Catalysing Green Technologies for Sustainable Water Service Delivery

D3: Feasibility Study Fieldwork Report

ISO 9001:2008 CERTIFIED

Terms and Abbreviations

Term/Abbreviation	Meaning
ASALs	Arid and semi-arid areas
CSOs	Civil Society Organizations
CTCN	Climate Technology Centre and Network
DANIDA	Danish International Development Agency
EU	European Union
PPP	Public Private Participation
UDP	UNEP DTU Partnership
WSTF	Water Services Trust Fund

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E. EXECUTIVE SUMMARY

E.1 Context

Water services in Kenya are often inadequate, unsafe and unsustainable. The arid and semi-arid and poor peri-urban areas are mostly vulnerable and are largely characterized by low water services provision and severe water scarcity, where the demand substantially surpasses its availability. Additionally, climate change is expected to significantly impact on water availability and therefore creating the needs of climate proof investments for improved water access in underserved areas in Kenya.

E.2 Objective of Study

A pre-feasibility study is underway to determine the technical, economic and social feasibility of water pans, solar and wind pumping systems for improved water services and climate proofed infrastructure.

EA. Field data collection

Towards developing this study report, a field study took place between 28th November and 17th December 2016 in four counties (Baringo, Embu, Homabay and Isiolo), selected upon nationally representative sample taking to account the seven ecological zones in Kenya, peri-urban experiences in these counties and areas where the Water Services trust Fund (WSTF) have active interventions.

The study utilised different tools (user survey, technology point manager, semi-structured interviews, observations and case studies) to collect first hand data and relevant information aimed at understanding the various contextual features that greatly allow the use or limit the viability of water pans, solar pumping system and wind pumping system. Additionally, the data collection process also intended to understand the attitude and preferences of the technology users, institutional barriers, financial barriers, technology relevance and management issues that limits or enhance adoption of these technologies.

Typically, the study team spent six days in each county. The first day at each county visit was set apart for consultation with key informants, including the county government, water resources management, water services providers, and civil society organisations. Specific study areas were identified by cluster sampling through the use of electoral boundaries.

Consultation with national actors and technology provider is continuing in order to clarify issues and idea coming out from the field data collection.

E.4 Challenges and opportunities in field data collection

Various factors affected the initial plan that intended to guide the data collection method. The initial plan on the areas to visit changed based on the information obtained on the first day from the different key informants. In some areas, the planned areas were far apart and more travel time would have been required to reach to these places. Some factors affecting the initial plan were; long distances, poor road network and availability of low cost technology in selected areas.

Various opportunities facilitated the data collection mission, among them; availability of project records from the management committees, having a WSTF contact person and having various leaders of a management committee of a specific technology(allowing to probe the leaders based on their mandate).

E.5 Data Summary

Field data collection mission visited 87 technology points, interviewed 125 users and 21 key informants. 26 unique observations were captured through the use of the case study tool. The team summarised their daily observation using the daily report tool. A total 13 daily reports were submitted.

County	Semi-structured interview	Water Manager Form	Water User Form	Case study	Daily report	Totals
Isiolo	6	21	23	9	6	65
Baringo	6	20	26	2	2	56
Homabay	5	19	35	11	4	74
Embu	4	27	41	4	1	77
Total	**21**	**87**	**125**	**26**	**13**	**272**

The study team identified the various green technologies in use; solar and wind for water pumping; and water pans, sand dams for water storage purposes. In addition, diesel generators and grid electricity are widely in use for pumping energy of water supplies. In all the four counties, the target low cost technologies have been installed in rehabilitation of old infrastructures and in other cases as part of new projects. Various forms of partnerships between the beneficiary community, government and civil society organisations were observed, mainly in terms of sharing capital investment. In several instances, individual operators run community owned technologies for profit.

County	Solar	Wind	Water pan	Diesel Engines	Total
Baringo	7	1	5	6	19
Embu	1	3	4	3	11
Homabay	8	1	4	2	15

Isiolo	12	2	4	2	18

E.6 Key observations and way forward

It was observed that low cost technologies (wind pumping systems, sand dams and water pan and to some extent small wind and solar-wind hybrid pumping system) alongside other technologies (grid electricity, diesel powered generators and hand pumps) have been adopted in the target areas. Nearly all water pans and solar technology points observed are less than 7-years old, most of them installed between 2013 and 2016. Data analysis will among others scrutinise if these technology types have recently been introduced in the target areas or the older installations have failed function. Good number of mechanical wind pumping system (Kijito wind pumps and hand pumps) have been abandoned and replaced solar system or diesel pumps owing to maintenance challenges.

Most technology points are isolated and managed by self –regulated community management committees. The committees are tasked with the mandate of taking care of the technology in terms of ensuring their operation, maintenance, revenue collection and addressing immediate concerns of the beneficiaries/water users. The quality of service and operations schedule varies widely.

The running and maintenance cost of diesel and grid electricity system for water supply is generally high compared to fair cost in maintain solar and wind powered systems. In all pumped system, water consumers are paying for domestic and livestock consumption ranging from Kenya shilling 2-5 per 20 litre Jerrican and 1 or 5 shilling for big stock, but rarely for use of waters pans and sand dams.

The collected data will be analysed according to the study design to inform factors and conditions influencing successful uptake of the technology.

1. INTRODUCTION

1.1. Background

Water Services Trust Fund (WSTF) is a State Corporation established with a mandate to mobilize finance for the provision of water services to the underserved areas in Kenya. WSTF has been in the forefront to enhancing sustainable water supply especially in underserved areas in the country and therefore informing the need of this study.

WSTF requested technical assistance from the Climate Technology Centre and Network (CTCN) to catalyse low cost green technologies for sustainable water service delivery in Northern Kenya and peri-urban areas. UNEP-DTU Partnership (UDP) was contracted by CTCN to provide assistance; firstly to analyse the feasibility and sustainable deployment of 3-specific low-cost green technologies for improved water services in underserviced rural and Peri-Urban areas, and especially in arid and semi-arid areas (ASALs), which covers over 80% of Kenya's land surface. The technical assistance also explores sustainable model for deployment of the identified technologies, and analyse private sector engagement potential in their deployment.

The ASAL normally experiences low, erratic and unreliable rainfall, with frequent droughts even within the rainy seasons. Hence unreliable and poorly distributed rainfall patterns is the most limiting factor to settlement and agricultural production. In addition to that, drought occurrence in Kenya is preceded by wet seasons or years when so much water is lost as runoff. This is a clear manifestation of the need to promote water harvesting technologies both for domestic and agriculture use and to manageably extract underground water during the dry seasons. There is need to create sustainable ways of dealing with inadequate water supply.

The aim of the technical assistance is to;

i. Determine the technical, economic and social feasibility of three water technologies for the targeted areas, through a pre-feasibility study entailing in-depth primary and secondary data collection and analysis.
ii. Identify potential private sector actors and Public Private Partnerships (PPP) within the water sector for the deployment of green water technologies.
iii. Develop a PPP business model in collaboration with relevant stakeholders model and build their capacity to engage in PPP.
iv. Develop a concept note to trigger future funding i.e. to enable piloting of technologies, supporting implementation of PPP etc.

1.2. Objectives of the field study

The field study aimed at collecting first-hand data and useful information to assist in understanding the various contextual features that greatly allow the use or limit the viability of water pans, solar pumping system and wind pumping system.

1.3. Study Location

The field study was carried out in four (4) counties out of 47 counties in Kenya namely Baringo, Embu, Homabay and Isiolo. The counties are selected to represent the different agro- ecological zones in Kenya with priority to counties identified for investment programmes funded by EU and Danida. The following map highlights the study area;

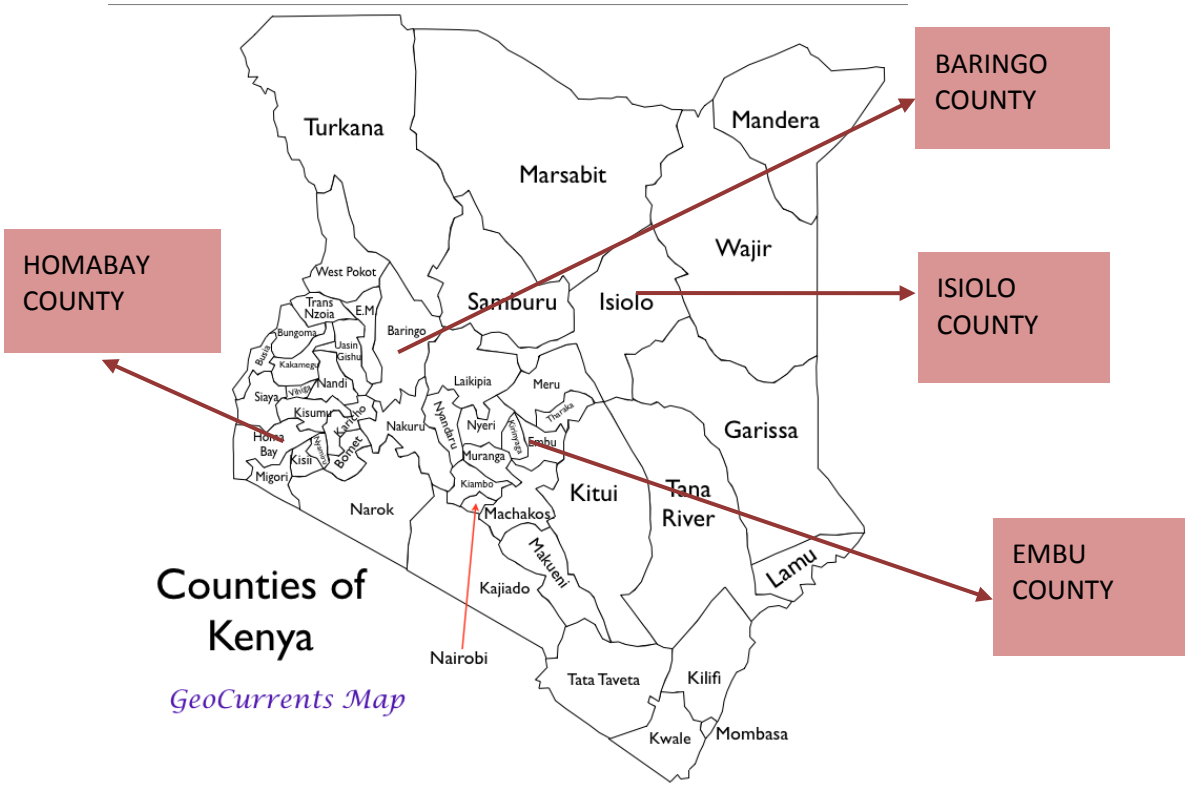


Figure 1: Counties visited

The counties selected were selected to represent the different ecological zones in Kenya. The table below describes the ecological zones, available technologies and WSTF interventions within the study counties.

