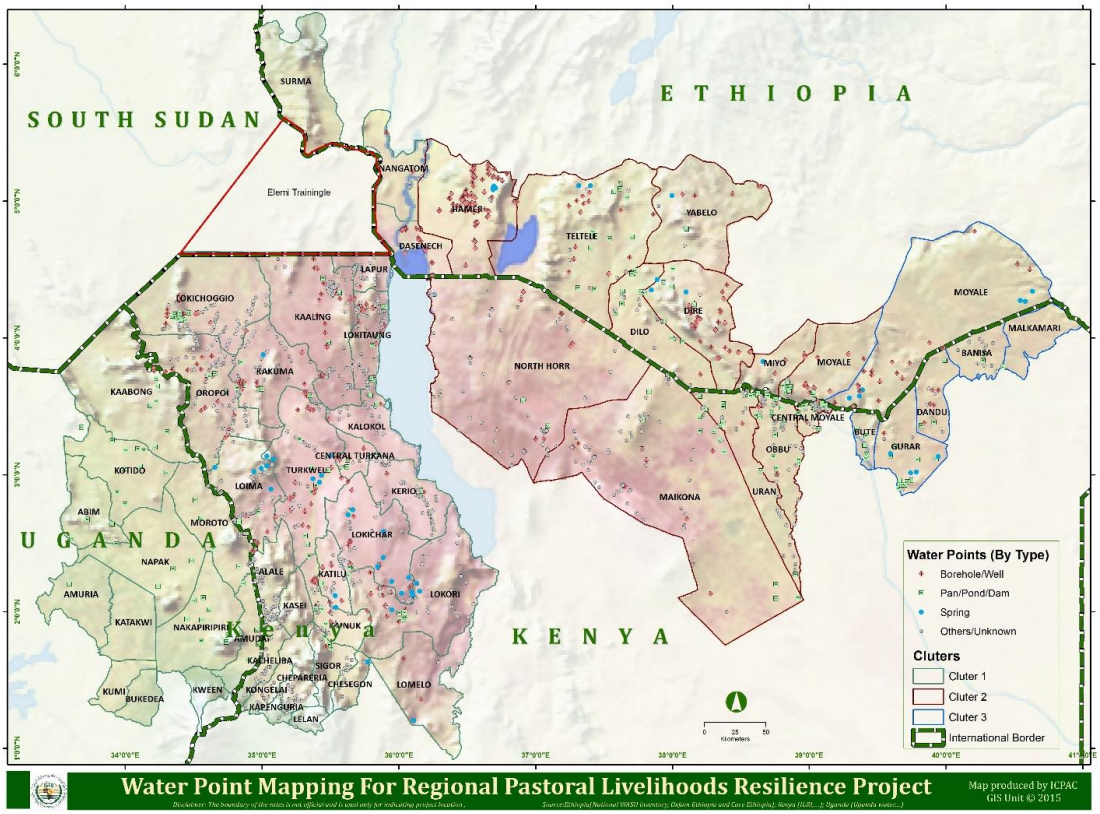
Regional Pastoral Livelihoods Resilience Project (RPLRP)

Abridge Summary of the Water point data compilation



Report

November 2015

Table of Contents

1. Introduction

The Regional Pastoral Livelihoods project (RPLRP) is a World Bank funder project and the Project objectives are to enhance livelihood resilience of pastoral and agro-pastoral communities in cross-border drought prone areas of Ethiopia, Kenya and Uganda Countries and improve the capacity of these Countries' governments to respond promptly and effectively to an eligible crisis or emergency. There are five major components under this project and these are;

1. **Natural Resources Management:** aims at enhancing the sustainable management and secures access of pastoral and agro-pastoral communities at natural resources (water and pasture) with trans-boundary significance
2. **Market Access and Trade:** aims at improving the market access of the agro-pastoralists and pastoralists to the intra-regional and international markets of livestock and livestock products.
3. **Livelihood Support:** aims at enhancing the livelihoods of Pastoralist and agro-pastoralist communities.
4. **Pastoral Risk Management:** aims at enhancing drought-related hazards and preparedness, prevention and response at the national and regional levels.

The water point mapping task comes under component one of natural resources and more specifically under sub component 1.4. In the water point mapping the first key task was to compile data from different offices of the three countries so as to see what is already available and what is not. This has informed the planning for the 2016 tasks under the water component of the RPLRP project which is presented under section 3.

The data compilation task was undertaken in all of the three countries involving different sources. The data collection task from the offices were not limited to the IGAD cluster areas but for sake of the scope only the water points for the three clusters will be discussed in this report. Some of the challenges faced for this water point mapping tasks were some of the data obtained lacked the XY coordinates and thus cannot be mapped, some of the data sets are old and finally inaccuracies on the GPS numbers are also noticed.

After the data is compiled from the countries, data standardization, categorization and mapping are carried out. Accordingly, the water points are classified in to one of the four units (Borehole, Pan/Pond/Dam, springs and others/unknown). In total 1766 water points are mapped, of which 490 are identified as Boreholes, 259 Pan/Pond/Dam, 56 springs and 982 as others/unknown.

2. Major Tasks

2.1. Field Mission for data compilation

Under the subcomponent of the RLPRP project Water Resources and water point mapping is key issues to be addressed in the first phase of the project. For this teams from ICPAC have visited Ethiopia and Uganda to assess and collect secondary data on water points in the project area. Accordingly, Dr. Mohammed went to Uganda and Dr. Ahmed to Ethiopia. This report is the compilation of the outcome of the visits with appropriate recommendations.

