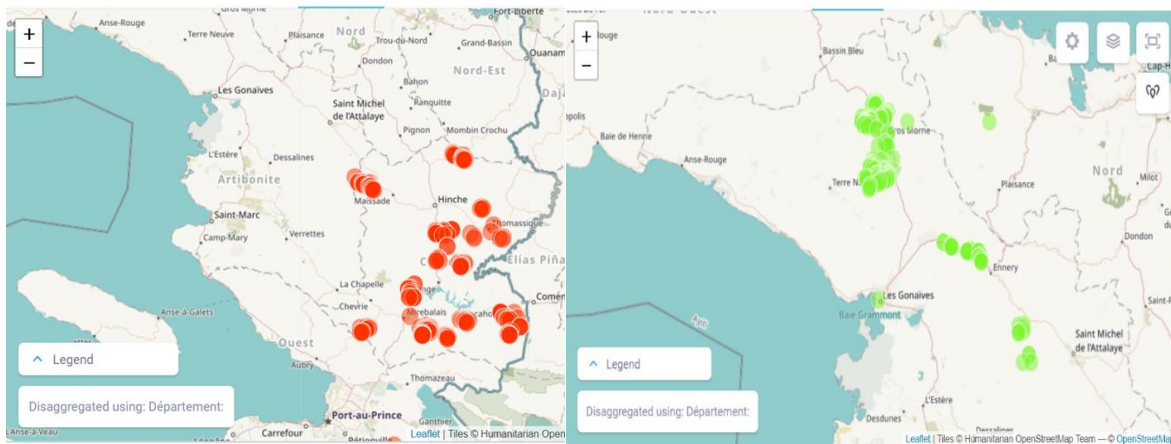
On 10, 17 and 30 September 2020, pre-bidding conferences were organized to inform potential bidders on the project. The tender was published on haitibusinessdevelopment.com.

Main features of the tender:

- Farmers can choose another Service Provider after conclusion of the BDI project; and
- The BDI project will provide a set of Standard Operating Procedures as well as a list of brokers in the US.

Closing date for the tender was in October 2020. As a result of the tender, the following bidding companies were selected:

Company	Contact Person	Email
Giradel S.A.	Emmanuel Calixte	ecalixte05@gmail.com
HBC Group	Bernady Sainvil	bernadysainvil@gmail.com
Societe Agricole Vert	Samuel Fanfan	fanfan_samuel@yahoo.com
ETS. JB. VITAL S.A.	Geoffrey Handal	jjeanniton@etsjbvitalsa.com handal@etsjbvitalsa.com



The main points of attention and bottlenecks were that a MPU needed to be able to meet all the requirements of the postharvest SOP as well as the quarantine requirements by USDA-APHIS. The latter being required to make it suitable for mango export to the US.

The WUR team was therefore asked to make a design for a MPU that would meet the SOP requirements. Based on that design (see Figure 2), USDA-APHIS would be asked to comment on it in order to come to a design that could pass the USDA certification test.

