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Update and Progress Report on

Project Tatirano (Phase II): Improving access to clean drinking water via rainwater harvesting in the Anosy Region, southeast Madagascar

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1. Summary

Project Title: Tatirano – Improving access to clean drinking water via rainwater harvesting in the Anosy Region, southeast Madagascar

Objective: To promote rainwater harvesting in the southeast of Madagascar by introducing household systems across eight communities

Target Population: 1,220 people across the eight communities in the Mahatalaky and Mandromodromotra rural communes of southeast Madagascar: Manafiafy, Ampanasatomboky, Ambandrika, Tsiharoa Ambondro, Tsiharoa Ampasy, Belavenoky, Mahialambo and Mandromodromotra (see *Figure 1)*.

Executive Summary:

While 65% of Madagascar's 25,600,000 people live in rural areas, just 35% of this population have access to improved water sources (JMP, 2015). As the world's most unequal country for access to improved drinking water (JMP, 2017), it is perhaps unsurprising that only 28% of households in the Mahatalaky and Mandromodromotra rural communes in the southeast of the country are satisfied with their current water source. Rainwater harvesting (RWH) has the potential to significantly improve these indicators.

Whilst rainwater has been collected for millennia across the globe, and rainfall in the Anosy Region is consistently high throughout the year, RWH is not widely practiced in this remote corner of the country. In addition to its substantial health benefits, when RWH is practiced at the household level the technique eliminates the opportunity costs associated with water collection, affording more time for educational, economic and entrepreneurial activities.

Building from the Phase I RWH system, which continues to provide clean water to 144 school children and their community in Sainte-Luce, Project Tatirano Phase II is introducing RWH at the household level. Extensive research over the first six months of the project, including willingness to pay (WTP) analyses and product design research, has informed the development of an 18-month implementation model. The RWH systems have been designed, tested and costed; a subsidy level has been set; and the geographical scope of the project has been expanded to cover eight communities within the Mahatalaky and Mandromodromotra rural communes. The project has also been presented to and well received by several local, governmental and international organisations.

This progress report details the activities conducted over the last six months, summarises findings from the research period and outlines the adapted implementation model.

