COLUMBIA WATER CENTER
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

Rainwater Harvesting in Dilla, Ethiopia

Feasibility Study

Project sponsor: Ceil & Michael E. Pulitzer Foundation Inc.
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Time covered: April 1st – June 30th, 2017
July 2017

Executive Summary

The funding for the Rainwater Harvesting (RWH) in Dilla, Ethiopia feasibility study was approved in late March 2017 and made possible by generous support from the Ceil & Michael E. Pulitzer Foundation. Upon approval, the Columbia Water Center (CWC) team at the Earth Institute, Columbia University, focused on planning a visit to the selected area in Southern Ethiopia to perform this feasibility study and confirm the assumptions presented in the project scope. This report is a summary of the findings obtained during the field visit that took place from June 12th to June 25th and includes recommendations for moving forward. During the visit, the project team met with multiple NGOs, regional and local government institutions such as Water and Health authorities and the Meteorological Society in Addis Ababa, Hawassa, Dara Woreda (District), and Dilla Town. We visited eight sites (schools and health centers) in Dara Woreda where RWH systems are already in place, and we toured Dilla Town's Water Supply (the treatment plant and reservoir).

Based on our findings, we recommend changing the initial scope of the project which entailed building a new RWH system at Dilla Health Center, and instead focus on repairing and creating a sustainable training and management strategy for existing RWH systems in health centers in rural areas that do not have access to other sources of water (specifically at Dara Woreda). A *water disinfection and water quality monitoring plan will be included as part of the implementation as these are not common practices in current RWH systems in the area. The rationale behind the proposed intervention is that while other organizations have implemented RWH systems in health centers in Ethiopia, they tend to fall into disrepair and misuse due to poor training and management. The NGOs we met with acknowledged this as a major challenge. These NGOs, along with the many working RWH in the region, will be targeted for participation and application of this work as the project is scaled. These efforts will result in a more holistic program approach that increases sustainability and functionality of RWH systems at health centers. A formal change of scope will be submitted for approval.*

Visit Objectives

1. Confirm if rainwater harvesting is a feasible path forward for improving water supply/access at the Health Center located in Dilla, SNPR, Ethiopia.

2. Get a thorough understanding of Dilla Town's existing water supply (identify strengths and issues) complementing the general information obtained in phase 1 from the original scope.

3. Assess the potential financial benefits of the RWH systems (i.e. net present value, payback time) considering local water tariffs, maintenance costs, and the reliability of the systems (the expected percentage of the demand that could be covered).

4. Compare the results versus alternative options (i.e. upgrading the current water supply system, designing large-scale/centralized RWH facilities, etc.).

5. Solidify potential regional implementing partners for scale-up of the project.

Observations, Conclusions and Recommendations

1. The original scope of work needs to change. Building a RWH system at Dilla Town's health center is not the best way to address water shortage at that location. From the meetings and site visits, we learned that RWH systems have not been successful when another water supply alternative is available, even when it is not reliable. This theme emerged in many interviews with diverse stakeholders. In the specific case of Dilla Town Health Center, we learned that a $7 million (an equivalent of 155 million Ethiopian Birr (ETB)) water supply expansion led by the World Bank is projected to start in 2018. The goal is to increase water coverage in Dilla Town from 61.9% to 90%. We confirmed that the health center has real water shortages (they get piped water once a week and store it in an open and rusty 10,000-liter container; they use 1,000 liters/day and need 5,000 liters/day to operate properly), and they would benefit from the water supply expansion.

2. According to the Director of the Dilla Town Water Supply Enterprise, "the biggest issue is not the water availability but rather infrastructure." The current production is 59 liters/second, with 12 liters/second coming from surface water and 47 liters/second from six boreholes. They estimate that on average they provide water twice a week to residents and institutions, but this differs across town (for example, some places receive water once every two weeks as confirmed during household visits). The paying customers include 7,700 households, with 2,000 of these households served by 38 community taps. The percentage of the population covered is 61.9%. The water lost in leakage is estimated to be 22%, but in a field inspection to their installations, we believe this is an underestimate. The water expansion project will change the current slow sand filter to increase production, and five boreholes will be built to reach 90% coverage taking into account population forecasts for the next 20 years. A detailed source and baseline analysis was performed by Planet Consulting, the consultant in charge of the project. Water is subsidized, the production cost per cubic meter (m^3) is 5.5 Ethiopian Birr (ETB), and the starting tariff is 3.85 ETB/m^3 for up to 5m^3 with incremental increases for larger volumes, meaning the water authority operates at a deficit, with its budget coming from the government. As part of the new project, a business plan will be proposed to the water authority to operate more efficiently. After visiting the water treatment plant and the distribution system, we believe that other improvements to the current system are necessary. We provide a list of recommendations in Appendix II. Overall, improving the efficiency of the current system can help to have better operation practices in the expansion.