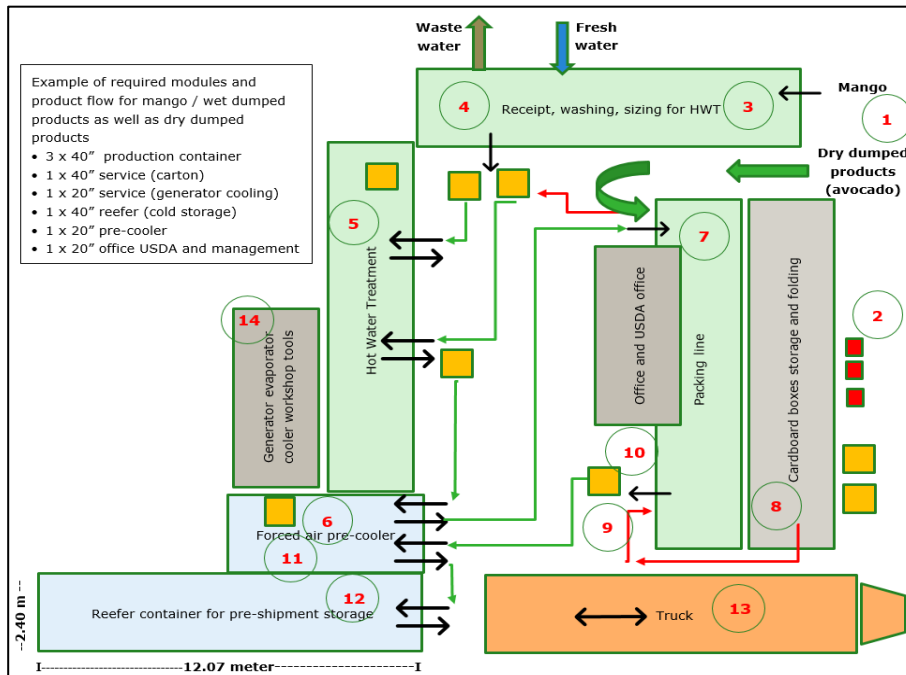


Figure 2 Concept design for MPU for mango for discussion with USDA

In September 2020 a concept design (see Figure 2) for a Mobile Packing Unit for mango was sent to USDA-APHIS to serve as a basis for discussions which took place during a conference call in October 2020. Present from the side of USDA were (amongst others) Lisa Kohl and Carina Barth.

To their knowledge, this was the first time that the concept of a MPU was proposed and they also recognize that the US policy on phytosanitary issues favors groups of businessmen in emerging markets while they actually would like to have smaller farmers have access to the US market as well. USDA representatives therefore expressed their willingness to cooperate with the project in order to come up with a design of a MPU that can be USDA certified.

They had studied the design and come up with some technical questions and remarks, mostly related to quarantine and the possibility to certify:

- How often do we plan to move the facility? To what locations? APHIS officials would have to move with it.
- Batch system / tank HW immersion treatment
 - Hoist equipment for loading/ unloading of fruit
 - Maintaining water flow, quality and temperature (Boiler heating capacity)?
 - Power supply (Generator + second generator as back-up?)
 - Treatment should be automatic requiring computers, microprocessors which should be in a climate-controlled room
- Quarantine area – commodities must be moved to insect-free enclosure immediately after treatment. How will this be accomplished?
 - Packing line equipment, hydrocooling equipment, cool storage room (if applicable) should be in the quarantine area
 - Use of air curtains, screened or enclosed rooms, insect proof containers
 - Closure quarantine area when not in use
- When loading treated fruit, trucks must form a fly-proof seal with exterior wall
- Waste disposal
- Once facility has been USDA- approved and certified, no further changes may be made without APHIS approval
- Any proposed changes/improvements must be requested in writing
- Facility submits facility change request (similar to initial application)
- TMT approves
- POP certifies

The WUR team adapted the design to be able to meet the demands as mentioned above that were raised by USDA-APHIS (see Figure 3, two versions). The Model became more compact with a quarantine area between two trucks/reefers.

