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Interim Report on:

Project Tatirano: Improving access to clean drinking water via rainwater harvesting in Sainte Luce, Anosy Region, southeast Madagascar

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1. Summary

15,600,000 people living in rural Madagascar do not have access to improved water sources (WHO/UNICEF, 2015) and thus the need for innovative and sustainable alternatives to contaminated sources such as ponds, rivers and ill-kept wells is paramount. Coupling this with heavily gendered responsibilities of collecting water, which can take up to five hours per day (Tatirano Baseline Studies, 2015), the potential to improve health and wellbeing in this impoverished part of the world by simply providing clean drinking water is enormous.

Project Tatirano seeks to highlight to the rural village of Sainte Luce the benefits of an alternative mode of collecting clean drinking water by demonstrating rainwater harvesting on the local school roof, providing clean water for the primary school children.

The period from February to May saw the second phase of construction prepare the school site for the arrival of the two plastic water tanks. During this time an exciting immediate behavioural change was observed at the school as people temporarily collected rainwater from the roof instead of the bacteria-laden well 20 metres away.

Tank procurement has overcome numerous challenges and culminates in the arrival of the tanks from Tamatave Port in the north of the island in early June.

All water sources were biologically tested in Ambandrika to accurately share the importance of clean drinking water and good WASH practices with the community. The outcome showed how every water source currently available to the community is contaminated with coliform (faecal) bacteria and far below the WHO's guidelines for drinking water quality. The results were shared and discussed with the Tatirano Management Committee (TMC) during their bi-monthly meetings. This discussion is being formalised into an information-sharing seminar series developed by the Project Manager and delivered by the Head of Construction. The series is ongoing and is focussing on ensuring the members understand the need for the project and how to maintain and manage the rainwater harvesting system effectively and sustainably.

Plastic Tatirano-branded water bottles for use by the beneficiary primary school children have been purchased. These will not only allow the students to take clean water home after school, but also promote the availability of clean rainwater to the community.

2. Activity Detail

1. Construction Phase II

The second phase of construction was carried out over four days in February in order to prepare the school site for the arrival of the tanks. The guttering and the second tank foundation were the main focus, alongside minor repairs to the school's brickwork and facia boards.

Following the construction of the first foundation, the second was straightforward and the concrete and reinforcement were completed quickly. Both foundations were levelled the next day by the application of a thin layer of cement, important for consistent loading on the tank when filled with water.

Left: *Tatirano's skilled staff, Tafa, works in the heat of the day to level the foundations.*
Right: *The two finished foundations awaiting the arrival of the tanks.*

Work on the installation of the gutter brackets and gutters began with sunrise in the morning and followed the opposite schedule of the school classes to minimise impact on the students' learning. The guttering proved more challenging and problematic than expected due to difficulties in drilling screw holes for the gutter bracket supports without an electric drill. Additionally, the gradient needed for the gutter to convey water with gravity to the tanks proved complicated to achieve

Left: *One of the 16 gutter brackets needing adjustment for perfect water flow to the tanks.*
Right: *Bernard clips on the gutters to test water flow.*

because the building was not consistently level, with neither the roof nor facia boards following straight lines.

The value of rainwater harvesting in Sainte Luce materialised when it began to rain within 10 minutes of completing the guttering on the front of the building. People stopped using the well at the opposite end of the school building to collect water pouring from the gutter; the instant behavioural change represents both the longevity of the system and the practice of rainwater harvesting in the community.

Left: *Casual labourer, Colas, pours a bucket of well water at one end of the roof to test the gutter.*
Middle: *Villagers queue up to collect the clean rainwater pouring from the roof.*
Right: *Tafa repairs concrete work on the building.*

Unfortunately some activities, such as the precise placement of the gutter brackets, took more time than anticipated and therefore when the tanks arrive, the construction team will travel to Sainte Luce to spend three days completing the system, including tank installation.

2. Water Testing

It was essential to test all water sources in Ambandrika in order to fully and accurately inform the community about the quality of water that they are drinking. Results showed that all water points are contaminated with coliform (faecal) bacteria, emphasising the need for alternatives.

Comprehensive testing was completed on the four water sources in Ambandrika: at the bridge, the school well, the SEED camp well and the rainwater harvesting system at the SEED camp. The lattermost of these was of significant interest because of the direct correlation with Project Tatirano. The school well and the river water at the bridge are the only sources currently available to the community because the second well is broken. Small streams far into the forest are also sometimes used, despite taking hours to reach by foot; these were not tested but may be included in future analyses of water access and quality in Sainte Luce.