Table 1: Selected Counties for the field Survey

Select County	Zones covered				Available technologies	WSTF Interventions
	Humid	Semi humid	semi - Arid	Arid		
Baringo					3 Technologies (Solar, Wind& Water pans)	European Union
Isiolo					3 Technologies (Solar, Wind& Water pans)	Green growth
Embu					3 Technologies (Solar, Wind& Water pans)	Peri urban experience
Homabay					2 Technologies(Water pans & Solar)	Peri urban & PPP experience

1.4. Field data collection process

The field data collection process began on 28th November 2016, with the processing commencing in Embu County (from 28th November to 3rd December) Isiolo County (from 5th to 10th December) Baringo and Homabay County (from 13th to 17th December). The field team spent six days in the field, the first day in each county was set aside for consultation with key informants namely county government, water resources management, civil societies organizations and water services providers.

The field data collection process entailed collecting data from various key informants, technology users and technology caretakers or managers. The county government under the departments of water identified the common technologies used in their respective counties and advice on the areas that the field team is likely to have a close contact with the various technologies. From the experience gathered in Embu, the water manager was revised to accommodate new questions that were coming out from the initial discussion by key informants and water managers. The case study and daily reporting tools were introduced in which the former captured the unique observations made during the data collection process whereas the later gave a summary of the day's activities.

From the field study the following was greatly observed in regard to factors affecting the successful uptake and provision of low cost technologies for sustainable water supply;

i. Acceptance of the technology by the community
ii. Users Know how skill in operation and maintenance
iii. Ability of users to pay recurrent cost of operation and maintenance
iv. Post implementation support by the various water actors such as governments, technology supplier, CSOs.

Following discussion with various key informants on the first day in specific counties several changes were made in regard to area of visit. The various factors that affected the initial plan were;

i. Long distance to study area (a case of Sericho in Isiolo County, Silale in Baringo County)
ii. Various actors working in different areas (case of Baringo county where the team visited Mogotio to get to understand how world vision (CSOs) is adopting the use of low cost technology in sustainable water supply)
iii. Vast areas and limited time in the field (in all counties)

The following maps show the changes in study locations in specific counties;

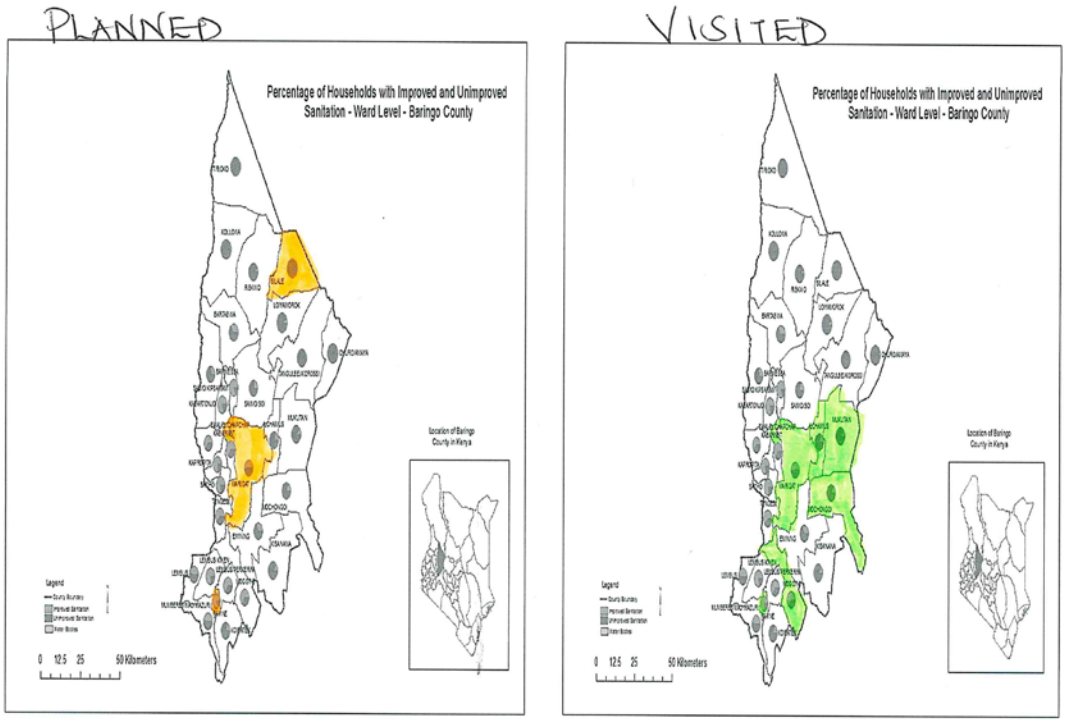


Figure 2: Baringo County Study location

In Baringo County the initial plan was to visit Kabarnet, Marigat, Silale and Eldama Ravine. However, during data collection mission the team managed to visit Mogotio, Mochongoi, Muktani, Kabarnet, Marigat and Eldama Ravine. Silale was left out owing to the prevailing security situation in that area at the time of study.

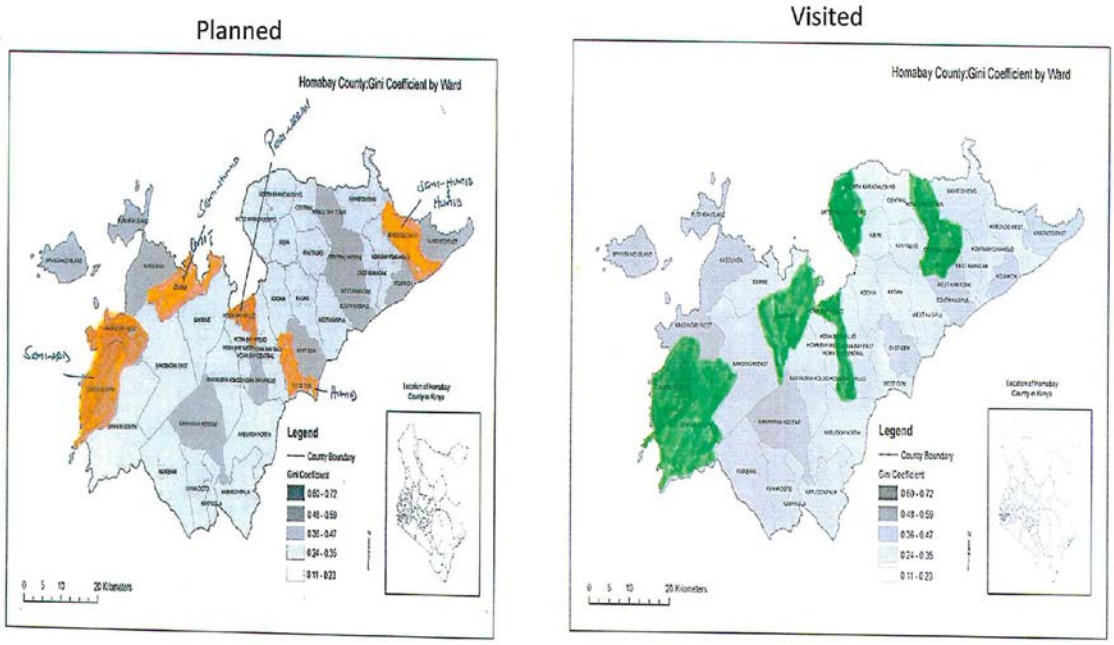


Figure 3: Homabay County Study location

In Homabay County, 3 additional locations were covered (Gwassi Homabay central, Kendu Bay and Central Kasipul wards) and the visit to Kabondo West as initially planned was abandoned due to limitation of time.

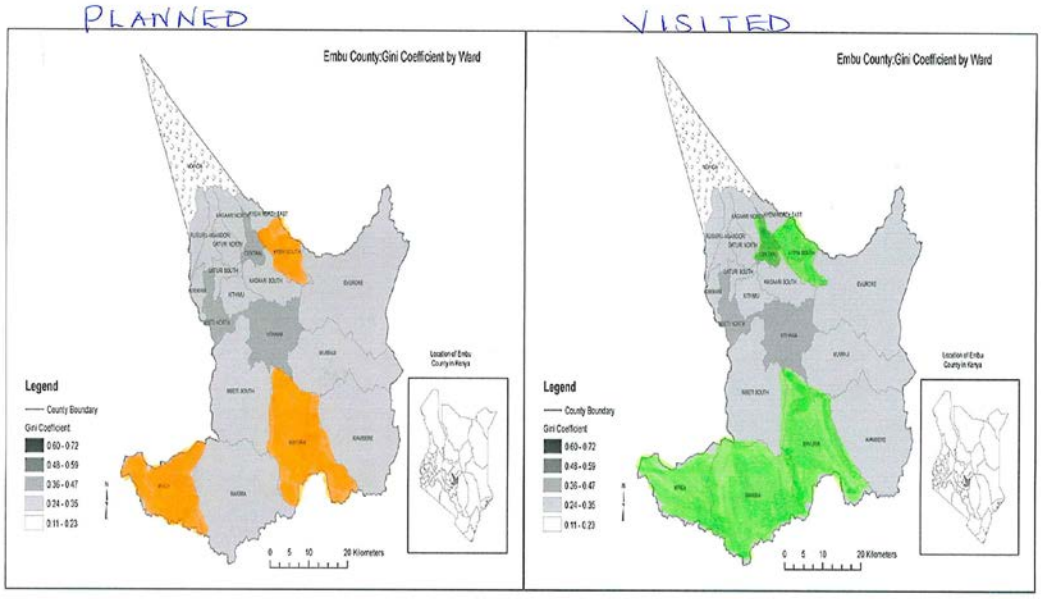


Figure 4: Embu County Study Location

As shown in the above map, the team visited Makima ward which was not in the initial arrangement. This is due to the fact that ward boundaries are crossed in the field.