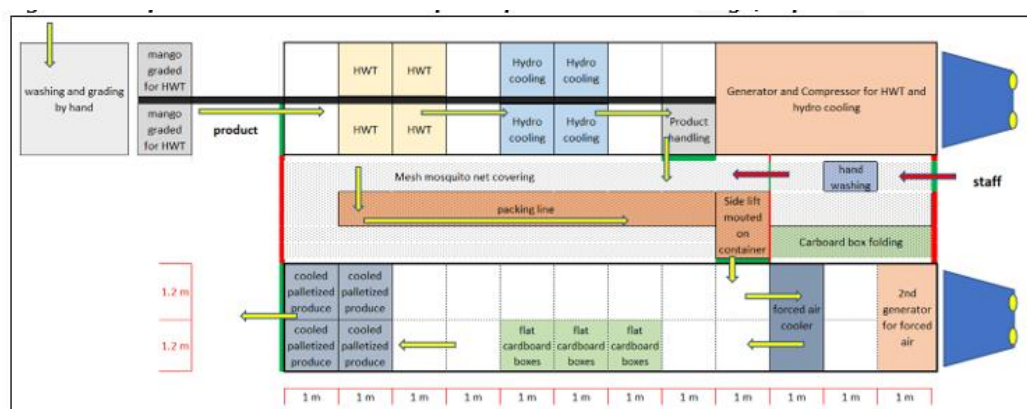


Figure 3: Product flow, side view of the HWT and hydrocooling

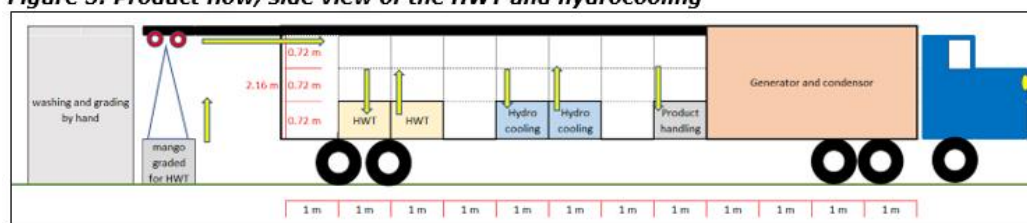


Figure 3 Adapted concept design for MPU for mango for discussion with USDA

Source: WFBR

Based on the adapted concept design, USDA-APHIS came up with the following eight Additional Technical Questions and the additional facility certification:

a. Water used for washing, dipping, hydrocooling

- i. Should be chlorinated at a level not to exceed 200 ppm. Will this be done? (see USDA Treatment Manual (TM) p. 3-3-5) 02/2020-30
- ii. Issue of transporting water -> hydrocooling is not a requirement, fruit can be air-dried after HWT

b. Forced air cooling

- i. There was some conflicting information whether hydrocooling or forced air cooling would be used (see p. 8), but then Figure 4 indicates both. The most recent proposal indicates hydrocooling and forced air cooling when fruit is in boxes (see also comment under 1.a.ii).
- ii. APHIS does allow the use of fans in the screen room to blow air over the fruit as soon as they are removed from the hot water tank (if desired). However, ambient air cannot be less than 70°F

c. Need some details on treating/cooling fruits

- i. Hydrocooling should be done after waiting period of 30 min following HWT, unless original treatment is extended for 10 min.
- ii. Proposal indicates 45 min hydrocooling (see p. 14), so is that 30 min waiting period + 15 min hydrocooling (TM suggests hydrocooling of 20 min in some schedules)?

d. Quarantine area

- i. This tent is being set up/broken down location by location. How is it being rolled up and unrolled again? Does the inside always stay on the inside and the outside on the outside? Need to make sure that no insects clinging on the outside get inside the tent.
- ii. Still unclear from the drawing how safeguarding is achieved when fruit comes out of HWT. The tent/mesh between the two tanks will not be sufficient. Indicated in pink in the figure 4 below of the concept proposal is the required quarantine area.

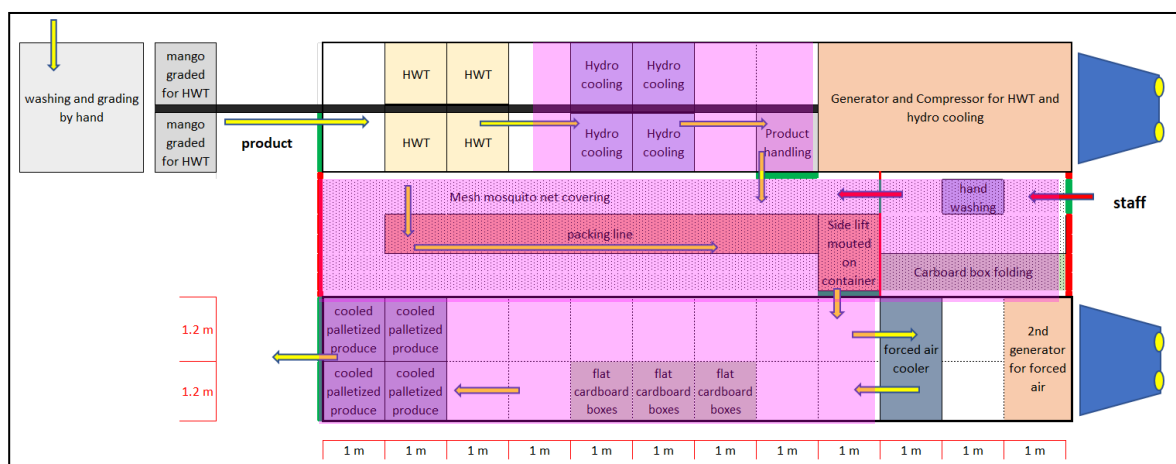


Figure 4 USDA quarantine area indication in the updated MPU design

Source: WFBR

e. Cardboard box folding

- i. Insect-proof packaging is required
- ii. Packaging (used or new) must be checked/cleaned for pests so that the packages are not a source of pests and contamination (TM p. 3-6-2) 08/2011-66 -> how will this be accomplished?