Left: *Biological testing setup in the research centre in Sainte Luce.*
Middle: *Harry and Theo test the turbidity of water at the bridge whilst women and children continue washing themselves and laundry in the background.*
Right: *Testing the pH level and conductivity at the school well.*

Biological Testing

This is the most important test for water quality and health impact in the community. The test involves filtering a sample to trap bacteria in the water on a micro-pad before incubating at 44°C for 18 hours. Following incubation the bacteria on the pads were large enough to be counted.

World Health Organisation (WHO) *Guidelines for drinking water quality* (2011) state that coliform bacteria must not be detectable in any 100 ml sample of water directly intended for drinking; unfortunately all samples in Sainte Luce returned with a high presence of bacteria, including those at the SEED camp. Results will be shared with the community to highlight the need for clean alternatives, while the SEED camp will ensure its facilities receive proper cleaning and maintenance.

Left: *Two water samples taken from each source ready to be tested.*
Right: *Coliform bacteria observed here as yellow spots on the filter pad – all spots of diameters between 1mm and 3mm were counted.*

Table 1: Coliform count in common Sainte Luce water sources

Source	Bridge	School well	Camp RWH	Camp well
Coliform count (per 100 ml)	96	51	29	46

While older members of the community are likely to have developed immunity to the particular contaminants in the water, children are more vulnerable to the pathogens. The complications of consuming dirty water are multidimensional and sequential; high instances of diarrhoeal disease contribute to missed school days, malabsorption within already limited diets, high morbidity and mortality rates, and an overall perpetuation of poverty. These are some of the defining reasons for targeting children in this pilot project, with the water test results emphasising the acute need for alternative water sources to be made accessible to the community in terms of both cost and skills.

The TMC seminars following the water testing strongly iterated to the members through theory and demonstrations, the presence of contaminants within Sainte Luce water sources. Members acknowledged their understanding of dirty water, and its cause of ill-health, but stated they had no other choice. The potential of Tatirano to fill both the gap in knowledge and practice is significant.

A full length report on the water testing in Ambandrika is available upon request.

3. Tatirano Management Committee (TMC)

Meetings with the TMC have continued on a bi-monthly schedule with mainly positive feedback. In the two most recent meetings, seminars were designed by the Project Manager, Harry, and delivered by the Head of Construction, Lomba, to share knowledge about the fundamentals of the project. The first seminar included the following chapter titles:

1. How do we use water?
2. What is contaminated water?
3. Why is contaminated water bad for our health?
4. How clean are the water sources in Ambandrika?
5. Why rainwater?
6. Step-by-step Tatirano

Lomba delivered the first seminar to the full engagement of all 15 members for one and a half hours. All members participated and took notes in their exercise books that had been issued to each of them at the beginning of the session. The second seminar involved a 15 minute recap of the main summary points covered in the previous session, followed by a health ‘triggering’ carried out by an external specialist, David. The triggering comes from the Community-Led Total Sanitation (CLTS) methodology, which prescribes inciting shock and shame in participants to realise that their sanitation practices – namely open defecation – lead to consumption of water contaminated by

their own faeces, resulting in illness and disease. David managed to obtain unanimous acknowledgment that by consuming water from the school well or the stream, the community was affectively drinking faeces.

With a solid understanding of the fundamental need and design of the project, and the rationale around the rainwater system, the next seminar will address good management and maintenance practices.

The collaboration and motivation of the committee has been impressive, especially considering its large membership. This latter fact sparked a misunderstanding between a few individuals regarding the old roof, in turn leading to the resignation of three members. However, there has been a strong response by the remaining 15 members, highlighted by very high attendance since the event. The meetings in the immediate future will focus on preparing for the arrival of the tanks, the day-to-day usage of the system and the distribution of the water bottles to the children.

Left: *David (photo left), leads and encourages members of the TMC in a group exercise that involved drawing the village and labelling water points and open defecation sites.*
Right: *David demonstrates that the colour of water cannot classify it as either clean or contaminated.*

4. Tank Procurement – Challenges and Solutions

It was stated in the February 2016 Interim Report that the two 10,000 litre plastic tanks were to be sourced from South Africa for imminent arrival in Madagascar. However their selection and delivery to Madagascar has been much more complicated than anticipated.

The first problem encountered was the tank dimension relative to a standard shipping container. The tanks were 7cm too wide for a standard container and therefore had to be shipped on a “flat-rack” container (see below). This increased the cost by a considerable amount and thus required significant further research into the cheapest mode of transport to Madagascar.