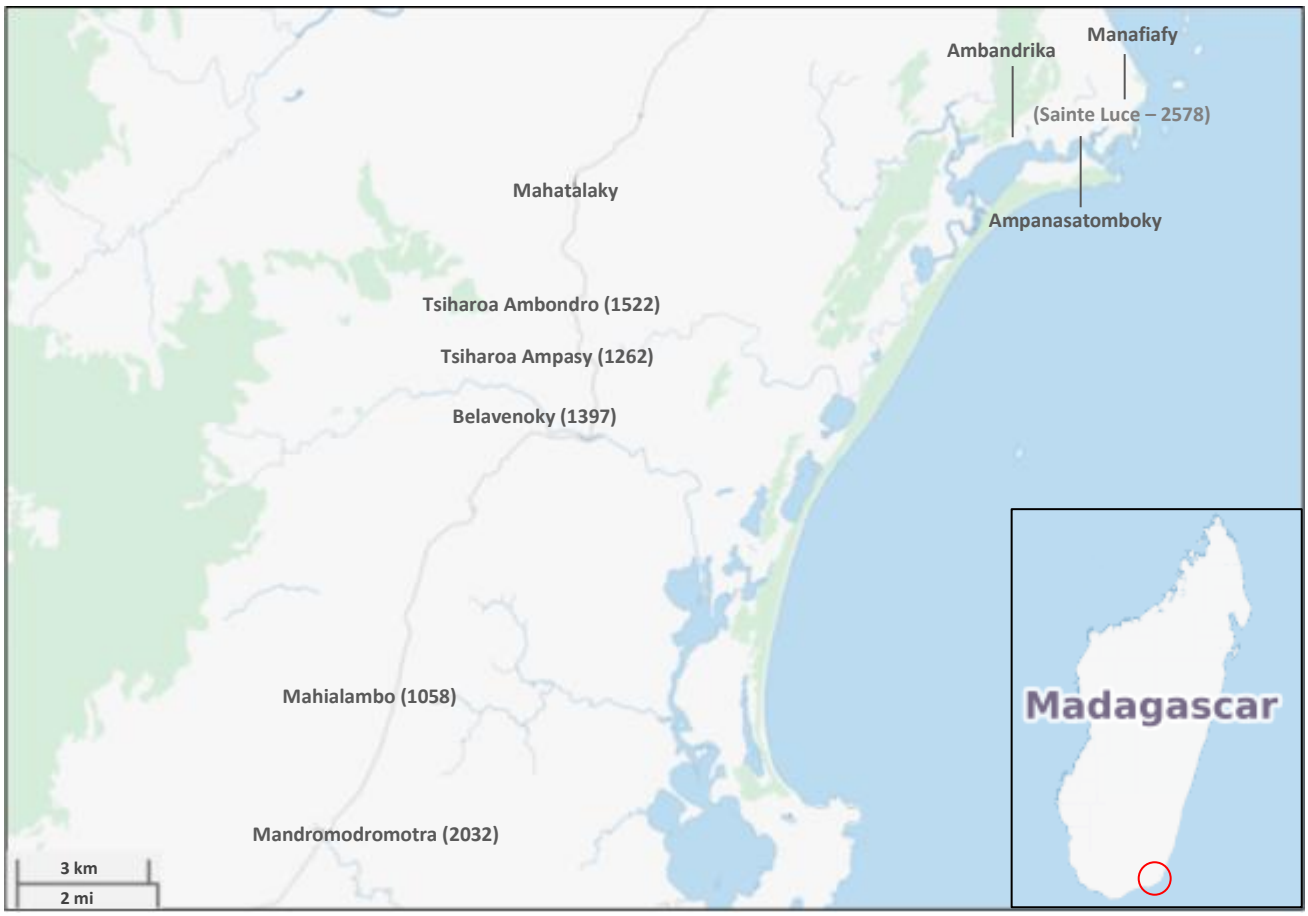


Figure 1: Map illustrating locations of selected communities and their populations.

(Pop. statistics: (ONG ASOS, 2006) (World Bank, 2015); map: (OpenStreetMap, 2017))

2. Project Detail

In accordance with the first project detail accepted by The Travers Cox Charitable Foundation in January 2017, the project detail has been updated following the initial six-month research period. In summary, the target of reaching 200 households still remains but now covers eight communities, including the original proposed *fokontany* (cluster of villages) of Sainte Luce (covering the Manafiafy, Ampanasatomboky and Ambandrika communities). The project was expanded to include additional communities in order to test RWH as a replicable method of accessing clean and convenient drinking water. By including more communities rather than focusing exclusively on Sainte Luce, the project's replicability will be more reliably confirmed. Targeting more communities will also increase the number of suitable households to target in line with WTP analysis.

Of notable change within the outcomes listed below is the removal of the reduction of self-reported prevalence of diarrhoea among children. Diarrhoeal disease in children is heavily dependent upon the three interrelated prongs of water, sanitation and hygiene (WASH) access, practices and behaviours. While water and hygiene will be addressed directly through this project's

activities, without improving sanitation facilities, it is unlikely that a significant drop in the prevalence of diarrhoea in children over the study period will be observed.

Other outcomes and outputs originally proposed were also amended following the research period; adjustments sought to portray more realistic and useful aims for project.

2.1 Outcomes[1,2]

1. A 20% decrease in amount of time spent collecting water by households
2. A 20% increase in amount of water brought to and stored at households
3. A 60% reduction in faecal coliforms in households' main source of drinking water (/100ml)
4. 80% of households maintaining and managing kits to a high standard
5. 50% increase in score achieved by participating households in a questionnaire testing knowledge of WASH concepts

2.2 Outputs

1. A household RWH system is designed, tested, sourced and priced by June 2017. **Completed**
2. The total population reach of the RWH systems is determined by June 2017. **Completed**
3. A WTP analysis of eight target communities is written up by June 2017. **Completed**
4. A Financial model generated to determine beneficiary-paid subsidy of Tatirano systems is determined by June 2017. **Completed**
5. The total cost per litre to each beneficiary is calculated by June 2017. **Completed**[3]
6. The design, refinement and piloting of education seminars for relevant knowledge sharing at the household level before implementation with households in September 2017.
7. A total of 200 household systems installed by December 2018 across eight target communities.
8. Three education classes delivered to every household signed-up to the intervention on the subjects of WASH, maintenance and management
9. Monitoring, evaluation and learning (MEL) of the intervention will target a publication about the health impacts to the wider WASH community by end of project.
10. MEL of project activities will target an engineering-based publication about the system's effectiveness in supplying clean drinking water to rural communities by the end of the project.