The mission objectives were

- to discuss with project staffs on the data collection tools and templates for water infrastructures in the RPLRP project areas in both countries
- Visit offices to explore secondary data availability on the location, type and description of water points in the project areas.
- Guide in-country project officers on how to collect data from the project areas and deliver to IGAD-RPLRP project office (based on the agreed time plan)

2.1.1. Uganda Mission (By Dr. Mohammed Hassan)

Meetings were held with the Project Coordinator, Natural Resource Management (NRM) coordinator and Water engineers involved in water resources development in the area (Details of meetings held and points discussed are shown in the annex).

The meetings with these officers highlighted that very little development of water resources was done before the last 10 years due to civil conflict. The Karamoja Land Intervention Project (KALIP) and Northern Uganda Social Action Fund (NUSAF) funded by the EU and WB respectively was initiated to develop the area.

There are 12 districts considered project area, seven are what constitute the Karamoja area while five are neighboring districts where the market routes reach.

Together this projects developed approximately 60 valley tanks and 5 dams, this work was done by the Water Resources department of the Ministry of Water and Environment (MWE). It was also clarified that very few boreholes exist in the region and they are mainly for domestic water. The MWE plans to develop 15 windmills in this budget year while the RPLRP plans to construct 170 boreholes and 13 valley tanks. The MWE longterm plan is to have a valley tank or pond for each parish and a dam for each sub county.

The MWE has been the only known actor in developing water resources in the area, consequently the NRM coordinator will send the data capture form to the District Water Engineers (through the MWE) to provide the data required for mapping. The tentative

timeline is for NRM to send the data received to ICPAC hydrologist by 20th October while the ICPAC hydrologist will share the draft maps by 30th October.

The Uganda RPLRP requested for a validation workshop to be conducted and funded by the regional RPLRP to discuss and validate the maps and also motivate those with extra information to share it.

Issues of Concerns

The Uganda RPLRP is in the process of carrying out four consultancies which will also do mapping including water resources. These are baseline, Socio-economic, Environmental and Geophysical surveys. These consultancies are at procurement stage and will be completed by March 2016. Thus the same activities and even detailed field work will be done and there is concern as to whether it is necessary to produce maps that will be changed and enhanced in a few months' time. It also calls for more close coordination of plans between the National and Regional RPLRP projects.

There is also concern on the need to coordinate the various IGAD mapping activities to benefit from synergies and also use resources more efficiently.

2.1.2. Ethiopia mission (By Dr. Ahmed Amdihun)

Tasks Accomplished

Desk study and Preliminary Discussions

The first task on the 29th September was to contact the focal person for the water component of the RPLRP project in the Ministry of Agriculture, Mr. Endalkachew and brief the mission objectives. This was followed by discussions and joint planning the two days tasks of visit to the different offices.

Office Visits

The mission targets two groups of offices that might have data on water points in the RPLRP project area. These are governmental and non-governmental organizations.

a) **Ministry of Water, Irrigation and Energy:** National WASH Inventory was conducted in 2011 and we are told data on water points across the country is available. Accordingly, we have produced a letter from Ministry of Agriculture and visited the office. The Director directorate (Mr.Nuredin) has approved our request to get the data and lead our case to the expert (Mr.Tamiru cell phone +251911434154). He pointed out that the data is available at

http://ethiowashmis.gov.et however, the website is down and next day he was in a meeting for three days. Thus, Endalkachew is tasked to follow-up this case and get us the data.

b) **Postural Community Development Project: Federal project Coordination Unit:** We have arranged a meeting with the project Manager Mr. Seid(Cellphone: +251911840831)and discussed the data available with them. They have agreed to contact their regional project staffs and inform us what is available and what is not. However, they made it clear that the water point data with them is aggregated to the Kebeles not in XY coordinates. This task is also given to Mr. Endalkachew as they didn't provide us with the data until Thursday afternoon 1st October 2015.

c) **IWMI/ILRI:** The visit to International water management institute was made on Wednesday 30 September 2015. The Contact person was Mrs.Nigist[Email: n.wegaye@cgiar.orgcellphone: +2519116172190]. We were informed that they have no such data but we get a CD of IWMI publication in the water sector from 1985-2012. Together we have visited ILRI which is working on livestock. We are informed that they don't have the data we are looking for.

d) **WaterAID Ethiopia:** Mr.Gashaye Chekol [e-mail: gashayecheckol@wateraid.org, cellphone +251911157061]program manager is contacted and he is indicating that there exists a master plan on water infrastructure development in Borena Zone which he is expected to send me soon.

e) **OXFAM-Ethiopia:** The visit to Oxfam Ethiopia led us to Mr. Meheteme[e-mail: mtora@oxfam cell Phone +251911465499]who is willing to provide us water point data from the area and this is indicated in the annex-1 of this document.

f) **Care Ethiopia/World Vision**: These two organizations are not visited but information was obtained through a contact person[Mr.Beresa cell phone +251912954545] and we are told that there are some data available on water points in the Borena area. He is willing to compile and send the files in this week.

Consolidation and Visualization

At the end of the visits we sat down with project water component focal person Mr.Endalkachew to discuss on the achievements of the two days visit and way forward on

how to proceed from what we have obtained. It is agreed that Mr. Endalkachew will re-visit Ministry of water resources to get the 2011 national WASH inventory and data from Postural Community Development Project. He will also visit SNV office which we can't make due to shortage of time. In addition Endalkachew is also tasked to call and communicate with the regional staffs to inquire and get data on water points.

Afterwards Ahmed will compile the data and make key recommendation on how to handle the data together with data from Kenya and Uganda to prepare water point map for the RPLRP project areas.

There are two major ways of mapping followed and these are preparation of standard maps and development of a web based portal to show the water points. The Maps are presented under Annex of this document and the web based application will be available soon.