*The tanks loaded onto the back of the lorry in Durban, South Africa before shipping. The photo on the **right** illustrates the tiny out of gauge on the flat rack container. Photo courtesy of Heneways Freight Services*

While three smaller 6,000 litre low-profile tanks would have fitted inside a standard container, this option presented two problems that inherently oppose the aims of Project Tatirano. The low-profile tanks would require small interconnecting pipes, which would increase the risk of breaking and/or collecting dirt in the setup; and three smaller tanks, with a higher surface area, would require more frequent and involved maintenance and cleaning. Three tanks would also complicate the system for the community, distracting from the intended simple and replicable model, and potentially detracting from household replication of the system. Therefore, the original preference for two 10,000 litre tanks was elected as the more sustainable option.

The shipment was made to Tamatave on May 2nd, the only accessible port, located in the northeast of the country. Although using the charity's allowance of one container free of import tax per year avoided considerable expenditure and permitted the use of the higher quality South African tanks, excessive paperwork and miscommunications from Customs and the Port Authority has significantly delayed tank arrival. The tanks are currently in transit from Tamatave and are expected in Sainte Luce in the first half of June.

5. Tatirano Water Bottles

Tatirano-branded water bottles have been purchased for each Ambandrika primary school student. A seemingly ordinary school item, water bottles will provide children with a vessel not only for use at school, but to take clean water home. The clear water in the bottles can be seen easily because the plastic is transparent and colourless, and the bottles will serve as a visual reminder that clean water is attainable if rain is collected.

The Tatirano bottles in storage in Fort Dauphin, ready for distribution to the school children.

6. Ambandrika School Latrines Repair

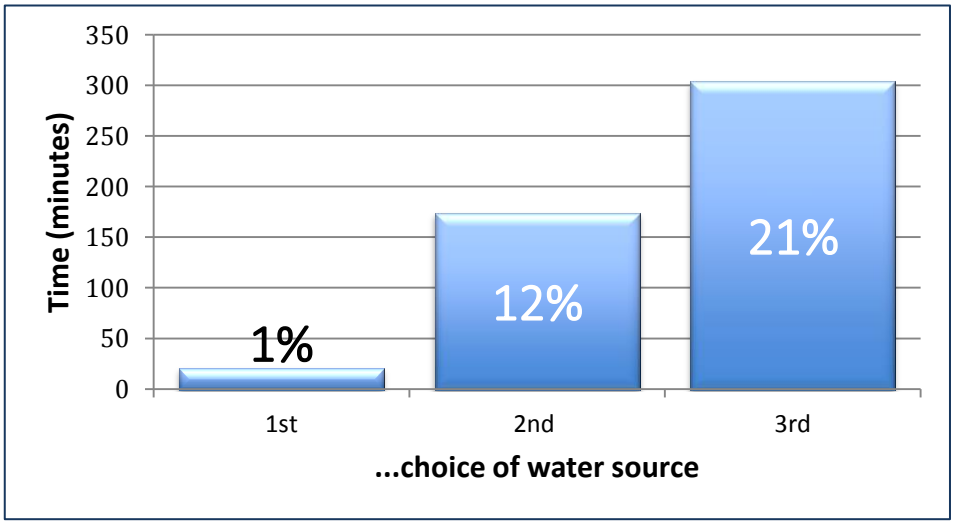
The first interim report noted that the Ambandrika primary school latrines were not used due to the rusted and leaking roof and the absence of doors. Project Tatirano collaborated with another SEED project, Mitsinjo, to repair the latrines back to a functional level. (Mitsinjo has run a range of complementary activities for two years to improve nutrition and health while also increasing livelihood opportunities across a number of rural communities, including Sainte Luce).

The majority of repair activities such as the doors, cleaning and painting were completed through the Mitsinjo budget. Two of the factory-galvanised corrugated roofing sheets, left from the school roof repair, were used for the roof of the latrines.

Left: *School latrines pre-repair work.* ***Right:*** *Post-repair work.*

7. Baseline Statistical Analysis

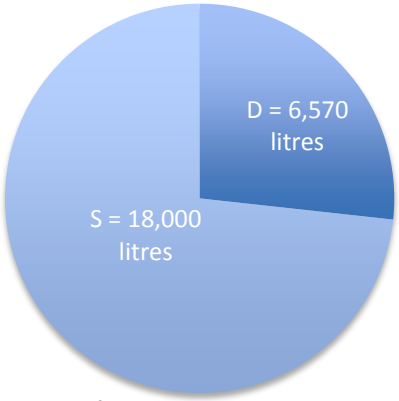
Statistical analysis of the baseline study carried out in Ambandrika in November has been completed in the second quarter of Tatirano. The baseline will act as a measure of project effectiveness within the community of Sainte Luce.