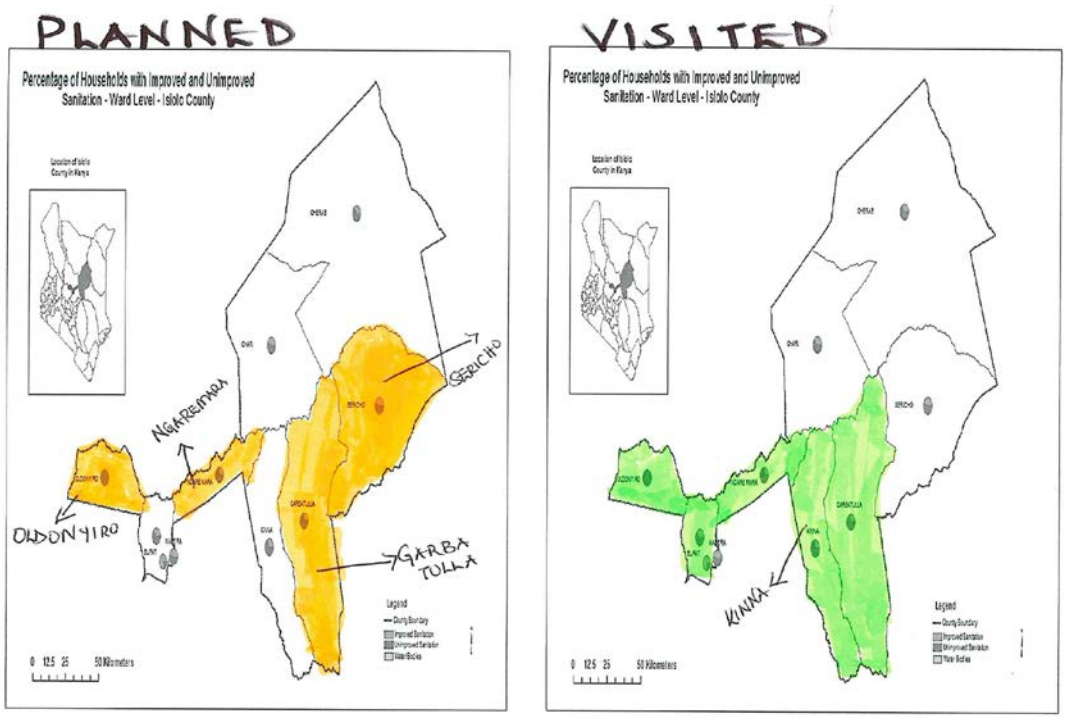


Figure 5: Isiolo County Study location

In Isiolo, the team abandonned the visit to Sericho due to the long distance required for travel, and instead incorporated Burat, Kinna and Isiolo Central areas.

The changes of study areas during the data collection process were still within the ecological zones set in the technology prioritization process. It was evident that various technology investments namely solar pumping system, wind pumping system, diesel pumping system, electricity pumping systems, water pans, sand dams and shallow wells have been adopted in all the counties visited. In some areas there has been new infrastructures installed with low cost technologies while other it is rehabilitation of old infrastructures to accommodate the low cost technology. Partnerships among various actors in the water and energy sector were observed in the development of these water supply infrastructures. The partnerships were mainly formed to share capital costs among beneficiary communities and national/county government or community and NGOs. In a few instances, individual operators were operating community owned water points for profit. In only one case (in Homabay) ana arrangement with a private operator had been formalized according to regulations. The private sector is predominantly involved in supply and installation of the technologies and are rarely involved in maintenance subsequently. The pictures below highlight some of the partnerships observed.

Erenet solar pumping system financed by Climate Development Foundation (CDF) and the Italian Development cooperation.

Rural Water supply in Baringo County financed with Japanese grant .

Community owned Daaba Juu shallow well in Isiolo developed by the Kenya Red Cross society in collaboration with the Daaba Juu Community and the Ministry of water and irrigation.

Kanyathiang Water Supply project in Homabay funded by UNICEF, GOK and the beneficiary community and run by a private operator.

2 METHODOLOGY

c[illegible] Semi-humid, and Semi-humid to semi-arid, semi-arid, arid and very arid and the peri-urban experiences in these counties. Further, study areas within these counties were identified through cluster sampling through the use of electoral administrative and electoral boundaries.

The electoral wards within each county were listed and used as the basic clusters. The study clusters were then randomly selected from the list of electoral wards. Once the study clusters were identified random sampling was used to identify particular technology and therefore each technology identified had an equal chance of being selected. Further, random sampling ensured that the sample would represent the variation among the technologies being used for enhancing water supply in each county.

Despite efforts to minimise the obtrusiveness of the field study, the field study team encountered some changes in the initial identified study clusters. The factors influencing the obtrusiveness in the field are;

i. The counties cover vast areas and therefore substantial time was spent in travel between different technology points. This constrained available time for data collection.
ii. Poor road terrain and distances between initial study clusters especially in Baringo and Isiolo
iii. Cases of insecurity in Isiolo and Baringo County
iv. Lack of basic database of water technology points coupled with field guides subjectivity in term of identification of water services projects and understanding of geographical boundaries.

2.2. Preparation of tools and 'training'

Before embarking on the field study the consultant familiarised the field team with research tool and the data collection instruments to ensure that the field team had complete understanding of the purpose and procedures of the feasibility study. Moreover, the tools were reviewed for amendment after the first day in Embu for clarity. By the end of the familiarisation session and fine tuning the tools, there were substantial agreements on the study indicators and how to respond to the questionnaires.

2.3. Data Collection Methods

The table below summarises the various survey tools used during the field study, the respondent for each tool, choice of respondents and the research questions answered by each tool.

Table 2: Data Collection methods

Survey Tool	Respondent	Choice of respondent	Research question answered

Water Manager survey tool	Caretaker or a member of the community technology management committee	The choice of respondent was greatly influenced by the direct contact with the technology in terms of its; - Technical operation - Cost of operation and maintenance, - Revenue collected, - Challenges in operation and maintenance of the technology - Skills and know-how of technology operation of a respondent.	▪ Do the identified technologies provide functional mechanism for climate proofed water supply? ▪ Do the identified green technology cost-effectively and sustainably increase water supply in target areas? ▪ What are the community attitudes and perceptions of the specific technology for water supply project?
Water user survey tool	The water user	The choice of respondent was influenced by: - A person daily interaction with the technology during obtaining water.	▪ What are the community attitudes and perceptions of the specific technology for water supply project?
Semi Structured interview form/ Focus group Discussions	In line ministries in national and local government, Water Resources Management Authority, Water services boards, water services providers, civil society organizations and community management committee	The choice of respondent was; - The ability to obtain first-hand knowledge on low cost technologies that enhances sustainable water supply in the study area	▪ Do the identified green technology cost-effectively and sustainably increase water supply in target areas?
Field Observation	The field assistants	observation and examination on the technology sites to capture the technology condition	▪ Do the identified technologies provide functional mechanism for climate proofed water supply?
Case study tool	Field Assistants	Unique observations on the holistic operation of a technology based on its operation and maintenance, its development, its management and on its interaction with the larger community were captured through the use of the case study survey tool.	▪ Do the identified technologies provide functional mechanism for climate proofed water supply?
Daily Report Tool	Field Assistant	The tool will give a summary of the day's activity	Complement all the research questions

In addition to the above data collection methods, the study team adopted the use of observation and examination on the technology sites to capture the technology condition. Unique observations on the holistic operation of a technology based on its operation and maintenance, its development, its management and on its interaction with the larger community were captured through the use of the case study survey tool.

To enrich the data collected, certain measurements such as volume, flow rate, distance and population were captured. The following instruments were used in the measurements;

Table 3: Measurements methods

Measurement	Method used/Instrument
Volume	Linear measurements of both length, width and depth
Population	Number of households * the number of people per household
Distances	The time used by a user to a technology point

The following are summaries of the data collected in the various counties;

Table 4: summary of data collection in all the four counties

County	Semi-structured interview	Water Manager Form	Water User Form	Case study	Daily report	Totals
Isiolo	6	21	23	9	6	65
Baringo	6	20	26	2	2	56
Homabay	5	19	35	11	4	74
Embu	4	27	41	4	1	77
Total	**21**	**87**	**125**	**26**	**13**	**272**

1.4. Data Collection Methods Pros and Cons

The data collection methods employed for the field study had some pros and cons in ensuring that quality data was obtained. The table below highlights the advantages and disadvantages of the method of data collection.

Table 5: Data methods pros and Cons

Methods	Purpose	Pros	Cons

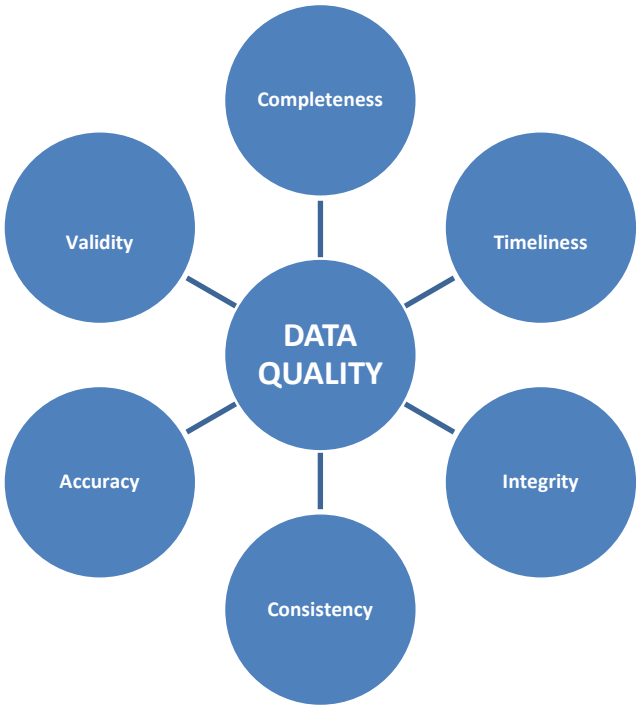
Questionnaires	Obtain detailed information technology in use for water supply	- Can be administer to many people - Can be adapted into various forms (mobile application, paper and verbal)	Not able to get full story especially if the questions are closed
Key Informant Interviews	Obtain first-hand information on the various technologies being used for water supply in the selected counties	- Respondents define what is important - Possibility of exploring issues in depth - Opportunity to clarify responses through probes - Sources of leads to other data sources and other key informants	- Can be time consuming to set up interviews schedule that suits the informants
Focus groups discussion	Explore information in depth of the observed technology through group discussion	- Participants define what is important - Some opportunity to explore issues in depth - Opportunity to clarify responses through probes	- Can be time consuming - Difficult to collect sensitive information
Observation	Gather accurate information about the technology condition.	- Access to people real life situations in obtaining water for their use - Good for explaining meaning and context	- Often viewed as subjective - Difficulty in categorizing the observations

1.5. Data Quality

During the field study data quality was assured by way of triangulating the data. This was achieved by collection of data from various methods described above as well as the use of divergent methodologies. Triangulation of data is expected to strengthen the feasibility report due to increased credibility and validity of the data collected. Triangulation in the field study followed;

1. **Data source triangulation**— Achieved through using evidence from different types of data sources, such as primary and secondary research or interviews, documents, , photographs and observations
2. **Methodology triangulation**—achieved by way of combining multiple methods to gather data, such as documents, interviews, observations, questionnaires or surveys.