2.2. Summary statistics for Water point data

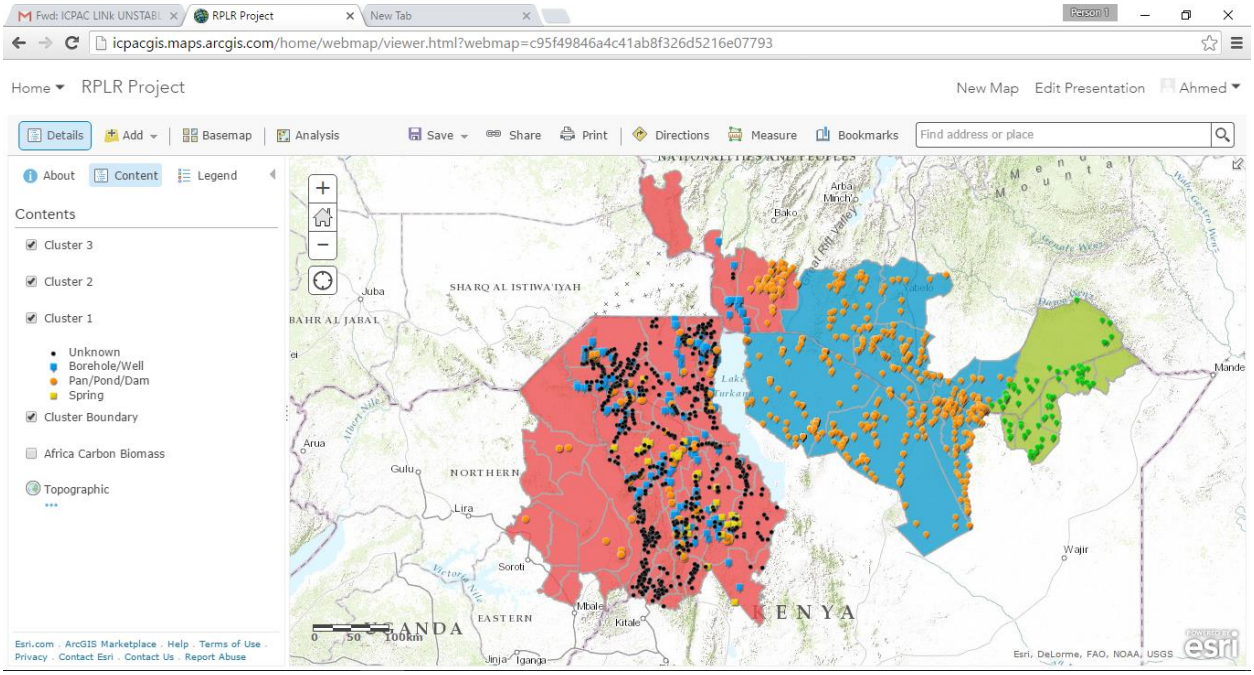
The water point mapping task was accomplished based on secondary sources which are often incomplete or obsolete. However, this data has informed us all the opportunities and challenges on water point data in the project area. Now lets present the statistical summary pf the data as follows

Water Point by Type	
Type	**Count**
Borehole/Well	490
Pan/Pond/Dam	259
Spring	56
Others	982
Total	**1787**

Water Points by Country					
Country	**Borehole**	**Pan/Pond/Dam**	**Spring**	**Others**	**Total Water points**
Ethiopia Side	272	40	22	44	378
Kenya Side	215	148	34	883	1280
Uganda Side	-	62	-	46	108

Water Points by Cluster					
Cluster #	**Borehole**	**Pan/Pond/Dam**	**Spring**	**Others**	**Total Water points**
Cluster 1	181	111	29	595	916
Cluster 2	277	106	13	342	738
Cluster 3	32	21	14	20	87

The maps are presented at the annexes of this document and the highlight of the app developed to visualize the water points is given as below.



2.3. The Overall assessment and Way forward

Obtaining data from secondary sources is not easy (as anticipated earlier) and most of the data obtained are either obsolete and/or with very small coverage of the RPLRP.

After looking at the data available in Ethiopia on water points in the project areas the following remarks are made:

a) In order to get up-to-date and inclusive data about water points there should be a way to strengthen the ongoing tasks of each member country to collect data on the existing and make recommendations on the proposed water locations. This can be achieved through IGAD by harmonizing their plans and agreeing on the work procedures with common timeline.

b) If we are so in need to the existing water point data; field work to the project areas could be mandatory but this needs resource, time and well preparation from the IGAD side.
c) The data we are expecting to get will finally inform us on what appropriate actions to take in order to achieve the water point mapping task.(15 October 2015)

3. 2016 PLAN FOR WATER COMPONENT OF THE RPLRP

The Regional Pastoral Livelihoods Resilience Project (RPLRP) now in its first year of operation aims at providing regional solutions to the pastoralists in the cross-border ASAL areas of Ethiopia, Kenya and Uganda who currently have national projects and potentially other countries in the greater horn of Africa. The project is specifically expected to give a package of investments and services to the three targeted cross-border clusters

The Water resources sub component under the natural resources management component has two outputs which are (i) regional/national maps available of water resources uses and users(for investment) refined and disseminated and (ii) Infrastructures for water resources access developed / rehabilitated. The activities under the first output area: updating and refining available maps of water resources as a continuation of IGAD HYCOS, domesticating available IGAD maps on water resources and supporting knowledge management which is a cross-cutting activity.

The project appraisal document (PAD) emphasizes the use of innovative approaches to delivering regional public good, this includes use of ICT and mobile phones in delivering and sharing information on markets, prices, climate conditions, water availability, and conflict-affected areas.

Activity A1: Updating and refining available maps of water resources as a continuation of IGAD HYCOS

Two sub-activities are planned under this: Harmonization of available water resources maps and maintenance and improvement of IGAD-HYCOS and other available water databases.

Harmonization of available water resources maps:

Maintenance and improvement of IGAD-HYCOS and other available water databases: IGAD Hycos project now in its final year is expected to produce water resources information (water levels and quality in mainly rivers) for approximately 100 stations in the region. Only one station (on Turkwel River in Kenya) is the project cluster due to the fact that cluster area is ASAL with few perennial rivers.