f. Netting with a mesh size of max 0.6 mm

- i. The minimum requirement for netting is 100 mesh/in² => 0.0059 in = 0.14986 mm. Thus, a mesh of 0.6 mm would provide openings that are too large. 100 mesh/in² or higher will be acceptable.

g. Cleaning the units

- i. How are they fumigated? What pesticide would be used?

h. Disposal of rejected fruit

- i. What is the plan to remove culled, cut, and rotting fruit from the premises on a regular basis?
- ii. Rejected fruit should not be in the quarantine area. Fruit should be rejected prior to entering the treatment tank. The revised proposal indicates that waste disposal is outside the quarantine area (see p. 12); collect rejected fruit in covered containers.

If damaged fruit is detected after the treatment, fruit should be removed and placed into covered containers and removed from the premise

Facility Certification: every time the facility moves, it will have to be recertified.

These adaptations were made in the design and in December 2020 the tender was published for the construction of four Mobile Packing Units based on the adapted design (see Figure 4). The bidders were invited to adapt the design as they see fit, as long as it meets the SOP- and USDA requirements. Before starting the construction, the company that will be awarded the contract needed to assure the design is approved by USDA-APHIS. Closing date of the tender was early February 2021

Also, in December, in Haiti a new company was established by the 72 farmers that have participated in the exports earlier in the project. This company (Société de Production et de Transformation des Produits Agricoles d'Haiti S.A.) will own the 4 MPU units. The company will have to respect the following requirements:

- The farmers will be able to provide space to place the MPUs, 2 in Artibonite and 2 in Plateau Central;
- The units can stay for the mango season in one location, so APHIS needs to certify only once;
- For the avocado season, the cooling container can really be mobile and follow the avocado harvest (even going to other areas of the country);
- The manufacturers need to deliver only the 2 containers and netting for the packing area, set it up and get the APHIS certification;
- The trucks and trailers for moving will be rented locally through another contract;
- The manufacturers need to provide training to the Service Providers that will operate the MPU; and
- The Service Provider could be selected from the ones under contract for avocados, with a contract extension for mango.

The company TecnoVe based in Ciudad Real, Spain, was awarded the contract for the construction of the four MPUs and started to draw detailed design drawings. Several discussions took place with World Bank and WUR team regarding the optimum design (all subject to confirmation by USDA-APHIS).

In the latest version of the design, the containers were replaced by trailers because that would make the MPU much more flexible and easier to use. Also, the insect-net-covered space between the 2 trailers has been replaced by hard-top movable ceiling and floor. The final design looks as follows (see figures 5-6-7-8 below):