The following data quality dimensions defined the threshold for the weighting and ensuring the obtained data is an accurate measure.



The aspects are defined below on how they significantly contributed to the data quality as whole.

- ✓ **Validity**: Are all the data values within the value domains specified by the research questions?
- ✓ **Accuracy**: Does the data reflect the real world observations?
- ✓ **Consistency**: is data consistence between the various survey tools?
- ✓ **Integrity**: are the relations between entities and attributes consistent?
- ✓ **Timeliness**: is the data available in the time needed?
- ✓ **Completeness**: is all necessary data present?

3. DATA PRESENTATION

The use of the mobile application to collect data allowed divergent ways in presenting the captured data.

The Mobile application tool allowed;

i. Mapping of the various technology points (Figure 6: Technology point/managers survey, Figure 7: User Surveys)
ii. Collection of data which is displayed in an excel form minimising the cost and time for data entry

This presentation of data gives a clear view on the areas visited during the field study improving the quality as well as assisting in data standardisation.

Figure 6: Technology point/managers survery

Instant data visualization through the mobile based application helps quickly in identifying any issues or problems with data before analysis by making results available in real time to broader audiences. Moreover, visualization of data collected (including GPS and pictures) have vivid account of the technology. This supported progress monitoring of the data collection and early interventions, or feedback to the interviewer, where necessary.

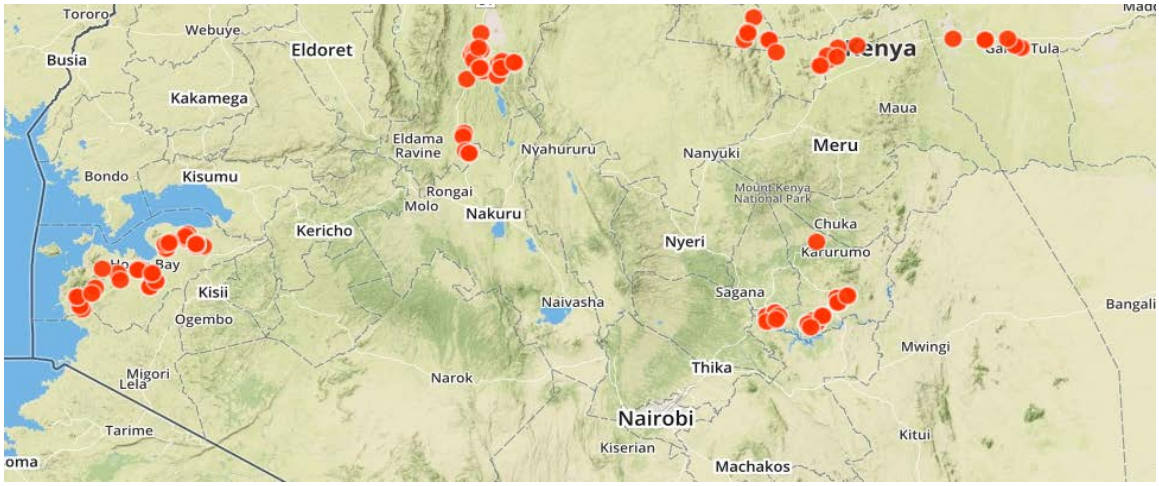


Figure 7: Technology users/ beneficiaries survey

The following tables describe the general representation of the data collected in the respective counties. It outlines the various technology observed, their functionality, common uses of water and challenges observed from this technology.

Table 6: Embu County Data Summary

TECHNOLOGY	NO	FUNCTIONAL	COMMON USES	COMMON CHALLENGES
Solar	1	1	- Domestic	- During cold and cloudy days the volume of water is low and at times none
Wind	3	1	- Institution - Domestic	- Maintenance - Works only during the windy season
Grid Electricity	4	4	- Domestic - Livestock - Institution	- High electric bill - Affected by black outs - Limited uses (cannot irrigate)
Diesel/ Petrol Generator	2	2	- Irrigation - Commercial - Domestic - livestock	- high cost of fuel - high cost of maintenance
Gravity	3	3	- Livestock - Small scale farming - Domestic - Institution	- Non-revenue water - Lack of a proper way to collect revenue - Limited uses (not used for commercial irrigation)
Hand Pump	11	11	- Livestock - Domestic - Institutional	- Wearing of the rubber around the plunger - Miss management - Low revenue - Limited uses
Water Pan	4	4	- Domestic - Irrigation - livestock	- siltation - pollution
Total	28	26		

Table 7: Isiolo County Data Summary

TECHNOLOGY	NUMBER	FUNCTIONAL	COMMON USES	COMMON CHALLENGES
Solar	12	12	- Domestic	- During cold and cloudy days the volume of water is low and at times none
Wind	2	o	- Institution - Domestic	- Maintenance - Works only during the windy season
Grid Electricity	4	4	- Domestic - Livestock - Institution	- High electric bill - Affected by black outs - Limited uses (cannot irrigate) - Non-revenue water
Diesel/ Petrol Generator	2	2	- Irrigation - Commercial - Domestic - livestock	- high cost of fuel - high cost of maintenance - lack of spare parts - lack of technical skills
Gravity	0	0	-	-
Hand Pump	1	1	- Livestock - Domestic - Institutional	- Wearing of the rubber around the plunger - Miss management - Low revenue - Limited uses
Water Pan	4	4	- Domestic - Irrigation - Livestock - Irrigation	- siltation - pollution - backflow at the inlet
Total	25	25		

Table 8: Homabay Data Summary

TECHNOLOGY	NUMBER	FUNCTIONAL	COMMON USES	COMMON CHALLENGES
Solar	8	7	- Domestic - institution	- During cold and cloudy days the volume of water is low and at times none - Poor management - Low revenue - Lack of spare parts
Wind	1	0	- Institution - Domestic	- High cost Maintenance - Works only during the windy season - Volume produced is low
Grid Electricity	4	4	- Domestic - Livestock - Institution	- High electric bill - Affected by black outs - Limited uses (cannot irrigate) - Non-revenue water - Pipe blockage - High pressure causing the pipe to bust. - In the water kiosks the gate valves wear out quickly. - Poor management
Diesel/ Petrol Generator	2	2	- Irrigation - Commercial - Domestic - livestock	- high cost of fuel - high cost of maintenance - lack of spare parts - lack of technical skills
Gravity	2	2	- Domestic - Livestock - Small scale farming	- Non-revenue water - Pipe blockage - Leakage in the joints - Low revenue collection - Lack of technical skills -
Hand Pump	5	2	- Livestock - Domestic - Institutional	- Wearing of the rubber around the plunger - Miss management - Low revenue - Limited uses
Water Pan	4	4	- Domestic - Irrigation - Livestock - Irrigation	- siltation - pollution - Eutrophication - Turbidity
Total	**26**	**21**		

Table 9: Baringo County Data Summary

TECHNOLOGY	NUMBER	FUNCTIONAL	COMMON USES	COMMON CHALLENGES
Solar	7	4	- Domestic - institution	- During cold and cloudy days the volume of water is low and at times none
Wind	1	0	- Institution - Domestic	- High cost Maintenance - Works only during the windy season - Volume produced is low
Grid Electricity	3	3	- Domestic - Livestock - Institution	- High electric bill - Limited uses (cannot irrigate)
Diesel/ Petrol Generator	6	6	- Irrigation - Commercial - Domestic - livestock	- high cost of fuel - high cost of maintenance - lack of spare parts - lack of technical skills
Gravity	2	2	- Domestic - Livestock - Small scale farming	- Non-revenue water - Pipe blockage - Leakage in the joints - Low revenue collection - Lack of technical skills -
Hand Pump	0	0	- Livestock - Domestic - Institutional	- Wearing of the rubber around the plunger - Low revenue - Limited uses
Water Pan	5	5	- Domestic - Irrigation - Livestock - Irrigation	- siltation - pollution - Eutrophication - Turbidity
Total	**24**	**20**		

4. TECHNOLOGY SNAPSHOT

From the four counties selected, it was evident that there are various divergent methods used in pumping and storing water.

Hydram

Diesel Engine

Solar PV

Mechanical Wind system

Hand pump

Grid Electricity

Water Pans

Storage tanks

During the field study, various observations were made with regards to the selected low cost green technology for water supply, namely solar water pumping system, wind water pumping system and water pans for storage. Data was also collected from other technologies such as electric water pumping system, diesel generators for water pumping, earth dams, sand dams to allow comparison analysis between selected technologies and other technologies being used for water pumping. The table below provides a summary of the field observations;

Table 60: Summary of key observations

County	Technology	Numbers	Observation
Embu	Gravitational flow	3	- The county is divided into two regions namely the highland and low lands - In the highland region gravitation flow is used in supply water
	Diesel Generators	2	- Diesel generators are being used in supply of water especially in the low land of the county
	Grid Electricity	4	- The area is well connected to the grid electricity and therefore cases of electricity being used for pumping were evident
	Solar water pumping system	1	- In the lowlands area of the county solar pumping system have been adopted. There has been renovation of old infrastructure to accommodate the use of solar
	Wind water pumping systems	3	- There are several cases of wind pumping system being used for water supply. Nonetheless, out of the three wind pumping visited one was functional. The functional one is used for institutional use within a school.
	Hand pumps	11	- Hand pumps were observed in several parts of the lowland region in the county. The hand pumps are used to serve a small community although during dry season the point serves an increased number of population

	Water Pans	4	-	There are several water pans in the county especially in the sub-humid to humid ecological zone
Isiolo	Gravitational flow	0	-	There were no gravitational system in Isiolo town
	Diesel Generators	2	-	There are several diesel powered generator within the county. In some of the areas, the national and county governments are moving from diesel to solar water pumping system
	Grid Electricity	4	-	Isiolo County is not well connected to grid electricity. In major towns such as Isiolo central and Garbatulla north centres have been connected to grid electricity and presence of electricity being used for pumping. - In kipsing and Ngaremare the centres are not connect to grid electricity and therefore other water pumping technologies have been adopted instead.
	Solar water pumping system	12	-	Solar pumping system has been used for water pumping in most technology points visited. - There has been numerous works by different actors to renovate water points by integrating solar pumping.
	Wind water pumping systems	2	-	The team visited one wind pumping technology point
	Hand pumps	2	-	There are various hand pumps within the county. The hand pumps normally serves fewer numbers of household based on their proximity to this technology point
	Water Pans	4	-	The county has several water pans. There was one water pan which was initially being used as a burrow pit.
	Sand Dams	2	-	Several sand pans along seasonal rivers in Kipsing.
Baringo	Gravitational flow	2	-	In the highland regions of the county gravitational flow is used for supplying water in Kabarnet and Eldama Ravine. The water is from Kirandich and Chemususu dams.