In order to improve water resources information availability in the project area it is proposed to use part of the budget for this sub activity to develop water points available and forecasted water resources information products focusing initially in the project clusters but with potential for up scaling to the whole region. This product will initially cover water points (pans and tanks) that were mapped under activity A2 and has a concept developed and attached herewith as an annex.

The products developed from this activity will be disseminated under the Water Resources Information System to be developed under Activity A3.

Activity A2. Domesticate available IGAD maps on water resources

Keep refining available maps of the project area to meet countries needs: Regarding this aspect, a draft Water Resources map for the three border clusters has been prepared in 2015 based on secondary data from public institutions and NGO's in the Ethiopia, Kenya and Uganda. The draft maps shows the location and type of static water resources point. This includes boreholes, shallow, wells, pans and tanks.

The Maps will be validated by the RPLRP field staff from the three countries early 2016 and comments and correction taken for further refinement of the maps.

Activity A3. Support Knowledge management

The main activity under this is Setting up integrated information system accessible to member countries, Geonude with limited access for particular users**:** It is hereby proposed to set up an integrated water resources information system (IWRIS) which will among other aspects be used for disseminating water related information and database for the project area. Due to the specialised nature of the IWRIS this activity will most likely be tendered as consultancy. A detailed ToR will developed later but the information that will be in the IWRIS will include

- Rainfall information,
- Water resources information
    - water pan status from the results of the water points modelling,
    - flood and drought maps from the regional early warning system currently under development in ICPAC
- Current and projected populations and
- Current and projected water demands

The system will also provide a forum for information exchange among the stakeholders and general public.

The main points to consider in developing the IWRIS are that it will;

- have an expandable architecture so that new information products can easily be added in future.
- be able to hold various types of products or information such as maps, numerical data, reports and information exchange with stakeholders.
- be able to support rapid and automatic data update and,
- support web visualisation and data/alert dissemination via internet, mobile apps and emails.

Budget

Activity	Description of Action	Item	Unit price (US$)	No	Total (US$)
Activity A1: Updating and refining available maps of water resources as a continuation of IGAD HYCOS	Set up a Water Points Monitoring, Modelling and Forecasting System	Water level loggers	500	9	4,500
		Field trip to survey water points dimensions and install Water level loggers (1 trip in each country 2 pax) (Ticket: $500*2, DSA: $200*5*2 Local Transport $1,000	4,000	3	12,000
		Field trip to download data (two trips in each country just before the rain season begins) $500*1, DSA: $200*5*1 Local Transport $1,000	2,500	6	15,000
				Sub Total	**31,500**
Activity A2. Domesticate available IGAD maps on water resources	Refining available maps of the project area to meet countries needs	Workshop to validate maps (20 participants from 3 countries and IGAD HQ $500*20, DSA: $200*2days*20pax Workshop facility $5,000	23,000	1	23,000
				Sub Total	**23,000**
Activity A3. Support Knowledge management	Development of Integrated water resources information system (IWRIS)	Consultancy Lumpsum	20,000	Lump sum	20,000
		Necessary hardware: Computer Software as per consultants specs	5,000		5,000
				Sub Total	**25,000**
				Grand Total	**79,000**

ANNEX: CONCEPT

Set up a Water Points Monitoring, Modelling and Forecasting System for the Project Area

Background

Mapping of water points in the region has aided the understanding of spatial availability of water resources in the project area. An attempt is made here to monitor the temporal availability of water resources in the identified points and forecast the availability of the resource in the near future.

This will aid in decision support to target areas that will require investment in infrastructure development to enhance water availability while in some other places it might require well framed management on the sustainable use the resources. It will be the basis for setting up a water information and Early warning systems in the region.

The USGS Early warning web has water pan monitoring information for about 57 points (34 in Ethiopia and 23 in Kenya) but not all are in the project area. The information available is percent water level, median and water point surface area. However more information is needed to make informed decision, for example percent water level doesn't indicate how much water is available nor is the demand clear. It therefore calls for further improvement of this system with local knowledge such as type of structure, volume-depth-surface area relationship as well as an estimate of demand and validation in a few sites.

Objectives

The objectives of the activities proposed hereunder are

1. **to carry out a** simple water balance (similar to ones undertaken by USGS) of the identified water points in the three border clusters and confirm the soundness of this method with field measurement at a few points

2. Establish and operational water monitoring and forecasting system based on the above water balance and driven by near real time climate date and future climate forecasts among others.

3. Developing a Web based visualisation and dissemination system for the monitoring and forecasting system

The objective of this exercise is to develop water resources map (surface and ground) and associated database for the three clusters through collecting and collating available secondary information in the countries in line with the output for subcomponent 1.1 on water resources development.

Activities

Catchment Delineations and extraction of other hydrographic features: SRTM or Aster DEM of various resolution depending on the size of the basin.

Land Cover/Land use mapping: Using Modis, this is important to determine such aspect as runoff coefficient which is the ratio of rainfall that will result in surface runoff.

The main drivers of water balance models is rainfall (P) (or a portion which contributes runoff (R)) demand (from human and livestock) (D) and loss through Evapotranspiration(ET), and infiltration/percolation (I).

R-D-ET-I= Change in Storage (±)

Rainfall and Evapotranspiration Data processing: The main drivers of water balance models is rainfall and Evapotranspiration (ET) and d. RFE and TRMM/GPM data will be used for rainfall while Potential ET from the USGS will be used to compute for the water balance

Modelling of Small Water points: Using the IGAD Regional Pastoral Livelihood and resilience project mapped water points, the water points volume/water level modelling will done using the simple water balance explained above.