3. An analysis of the economics of RWH systems at the sites visited (Appendix III) shows that the RWH systems in health centers have an approximate payback period of 10 years while in schools the payback time is longer because demand is lower. However, if well maintained, the useful life of RWH can be up to 20-25 years. The analysis doesn't take into account the costs of not having water at the health centers. Many of the sites do not have enough water to do basic services, even to wash newborns and their mothers, and do not have water to clean the facilities or even to administer medicines. It is a risk for the patients and health workers alike. The externalities incurred from lack of access, if quantified, could further justify the costs of implementing RWH when other water sources are not available. Also, an expansion of the existing systems by increasing the catchment area and therefore augmenting their reliability can reduce the payback time. RWH is only recommended in places where no other source besides jerry cans, is available.

4. As mentioned in points 1 and 2, a process is already in place to expand Dilla's supply. However, visits to other health centers in adjacent communities like Dara Woreda in the Sidama Zone, located just north of Dilla, made it evident that the area has big issues with water supply. The health centers' directors and workers expressed a big interest in having more water. The area receives high precipitation during the wet season, and therefore rainwater harvesting schemes have been implemented by other NGOs. However, the majority of the systems that we visited in schools and health centers have fallen into some

form of disrepair, mainly due to: 1) Poor maintenance, 2) poor training or people rotation (the ones who were trained had left), 3) poor construction/construction materials, 4) engagement with the users. The main problem is, therefore, long-term sustainability of the systems. Another area of concern is water quality, which has never been monitored in the existing systems. Our recommendations to move forward with the project are the following:

a. **Repair existing RWH systems at health centers**. Create a survey of existing RWH systems in health centers in Dara Woreda. Different indicators of the status of the systems would be compiled. The surveyed health centers would have to apply to be eligible for the repairs and training. The application process is intended to filter the health centers that are truly interested in the intervention and that are more likely to maintain it in the future, which will make the systems more sustainable and capacity building more effective. There would be a shared cost of the repair between the health centers and this project of at least 10%. The number of health centers that would benefit from this scheme would be confirmed once we receive an estimate of the costs and fees from our implementing partner, but the intention is to have four or five centers for the pilot as identified in Dara Woreda.

b. **Training**. The repairs will be accompanied by training for the employees of the health centers. No per diem will be given to anyone during the training (a common practice in Ethiopia). We will identify local contacts that can be contacted in case of disrepair. The costs of repairing the systems in the future will have to be absorbed by the health centers.

c. **Sustainability**. We plan to test three different management structures to maintain the conditions of the systems in the long term. Two audits of the systems would be conducted per year to assess if the systems are being properly operated and maintained and review which management structure is working best. This monitoring would have to be executed by the partnering organization.

d. **Water quality.** In all the interviews and visits we conducted nobody had ever measured water quality of the systems, and none of them were being disinfected. A sampling strategy of existing systems would be developed to at least have a snapshot of the water quality that is being used. The results of the water quality survey would be used to determine actions to implement in the trainings and monitoring of the systems.

5. Plan International Ethiopia has been identified as a potential partner for the implementation. We met on two occasions, and they facilitated the site visits and meetings with the Sidama Region Water and Health authorities.

A detailed change of scope will be submitted for approval.

Appendix I – Visit Agenda and Timeline, and Detailed Agenda

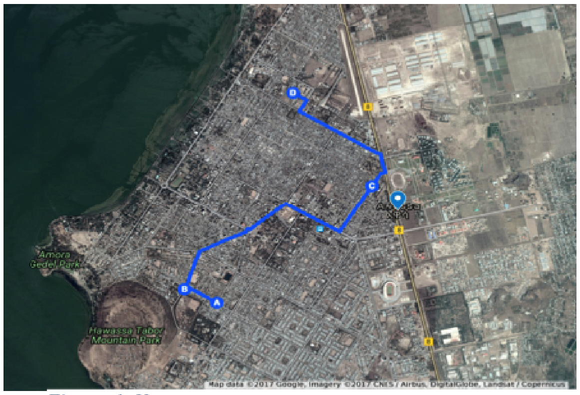


Figure 1. Hawassa

June 11

First day in Addis Ababa
- Meet with RAIN Foundation

June 12

Travel to Hawassa (Figure 1)
A. Meet with Plan International Ethiopia
B. Meet with Regional Health Bureau