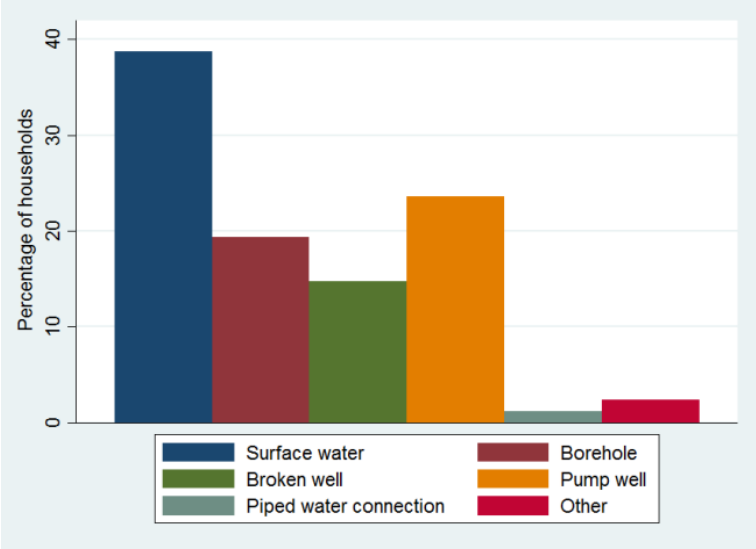
[1] All outcomes to be achieved by endline assessment in October 2018. See *Monitoring, Evaluation and Learning (MEL)* for more information on the methodology for measuring these outcomes.
[2] Full details of the changes and the accompanying justification documents are in Appendix A
[3] The detailed results of outputs 1 – 5 are within the text. Output 1: System costs 240,350 Ar including transport. Output 2: total reach = 1,220 people. Output 3: 38% subsidy paid by SEED. Output 4: Over a conservative period of intended system functionality of five years, cost to beneficiary = 38Ar/15L bucket.

2.3 Activity detail

2.3.1 Willingness to Pay (WTP) analysis

A WTP assessment was conducted across the eight target communities to assess demand for Tatirano Phase II household RWH systems and collect data on the amount of money households would be willing to pay for their own system. Additionally, the research sought to ascertain local attitudes, priorities and current means of drinking water provision in target communities. Data was collected through a household survey which was administered by trained enumerators over a 13-day period, resulting in 258 completed questionnaires.

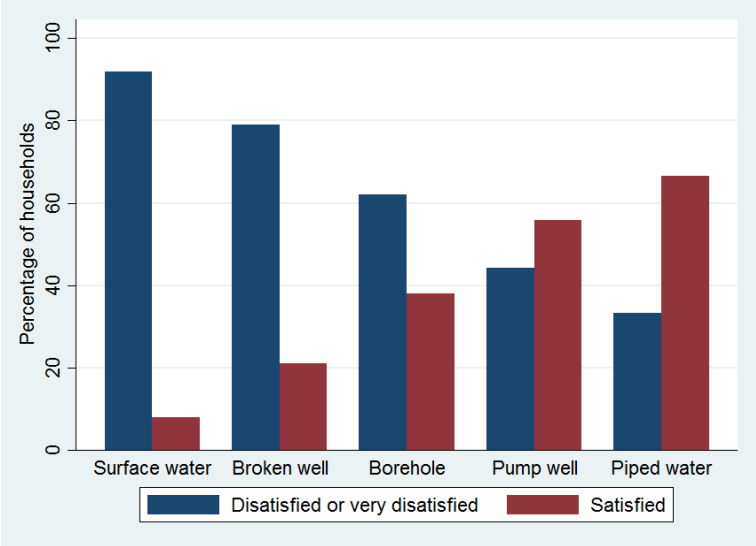
Results showed that the state of drinking water supply was extremely poor in the surveyed communities. At the time of the research there were high levels of reliance on surface water and unprotected boreholes as primary sources of drinking water (58% of households) and limited access to improved water sources[4] (only 21% of households – see *Graph 1*). While levels of satisfaction with these sources of drinking water were very low, especially for those households relying on unimproved sources[5] (*Graph 2*), access to water was on average prioritised below access to healthcare, education and food.