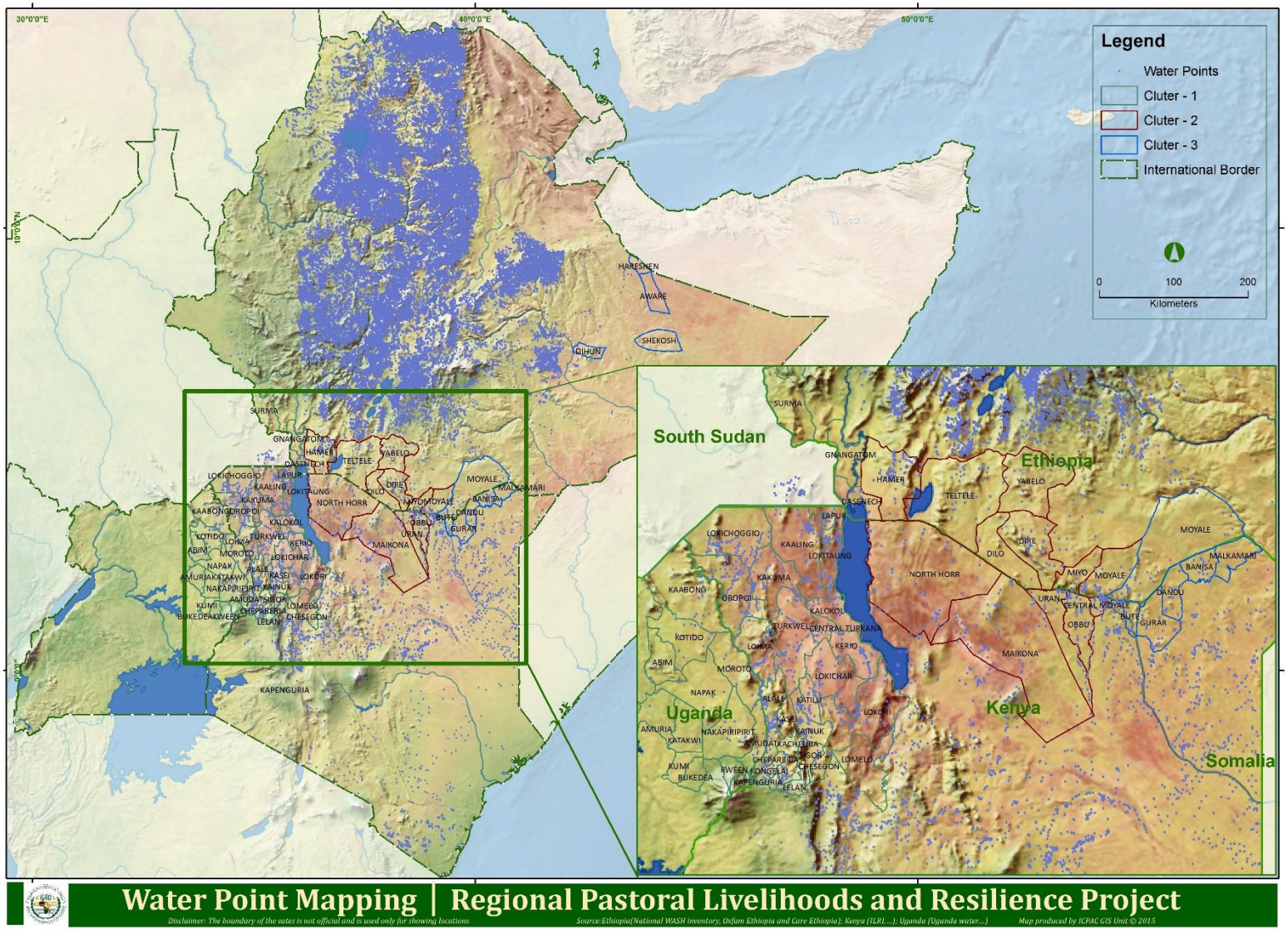
Forecasting of Water Resources
ICPAC carries out and issues seasonal climate forecast in February, May and August each year. These forecasts include rainfall and temperature. The forecasts which are normally in probabilities will be transformed to amounts and downscaled to the necessary temporal and spatial resolution using acceptable methodologies. This downscaled data will be then be used in the modelling activities stated above to forecast water resources at least a month into the future.

Validation of type surface area, depth volume relationship survey: A maximum of 9 water points will be selected for validated the output from this system. Three per cluster per country and each representing a type of water point. Survey will be undertaken in this sites and measurements taken and a water level logger installed to collect daily water level data.

4. Summary

In general what has been achieved so far is quite significant and contributed a lot in guiding the need for future data layers which are missing or incomplete. The forth coming verification/validation workshop will further advance both the precision and coverage of the water point mapping exercise.

