

# Document 526

## POST IMPLEMENTATION REPORT

CHAPTER: [EWB-JSC South Houston Professionals](#)

COUNTRY: [Rwanda](#)

COMMUNITY: [Mugonero](#)

PROJECT: [Fruit Dehydration for Rwanda Orphanage](#)

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PREPARED BY  
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[Samantha Snabes](#)  
[Matthew Fiedler](#)

[Submittal Date](#)  
November 4th, 2011

## **Post Implementation Report Part 1 – Administrative Information**

### **1.0 Contact Information**

	<b>Name</b>	<b>Email</b>	<b>Phone</b>	<b>Chapter Name or Organization Name</b>
<b>Project Leads</b>	Jack Bacon	john.bacon-1@nasa.gov	281-814-8665	EWB-JSC
	Tyler-Blair Sheppard	tyler-blair.a.sheppard@nasa.gov	540-336-7531	EWB-JSC
<b>President</b>	Mike Ewert	president@ewb-jsc.org	832-6923073	EWB-JSC
<b>Health and Safety Officer</b>	Angela Cason	secretary@ewb-jsc.org	832-385-4996	EWB-JSC
<b>Assistant Health and Safety Officer</b>	Samantha Snabes	treasurer@ewb-jsc.org	832-746-0922	EWB-JSC
<b>Education Lead</b>	Angela Cason	secretary@ewb-jsc.org	832-385-4996	EWB-JSC
<b>Kigali-Materials/Transportation Contact</b>	Peter Muligo	peter.muligo@mannaenergy.com	N/A	Manna Energy
<b>Kigali- Fruit Processing Expert</b>	Ralf Loeper	ralfloeper@gmail.com	N/A	N/A
<b>Mugonero-Orphanage Director</b>	Victor Monroy	Lesperancerwanda@aol.com	0025008545731	N/A

### **2.0 Travel History**

<b>Dates of Travel</b>	<b>Assessment or Implementation</b>	<b>Description of Trip</b>
May 2005	Assessment	Mugonero Hospital (water quality/quantity)
January 2006	Implementation/ Assessment	Mugonero Hospital (solar lighting installation and water collection assessment)
June 2006	Implementation/ Assessment	Mugonero Hospital (rainwater catchment installation) Mugonero Orphanage (water quality/quantity assessment)
August 2007	Implementation	Mugonero Orphanage (water treatment installation)

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August 2008	Assessment	Mugonero Orphanage (fruit drying)
August 2011	Implementation	Mugonero Orphanage (fruit drying)

**3.0 Travel Team**

#	Name	E-mail	Phone	Chapter	Student or Professional
1	Angela Cason	secretary@ewb-jsc.org	832-385-4996	EWB-JSC	Professional
2	Matthew Fiedler	matthew.j.fiedler@nasa.gov	281-483-7237	EWB-JSC	Professional
3	Tyler-Blair Sheppard	tyler-blair.a.sheppard@nasa.gov	540-336-7531	EWB-JSC	Professional
4	Samantha Snabes	treasurer@ewb-jsc.org	832-746-0922	EWB-JSC	Professional

**4.0 Health and Safety**

**4.1 Incident Reports**

Did any safety incidents occur during this trip? \_\_\_ Yes X No

If “Yes,” please submit your completed Incident Report as a separate attachment with this report. If your HSO has not yet filled out the Incident Report, a blank form can be found on the EWB-USA website – Member Pages – Project Process – Health and Safety Program.

**5.0 Budget**

**5.1 Cost**

Expense	Total Cost
<i>Airfare</i>	8,168.70
<i>On Ground</i>	1,510.50
<i>Materials</i>	1,691.19
<i>Other</i>	674.00
<b>Total</b>	<b>\$ 12,044.39</b>

**6.0 Project Discipline(s): Check the specific project discipline(s) addressed in this report. Check all that apply.**

**Water Supply**  
 \_\_\_ Source Development  
 \_\_\_ Water Storage

\_\_\_ Water Distribution  
 \_\_\_ Water Treatment  
 \_\_\_ Water Pump

**Sanitation**  
 \_\_\_ Latrine

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Gray Water System  
 Black Water System