Graph 1: Current main source of drinking water across the eight communities.

Encouragingly, results illustrated both a high level of interest in the Tatirano RWH kits as well as a high level of willingness to pay for the system. Indeed, 95% of households surveyed thought the system would be useful to them after watching a demonstration video, while 92% were prepared to pay for it. When offered the choice of payment options, households that were willing to pay demonstrated an overwhelming preference for staggered repayment (89%) over time rather than

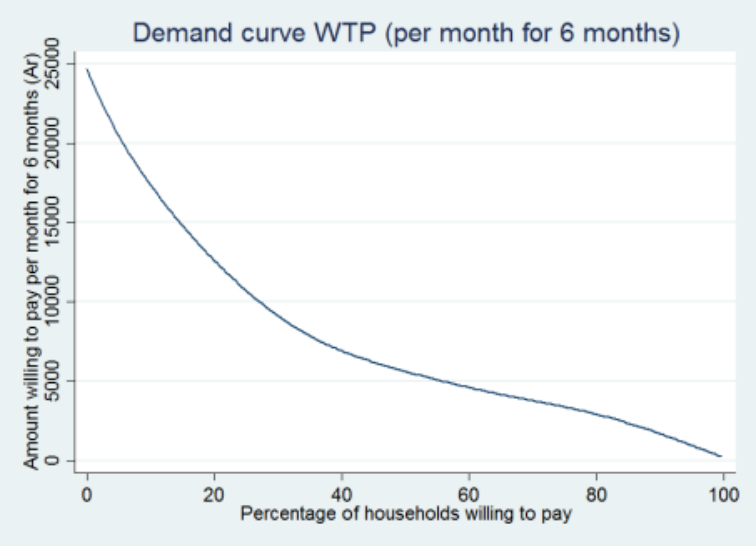
[4] Improved water source defined using the JMP: "[a water source] that…is protected from outside contamination, in particular from contamination with faecal matter." (JMP, 2015)
[5] Unimproved water source does not meet the above criteria as defined by WHO's JMP report. (JMP, 2015)



Graph 2: Satisfaction with current water source by water source type

up-front payment. The average amount that households were prepared to pay over a six-month period was 7,700 Ar per month.

A key function of the WTP analysis was to provide data on the number of households that would be willing to pay for the system at different proposed prices. For example, the analysis showed a set monthly cost of 15,000 Ar for six months would result in 10% of households in target communities willing to pay for the system. From this data a demand curve was generated (*Graph 3*) to visualise the relationship between cost and demand.[6]



Graph 3: Percentage of households willing to pay against price of the system (per month for 6 months)

[6] Full written report of WTP analysis is available upon request.

2.3.2 System design, material selection and sourcing

In order to promote long-term sustainability, the project seeks to develop household Tatirano systems that are functional, affordable, durable, easily accessible and replicable using materials found locally. Key components that were researched included the collection area, conveyance method, storage facility and first flush diversion system.

A 250-litre plastic tank was selected for numerous benefits; installation does not require a skilled artisan; the materials are durable; and the lightweight and manageable size allows for relocation and easy cleaning. Widespread local availability of these tanks was taken into consideration when selecting the tank type for the school system constructed in Phase I, with plastic water tanks considered easily replicable for non-skilled artisans. Whilst Phase II considered other material options, in order to introduce RWH as an effective method of providing clean drinking water, installation and management of the household system needed to be kept very simple and importantly, affordable.