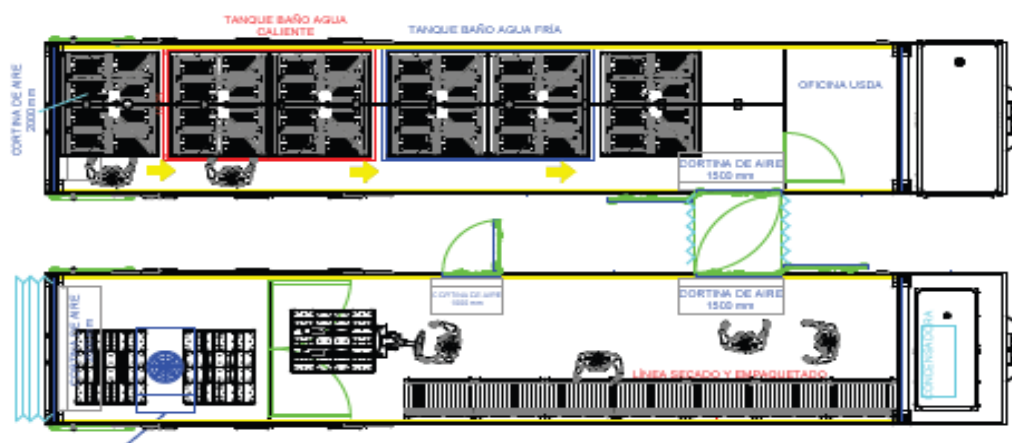


Figure 5 Top view of MPU: left HWT, right: packing and forced air cooling

Source: TecnoVe, Spain

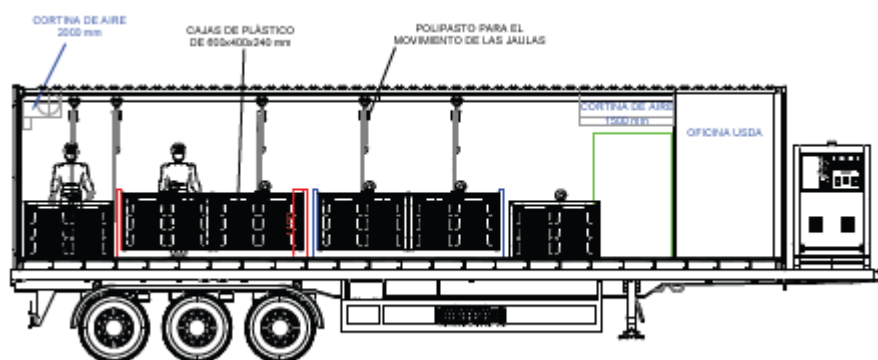


Figure 6 Side-view left trailer (HWT and hydrocooling)

Source: TecnoVe, Spain

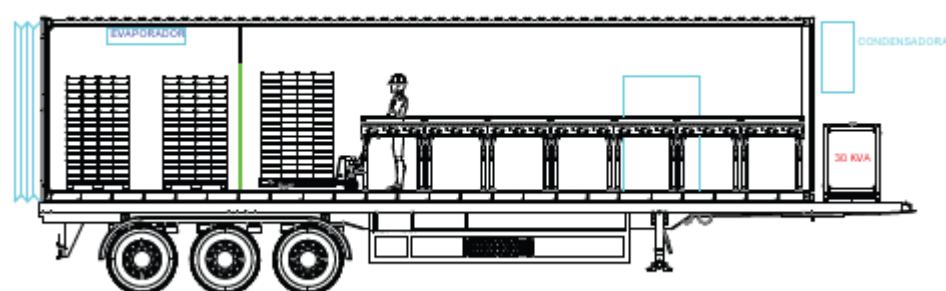


Figure 7 Side-view of the right trailer; packing and forced-air cooling

Source: TecnoVe, Spain

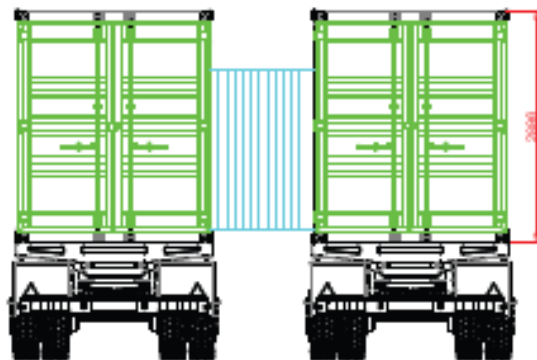


Figure 8 *Rear-view of the two trailers and their fly-proof connection*

Source: TecnoVe, Spain

Postponement MPU implementation

However, it turned out to be impossible to finalize the construction of the four MPU within the timeframe of the project, let alone put them into operation. MCI and the World Bank therefore postponed the MPU contracting to a new project extension, which is to become operational by late 2021.

5 Trial shipments to USA

During 2021, trial shipments of avocado to the US were done by the new avocado LSP. The shipments were done by air transport but the broker in Florida was not satisfied with the quality that was supplied in the first batches. A Quality Inspection Report revealed that some of the avocados were of good quality but there were complaints about insects and complaints (especially in a second shipment) on a lack of uniformity:

- Overripe avocados in a box together with good quality ones,
- Different sized in one box, and
- Bad presentation (not neatly packed).

It was agreed that the WUR team would perform quality inspections conform the ones done in Florida, prior to any new shipment and that these inspection reports would be sent to the broker prior to shipment to allow him to reject or approve the shipment and to inform him about the quality to expect at arrival. At the same time this would allow the project to advise on strict implementation of the avocado SOP as these were clearly not followed as they should be.

There is for example strong suspicion that farmers picked up fallen avocados and supplied these together with ones they picked from the trees. This explains the difference in maturity at destination. Strict control is required, as well as imposing fines on farmers that do not comply.