June 13

C. Meet with Regional Water Bureau
D. Meteorological Society Request for Information

June 14

Travel to Sidama and Gedeo Zone (Figure 2)
A. Visit Tefari Kela Health Center
- Visit Kebado Hospital
- Visit Banqo Markose Health Center
- Visit Teramaye Dara School

B. Stay at Don Bosco Catholic Church

June 15

- Visit Korate School

C. Visit Odo la Health Center
D. Visit Saffa Health Post
E. Meet with Dara Woreda Water and Energy Bureau

June 16

F. Meet with Dilla Town Water Supply
G. Visit to Dilla's water supply river diversion, treatment plant, and reservoir

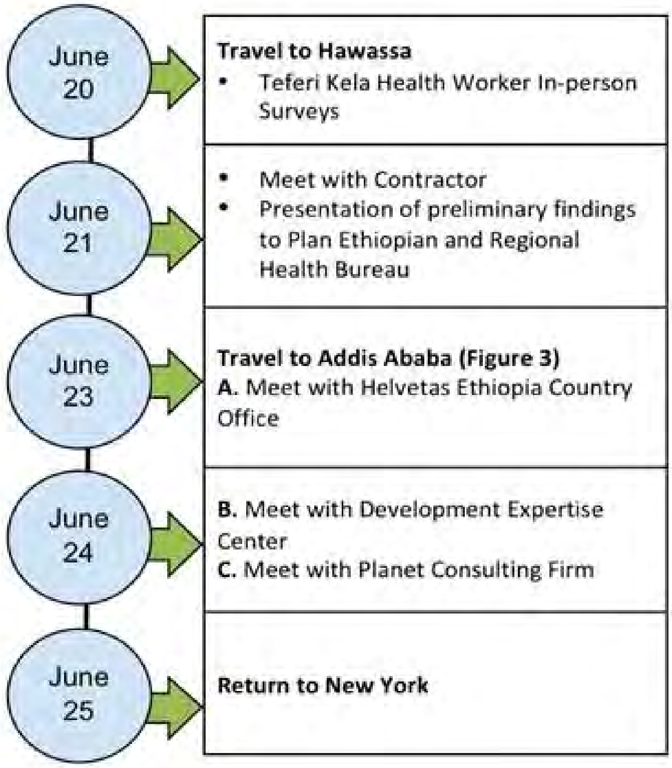
June 19

H. Meet with Gedeo Zone Zonal Water Authority
- Household RWH system site visit and interview

I. Visit to Di la Health Center
- Fiberglass cistern shop visit for price consultations

Figure 2 Sidama and Gedeo Zone

Figure 3 Addis Ababa



Detailed Agenda of the Feasibility Analysis Trip: June 11 – June 24, 2017

June 11

- Meeting with Selamawit Zewdu, former RAIN Foundation Consultant, Addis Ababa

June 12

- Meeting with Berhanu Tunsisa, Plan International Ethiopia, Hawassa, SNNPR
- Meeting at the Regional Health Bureau in Hawassa with:
  - Malie Matie: Disease Prevention and Health Promotion, Hygiene and Environment
  - Amare Birhanu: Global Sanitation Fund Regional Lead
  - Desalegn Guru: Regional Disease Prevention and Promotion
  - Ephram Brohanes: WASH Technical Lead, UNICEF

June 13

- Meeting at the Regional Water Bureau in Hawassa with:
  - Birhanu Debisso, Hydrogeologist
  - Abesaw Getachew
- Meeting with Samuel Tilahun, Meteorological Society Request for Information, Hawassa

June 14/15

- Site visits to the following RWH systems in Dara Woreda, SNNPR:
  - Teferi Kela Health Center, Kebado Hospital, Banqo Markose Health Center, Teramaye Dara School, Korate School, Odolla Health Center, Saffa Health Post

June 15

- Meeting with Gizaw Buchacha, Head of Water Office, Dara Woreda Water and Energy Bureau, Kebado, SNNPR
- Meeting with Medinet Abata, Sanitation Officer, Dara Woreda Water and Energy Bureau, Kebado, SNNPR

June 16

- Meeting with Mr. Amare Baqqalake, Manager, Dilla Town Water Supply, Dilla, SNNPR
- Visit to Dilla's water supply river diversion, treatment plant, and reservoir, Dilla, SNNPR