Drainage  
 Dams

Water Storage  
 Soil Improvement  
 Fish Farm  
 Crop Processing  
Equipment

**Structures**

Bridge  
 Building

**Energy**

Fuel  
 Electricity

**Civil Works**

Roads

**Agriculture**

Irrigation Pump  
 Irrigation Line

**Information Systems**

Computer Service

**7.0 Project Location**

**Longitude:** E 29 ° 17.264'

**Latitude:** S 02 ° 10.032'

## **Post Implementation Report Part 2 – Technical Information**

### **1.0 INTRODUCTION**

The Johnson Space Center (JSC)/South Houston Professional chapter of Engineers Without Borders-USA has been working in Rwanda since 2005 on water treatment, water provisioning, and energy provisioning appropriate technologies in the Mugonero region. After installing a water treatment system at the L'Esperance children's orphanage in the summer of 2007, the team has focused its efforts to help the orphanage reach economic sustainability through the processing and sale of dried fruit. An initial fruit drying assessment trip in 2008 provided additional information and important lessons learned, which have led to different prototypes being investigated by EWB-JSC chapter members. As part of our implementation trip we installed and tested a solar dehydration prototype system, which the orphanage director will ultimately assess for feasibility and appropriateness for full scale operation at the orphanage.

### **2.0 PROGRAM BACKGROUND**

The EWB-JSC chapter has for several years worked to engineer infrastructure solutions at the L'Esperance Children's Village Kigarama orphanage in rural Rwanda near both the town of Kibuye and the famed Mugonero Hospital. The orphanage is home to 127 orphans, many of whom have the HIV virus, resonating back to the Rwandan Genocide in 1994. The orphanage is supported in various ways by EWB-JSC, and EWB Colorado chapter, Manna Energy, Birambye International (a non-profit engineering firm in Colorado), and several other non-profit Non Governmental organizations. EWB-JSC has been responsible for providing a successful Bring-Your-Own Water (BYOW) purification and filtration system to the orphanage and has collaborated in varying levels of effort with EWB Colorado on several other projects, including rainwater catchment, solar power, high efficiency cook stoves, and crop irrigation. The orphanage comes under managerial and financial control of the Seventh Day Adventist Church, and its on-site director is Mr. Victor Monroy, a horticulturist originally from Guatemala. In 2007 Mr. Monroy asked EWB-JSC to assist in developing infrastructure for a vast agricultural project he was initiating, called the Orchard Project, which would allow the orphanage to become economically self-sufficient by selling highest quality premium produce in the developed world. Drip irrigation, water storage, food processing, sterile facilities, water management, waste management, packaging, food storage pre- and post-processing, and improved energy infrastructure are all necessary features of this endeavor. Fruit drying is on the critical path to success of this project because (1) the orphanage lacks sufficient electricity to refrigerate the fresh produce, (2) transportation to the markets is not possible on a schedule to keep fruit from spoiling, and (3) roads follow 26 kilometers of exceptionally tortuous dirt paths that would bruise whole produce. In addition, at this point in the development of the Orchard Project, a means of drying fruit is a crucial remaining hurdle to finding a buyer for the fruit.

### **3.0 TRIP DESCRIPTION**

The following is a summary of the tasks that were accomplished during this trip.

Dryer Build – The travel team successfully constructed three solar dryers to the specifications described in section 5.3 below. The first dryer was built with the travel team working with local craftsmen to transfer the dryer build knowledge to local workers. The second dryer was built by the travel team members providing a smaller amount of direction to the local craftsmen and orphanage staff. The third dryer was constructed exclusively by the local staff and craftsmen with travel team member supervision. Orphanage staff members were then trained on dryer operations and the dryers operated at the location specified by the orphanage director.

Fruit Processing- A fruit processing station was organized to allow storage, cleaning, husking, slicing and operations. Provisions were made for food safety testing and waste removal.

Data Collection- Food safety data including bacteria and yeast/mold samples from the fruit and the fruit processing station were taken. Fruit weight was recorded before and after drying to determine moisture loss and final weight ratio. Temperature data from inside the solar dryer was recorded to determine drying efficiency during a variety of weather conditions.

Education of Staff- Orphanage staff was trained to perform all steps of dryer construction, dryer maintenance, fruit processing, loading and unloading fruit from the dryer, bacteria and yeast/mold food safety testing and data collection of fruit weights and dryer temperatures.

## **4.0 COMMUNITY INFORMATION**

### **4.1 Description of Community**

L 'Esperance Children's Village Kigarama orphanage in rural Rwanda near both the town of Kibuye and the famed Mugonero Hospital. The orphanage is home to 127 orphans, many of whom have the HIV virus, resonating back to the Rwandan Genocide in 1994. The orphanage comes under managerial and financial control of the Seventh Day Adventist Church, and its on-site director is Mr. Victor Monroy, a horticulturist originally from Guatemala.

