Water Sources Inventory for Northern Somalia

Technical Report No W-12

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Somalia Water and Land Information Management Project
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1.0 INTRODUCTION

1.1 Background and Justification

Because of the civil strife in Somalia for the past 18 years, the Somali institutions that held important water and land related information have been destroyed. As a result most of the information on water and land resources were damaged or completely lost. The Somalia Water and Land Information Management (SWALIM) project was established with a primary objective of filling the gaps in the information necessary for water and land resources planning and management. The project has a long term goal of building Somali institutions' capacity by providing crucial information on water and land resources for use in national planning and decision making.

As part of the SWALIM's activities in information management, the Somalia Water Sources Information Management System (SWIMS) was developed. The SWIMS software, developed in phase II of SWALIM, was meant for partners working in the water sector in Somalia to collect and manage water sources information and contribute to a national database of the water sources. The software is designed to store and manage a wide range of data for different types of water sources used in Somalia: boreholes, shallow wells, springs, dams, and berkads.

The number of water sources information collected in SWIMS through partners implementing water projects in the field during SWALIM II was limited. Only 750 water sources data was received for a period of more than a year, and in many cases the data covered only a small section of the essential information. As a result it become necessary for SWALIM to move to the field and do an inventory of all water sources points in Somalia. A country wide survey was launched, in collaboration with UNICEF, for the strategic water points: boreholes, springs, dams and shallow wells which last long into the dry season. There are many point water sources in Somalia, which would take many months to survey. Majority of these sources are however seasonal, lasting only a few weeks after the rains. They include berkads and some shallow wells, and are used only during the rainy season. When they dry out the local communities look for alternative sources of water. The limited resources available for the survey could not cover all the water sources in the country. Only the strategic water points were surveyed, as they are the source of water for the local communities when the seasonal sources dry out.

The survey started in the Northern part of the country: Somaliland and Puntland, with plans of extending to the South/Central Somalia when security situation allows. As a way of capacity building in the Somali institutions, the survey teams were composed of the ministry staff. In Somaliland, the teams were from the Ministry of Water and Mineral Resources (MWMR) and in Puntland from Puntland State Agency for Water, Energy and Natural Resources (PSAWEN).

1.2 Survey Objectives

The overall objectives of the point water sources survey were to:

- Determine the spatial distribution of the point water sources across the country.
- Document the status of the point water sources concerning their function and use, physical parameters, water quality, demand and supply.
- Improve the national database of the water sources for Somalia
- Build national capacity for future inventory surveys of strategic point water sources

The specific objective of the survey was to establish and document the status of strategic point water sources throughout Somalia in regard to their location, function and use, physical parameters, water quality, demand and supply.

1.3 Expected Outcomes

Prior to the inventory survey, the water sources database for Somalia had many gaps in terms of missing sources or incomplete essential information for the existing sources. The water sources inventory survey aimed at collecting more information on the essential parameters, hence improving the existing database.

The findings of the inventory survey are expected to form a base for the long term monitoring of the water sources and intervention activities. From the survey, the location and current status of the strategic water sources was determined, opening a window for future surveys and monitoring.

Different types of maps are expected to be generated from the survey. The maps, done at region and district level, are expected to be useful in determining the spatial distribution and functionality of the water sources.

The results of the survey are expected to be used in the subsequent SWALIM phases to develop complete hydro-geological maps for national water use planning and management. SWALIM's partners in the water sector in Somalia are also expected to benefit from the survey results in making informed decisions about intervention requirements for the water sources.

Data forms filled in the survey will be archived at SWALIM's Nairobi office and liaison offices. An archive of the same will be created at the data centres hosted at PSAWEN in Garowe and MWMR in Hargeisa for future reference.

1.4 Purpose of the Report

This report describes the procedure, challenges and achievements of the water sources inventory survey carried out in Northern Somalia. A detailed analysis of the results obtained is presented as a chapter in the report. District maps generated from the data are attached at end of the report as annexes.

2.0 SURVEY PLANNING AND PREPARATIONS

2.1 Pre-Survey Activities

There were several activities which were necessary to carry out before the start of the survey. These Include:

- Planning for the survey
- Training of survey teams
- Community sensitization

2.1.1 Planning for the survey

The enormous work involved in the inventory survey required good planning and preparations to ensure smooth running of the activity. Two levels of planning meetings took place, in Nairobi and in the field, Hargeisa and Garowe. The Nairobi planning took place in the second week of April 2008 with participants from SWALIM Nairobi and regional liaison officers, hired consultants and representatives from some partner agencies. In this meeting, Somalia was divided into three regions: Puntland, Somaliland and South/Central Somalia. In each of these regions, survey was to be carried out by several enumerators headed by a regional coordinator. The South/Central Somalia was to be further sub-divided into three sub-regions due to the large area coverage. The Puntland and Somaliland surveys were planned to start beginning of May, while in the South/Central regions the survey would start at a later date depending on the security situation on the ground.