	Diesel Generators	4	-	There are several diesel generators in the county.
	Grid Electricity	5	-	The study area within this county is well connected by electricity. Nonetheless there are few water points whose pumping is done through electricity.
	Solar water pumping system	6	-	The county government reports that it is transiting to solar pumping system in supplying water
	Wind water pumping systems	1	-	The team managed to visit one small turbines pumping system. This point is considered to be a hybrid technology since it has both solar and wind system for pumping water although the point is not functional
	Hand pumps	0	-	The county official reported to have several hand pumps although the team never visited one.
	Hydram	1	-	The team visited one hydram which was not functional.
	Water Pans	3	-	Water pans are predominant storage technologies in the county. The outstanding thing was a series of water pans observed in Mogotio Sub County. Evident of improved water pans whereby the community has a specific collection point for the water.
Homabay	Gravitational flow	2	-	In Gwassi hills there is a spring which uses gravitational flow to supply water. Kanyathiang water treatment project water is abstracted from the river and pumped to the treatment plant via electricity after the treatment water is stored in a tank and distributed via gravitational flow.
	Diesel Generators	2	-	There was evident use of diesel generators for pumping water
	Grid Electricity	4	-	The county is fairly connected to grid electricity although household distribution of electricity is not evident. There are few cases of electricity being used for pumping.
	Solar water pumping system	8	-	The area visited during data collection process solar is being used

			for pumping water.
Wind water pumping systems	1	-	The team visited one wind technology. The technology is not functional
Hand pumps	5	-	Hand pumps are most prevalent technology in the county
Water Pans	4	-	There are several water pans in the county. Users draw water directly from the source.
Bucket	1	-	These technologies were observed when obtaining water in shallow wells and water pans

From above table, it was observed water supply in the selected study areas varied based on the ecological zones. In the humid and semi-humid areas of Homabay, Baringo and Embu counties the method of water supply is through gravitational flow while in the arid and semi-arid areas the use of diverse energies such as solar, wind, grid-electricity and diesel powered generator in supply of water was evident.

4.1. Study support and limitations

During the field data collection process, various factors supported the process. These are:

i. Having a WSTF contact person in the field with great assistance from field guide
ii. Having a county overview on the water situation and various water pumping technologies adopted across the county
iii. Having to meet the community management committee during their regular meetings
iv. In some areas, the caretaker presented all documents pertaining to a technology point.

On the other hand, other factors limited the collection of data;

i. Absence of water managers in technology points
ii. Lack of specific data such as borehole depth, borehole yield, construction cost and revenue collected
iii. Language barrier

4.2. Unique Observations

During the field study there were various outstanding observation made regarding water supply in certain areas. The following case studies describe the scenario in different areas within the selected counties;

EMBU COUNTY

The Wakali Borehole was done by Plan international in 2002 with a hand pump used for abstracting water. In 2012 Grandfos Company rehabilitated the borehole by installing solar panels and a pre-payment system. Initial agreement between the water point management committee and Grandfos was that Grandfos would collect the revenue collected from this technology for 10years to recover the technology installation and rehabilitation costs. The coverage of this borehole is a radius of 5Km with a 20 litres jerrycan going for 2 Kes. Some of the highlighted challenges in this agreement as reported by the users are;

a. Lack of monthly reports on amount collected by Grandfos
b. Only the people with the prepaid card can access water at this point
c. When the card is lost another person can use it to access water

ISIOLO COUNTY

Garbatulla North Town is supplied with water from 4 bore holes that are placed in different locations. One borehole is using solar water pumping system, two are using electricity and one is operated using grid electricity. The diesel powered generator was not functional by the time data was being collected.

The management committee for this water supply indicate that the diversification of technologies used for pumping have enabled the community to have constant water supply although rationing in other times take place. The connected homes pay a flat rate of 400kes.

Homabay County

The Otunga water supply project was commissioned in 2012 and was funded by UNICEF and GOK to a tune of Kes 8,500,000 and was targeted to serve 6000 people. It involves protecting of spring, includes a sump tank, pump tank, rising main, masonry storage tank of 100m3 and supplied to the three water kiosk. The challenges;

1. Low flows in the stream especially

Baringo County

Chepkoryande water pan can be classified as an improved water pan. It is well design to retain water with rubbles placed at the inlet to break water floor speed and reduce siltation. The water pan is well fenced to limit direct access by humand and livestock to the water pan. There is a water kiosk to allow a water collection point facilitating ease in revenue collection. There is a watering trough for livestock use. Saniation facilities have been constructed around the water pan minimising possible contamination of water.

5. SUMMARY AND CONCLUSION

Various technologies have been adopted to enhance water supply in the study areas and increasingly a number of low cost technologies (solar and wind pumping systems, sand dams and water pan) are in use alongside other technologies (grid electricity, diesel engines and hand pumps).

In the humid and semi-humid areas, gravity flow is more prevalent corresponding to the opportunity presented by higher altitude This is particularly the case in Baringo and Embu Counties. There are numerous current and on-going efforts to improve water supplies service by various actors such as civil society's organizations, the national and county governments, faith based organizations and community based organizations to renovate old infrastructures (using diesel generators, mechanical wind system, and hand pumps) by incorporating low cost technologies for sustainable water supply.

Management of most technology points is done by the community through well-established management committees. The management committees are tasked with the responsibility of taking care of the technology in terms of ensuring the technology is operational, revenue collection is adequate, maintenance of the technology and ensuring there is constant water supply. Generally, the cost of operating and maintaining diesel and electricity powered generators for water supply is high in comparison with fair cost in maintaining solar and wind powered systems.

6. REFERENCE DOCUMENTS

Various reference documents were collected to assist in further investigations. Some of the documents obtained are;

a. Borehole completion records: outlines the pump details of a specific technology
b. Project proposals by different community based organizations
c. Bills of quantities for certain technological points

7. KEY STAKEHOLDERS TO BE CONSULTED

In the course of the field data mission, the study team came across names of technology providers and facilitators, who probably hold important experiences relating to deployment and performance of selected technologies. These people and companies will be consulted for insights and validation of field data.

The Table 12 summarizes the company and individuals to be consulted;

Table 7: Key stakeholders to be consulted

Category	Organization	Technology Focus	Questions For Probing	Contacts
Technology Suppliers	Davis & Shirtliff	Solar water pumping systems	- Pump specifications - Technology Performance - Cost of technology - Number installed - Financial Arrangements - Trends - Technology lifespan	Industrial Area, Dundori Road, Nairobi. Mobile: +254-733 610085 / +254-711 079 000 / +254-727 696800 / +254-736 696800
	Go solar systems	Solar and wind pumping system	- Pump specifications - Technology Performance - Cost of technology - Number installed - Financial Arrangements - Trends - Technology lifespan	South B Shopping Centre. South Gate Centre. Tel : +254 020 2400 236 : Mobile : +254 721 207 949; Mobile : +254 722 895 922
	Epi-centre Africa	Solar Water pumping system	- Pump specifications - Technology Performance - Cost of technology - Number installed - Financial Arrangements - Trends - Technology lifespan	Prime Cartons Building, Off JKIA turnoff

	Bobs Harries Engineering Ltd -	Wind pumping system	- Pump specifications - Technology Performance - Cost of technology - Number installed - Financial Arrangements - Trends - Technology lifespan - O & M of the technology	+254 67 24207 or 24238
Policy makers/ Regulators	National Water Conservation and Pipeline Corporation	Water Pans	- Number of constructed water pans - Technology lifespan - Challenges of water pans as storage technologies - O&M of the technology	Dunga Road-Industrial Area, P.O Box 30173-00100, Tel: +254 20-6556600/1/2/3/5 Hot Line: +254 20-6531047
	National Drought Management Authority	Water Pans	- Number of constructed water pans - Technology lifespan - Challenges of water pans as storage technologies	8th Floor Lonrho House, Standard Street, Nairobi. +254 020 2224324, , +254-020-2227982. +254 722 200656 +254724575233- Baringo office
	Water Services Regulatory Board (WASREB)		- Water tariff rates	
Civil Organization	World Vision (Area Development Program ADPS)		- Technology Performance - Cost of technology - Number installed - Technology lifespan - O & M of the technology	Karen Road, off Ngong Road, Office: +254 732 126 000, +254 711 086 000 E-mail: WV_Kenya@wvi.org
Donors	SNV		- Technology Performance - Cost of technology - Number installed - Technology lifespan - O & M of the technology	Ngong Lane, off Ngong Road Tel.: +254 724 463355 Email: kenya@snv.org

8. ANNEXES

8.1. Field Itinerary

County	Wards	Number of teams	Dates
Embu	Embu Town	1	28-12-2016
	Runyenjes	2	29-12-2016
	Mavuria	1	30-12-2016 & 1-12-2016
	Mwea	1	2-12-2016
	Kiritiri	1	3-12-2016
Isiolo	Isiolo Central	2	5-12-2016
	Burrat	1	5-12-2016
	Ngare Mara	1	6-12-2016 & 7-12-2016
	Kipsing	1	7-12-2016 & 8-12-2016
	Garbatulla North	1	9-12-2016 & 10-12-2016
Baringo	Kabarnet	1	13-12-2016
	Marigat	1	14-12-2016
	Muktani	1	14-12-2016 & 15-12-2016
	Mogotio	2	16-12-2016
	Elda Ravine	1	17-12-2016
Homabay	Homabay central	1	13-12-2016
	Rachungo'	2	13-12-2016 & 14-12-20016
	Gwasii	1	15-12-2016
	Homabay West	1	16-12-2016
	Homabay South	1	17-12-2016

8.2. Pictorials

BARINGO COUNTY				
Name: Balena Borehole Technology Type: Solar Power Year of Installation: 2015 Storage Tank: 50m3 Functional	Name: Silango BoreHole Technology Type: Wind and Solar Power Year of Installation: 2012 Storage Tank:15m3 Not Functional	Name: Radat Bore hole Technology Type: Disel Generators Year of Installation: 2009 Storage Tank:100m3 Functional	Name: Tupkir Bore Hole Technology Type: Grid electricity Year of Installation: 2016 Storage Tank:10m3 Functional	Name: Chemogorion Water Pan Technology Type: waterpan Year of Installation: 2006 Functional
				

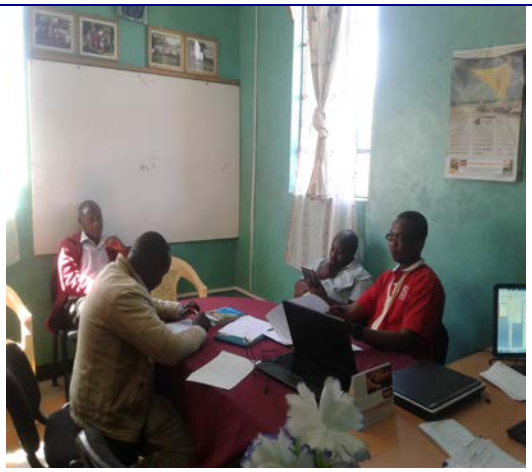
HOMABAY COUNTY		
Name: Kobar Community Water Scheme (Borehole) Technology Type: Solar Power Year of Installation: 2013 Functional. Feeding 5 Water Kiosks	Name: Magunga Community water project Technology: Type: Diesel Pump Year of Installation: 1959 Functional. Feeding a 5 Km radius Population	Name: Maji Mbili Water Pan Technology: Type: Waterpan Year of Installation: Functional.
		