### **4.2 Community Relations**

EWB-JSC South Houston Professionals have been working with Victor Monroy and his staff since 2006 and thus have a strong working relationship with them. Victor assigned three gentlemen to be the fruit drying system main workers.

1. Danny is one of the workers at the orphanage that harvests pineapple and will be in charge of bringing the pineapples needed to dry to the processing facility. While there each traveler spent time harvesting pineapple with Danny. He also observed and participated in the processing of the pineapple to prepare it for the dryers.

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2. Eldad is the orphanages kindergarten teacher and one of the boys house fathers. He served as our interpreter during the dryer builds. He wanted to understand all aspects of the solar dryers and how to operate them. With this he assisted in the processing of the pineapple and data collection from the dryers.
3. Samwel is the main dryer person assigned to work with us. Having grown up at L'Esperance, he is familiar with the workers and the children. He has also become the mechanic for the orphanage which made him a great fit for this project. He assisted in the second dryer build, screen building, pineapple harvesting, pineapple processing, and data collection from the dryers. With him being assigned to this role he took ownership of it and wanted to understand everything we were doing and why so that he could do a good job with the dryers after we left.
4. Ralf Loeper, a German citizen contracted by the Rwandan government to support economic growth initiatives has accepted appointment and responsibility to be the fruit processing coordinator. Ralf has extensive training and experience in food safety testing, food processing requirements, organic certification, and sustainable business practices. As the processing project lead for L'Esperance, EWB-JSC has devised a communications and project plan that includes regular communications to ensure that functions and tasks that overlap EWB-JSC technical responsibilities are efficiently coordinated. This outcome is a result of two days of interaction while at the orphanage and several post trip exchanges. While in Rwanda, Ralf and one EWB-JSC traveler visited a local co-op also engaged in pineapple processing in order to discern processing and design overlap in a fully functional setting. Communications with the Co-op President have also been initiated to ensure that best practices are shared.

## **5.0 PROJECT SUMMARY**

### **5.1 Summary**

During this pilot implementation trip, EWB-JSC built and tested three solar dryers of identical design. These dryers were built on schedule and the intended training of orphanage personnel and local craftsmen in their construction was completed on time. The proposed plan to build three dryers with diminishing levels of EWB-JSC personnel involvement and instruction in the construction was well executed and EWB-JSC is confident in the ability of the orphanage to build more dryers at their discretion. Testing of the dryers was somewhat hindered by the unseasonal amount of rain that occurred during the trip. However, there was sufficient time built into the trip to ensure that education on their operation was transferred, and ongoing communication is occurring between Victor Monroy and EWB-JSC to ensure that any issues are fully vetted and resolved.

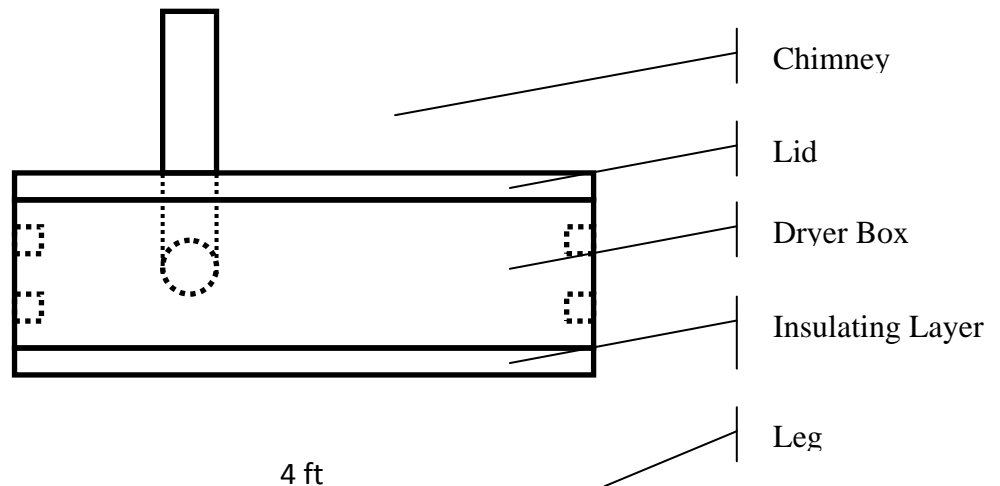
Additional testing for water and fruit bacterial contamination was undertaken. This is discussed further in Section 6.3.