2.1.2 Training of survey teams

A week long training was conducted to familiarize the surveyors with the survey equipment and survey procedures. The training, conducted by SWALIM staff, was done in two stages: theory and practice. In the theory sessions, the data forms and principles behind the equipment and parameters were explained. In the practical sessions, the surveyors were taken to the field to do the actual measurements and recording in the field data forms. The hands-on training was done on the use of the equipment by visiting some of the water points, and involved among others:

(i) Use of Global Positioning System (GPS) to identify the X-Y coordinates of a water source as well as tracking paths followed.
(ii) Use of a multimeter to measure the basic water quality parameters namely pH, Electrical Conductivity (EC), temperature and Total Dissolved Solids (TDS).
(iii) Use of digital camera to take photos of the water points.
(iv) Use of dip meters to measure the depth of water in shallow wells and boreholes.
(v) Filling of the standard SWIMS field data collection forms.

At the end of the training the surveyors were able to go to the field and carry out the survey with minimum supervision.

2.1.3 Community sensitization by government authorities

The communities where the survey was to be conducted needed to be sensitized so that they cooperate with the survey teams once the activity begins. A senior ministry staff from Somaliland and Puntland moved across the regions informing the local authorities of the survey and purpose why it was being carried out. The sensitization exercise cleared the way for the survey teams to start the exercise.

2.2 Somaliland Survey Planning and Preparations

2.2.1 Hargeisa planning meeting

A planning workshop was held in Hargeisa following the initial planning meeting in Nairobi. The Hargeisa meeting took place on April 22nd 2008, after the potential candidates for the Somaliland survey team were prescreened, and a regional coordinator hired. The workshop engaged survey team members, representatives from partner agencies, and officers from the ministry of water in formulating the survey methodology and approach. The participants provided input from their own perspective, knowledge and experience on how to approach and conduct the survey.

There was a security concern expressed by most of the participants in the workshop regarding the safety of surveyors in Sool and Eastern Sanaag regions as periodic clan tensions are known in these areas. The Somali Red Crescent Society (SRCS) was however reported to be active and well respected by communities in the border regions between Puntland and Somaliland. The workshop therefore resolved to engage SRCS to conduct the survey in Eastern Sanaag and Sool regions.

2.2.2 Training of survey teams

A week long training was held in Hargeisa to equip the survey teams with knowledge on how to carry out the survey. The contents of the training were as outlined in section 2.2 above. The training took place at the FAO offices in Hargeisa in the first week of May, 2008. During this training, consultations amongst the team members agreed on the following divisions of the survey area:

Team 1: Awdal region and Gebiley district of Woqooyi Galbeed

Team 2: Woqooyi Galbeed region and Odweine district of Togdheer region

Team 3: Togdheer, Western Sanaag and Ainaba District of Sool region

Team 4 (SRCS): Sool and Eastern Sanaag regions

2.2.3 Community sensitization by government authorities

During the planning meetings held in Nairobi and the field, it was agreed that there was need to sensitize the local communities of the survey before the teams visit the field. This was to make the movement of the survey teams smooth when they start the exercise.

The director, Ministry of Water and Mineral Resources, undertook the sensitization exercise. His role was to move to the field and meet the region and district authorities, who would in turn mobilize the local leaders and inform them about the survey.

2.2.4 Start of actual survey

After the initial preparations and training, the Somaliland water sources inventory survey officially kicked off on 10th May 2008. The survey started from the coast moving inland. Each of the teams was equipped with:

- Survey equipment: - multimeter, dip meter, GPS handset, digital camera, field data forms etc
- Communication equipment: Thuraya phone (coordinator), sim cards and air time for two main mobile networks and HF radio in cars.
- Camping materials, generator, first aid kit, stationery etc.

To ensure a smooth start, Mohamud Egeh (Somaliland regional coordinator), Prof. Musse Shaie (SWALIM field coordinator), and Ali Ismail (SWALIM Liaison officer for Somaliland), were assigned to team 1, team 2 and team 3 respectively for the first week.

2.3 Puntland Survey Planning and Preparations

2.3.1 Garowe planning meeting

The other planning meeting took place in the first week of June in Garowe, after the selection of the survey teams and the regional coordinator for Puntland. Two survey teams were selected, each composed of three enumerators. The surveyors were selected from qualified and experienced staff from PSAWEN and the Ministry of Transport and Civil Aviation. Prioritization of the survey area and logistics of the survey were discussed in detail during this meeting.