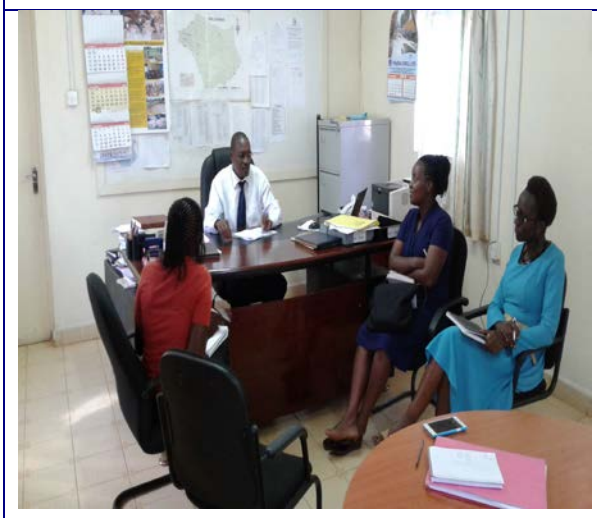
HOMABAY COUNTY		
Name: Kanyathiang Water Supply Project Technology Type: Grid Electricity Year of Installation: Functional.	Name: Kanyulondo self-help group (Shallow well) Technology: Type: Hand Pump Year of Installation: 2012 Functional.	Name: Gwassi Region-Kijito Technology: Type: Wind Technology Non- Functional.
		

ISIOLO COUNTY			
Name: Manyatta Zebra Technology Type: wind disconnected and solar functioning. Year of Installation: 2014 Storage Tank: 10m3	Name: Waliyana women Group Borehole Technology Type: grid electricity Year of Installation: Storage Tank:25m3	Name: Dicks Borehole Technology Type: solar with standby Diesel Generators Year of Installation: 2015 Storage Tank:50m3	Name: agea water pan Technology Type: Bucket system Year of Installation:
			

EMBU COUNTY		
Name: kawango Earth dam Technology Type: Bucket system Year of Installation: 2012 Storage : 30000m3 Functional	Name: kaluluine Borehole Technology Type: hand pump Year of Installation: 2013 Storage Tank:0m3 Functional	Name: Daaba Borehole Technology Type: solar system, generator and wind mechanical not functioning Year of Installation: 2006 Storage Tank:50m3 Functional
		

KEY INFORMANTS MEETINGS





8.3. List of Interviewers

NAME	EXPERTISE	POSITION	RESPONSIBILITY
Wangai Ndirangu	Civil and Water engineer	Consultant	- Overlall study oversight - Data Quality - Logistics management
Esther Wambui	Social and community development	Field Assistant	- Data Collection - Follow up on social issues of a particular technology
Peter Mwangi	Project management and Economic Analyst	Field assistant	- Data Collection - Follow up on economic issues of a particular technology
John Munene	Civil and structural Engineer	Field assistant	- Data Collection - Follow up on Technical issues of a particular technology
Jesse Toiyanka	Civil and structural Engineer	Field assistant	- Data Collection - Follow up on Technical issues of a particular technology
Anita Kihara	Community Development	Field Guide & WSTF contact person Embu County	- Field and language guide
Grishon Ngige	Environmental Engineer	Field Guide & WSTF contact person Baringo County	- Field and language guide
Hassan Tari	Natural Resource Management	Field Guide & WSTF contact person Isiolo	- Field and language guide
Martin Shikuku		Field Guide & WSTF contact person Homabay County	- Field and language guide
Livingstone Odundo		Language guide, Homabay	- Field and language guide
Gabriel Somo		Language guide, Baringo	- Field and language guide
Seth Mbogo		Language guide, Embu	- Field and language guide

8.4. List of interviewees

8.4.1. Water Manager

SURVEY_DAY	NAME OF INTERVIEWEE	NAME OF INSTITUTION/ GROUP	RESPONSIBILTY/POSITION	TELEPHONE	COUNTY
2016-11-29	Alfred gathaga	n/a	Chairman ENA	72900419	Embu
2016-11-29	Edwin Njue	n/a	WSP (Kyeni) Manager	720934134	Embu
2016-11-29	Mr. Henry Ngari	n/a	Secretary	721925783	Embu
2016-11-29	Samuel Muraithi Kagochi	n/a	Artisan	725271254	Embu
2016-11-29	Rufus Nyaga, Gerrishon Muringi, Elizabeth Stanley	n/a	Vice chairman, committee member, Treasurer	725660841	Embu
2016-11-29	Abedi Mugai	n/a	Treasurer	726236606	Embu
2016-11-30	Wanjiru Njeru	Kwagucana	Chair	72047035	Embu
2016-11-30	Ngodi	Iriamurai Catholic mission	Operation manager	72057181	Embu
2016-11-30	Felista Njeru	Kichaki borehole	Secretary	716478617	Embu
2016-11-30	Albert	Gachakii dam group	Chairman	721690558	Embu
2016-12-01	Gedion maeka	Utithini bore hole	Chairman	705949582	Embu
2016-12-01	Peter ngari	Ndunge earth dam	Chairman	708151121	Embu
2016-12-01	Christine kimeu	Kinyozi/salon	Owner,	710908186	Embu
2016-12-01	Abrusia	Git hesitate water project	Secretary	714651595	Embu
2016-12-01	Keith Micheal	Makange irrigation water project	Chair person	720255783	Embu
2016-12-01	Kago	Makima parish Catholic church	Manager	723415211	Embu
2016-12-01	Kamau	Ndunge community	Chairman	n/a	Embu
12/2/2016	Ruben njeru muraithi	Kawango earth dam	Secretary	702114545	Embu
12/2/2016	Mr. Mutua	Kawango earth dam project	Secretary	717265400	Embu
12/2/2016	Joseph muthoka	Consolation girl kijito wind pump kitaraka	Caretaker for the technology	718335744	Embu
12/2/2016	James kinyungu	Wakalia borehole	Caretaker	719710228	Embu

SURVEY_DAY	NAME OF INTERVIEWEE	NAME OF INSTITUTION/ GROUP	RESPONSIBILTY/POSITION	TELEPHONE	COUNTY
12/2/2016	David ngubi	Wango primary boarding	Caretaker	720297965	Embu
12/2/2016	Peter kavita	Karaba primary school	Chairman	721379397	Embu
12/2/2016	Mutisa Mutisia	Kaluluine borehole	Chairman	721888545	Embu
12/3/2016	Jenifer mwendia	Kirathe dispensary borehole	Chair person	711933389	Embu
12/3/2016	Njuki	Individual earth dam	Owner	721595695	Embu
12/4/2016	Murithii	n/a	Owner	72511732	Embu
12/5/2016	Chalse wambugi	Irrigation institute of Isiolo	Principal	710334930	Isiolo
2016-12-05	Joseph Waciuri	Isiolo water and sewerage company	Technical Manager	721955850	Isiolo
12/5/2016	Simon muirari	Mwangaza primary	Caretaker	795174899	Isiolo
2016-12-05	Mwanaa	Catholic dioceses of Isiolo	Caretaker	n/a	Isiolo
2016-12-05	Sr.flavia	Loretta school	Administrator	n/a	Isiolo
2016-12-06	Francis Lokato	Aregae	Vice chairman	717882668	Isiolo
2016-12-06	Francis lowa	Kindle borehole	Chair man	720019298	Isiolo
12/6/2016	Francis lua	Ngaremara borehole	Chairman	720019298	Isiolo
2016-12-06	James Itapar	Daaba borehole	Assistant chief	725729083	Isiolo
2016-12-06	Rose apua	Aremet actuator project	Caretaker	791640877	Isiolo
2016-12-07	Nyambulo	About a water and sanitation project	Caretaker	727378939	Isiolo
2016-12-07	Doris Lolmakar	Nanyoki	Chairman	n/a	Isiolo
2016-12-08	Maria rosa	Attend kijito pump	Member of water comittee	0	Isiolo
2016-12-08	Cosmos sike	Manyata zebra borehole	Chairman	71148514	Isiolo
12/8/2016	Pauline lomuria	Lowangila water protect	Treasurer	729160766	Isiolo
2016-12-09	Halkano Diba	Dicks borehole	Caretaker	0	Isiolo
2016-12-09	n/a	Waliyana women group	n/a	0	Isiolo
2016-12-09	Kanchara kunno	Taiboto	Watchman	704441353	Isiolo

SURVEY_DAY	NAME OF INTERVIEWEE	NAME OF INSTITUTION/ GROUP	RESPONSIBILTY/POSITION	TELEPHONE	COUNTY
2016-12-09	Hassan Abdi	Boji borehole	Chairman	706119510	Isiolo
2016-12-09	Abdi	n/a	n/a	n/a	Isiolo
2016-12-10	Allan	Garbatulla north Catholic church	Administrator	712568542	Isiolo
2016-12-10	Salad	Sharing yaks borehole	Treasurer	718413517	Isiolo
2016-12-13	Richard Totona	Kiradich Water Company	Water Supply Operator	715336466	Baringo
2016-12-13	Kiprop	Chsmugot	Caretaker	715356451	Baringo
2016-12-13	Richard Totona	Kiradich Water Company	Water Supply Operator	715336466	Baringo
2016-12-13	Livingstone Odundo	County government of Homabay	Deputy Director of water services	725249910	Homabay
2016-12-13	Kennedy otieno	Chief	Chief	714808056	Homabay
2016-12-13	David Rabilo Ouma	Tinga dam committee	Committee member	716264318	Homabay
2016-12-13	Richard Otieno Abongo	Kanyadhian'g water user association	Technical Manager	723091297	Homabay
2016-12-14	Peter	Loitip borehole management comitee	Treasurer	0	Baringo
2016-12-14	Ken	Silango water project	Chairman	725254244	Baringo
2016-12-14	William	Chemoregion water pan	Chairman	728421419	Baringo
2016-12-14	Kipsoi Lotis	Chemurungion Group	Caretaker	729496925	Baringo
2016-12-14	Edna Gatai	Losampurmpur	Care taker	716259003	Baringo
2016-12-14	Samuel Kaptunai	Sandai bore hole	Comitee member	721388480	Baringo
2016-12-14	Eric odeck,	Kobar community water project	Chairman	701070823	Homabay
2016-12-14	n/a	n/a	n/a	0	Homabay
2016-12-14	Steven Akandi	Kanyulondo self help group	Secretary	724235453	Homabay
2016-12-14	Joseph Anyumba	Nyamaulobiei self help group	Caretaker	728531479	Homabay