### **5.2 Difference Between Planned and Actual Implementation**

The differences between the proposed dryers from the TAC and what was implemented were minimal. They were as follows:

- The Plexiglas sheeting used for the lid was made from a single sheet, as opposed to the proposed three sheets. This was due to larger sheet being available in Kigali, something which was only discovered once in country. This was an improvement over the proposed design, as a single sheet had no seams to allow for heat to escape.
- The wood used to build the dryer was of slightly different dimensions than that was in the TAC, largely due to imperial to metric conversions.
- The chimneys were made of PVC instead of aluminum ducting, due to trouble finding ducting in Kigali. This eventuality was prepared for in advance and PVC chimneys were tested in Houston prior to travel. To account for the thermal differences in PVC vs. Aluminum, the chimneys were made slightly taller to provide the same buoyancy effect.

### 5.3 Drawings



**Figure 5.3-1- Front View Schematic of Solar Dryer**



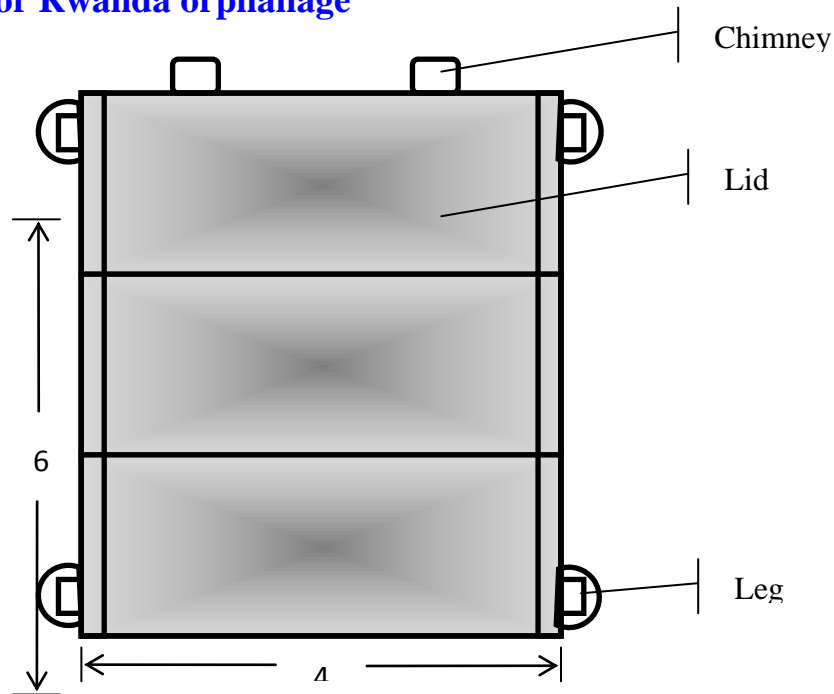


Figure 5.3-2- Top View Schematic of Solar Dryer

## 6.0 MONITORING

### 6.1 Project Monitoring

Project Discipline	Date of Completion (month/day/year)	Functionality (enter one range per project)			Enhancement (yes or no)	Duplication (yes or no)
		0-50%	50-75%	75-100%		
Solar Dryers	Dryer 1- 08/29/11 Dryer 2- 08/30/11 Dryer 3- 09/01/11	100% for dryer 1, 2, and 3			No	No

Testing of the Solar Dryers occurred after each was built. It included testing the interior temperature of the empty box using a 4-channel thermocouple and testing airflow through the dryer at the chimney outlet using an anemometer. Temperature and airflow fell within the ranges expected.

### 6.2 Monitoring of past-implemented projects

Project Discipline	Date of Completion (month/day/year)	Functionality (enter one range per project)			Enhancement (yes or no)	Duplication (yes or no)
		0-50%	50-75%	75-100%		
Water	August 2007	100%			No	No

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Treatment-BOYW				
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The previously installed Bring-Your-Own-Water treatment system was monitored and tested. Monitoring included observing orphanage workers use the system during nominal mode and demonstrate understanding of setup for backwash mode. Testing of the water after it had been run through the BYOW for turbidity and bacterial formations. The turbidity level was 0 and there were no bacterial present on the test strips. Testing occurred on August 29, 2011 and again on September 2, 2011.