With the majority of target household roofs constructed of *ravinala* (thatch made from palm fronds), the second most important factor considered was the collection surface. As *ravinala* is neither conducive to high runoff nor clean water conveyance, a suitable alternative was sought, including metal and various tarpaulin materials. Following a number of system design iterations that were tested based on performance during rainfall, durability of materials, simplicity of installation and cost, a modular roofing panel has been created using wood and tarpaulin (*Figure 2.)*

Whilst corrugated metal provides a neater, potentially more durable and efficient option, the cost is prohibitively high for the target market. However, with metal roofs preferred not only for superiority in keeping homes dry but as a status symbol for families who can afford them, numbers of metal roofs are increasing across the commune. Should RWH become more commonly practiced, system installation will be made easier on existing metal roofs.

Figure 2: Left: Simple modular roofing allows for easy installation and expansion to improve performance if desired. Right: Overflow first flush system made of a jerrycan maintains high water quality.

A simple overflow first-flush mechanism made from a cheap and locally available 20 litre jerrycan has been designed (*Figure 2)*; based on the successful Tatirano Phase I school system. The system collects dirt or debris that has accumulated on the roof or gutter during the dry period, or that falls during rainfall, before allowing cleaner water to simply overflow into the tank. The first-flush system on the school has been remarkably effective at maintaining water quality and initial testing showed promise for the household jerrycan setup to yield similar positive results.

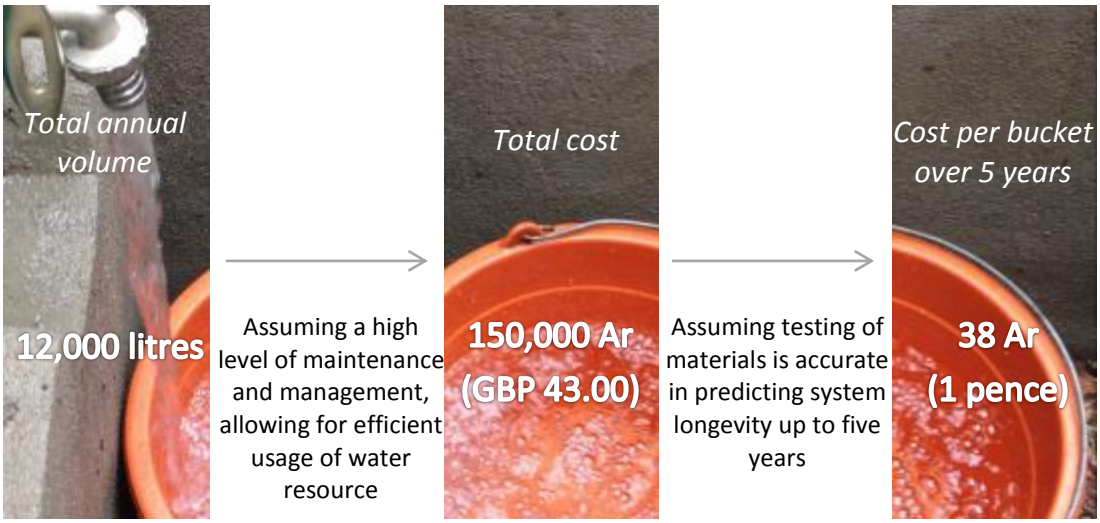
A basic setup made of three roofing modules (a total area of 8 m^2) will capture over 12,000 litres of water each year, representing over two and a half times the daily household drinking water demand. The modular collection and storage design allows for the possibility for households to increase either of these crucial components to improve performance. The basic system that will be offered in this project is outlined in *Table 1.* It should be noted that prices are volatile and subject to change, potentially changing the cost to SEED but not affecting the cost to beneficiaries.

Table 1: Breakdown of components and costs per system.

Item	Unit	Cost/unit (Ar)	No. units	Total Cost (Ar)
250 litre tank	Item	110,000	1	110,000
Jerrycan	Item	2,500	1	2,500
Tap	Item	27,500	1	27,500
Tarpaulin	Metre	10,000	6	60,000
Wood frame	Item	500	15	7,500
No. 5 Nails (roof)	Kilogram	5,000	0.5	2,500
No. 7 Nails (stand)	Kilogram	5,000	0.1	500
Chain	Metre	6,000	1	6,000
Padlock	Item	3,000	1	3,000
Transport	Item	20,000	1	20,000
Funnel	Item	850	1	850
			TOTAL (Ar)	**240,350**
			TOTAL (GBP[7])	**68.67**