WUR team member Yves-Laurent Regis conducted quality inspections including:

- Number of fruits per box
- Presentation in the box (loose/tight)
- Weight of largest and smallest fruit
- % of the skin with defects
- Penetrometer value (pressure/ softness/ stage of ripeness)
- Photographs
- General impression
- Shelf-life estimation

In annex 1 an example of a quality inspection report is provided.

6 Conclusions

Over the present contract period the WUR team provided coaching, training and advice that allowed the project to test, revise and agree with value chain actors on the Standard Operation Procedures for the three fruit chains (pineapple, mango and avocados). The SOPs were the basis to work together as different value chain actors on improving procedures and standards that allowed to test how small fruit growers in Haiti can have access to the US market.

During the past two years the WUR team provided a series of advices and recommendations, which were tailor made to the emergent needs as per the project request. All advices are documented and available upon request. Various have been already presented in the training report (like the mango quality chart, the de-sapping rack design and quality issues related to avocado) or the recommendation report. The WUR team assisted in strengthening collaboration of small fruit growers with fruit exporters, with a focus on avocado exporters in the last period of the project. Another technical service was the support on designing a Mobile Packing Unit that caters for the US importing requirements.

Various experiences and training events emphasize the importance of correct handling during first steps of the value chain. Especially at harvesting stage it is important to pick the correct fruits: mature but not yet ripe. Correct handling and applying the advices properly will avoid a large part of the current waste. Also, the last experiences with avocado export indicate the non-respect of applying SOP procedures by some of the participating avocado producers. It is therefore important that the project maintains a firm position on respecting quality standards as set in the SOPs. All chain actors have to acquire a mindset towards respecting the quality standards as export fruits have to comply with the highest quality standards. Farmers have to be aware of the criteria for rejection/approval and apply these already at of the harvest stage. Not complying with the quality standards will impede export of their fruits. Apart from handling requirements, this concerns also correct presentation of the fruit in the box with emphasis on uniformity! Uniform in size, in color, in ripeness stage and skin smoothness and tight (but not squeezed) in the box.

During the training sessions the use of visuals worked well to communicate SOPs and illustrate the different requirements for harvesting and handling fruits. For farmers the use of visuals worked well and should be maintained in future trainings. This could be combined with online training modules for the different steps in each of the SOPs.

An overall reflection is that for sustainability purpose it is advised that MCI considers where the institutional capacities can be strengthened within Haiti to assure that training modules and technical expertise related to professional fruit production, harvest, processing, storage and exporting can be situated. In that way knowledge and skills acquired during the project's life can be accessible for other Haitian stakeholders in the fruit value chains, also after the project has ended. This could be done by associating an education center like an agricultural college, a Haitian research institute for documentation, or a service provider who provides advice and consultation to the fruit sector.

Whereas the present contract period ends by end October 2021, the WUR team remains available for advising on ongoing avocado export tests and preparing a next phase to test the MPU as of 2022.

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- Standard Operation Procedures Mango. Project internal document version III October 2019
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- Standard Operation Procedures Pineapple. Project internal document version III October 2019
- Tender document Local Service provider (2019)
- Tender document Mobile Packing Unit (2020)

Annex 1

Pre-shipment quality inspection report (example)

Pre-shipment quality control report

General:

Location	Port au Prince, Haiti
Date	October 19 th 2021
Product	Avocado
Variety	Hass
Number of fruits assessed	5
Temperature setting of the cold storage	°C
Shipper	Farmer in the Thiotte districk, SE of Haiti
Transport	Land
Destination City	Not for a shipment
Receiver	Bernady Sainvil, HBC Group
Controller	Yves-Laurent Régis, WFBR
Contact e-mail	yvlaur@yahoo.ca
Contact Telephone	+509 37 24 8401

Samples

Sample 1	Avocado
Number of fruit per box	Not applicable
Weight of the box	Kg
Weight of the fruit	215 grams
Weight of the smallest fruit	grams
Fruit pulp temperature	6.4°C
Firmness	22.5 Lbs
Minor remarks (total of the below)	32 %
Sunburn (estimated % of the total fruit skin)	%
Scars (estimated % of the total fruit skin)	2 %
Lenticel spots (estimated % of the total fruit skin)	30 %
Major remarks	

Photographs:



<i>two halves of cut fruit</i>	<i>penetrometer measurement</i>	<i>weight indication on scale</i>
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<i>taking fruit temperature</i>	<i>top view box</i>	<i>pallet</i>