**6.3 Additional Information**

Due to time and resource availability, several additional tests were conducted while in Rwanda. These assessments included:

- A cultural assessment
- Documentation of current agriculture practices at the Children’s Village
- A hygiene and food safety assessment of all critical points in the fruit dehydration process
- Water and air bacteria and yeast/mold testing
- Thorough documentation on pineapple type and variety
- Evaluation and implementation of an early stage processing facility to reduce the safety risk associated with an edible solar dryer output

These analyses revealed that prior to travel, orphanage workers took few preventative measures to ensure that the fruit harvested was free from contaminants that could cause illness when ingested. After both education and sharing results of rapid result field testing of critical points which had been correlated with current cultural practices, behaviors were modified and a temporary processing location was established. The result was a dramatic reduction of bacteria, yeast and mold. This improvement can be attributed to EWB-JSC’s partnership with the orphanage using insights from Ralf Loeper and lessons learned at a nearby co-op (SEE Community Relations #4) to develop an interim food processing facility to support dryer loading and unloading activities. Going forward, Mr. Loeper will work with the orphanage to continue periodic food safety testing and processing improvements which will be shared with EWB-JSC in dryer design efforts.

At the advice of Mr. Loeper, EWB-JSC also invested time in cataloging the size, weight, and wetness of over 50 pineapples to compare against US pineapple so that variances could be considered in Houston, TX development activities. EWB-JSC is committed to fostering efficient communication with Ralf and additional collaborators who are assisting the orphanage in order to guarantee a safe food product that provides an optimum output for the orphanage’s sustainable, green business initiative.

**7.0 COMMUNITY AGREEMENT/CONTRACT**

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The agreement with L ‘Esperance children’s orphanage director Victor Monroy is that EWB-South Houston/JSC chapter is to provide sustainable means to dry the fruit growing in the properties orchard.

EWB-JSC will provide the technology and build the dryers that will then be maintained by L ‘Esperance. On subsequent assessment/implementation trips to L ‘Esperance Children’s Aid. EWB-JSC will inspect the dryers to ensure that they are continuing to work in the proper manner.

Funding for the maintenance of the dryers will come from the profits received by L ‘Esperance for sales of the dried fruit products.

During this implementation trip additional agreements to have EWB-JSC South Houston Professionals agreed to continue to work on year-round fruit drying design to be implemented at the orphanage in 2012.

**8.0 PHOTO DOCUMENTATION**

**9.0 LESSONS LEARNED**

1. If a materials list is sent to an in country point of contact 2 months prior to travel he can confirm all materials are available in country.
2. Having in country point of contact pre-purchase the materials prior to traveler’s arrival the materials cost will be lower.
3. If large scale builds are to occur (brickwork, concrete work, etc.) suggestion is that a small team arrive early to supervise the build. Additional travelers arrive at a later date to support completion of implementation work, **building the dryer on successive travel periods.**
4. Water content, weight, size, and acidity of local fruit must be considered in dryer designs
5. Agricultural and processing practices can have a large influence on output product safety.
6. Fruit dehydration is a very complex project that involves collaboration with multiple organizations and experts willing to contribute to aspects outside of the technical responsibility of EWB-JSC.
7. More thorough check of resources and other operations in country might yield valuable collaborations and assistance.

**10.0 PROJECT STATUS**

<b>Implementation Continues</b>	<b>Monitoring</b>
X	X

Implementation of a year-round fruit drying system is the next phase of the work at Mugonero, Rwanda. Monitoring of the data collected from the solar dryers installed on this implementation trip will continue.

## **11.0 NEXT PHASE OF THE PROGRAM**

The next phase of the program will be to design and install a sustainably powered year round fruit drying system. As part of this, the drying capabilities will need to be sized such that they can dry all of the pineapple, mango and guava grown at the orphanage. This is an expansion of the original dryer sizing for the orphanage, which was until now to only dry the pineapple, and came out of new information from the orphanage about their plans for the mango and guava, which had previously been juicing.

## **12.0 TECHNICAL LEAD ASSESSMENT**

The EWB-JSC team wrote this report as a collaborative effort between the four travelers from the summer 2011 pilot implementation trip. All studies conducted in preparation for the trip were completed prior to travel. This included Pre-trip training that will occur will include both cultural norms and etiquette, as well as travel safety. In particular, pre-travel sessions on the history of the 1994 Rwandan Genocide, its impacts and ongoing legacy were conducted for the team. Training of trip team members on all aspects of the solar dryer construction and operations also occurred.

**12.1 Technical Lead Name-** Tyler-Blair Sheppard

**12.2 Professional Mentor/Technical Lead Affirmation** As Technical Lead for this pilot project, I attest to my involvement in the alternative analysis and acknowledge and accept responsibility for the course of this project