[7] Using the budgeted exchange rate of 3,500 Ar = GBP £1.00

Below: over a five-year period, RWH proves to be a cost-efficient mechanism for delivering clean, proximate water to households



2.3.3 Household Financial Model

With Tatirano Phase II seeking the long-term sustainability of RWH systems, the project prioritises ownership and responsibility of the systems alongside the durability of materials. Learning from previous SEED projects has shown that infrastructure is more likely to be neglected or abandoned if beneficiaries do not contribute to it financially. Household payment for systems will also establish market demand for RWH and, if successful could lead to the development of a RWH-based enterprise. Taking into account key learning from the WTP and system research, a financial model has been developed that will facilitate families paying for their new water source.

Payment Structure

The team conducted extensive research of existing microfinance institutes (MFIs) in Fort Dauphin to explore the potential for MFIs to facilitate payment for Tatirano systems. This approach had the potential to reduce SEED's role in promoting RWH, as families would have access to finance for materials independently of SEED. Thorough research and community consultation revealed that this was not an appropriate approach. Key obstacles identified included prohibitive collateral requirements for loans; high membership fees and interest payments; and negative past experiences of MFIs. For example, community members talked of families that defaulted on loans losing *zebu* (Malagasy cow) which are of extremely high value in monetary, social and traditional terms.

Preliminary decisions made about the payment structure were informed by a combination of system research, discussions with key members of the experienced local team at SEED and the WTP analysis. A key concern highlighted by the team was the difficulty of marrying a rigid repayment structure with the inconsistent income most beneficiaries depend on. Additionally, the field team highlighted logistical problems that could be pre-empted and planned for, such as theft of materials.

Key data from the WTP analysis showed that 88% of the households would prefer to pay for a Tatirano system over time rather than in a single payment. Tatirano will therefore offer beneficiaries the opportunity to pay for their systems over a six-month period as an alternative to a one-off payment. No interest or collateral will be required, overcoming the barriers associated with MFIs. With the privilege of long-term planning unknown to the majority of families in the Anosy Region, who are forced to live day-to-day, shorter loan periods are unsurprisingly more widely preferable to reduced payback over longer periods. The amount payed for each instalment will depreciate over the six months to minimise the risk of default.

The loan period will be marketed to beneficiaries as a trial period, during which SEED maintains ownership of the system until the loan is fully repaid. This label seeks to mitigate problems of ceasing loan repayment mid-term, whilst households are protected from the embarrassment and stigma associated with 'defaulting' on loans. Rather, households that struggle to payback even after considerable negotiation periods with SEED will simply have 'finished' their trial period. As such, these households will be required to 'return' the materials instead of having them 'reclaimed'. In this situation, an 'end of trial' refund equalling 25% of the total amount invested will be returned to households. This seeks to help households that have sudden changes in circumstances, whilst the relatively low refund level prevents people from viewing the loan as a banking mechanism.

Marketing and sign-up across the eight communities will commence from September 2017, led by a new Community Loan and Marketing Officer (CLMO) position, currently being recruited for. This person will be responsible for promoting the RWH systems, signing up interested households, managing payment for all beneficiaries across the eight communities (based from Mahatalaky – see *Figure 1*), obtaining feedback and sharing this with the team. Being at the heart of communications between the project and beneficiary communities, the CLMO position will be crucial to the successful scale out, repayment rates and the relationship between the project and the communities.

Subsidy Level

Imperative to developing a price structure for the system was the relative cost of the 250-litre plastic tank. These tanks are widely used for a range of activities in Madagascar because of their manageable and useful size and affordable cost. In order to mitigate future problems of people using the intervention as a cheap avenue to purchase tanks for reallocation or resale, the minimum price of the entire system must be greater than the initial cost of these tanks plus associated costs of purchasing them in rural areas (including transport and per diems).

Accounting for these factors, households will pay a total cost of 150,000 Ar (GBP 43.00) over the six-month loan or 130,000 Ar (GBP 37.00) upfront. The reduced cost of the upfront payment system is designed to incentivise initial uptake which is anticipated to be the most difficult stage of the implementation phase. The project will thus be providing a 38% and 46% subsidy for loan and upfront payments respectively.