		
<i>detail fruit skin defect</i>	<i>detail fruit skin defect</i>	

Remarks:

- Check on fruit being tight in cardboard boxes
- Check on boxes secure on the pallet (edges and straps)

Sample 2	Avocado
Number of fruit per box	Not applicable
Weight of the box	Kg
Weight of the fruit	227 grams
Weight of the smallest fruit	grams
Fruit pulp temperature	7.9 °C
Firmness	23.2Lbs
Minor remarks (total of the below)	3 %
<i>Sunburn (estimated % of the total fruit skin)</i>	%
<i>Scars (estimated % of the total fruit skin)</i>	%
<i>Lenticel spots (estimated % of the total fruit skin)</i>	3 %
Major remarks	

Photographs:



<i>two halves of cut fruit</i>	<i>penetrometer measurement</i>	<i>weight indication on scale</i>
--------------------------------	---------------------------------	-----------------------------------

		
<i>taking fruit temperature</i>	<i>top view box</i>	<i>pallet</i>

		
<i>detail fruit skin defect</i>	<i>detail fruit skin defect</i>	

Remarks:


- Check on fruit being tight in cardboard boxes
- Check on boxes secure on the pallet (edges and straps)

Sample 3	Avocado
Number of fruit per box	Not applicable
Weight of the box	Kg
Weight of the biggest fruit	318 grams
Weight of the smallest fruit	grams
Fruit pulp temperature	5.4 °C
Firmness	24 Lbs
Minor remarks (total of the below)	29 %
<i>Sunburn (estimated % of the total fruit skin)</i>	%
<i>Scars (estimated % of the total fruit skin)</i>	4 %
<i>Lenticel spots (estimated % of the total fruit skin)</i>	25 %
Major remarks	

Photographs:



<i>two halves of cut fruit</i>	<i>penetrometer measurement</i>	<i>weight indication on scale</i>
--------------------------------	---------------------------------	-----------------------------------

		
<i>taking fruit temperature</i>	<i>top view box</i>	<i>pallet</i>

		
<i>detail fruit skin defect</i>	<i>detail fruit skin defect</i>	

Remarks:

- Check on fruit being tight in cardboard boxes
- Check on boxes secure on the pallet (edges and straps)

Sample 4	Avocados
Number of fruit per box	Not applicable
Weight of the box	Kg
Weight of the biggest fruit	219 grams
Weight of the smallest fruit	grams
Fruit pulp temperature	6.4 °C
Firmness	20.7 Lbs
Minor remarks (total of the below)	27 %
Sunburn (estimated % of the total fruit skin)	%
Scars (estimated % of the total fruit skin)	12 %
Lenticel spots (estimated % of the total fruit skin)	15 %
Major remarks	

Photographs:



two halves of cut fruit



penetrometer measurement



weight indication on scale



taking fruit temperature

top view box

pallet



detail fruit skin defect



detail fruit skin defect

Remarks:

- Check on fruit being tight in cardboard boxes
- Check on boxes secure on the pallet (edges and straps)

Sample 5	Avocado
Number of fruit per box	Not applicable
Weight of the box	Kg
Weight of the biggest fruit	197 grams
Weight of the smallest fruit	grams
Fruit pulp temperature	9.8 °C
Firmness	19.7 Lbs
Minor remarks (total of the below)	25 %
Sunburn (estimated % of the total fruit skin)	%
Scars (estimated % of the total fruit skin)	10 %
Lenticel spots (estimated % of the total fruit skin)	15 %
Major remarks	

Photographs:



<i>two halves of cut fruit</i>	<i>penetrometer measurement</i>	<i>weight indication on scale</i>
--------------------------------	---------------------------------	-----------------------------------



<i>taking fruit temperature</i>	<i>top view box</i>	<i>pallet</i>
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<i>detail fruit skin defect</i>	<i>detail fruit skin defect</i>	
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Remarks:

- Check on fruit being tight in cardboard boxes
- Check on boxes secure on the pallet (edges and straps)

Comments

Fruit generally looks poor due to overall presentation.

Color assessment: more observations needed

Occasional slight scarring, scabs, and lent spots

Fruit is cutting clean.

Firmness is mostly good.

Advice to sell immediately after arrival due to limited shelf life.

To explore
the potential
of nature to
improve the
quality of life



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