5. Annexes: Maps, Apps and Additional Information

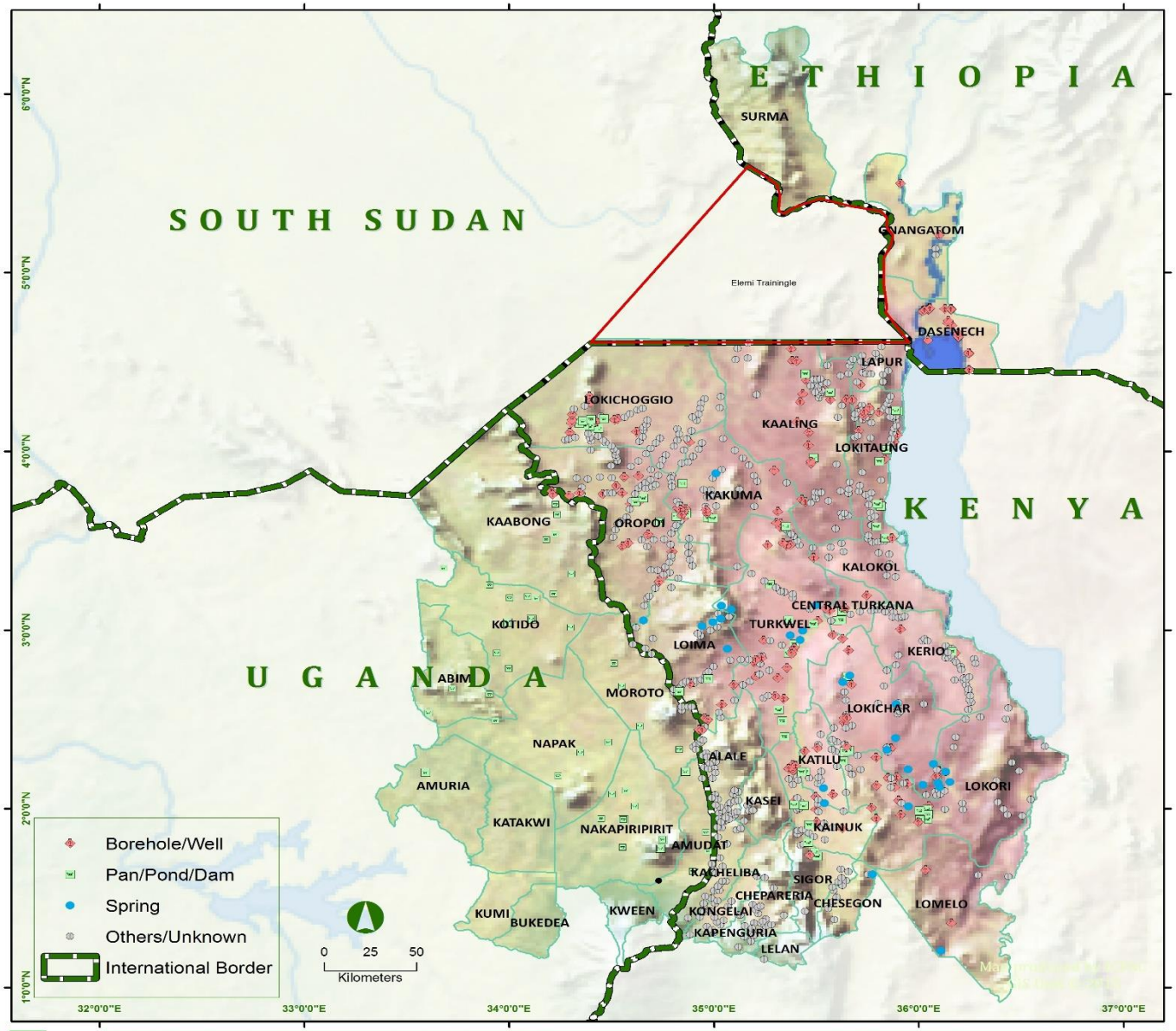


Water Point Mapping For Regional Pastoral Livelihoods Resilience Project

Disclaimer: The boundary of the sates is not official and is used only for indicating project location ,

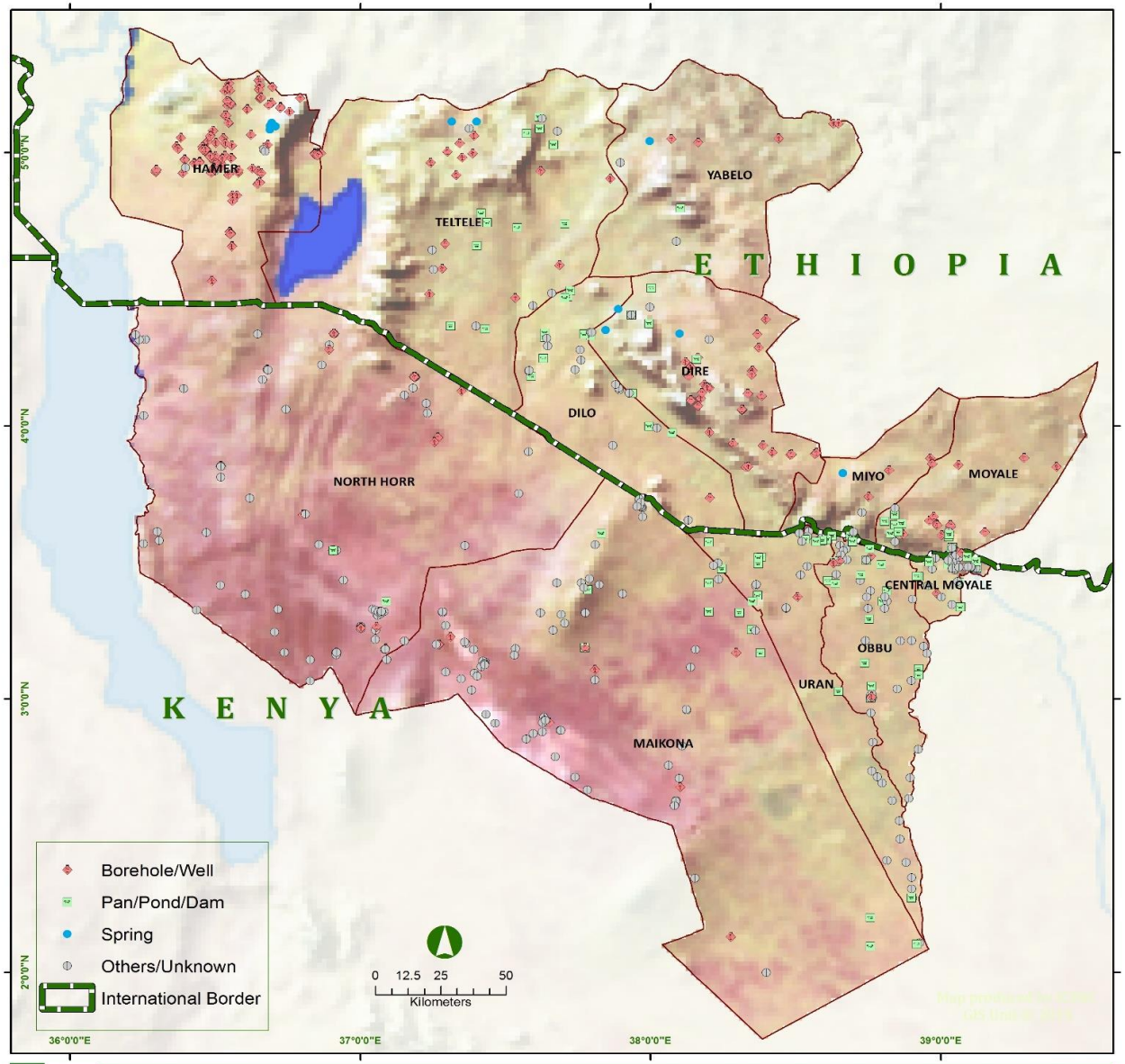
Source:Ethiopia(National WASH inventory, Oxfam Ethiopia and Care Ethiopia); Kenya (ILRI, ...); Uganda (Uganda water...)