The WTP analysis has played an important role in setting a subsidy level. Of the 2,230 households that comprise the eight target communities, 3.3% indicated they would pay 25,000 Ar per month and 2.2% would pay 130,000 Ar upfront, equating to 122 households in total. Whilst this is less than the target reach of 200 households it does not account for either anticipated increased willingness to pay following initial implementation, or for households under-reporting their willingness to pay with hopes to influence a lower price.

The subsidy levels are subject to change pending additional feedback from community leaders including Village Chiefs, Opinion Leaders and other local stakeholders over the coming months. The subsidy level is conservative to maximise flexibility and allow changes to be made easily. If alterations to the subsidy level are required, it would not be possible to increase the price following unexpectedly high initial uptake. Conversely, it would be possible for SEED to increase its contribution and reimburse those households that had already paid at a higher price.

2.3.4 Educational sessions

The educational strategy for this second phase of Tatirano consists of three classes delivered by the project's Community Liaison Officer (CLO) and will cover basic WASH education, system maintenance and management.

At the point of installation for each household, the first one-hour class will be conducted focussing on maintenance and management and the important health implications associated with the consumption of clean water and good hygiene practices. The second class, delivered within two months of installation, will focus specifically on WASH and will include a Community-Led Total Sanitation (CLTS) inspired triggering session. Triggering seeks to shame participants into realising their own behaviours – including widespread practice of open defecation, poor hand hygiene, and prioritisation of the most convenient rather than cleanest water sources – are key contributors to poor health outcomes. A final session, delivered nearer the time of full payment to participants, will recap on key concepts learnt in the previous two classes.

2.3.5 Fort Dauphin WASH

Following a presentation of Project Tatirano in a meeting with UNICEF and the Ministry of WASH (DIREAH) in Fort Dauphin, the team was invited to present formally to a group of WASH actors called the 'WASH cluster'. This presentation sparked a great deal of interest in the project. In the following days, SEED received an invitation courtesy of the President and Prime Minister of Madagascar to present Tatirano at the inauguration of a new rural UNICEF-implemented government water supply system. The inauguration was the focus of Madagascar's World Water Day 2017 and as such, the presentation was to the Minister for Water and a senior WASH Specialist from UNICEF. Tatirano gained positive attention again, and the UNICEF representative was particularly interested in a potential future application of specific system specifications to existing UNICEF RWH setups.

Further to this, Tatirano has presented at an exhibition hosted by the French Alliance on the subject of clean water alongside other significant actors such as the EU and CARE International. The project's involvement within the wider sphere of WASH actors in Fort Dauphin, and indeed Madagascar, is very positive for boosting the impact and reach of the learning from both the project and SEED's broader WASH activities regionally, nationally and internationally.

3. Monitoring, evaluation and learning (MEL)

SEED prioritises effective monitoring, evaluation and learning (MEL) strategies across all projects. Rigorous MEL not only facilitates an adaptive, learnings-based approach to project implementation, but provides crucial data on the success of a project in achieving its desired outcomes. Indeed, the adaptation of project outcomes and outputs from those listed in the original Tatirano Phase II project detail is indicative of applied learning from the extensive research conducted within the initial six-months.

Project Tatirano will use SEED's new RAG-rating system (red; amber; green) to regularly track activities and progress towards the achievement of SMART key performance indicators. These are regularly reviewed and updated by project staff with oversight from the in-country Head of Project Development and Project Development Coordinator in London, enabling SEED to adapt to any emerging project needs quickly and effectively, while keeping donors informed of key developments in real time. Further to this, findings generated from evaluation of key interventions and indicators will be disseminated to the wider WASH and international development communities, promoting sector-wide learning and development.

A semi-randomised trial will provide a framework to measure the effectiveness of the intervention. Comparisons of beneficiaries with non-participating households will be made through baseline and endline surveys, highlighting changes across key indicators for project outcomes over the 12-month period. Following international best practice recommendations for controlled trials, the results will not only inform future SEED projects, but will be disseminated nationally and internationally. Sharing avenues will include regional WASH meetings, international WASH and development platforms such as the CLTS Knowledge Hub, IWA WaterWiki and HayZara, and through publication in relevant academic journals.