Graph 1: Time spent collecting water from different choices of water sources in Ambandrika each day

Despite the significant time it takes to collect water from the 2nd and 3rd choice sources (Graph 1), interviewees/households explained that these are frequently used in Ambandrika because the water is deemed cleaner and the first choice sources often dry up in hot periods without rain. In addition, many households commented that they use different sources for differing purposes such as a stream far into the forest for laundry, and a nearby stream for cooking, drinking and bathing. While consistencies in data across the village point to data reliability, it should be noted that many individuals have an inaccurate perception of time and/or distance because of a low level of education and wide reliance on working in daylight.

Household yearly drinking demand (D) versus potential rainwater supply (S)



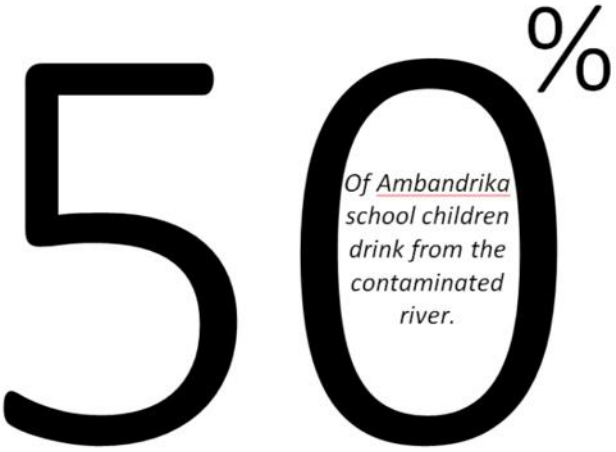
Left: *1.8 litres is the equivalent of about three and a half Tatirano bottles.*
Right: Graph 2: *the potential of rainwater harvesting in Ambandrika based on average roof area.*

It was reported that an average of eight buckets (118 litres) of water are collected per household per day, and that 95% of the time, water is collected by women and carried on their heads. If Project Tatirano scales-up and facilitates household systems, women will avoid the physical strain of carrying water and save up to five hours a day.

While self-reporting pointed to a demand for 1.8 litres per person per day in Ambandrika, this figure is likely to be slightly below the peak demand during the height of the summer months. In addition, the aforementioned problem of a lack of standardised measuring tools in Sainte Luce also applies to inaccurate perceptions of the amount of water consumed. Therefore a conservative drinking water demand of three litres per person per day was used in the calculations for Graph 2. The drinking water demand is based on an average household size of six people, while the yearly rainwater supply assumes the same runoff coefficient (percentage of rain that falls on the roof that is collected after losses) and the same conservative annual rainfall as used in the calculations for the school system. The total collection area of each household was estimated during interviews and the median value (15 m^2) thereof was used in this calculation.

Although these statistics are relatively conservative, they still highlight the potential for rainwater harvesting to service all drinking water needs in Ambandrika. Using the total potential volume of water that could be collected each day per household, 27% of those interviewed have sufficient roof areas to collect rainwater for all household water needs. Interestingly, while 27% of houses had above-average roof areas, these participants reported below-average water demands. It is possible that larger roofs correlate to higher wealth and a higher level of education, which in turn could point to more accurate data for the volume of water collected each day. If this reasoning is correct, it could be assumed that more than 27% of the households would collect sufficient volumes of rainfall for all water demands.

With 50% of Ambandrika school children drinking water from the contaminated river, Project Tatirano will be able to directly address this through the distribution of the water bottles. While it will not be possible to measure the quantitative positive effect on health within the short time period, the effectiveness will be easily qualitatively measured by repeated questionnaires with the children.



3. Conclusion and Future Work

Despite some logistical setbacks, the demand for Project Tatirano and its potential to contribute towards the clean water needs in Ambandrika have become increasingly evident. A highlight of the past quarter includes the continued growth of the TMC and its increasing sense of responsibility to the community it represents. The overwhelmingly positive reception of the seminar series will hopefully continue through maintenance training as the system is completed in the coming weeks.

The introduction of WASH classes into the school's curriculum was delayed in order for teachers and the Directrice (Headteacher) to develop a comprehensive understanding of the interconnection between water, sanitation and hygiene before sharing this knowledge with the children. Following the opening of the system in Ambandrika, meetings and workshops will be held with the teachers and the Directrice to plan WASH classes to supplement the existing material in the curriculum. While the possibility of scaling-up Tatirano after the pilot is under ongoing review, it will be heavily dependent on the reception of this project by the wider Sainte Luce community.