Map produced by ICPAC
GIS Unit © 2015



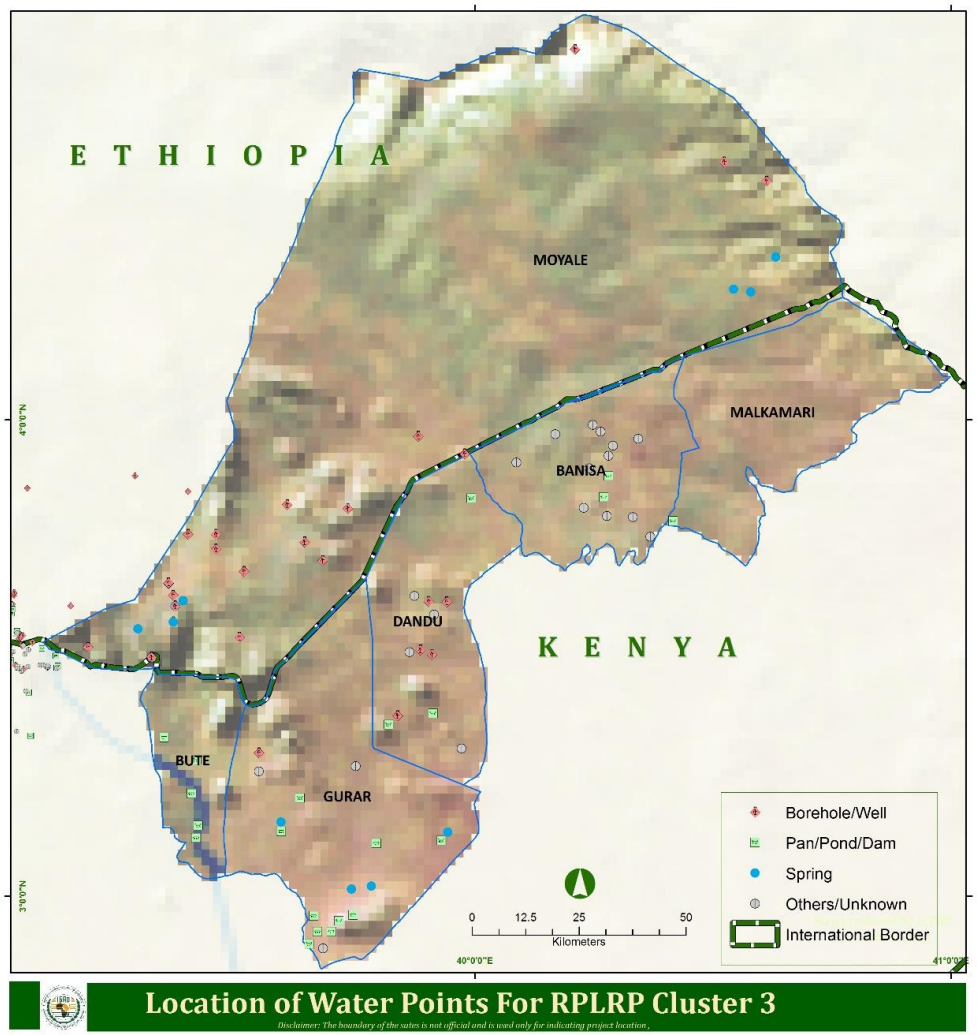
Location of Water Point For RPLRP Cluster 1

Disclaimer: The boundary of the sates is not official and is used only for indicating project location .



Location of Water Points For RPLRP Cluster 2

Disclaimer: The boundary of the sates is not official and is used only for indicating project location ,



Location of Water Points For RPLRP Cluster 3

Disclaimer: The boundary of the sates is not official and is used only for indicating project location ,

Data Obtained without Location information (coordinates)