4. Annex A

4.1 Outcome changes and justifications

Outcome – January 2017	Outcome – June 2017	Justification for change
30% reduction in self-report incidences of child diarrhoea	Removed	- Expected insignificant drop in diarrhoea as a result of intervention because of multiple unaddressed causes of diarrhoea - Unreliability of reporting diarrhoea incidences because of the taboo of discussing the subject
25% increase in self-reported wellbeing and general health since consuming rainwater instead of contaminated water	Removed	- Difficulty in establishing a reliable index for wellbeing
30% reduction in reported time spent collecting and managing water	20% decrease in amount of time spent collecting water by households	- June 2017 outcome estimated using data from more reliable and recent data collected from WTP analysis - RWH systems will not replace the need to use existing sources for non-sanitary water demand
80% maintain and manage their systems to a high level	No change	- Simple system design combined with comprehensive step-by-step guide should yield high standard of maintenance
Testing will demonstrate an average 40 count reduction in the presence of faecal coliform bacteria in RWH systems in comparison to the current contaminated well at six and 12 months following installation	60% reduction in faecal coliforms in households' main source of drinking water	- Reduction in count now accounting for eight communities. SEED's well management project, Fatsaka, found that contamination levels across wells from other communities had lower counts and thus the achieved 86% reduction in Sainte Luce in comparison to the first phase of Tatirano is unrealistic
	50% improvement in knowledge of key WASH concepts (Shrestha, 2014)	- The current evidence base on WASH education interventions in low-income settings suggests that a 50% increase in knowledge of good hygiene practices is a realistic and attainable outcome (Shrestha, 2014)
	20% increase in amount of water stored at the household	- Amount of water stored at the home is a proxy for improved hygiene practices: the more water households store at home, the better their hygiene practices are likely to be (WHO, 2003)

4.2 Output changes and justifications

Output – January 2017	Output – June 2017	Justification for change
Household RWH kit is designed, tested, sources and priced by June 2017	No change – completed	
Total population reach of the RWH systems is determined by June 2017	No change – completed	
WTP analysis of eight target communities is written up by June 2017	No change – completed	
Subsidy level determined by June 2017	No change – completed	
Total cost per litre to each beneficiary is calculated by June 2017	No change – completed	
One refresher RWH training workshop is delivered to TMC in Sainte Luce before pilot trials in July 2017	Removed	- TMC management and maintenance levels are high and refresher training deemed unnecessary
Refinement of education seminars for relevant knowledge sharing at the household level before implementation in June/July 2017	The design, refinement and piloting of education seminars for relevant knowledge sharing at the household level before implementation with households in September 2017	- Postponed to September 2017 due to underestimating the time needed for baseline, marketing and sign up preparation
Four educational knowledge sharing seminars are delivered to all participating households	Three education classes delivered to every household signed up to the intervention	- Realistic to deliver three classes given limited resources in the light of the geographic spread
50 pilot household trials implemented and monitored across the three hamlets of Sainte Luce during second six months	Removed	- Following WTP analysis and local research, the 18-month scale out period will be needed in its entirety to reach the 200 household target
Three focus groups with samples of participating households in Ambandrika, two in Ampanasatomboky and three in Manafiafy by the end of first year	Removed	- Household level interviews yield more accurate and useful information e.g. WTP analysis because of the absence of local politics present during community meetings
A total of 200 household systems installed by December 2018 across Sainte Luce	A total of 200 household systems installed by December 2018 across eight target communities	- Expanded to eight communities in order to reliably test the intervention as a replicable model - Targeting more communities will increase the number of suitable households to achieve the intended reach

MEL of project approaches is disseminated through three publications per year to national and international organisations, and international RWH and WASH forums	MEL of the intervention will target a publication about the health impacts to the wider WASH community by end of project	- Split into more specific publishing targets in order to achieve project's sharing potential in the national and international WASH/RWH communities
MEL of project approaches is disseminated through three publications per year to national and international organisations, and international RWH and WASH forums	MEL of project activities will target an engineering based publication about the system's effectiveness in supplying clean drinking water to rural communities	- Split into more specific publishing targets in order to achieve project's sharing potential in the national and international WASH/RWH communities

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