SURVEY_DAY	NAME OF INTERVIEWEE	NAME OF INSTITUTION/ GROUP	RESPONSIBILTY/POSITION	TELEPHONE	COUNTY
2016-12-14	Norbert Ouma	Kamato water supply	Chairman	724166122	Homabay
2016-12-14	Michael odour	Kingenyo group	Operator	719439004	Homabay
2016-12-14	Leakey Otieno	Nyabera Kaugo	User	700750872	Homabay
2016-12-15	Ivon Sergon	Balena Borehole Services	Caretaker	727629987	Baringo
2016-12-15	John Loitu	Nalepo women group	Caretaker	727797015	Baringo
2016-12-15	Kigen Jackson	Endau Loperet Water project	Chairman	726710375	Baringo
2016-12-15	Pastor joshua cheptoo	Radat community water project	Committee member	713698662	Baringo
2016-12-15	Pauline	Nasinya boreholw	Caretaker	718743758	Baringo
2016-12-15	Nelly	Sambar I water supply	Caretaker	70106850	Baringo
2016-12-15	Yegon kipkas James	Radat-Endoros community Water Project	Committee member	723222669	Baringo
2016-12-15	Sonya	Kigwa water project	Chairman	715476941	Homabay
2016-12-15	Jackson Othiambo	Cotengo water project	Caretaker	0	Homabay
2016-12-15	George Abebe	Magongb water supply	Patron of the system	725998729	Homabay
2016-12-15	Simon otieno	Kogore water project	Supervisor	713500132	Homabay
2016-12-15	Simon Ojala	Kudundo dam	Chairman	729202738	Homabay
2016-12-16	Lochaga	Chepkoryande	Chairman	721510491	Baringo
2016-12-16	Joshua	Oterit birehole	Caretaker	705387676	Baringo
2016-12-16	Cynthia Cherono Kiptoo	Kures bore hole	Caretaker	715770607	Baringo
2016-12-16	Mr samuel okode	ministry of water	Technician	726446396	Homabay
2016-12-16	Sphene orondo	GEB complen/a	Director	727643283	Homabay
2016-12-17	Solomon Biwott	Orinie Water supply	Caretaker	726273962	Baringo
2016-12-17	James juma	Personal	Owner	728878131	Homabay

8.4.2. Technology Users

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-11-30	Embu	mavuria	Kinthuri	Mary zippy kagendo mbuya	Through Rock catchment	796173949
2016-12-17	Homabay	Homabay_arucho	Rodi kopany area	Peter	Ochuna waterpan	Catherine Awour 0734050679
2016-12-16	Baringo	ravini	Mogotio	Grishon	Kuruyoniondet	none
2016-12-16	Baringo	ravini	Emining	Grishon	Oterit borehole	715908547
2016-12-13	Homabay	Homabay_arucho	Kanyipir	Linda akinyi	Yao water pan	792380214
2016-12-13	Homabay	Homabay_arucho	Kuyugi	Peter	Homawasco	710745217
2016-12-14	Baringo	mukutan	Kiserian	Grishon	Sirango	723709918
2016-12-14	Homabay	gwassi_north	Lamb west	Wangai	Aguko	C
2016-12-17	Homabay	Homabay_arucho	Kanyanda katuma location in katuma ward	Peter	Maji mbili water pans	Margaret Odhiambo
2016-12-01	Embu	mavuria	Makima	Joshua munyao	Matulamu water pan	726458530
2016-12-01	Embu	mwea	Ff	Josephine mukonyo	Ndune water pan	706684070
2016-12-01	Embu	mwea	Makima	David chaka	Ndune earth dam	727568538
2016-12-16	Homabay	kabondo_west	North kamagala central ward	Peter	Nyarede water point	Dickson choto 0790376094
2016-12-06	Isiolo	ngaremara	Daaba	Esther	Daaba community water project	72546754
2016-12-07	Isiolo	ol_donyiro	Kipsing	Esther	Lengwenyi water pan	0
2016-12-17	Homabay	Homabay_arucho	Rodi Achuona ward, kalanyakanyango location.	Evone Akinyi	Uchuna water pan	734896661
2016-12-14	Baringo	mukutan	Kaptabase	Esther	Kaptabase water pan	0

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-16	Homabay	kabondo_west	Osere location in kaepulu ward	Peter	Yao waterpan	Benson onyango 0706700482
2016-12-08	Isiolo	ol_donyiro	Ngarandare	Esther	Ngarandare lagha	0
2016-12-07	Isiolo	ol_donyiro	Nororoi	Esther	Nesheshai sand dam	721243640
2016-12-16	Homabay	gwassi_north	Kanyathiang location...kendu bay town ward	Peter	Kanyathiang water supply	Christine Opee 0706002430
2016-12-16	Homabay	Homabay_arucho	Kendu bay ward..kanyathiang	Peter	Kanyathiang water project	Irene Obala 0702011843
2016-12-14	Homabay	Homabay_arucho	Homabay west ward, north kanyabara location	Dancan ogula	Magari water community project	705702313
2016-12-16	Baringo	marigati	Kimerell	Jesse Kaetuai	Chepkoryande Water Pan	N/A
2016-12-16	Homabay	west_gem	North karatuong	Beatrice awoul	Kanyathia water supply	725384760
2016-12-16	Homabay	kabondo_west	Kindu town ward, north karatuongo location.	Bernard omondi	Kanyathian water supply	710737609
2016-12-16	Homabay	west_gem	North kamagak location, Nyalenda sub location.	Onyango Edward	Stadium borehole,	790376094
2016-12-16	Homabay	west_gem	North kamagak location, Nyalenda sub location.	Onyango Edward	Stadium borehole,	790376094
2016-12-14	Baringo	mukutan	Sirata	Grishon Muhoro	Eltepes water project	701328502
2016-12-07	Isiolo	ol_donyiro	Naloroi	Wangai	Naloroi narutikon	721243640
2016-12-06	Isiolo	ol_donyiro	Naloroi	Wangai	Naloroi narutikon	721243640
2016-12-06	Isiolo	ol_donyiro	Kipsing	Esther	Lengwenyi water pan	0

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-06	Isiolo	ol_donyiro	Nororoi	Esther	Nesheshai sand dam	721243640
2016-12-07	Isiolo	ol_donyiro	Linguruma	Esther	Kaftan rock catchment	0
2016-12-06	Isiolo	ol_donyiro	Linguruma	Esther	Kaftan rock catchment	0
2016-11-30	Embu	kyeni_south	Mbiruri	Annette Wanja Ireri		720617067
2016-12-13	Homabay	Homabay_arucho	Kibiri, kawathogone	Ishmile nyamboge	Oboro water pan	703255364
2016-12-16	Homabay	west_gem	Migwa ward, North kamagak location	Benta Athiambo	Kocele water supply	717727986
2016-12-16	Homabay	kabondo_west	Kawere west location	Peter	Otunga spring water project	Grace Gloria 0711213792
2016-12-13	Homabay	Homabay_arucho	Wadhgno nyongo	Peter	Homawasco	Jane akinyi 0713235727
2016-12-13	Homabay	kabondo_west	Karachuonya karipirr	Peter	Homawasco	716625341
2016-12-14	Homabay	Homabay_arucho	Kanyambala	Peter	Nyamangulo self help group	Mary Adhiambo
2016-12-14	Homabay	Homabay_arucho	North kanyabala	Peter	Yao waterpan	Rosemary Apollo 0724364499
2016-12-14	Homabay	Homabay_arucho	North kanyabala	Peter	Magare water project	Evelyne Akinyi 0790516428
2016-12-17	Homabay	west_gem	Homabay arujo ward, Katuma location	Odiwour Ronald	Maji mbili	705991286
2016-12-15	Homabay	gwassi_north	Gwassi location in gwassi south ward	Peter	Nyawacha water project	Agnet Atieno 0714882888
2016-11-30	Embu	mavuria	Kithhunthiri location	Joseph nyaga	Community owned rock catchment	723607712

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-15	Homabay	gwassi_north	Gwassi south ward	Peter	Kodundo dam	none
2016-12-01	Embu	mwea	Makima	Micheal	Earth dam owned by community	726943153
2016-11-30	Embu	mavuria	Mavuria	Jane muringi ngari	Gachaki dam group	782367947
2016-12-14	Homabay	Homabay_arucho	North kanyambala	Peter	Kanyolundo water scheme	Ruth kaserian
2016-12-01	Embu	mwea	Mwea	Alex muasya	Matilamu earth pan	0
2016-12-01	Embu	mwea	Makima	Celestine kanini	Ndune Earth pan	704881911
2016-12-06	Isiolo	ngaremara	Ngaremara	Wangai	Eregae	0
2016-12-14	Baringo	mukutan	Arabar	Esther	Kechemorongion water supply oroject	718744724
2016-12-15	Baringo	marigati	Gambo	Esther	Silonga borehole water project	700209616
2016-12-14	Homabay	gwassi_north	Ruma	Wangai	Kaugo	717781601
2016-12-03	Embu	mavuria	Githuthirie	Pithon mugo	Currently there are using piped water from EWASCO. But since the borehole is not functional there result to getting water from well during dry season	
2016-11-30	Embu	mavuria	Mavuria	Pauline njeru	Community get water from the sand dam	708325898
2016-12-06	Isiolo	ngaremara	Aragai	Esther	Aragai water project	706129410
2016-12-10	Isiolo	garbatula_north	Galbatula	Abiba	Fetch water from shallow well, matangari river, Dick borehole	710960847