			Source and Type	**Address**	**Location**	**Use and Users**	**Duration Water is Available**	**Source of Energy**									
No	**ID**	**Water point name**	**Water Source**	**Water Point Type**	**Zone**	**Woreda**	**Kebele**	**Sub-kebele / Village**	**Lat(Gps X)**	**Long(Gps Y)**	**Elev (m)**	**Nearest Market, Town, Village, etc**	**Distance (km) and Relative Direction from the Nearest Market, Town, Village**	**(E.g. Human, Livestock, Irrigated Agriculture, Wildlife, etc)**	**(E.g. 3 months - April, May and June)**	**(E.g. Diesel, Solar, Electricity, Manual, etc)**	**Remark**
1	RWH 1	hardiged	Rain water	pond	Jarar	Aware	hardiged										Functional
2	RWH 2	diita	Rain water	birka	Jarar	Aware	diita										Functional
3	RWH 3	laku	Rain water	birka	Jarar	Aware	laku										Functional
4	RWH 4	adadley	Rain water	birka	Jarar	Aware	adadley										Functional
5	RWH 5	guran	Rain water	pond	Jarar	Aware	guran										Functional
6	GW 6	mer mersane	Ground water	Shallowell	Jarar	Aware	mer mersane										Non functional
7	RWH 7	aware 1	Rain water	birka	Jarar	Aware	aware 1										Functional
8	GW 8	awre 2	Ground water	Hand dugwell	Jarar	Aware	awre 2										Non functional
9	RWH 9	awre 3	Rain water	birka	Jarar	Aware	awre 3										Functional
10	RWH 10	bukudabo	Rain water	birka	Jarar	Aware	bukudabo										Functional
1	RWH	gurdumi	Rain	birka	Jarar	Aware	gurdumi										Functional

1	11		water														
12	RWH 12	barta	Rain water	pond	Jarar	Aware	barta										Functional
13	RWH 13	madadle	Rain water	pond	Jarar	Aware	madadle										Functional
14	RWH 14	anano	Rain water	birka	Jarar	Aware	anano										Functional
15	RWH 15	kore	Rain water	pond	Jarar	Aware	kore										Functional
16	RWH 16	ado	Rain water	birka	Dollo	Warder	ado										Functional
17	GW 17	garlogu bay	Ground water	Hand dugwell	Dollo	Warder	garlogu bay										Non functional
18	RWH 18	lahelow	Rain water	birka	Dollo	Warder	lahelow										Functional
19	RWH 19	batrolda dis	Rain water	birka	Dollo	Warder	batrolda dis										Functional
20	RWH 20	agarweyne	Rain water	pond	Dollo	Warder	agarweyne										Functional
21	RWH 21	ferherari	Rain water	pond	Dollo	Warder	ferherari										Functional
22	GW 22	dawale	Ground water	Shallowell	Korahay	Shilabo	alen	dawale									Functional
23	RWH 23	bali ad	Rain water	birka	Korahay	Shilabo	lasole	bali ad									Functional
24	GW 24	kaboobi	Ground water	Shallowell	Korahay	Shilabo	danba ad	kaboobi									Functional
25	RWH 25	balishah	Rain water	birka	Korahay	Shilabo	aftol	balishah									Functional
26	RWH 26	fadigarad	Rain water	birka	Korahay	Shilabo	shilabo 1	fadigarad									Functional
27	RWH 27	shilabo 2	Rain water	birka	Korahay	Shilabo	shilabo 2	shilabo 2									Functional
28	RWH 28	gargaar	Rain water	birka	Korahay	Shilabo	karsoni	gargaar									Functional

29	RWH 29	jaledo	Rain water	birka	Korahay	Shilabo	jaledo										Functional
30	GW 30	baliwarir	Ground water	Shallowell	Korahay	Shilabo	baliwarir										Functional
31	RWH 31	labobar	Rain water	birka	Korahay	Shilabo	labobar										Functional
32	RWH 32	daanbiya	Rain water	birka	Korahay	Shilabo	daanbiya										Functional
33	RWH 33	qaydar	Rain water	birka	Korahay	Shilabo	tuloawil	qaydar									Functional
34	RWH 34	irgudban	Rain water	birka	Korahay	Shilabo	irgudban										Non functional
35	GW 35	laso ano	Ground water	birka	Korahay	Shilabo	laso ano										Functional
36	GW 36	gargaar	Ground water	Shallowell	Korahay	Shilabo	gargaar										Functional
37	GW 37	shaygosh 3	Ground water	deepwell	Korahay	shaygosh	shaygosh 3										Functional
38	GW 38	wijiwaji	Ground water	deepwell	Korahay	shaygosh	wijiwaji										Functional
39	RWH 39	sanbodhle	Rain water	birka	Korahay	shaygosh	sanbodhle										Functional
40	RWH 40	karindabayl	Rain water	birka	Korahay	shaygosh	karindabayl										Functional
41	GW 41	marogududshe	Ground water	deepwell	Korahay	shaygosh	marogududshe										Functional
42	RWH 42	biyolay	Rain water	birka	Korahay	shaygosh	biyolay										Functional
43	RWH 43	shaygosh 1	Rain water	birka	Korahay	shaygosh	shaygosh 1										Functional
44	GW 44	shaygosh 2	Ground water	deepwell	Korahay	shaygosh	shaygosh 2										Functional
45	RWH 45	gansale	Rain water	birka	Nogob	Duhun	gansale										Functional
46	GW 46	duhun	Ground water	deepwell	Nogob	Duhun	duhun										Functional

47	RWH 47	garasley	Rain water	birka	Nogob	Duhun	garasley										Functional
48	RWH 48	hararey	Rain water	birka	Nogob	Duhun	hararey										Functional
49	RWH 49	abesale	Rain water	pond	Nogob	Duhun	abesale										Functional
50	RWH 50	ayuun	Rain water	birka	Nogob	Duhun	ayuun										Functional
51	RWH 51	nanawe	Rain water	birka	Liban	Moyale	nanawe										Functional
52	RWH 52	harshilmi	Rain water	birka	Liban	Moyale	harshilmi										Functional
53	RWH 53	guji	Rain water	birka	Liban	Moyale	guji										Functional
54	RWH 54	gadaduma	Rain water	pond	Liban	Moyale	gadaduma										Functional
55	RWH 55	dugo	Rain water	pond	Liban	Moyale	dugo										Functional
56	RWH 56	bururi	Rain water	birka	Liban	Moyale	bururi										Functional
57	RWH 57	ley	Rain water	pond	Liban	Moyale	ley										Functional
58	GW 58	moyale 1	Ground water	deepwell	Liban	Moyale	moyale 1										Functional