June 19

- Meeting at the Gedeo Zone Zonal Water Authority, Dilla, SNNPR, with:
    - Yonas Asfaw, Water Scheme and Maintenance Officer
    - Abinet Minassie, Water Engineer
    - Alemayehu Girma, Water Quality Expert
- Household RWH system site visit and interview with Mimi Wendemagan, Restaurant Food Supplier, Dilla, SNNPR
- Visit to Dilla Health Center, Dilla, SNNPR and meeting with:
    - Misrak Berhanu, Head of Dilla Health Center
    - Kalkidan Gezahegn, Outpatient Diagnostics Focal Point

June 20

- Fiberglass cistern shop visit and price consultations with Meseret Snulut, Manager, Dilla, SNNPR
- Conducting the Teferi Kela Health Worker In-person Surveys, Teferi Kela, SNNPR, with:
    - Tesfaye Zerihun, Clinical Nurse
    - Almaz Getacho, Procurement Officer

June 21

- Contractor meeting with Kidanawi Kirubel Worku, Hawassa, SNNPR
- Presentation of preliminary findings to Plan Ethiopian and Regional Health Bureau, Hawassa, SNNPR
    - Berhanu Tunsisa, Plan Ethiopia
    - Ephram Yohannes, UNICEF Liaison to the Regional Health Bureau

June 23

- Helvetas Ethiopia Country Office Meeting, Addis Ababa, with:
    - Felix Bachmann, Country Director
    - Firiehiwot Yibeltal, Program Director

June 24

- Meeting with Berhanu Demissie, Deputy Executive Director, Development Expertise Center, Addis Ababa
- Meeting with Dereje Nigussa, General Manager, Planet Consulting Firm, Addis Ababa

Appendix II - Visit to Dilla Water Supply Authority treatment plant and reservoir.

The facilities of Dilla Water Supply were visited on June 16th 2017. This is a summary of the observations gathered during the tour. Overall, our findings show that the main gaps are in process control strategy, record keeping, and maintenance (ideally, automation of chemical dosing and water quality monitoring would be included). Additionally, the lack of a power generator and an unreliable electricity supply compromise the reliability of the water supply. As with many other sectors, electricity is a major impediment when it comes to improving production and service.

Description of the system and observations:

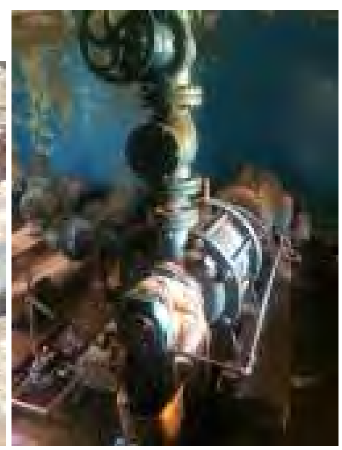
The river has a diversion that is routed through small basins to control the flow (most of the channel is not lined with concrete). As the river carries a large amount of sediments, a small tank is used to add a coagulant before passing to a sedimentation basin. The coagulant is not automatically dosed, and it depends on a person to go up to the tank every 13 hours to dose it. There is no registry to review if the coagulant was effectively dosed on time.

River intake

After the sedimentation basin, the water flows into a slow sand filter, and from there it passes to a disinfection tank. Disinfection is done with sodium hypochlorite, and it consists of a small barrel with a tube that is constantly emptying into the mixing chamber. There is no control over the dosage, and if the barrel is not replaced on time by the operator, the water is distributed without any form of disinfection. As for the coagulant, there is no way of knowing if the chlorine barrel is replaced or not. We were informed that sometimes the replacement does not happen. Someone is supposed to oversee the process and be present 24 hours/day at the site, but we couldn't find the operator during our visit.

Chlorination

Then the disinfected water gets pumped to the reservoir that is some kilometers away and at a higher elevation. The pump stops working when there are power outages, which can occur daily and with high frequency. There is no power generator because it is too expensive to run, so the production from the treatment plant stops. The reservoir has a capacity of 200 m^3. There is another new reservoir with a capacity of $500m^3$ but it stands empty because there is not enough production to fill it. The reservoir is also connected to the six borehole outlets, so all the water gets mixed there. Then distribution occurs by gravity. We were told that a large amount of water is lost before reaching the reservoir because of leaking pipes.



Inflow to the reservoir and pump from treatment plant to reservoir