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-14	Homabay	gwassi_north	Clement otieno and	Wangai	Ojawa CBO	725303653
2016-12-01	Embu	mwea	Makima	John njeru	Makima community water project in partnership with making irrigation project	721740445
2016-12-01	Embu	mavuria	Makima	Virginia ngui	Makima community water project	714992981
2016-12-14	Baringo	mukutan	Sadai	Esther	Sadai borehole water supply	720797818
2016-12-14	Baringo	mukutan	Kiserian	Jesse Kaetuai	JIKAS	N/A
2016-12-14	Baringo	mukutan	Chemorong'ion	Grishon Muhoro	Chemurung'ion dam	703146236
2016-12-14	Baringo	mukutan	Arabal	Grishon Muhoro	Chemurung'ion borehole	703350276
2016-12-14	Homabay	Homabay_arucho	Karanya kanyango	Peter	Kobar community water project	Susan kure 0725608820 Vinny owanga 0701917211
2016-12-15	Homabay	gwassi_north	Gwassi central - gwassi south ward	Peter	Kogore water project	Isabella Adhiambo 0717775358
2016-12-01	Embu	mavuria	Makima	Beatrice	Makima community water project	
2016-12-14	Baringo	mukutan	Kiserian	Grishon Muhoro	Losamburmbur	none
2016-11-30	Embu	mavuria	Mavuria	Mary njeru	Check dam	706566519
2016-11-30	Embu	mavuria	Mavuria	Salesio kithaka	Borehole	715809155
2016-12-01	Embu	mwea	Makima	Daniel Muthini ndia	Ndune borehole	713499920
2016-11-30	Embu	mavuria	Mavuria	Dominic njeru	Borehole	729487196
2016-12-01	Embu	mwea	Mwea	Anne Ndunge	Catholic mission Borehole(makima)	715120308

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-01	Embu	mwea	Makima	Virginia Gitonga	Catholic mission Borehole(makima)	726280004
2016-12-01	Embu	mavuria	Utithini	Monica	Community	790447946
2016-12-01	Embu	mwea	Makima	Agnes munyiva	Borehole	721172216
2016-12-16	Baringo	ravini	Mogotio	Grishon	Muya water project	723839725
2016-12-16	Baringo	ravini	Mogotio	Grishon	Mm	724342975
2016-12-16	Baringo	ravini	Mogotio	Grishon	Chepchomus borehole water project	none
2016-12-14	Baringo	mukutan	Silango	Jesse Kaetuai	Losampurmpur	none
2016-12-14	Baringo	mukutan	Keserian	Esther	Losampurpur borehole water supply	0
2016-12-05	Isiolo	ngaremara	Aragai	Esther	Aragai water project	706129410
2016-12-06	Isiolo	ngaremara	Aregea	Ceicilia	Aregea water project	729903347
2016-12-05	Isiolo	ngaremara	Aregea	Ceicilia	Aregea water project	729903347
2016-12-06	Isiolo	ngaremara	Burat	Peter Ekal	Echwa	792677045
2016-12-15	Baringo	marigati	Marigat	Jesse Kaetuai	Samburi Borehole	713534814
2016-12-08	Isiolo	ngaremara	Tractor	Esther	Tinga yards mkono	0
2016-12-06	Isiolo	ngaremara	Ngaremara	Selina	Don't know	721159920
2016-12-08	Isiolo	ngaremara	Atan	Benface kirion	Atan kijito	729216705
2016-12-15	Baringo	marigati	Marigat	Winnie	Sirinyo borehole water supply project	703907812
2016-12-15	Baringo	marigati	Edawo	Esther	Marinated pastors borehol3	714408677
2016-12-15	Baringo	marigati	Marigat	Grishon	Pastors borehole	729634210
2016-12-15	Baringo	marigati	Endau	Grishon	Samurai borehole	none
2016-12-15	Baringo	marigati	Ng'ambo	Grishon	Silonga borehole water project	701815968

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
2016-12-10	Isiolo	garbatula_north	Garba Tulla	Fatuma Hassan	Garba Tulla water project	Nil
2016-12-08	Isiolo	ngaremara	Manyatta zebra	Esther	Manyatta zebra water project	0
2016-12-15	Baringo	marigati	Salani	Jesse Kaetuai	Nasinya Water Project	726387683
2016-12-09	Isiolo	garbatula_north	Garbatulla north	Esther	Dix borehole	702126401
2016-12-05	Isiolo	ngaremara	Daaba	Esther	Daaba community water project	72546754
2016-12-09	Isiolo	garbatula_north	Burji	Esther	Burji borehole	705604333
2016-12-09	Isiolo	ngaremara	Burji	Esther	Burji water borehole	715342326
2016-12-09	Isiolo	garbatula_north	Typoto	Galgalo Antati	Tyboto borehole	N/A
2016-12-10	Isiolo	garbatula_north	Galbatula south, kulamawe	Hussain	Solar borehole	728336341
2016-12-14	Homabay	Homabay_arucho	North kanyabar location	Eusebius okelo ndong	Kobar community project	713972046
2016-12-15	Baringo	marigati	Endau	Jesse Kaetuai	Endau Irrigation scheme	724871234
2016-12-07	Isiolo	ol_donyiro	Kipising	Esther	GSM borehole	791852540
2016-12-07	Isiolo	ngaremara	Kipsing	Joyce lolmakar	Kipsing borehole	715103397
2016-12-15	Homabay	gwassi_north	Kibwerr...gwassi east ward	Peter	Kigwa water project	Victor Owino 0797113876
2016-12-15	Homabay	gwassi_north	Gwassi central in gwassi south ward	Peter	Magunga community water supply project	Karena Akeyo chem 0706676287
2016-11-30	Embu	mavuria	Mavuria	Patrick ireri	Iriamurai Catholic parish	702955007
2016-11-30	Embu	mavuria	Mavuria	Margaret njuki	Individual	719257679
2016-11-30	Embu	mavuria	Mavuria	Nancy Njiru	Kachaki borehole	721690558
2016-12-15	Homabay	gwassi_north	Gwassi south ward	Peter	Kotengo water project	Elizabeth Gembe
2016-12-02	Embu	mwea	Karaba	John Mutuko	Grandfos	700896459
2016-12-02	Embu	mwea	Karaba	Benards	Grandfos	704017787

SURVEY_DAY	COUNTY:	WARD	LOCATION:	NAME OF THE INTERVIEWEE	SUPPLY SCHEME	TELEPHONE NUMBER
				mwange wambua		
2016-12-01	Embu	mwea	Makima	Fr.Mugo	Makima catholic parish	722360634
2016-12-01	Embu	mwea	Makima	Peter kimeu	Ndune wendo bore hole	726915905
2016-12-02	Embu	mwea	Karaba	Esther	Kawango	72337612
2016-12-02	Embu	mwea	Karaba	Esther	Kaluluini borehole	728661642
2016-12-02	Embu	mwea	Karaba	Mr Mauta Samuel	Consolata karaba bore hole	72337477
2016-12-02	Embu	mwea	Karabawango parish	Duncan Mutua	Karaba wango parish	721219707
2016-12-02	Embu	mwea	Karaba	Precila wangechi	Don't know	727334507
2016-12-02	Embu	mwea	Karaba	Peter mulo	Karaba water project	722443553
2016-12-02	Embu	mwea	Karaba	Wambua francis	Grandforce Wakalia Wachoro borehole	721855482
2016-12-02	Embu	mwea	Mwea	Margaret wakini Mutugi	Consolata mission Borehole project	724699515
2016-12-02	Embu	mwea	Riakanau	Sabina mutugwa	DOE Karaba Wang parish water project (Kijito)	721498290
2016-12-02	Embu	mwea	Karaba	Veronica Kavata	Kalulune borehole water project	0
2016-12-02	Embu	mwea	Karaba	Dennis Mwasyia	Karaba water project	710563169
2016-12-03	Embu	mavuria	Kithunthuriri	Theresiah wangechi	Kirathe dispensary borehole project	0

8.4.3. List Of key Informants

SURVEY DATE	ORGANIZATION/ GROUP:	NAME OF INTERVIEWEE(S)	. LEVEL OF RESPONSIBILITY	PLACE OF INTERVIEW	TELEPHONE	EMAIL ADDRESS	COUNTY	WARD
2016-12-05	Water resources management authority		Assistant technical coordination manager	Middle Ewaso Ngiro Sub region offices in Isiolo	722100667	n/a	Isiolo	county_hq
2016-12-05	Kenya Rapid	Emmanuel Olela	Isiolo County lead; MEAL (Monitoring Evaluation accountability and learning) officer	Isiolo	780224481	Emmanuel.Olela@crs.org; Peter.nyomoko@crs.org	Isiolo	county_hq
2016-12-05	County department of water, Energy and climate change	Roman Omitu	Sub-county water officer	Isiolo	724568049	Romanomitu2014@gmail.com	Isiolo	county_hq
2016-12-05	Caritas	Jane Wanjiku	Communication, mobilisation and WASH focal person	Isiolo	724843618	wanjiku.jane1@gmail	Isiolo	county_hq
2016-12-09	Garbatulla water supply project	Abdi Garba	Management comittee	Garbatulla north town	0701166666	n/a	Isiolo	garbatula_north
2016-12-16	Kenya Red cross	Bevly	Coordinator Baringo south	Baringo	725506154	bevlyyegon@gmail.com	Baringo	county_hq

2016-12-16	Red Cross	Bevlyine Beogon	Coordinator for Baringo South	Red cross offices	0721247109	n/a	Baringo	Marigat
2016-11-30	Embu county government	Steve njuki	Chief officer water, land and environment	Embu	72563545	Steve.njuki@Embucounty.co.ke	Embu	county_hq
2016-11-30	Ministry of water and irrigation- upper Tana	Njeru	District water Officer	Embu	716409045	n/a	Embu	county_hq
12/13/2016	County government of Homabay	Maryline Akinyi Agwa	Chief Officer-Water Services and Environment	Homabay	721835156	Marylineagwa@gmail.com	Homabay	county_hq
12/13/2016	County government	Livingstone Odundo	Deputy Director of water services	Homabay	725249910	Odundol@yahoo.com	Homabay	county_hq
12/13/2016	County ministry of water and irrigation	Job tomno	County Executive	County offices	722734511	tonmko@Baringocounty.co.ke	Baringo	county_hq
12/16/2016	World vision mogotio	Victor	Project coordinator	Mogotio office	729432060	n/a	Baringo	Ravine
12/16/2016	Muiya borehole water supply project	Peter lagan Zachary James koech	Treasurer	Baringo	721239098	n/a	Baringo	Ravine
12/16/2016	Chepchomus community Water Supply	Joshua kiptigen Nancy tanui Joy ruto	Treasurer secretary caretaker	Technology point	724671054	n/a	Baringo	Ravine
12/17/2016	EldamaRavine water and	Nothing chebii	Managing director	Ravine	792915113	esrawasco2007@yahoo.com	Baringo	Ravine

sewerage company

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