2.3.2 Training of survey teams

Similarly to Hargeisa, a week long training was conducted to familiarize the surveyors with the survey equipment and survey procedures. Again, the training, conducted by SWALIM staff, was done in two stages: theory and practice. The training contents a re as outlined in section 2.2 of this report. For the hands on training, the survey teams visited the water points within Garowe town.

The survey teams were divided into two, each comprising of three members. The team members came for PSAWEN and the Puntland Ministry of Interior. Both teams agreed to start the survey from the coastal areas moving down.

2.3.3 Community sensitization by government authorities

The need for community sensitization before the surveyors visit has been discussed. In Puntland, the exercise was carried out by a senior staff from the ministry of interior. He visited the regions before the survey teams moved in to make the communities aware of their presence and aim of the survey.

2.3.4 Actual Survey

The actual survey for Puntland kicked off on 26th May 2008, soon after the week long training in Garowe. The teams were equiped with the same equipment as in Somaliland namely:

- Survey equipment: - multimeter, dip meter, GPS handset, digital camera, field data forms etc
- Communication equipment: Thuraya phone (coordinator), sim cards and air time for two main mobile networks and HF radio in cars.
- Camping materials, generator, first aid kit, stationery etc.

The survey started in Bossaso, with the assistance of Fu'ad, SWALIM's assistant Liaison officer for Puntland in the first few days.

3.0 SURVEY PROCEDURE

The actual survey in the field involved several activities:

- Visit to the selected strategic water point
- Measurement of water source parameters
- Data entry into standard SWIMS data collection forms

The collected data was transferred into SWIMS, verified, validated and analysed at the end of the survey.

3.1 Selection of strategic water points

There are many water points in Somalia, but the majority are seasonal, and do not last long into the dry season. The survey was carried out only on strategic water sources, which the population rely on during drought periods. Although not all the sources considered strategic last the entire dry season, majority sustain water for months after the rains stop. Selection of the strategic water sources was done in consultation with PSAWEN staff and local communities who are well conversant with the water points.

3.2 Parameters monitored in the water sources

The standard SWIMS data collection forms used in the survey have a wide range of parameters to be monitored. However, the limited time available for the survey could not allow measurement of all the parameters. Emphasis was put on the essential parameters, and other parameters which were easy to determine in the field within the available time and equipment. The parameters monitored include:

- Location details: GPS coordinates, source name, region and district where the source is located.
- Functional status and users of the source.
- Physical parameter: well depth, static water level, etc. of the source.
- Basic water quality: pH, EC, Temperature, TDS, colour, smell, etc. of water.
- Water supply and distribution network.
- Ownership and management of the source.

For every source visited, a digital still photo was taken which would help to better visualize the condition of the water source. The photos are linked to the source attributes and archived in SWIMS database alongside the other data collected.

3.3 Steps followed in data collection

Data collection procedure followed a "*Field Data Collection Guide*" prepared to guide the surveyors. The data collection guide is attached in Annex B of this document.

3.4 Coordination and monitoring of the survey in the field and Nairobi

The survey teams composed of three enumerators. The teams were under the guidance of a regional coordinator. However, the hired regional coordinator for Puntland resigned

soon after the team's training, just before the survey kicked off. SWALIM's liaison officer in Puntland took over the coordination of the two teams for the rest of the survey.

During the survey, liaison officers, in close collaboration with the field coordinator (Somaliland) provided the link between the survey teams and SWALIM's office in Nairobi. He also took charge of all field logistics involved in the survey. SWALIM's water coordinator gave the overall guidance and coordination of the activity.

Weekly updates on the progress of the survey were sent to SWALIM by the liaison officer/field coordinator. The updates included GPS coordinates for the sources visited as well as tracks followed by the survey teams. These data were downloaded and plotted over a map of Puntland in order to determine the spatial coverage of teams and advise them accordingly.

4.0 RESULTS AND ANALYSIS

4.1 Data Entry

The data collected during the inventory survey, and filled in the standard data collection forms was entered using the Somalia Water Sources Information Management System (SWIMS). The SWIMS software was developed by SWALIM for the agencies working in the water sector in Somalia for the construction and maintenance of point water sources data for the country.

Data entered into SWIMS was used to generate MS Excel reports for the water sources, which were used for the regional and district analysis discussed below.

4.2 Data Verification and Validation

The water sources inventory survey was carried out by ministry staff, in close consultation with the regional and district authorities who linked them to the local communities. Most of ministry staff have a lot of field experience. The involvement of people well conversant with the survey area, coupled with a thorough training done on the survey teams was intended to have the most accurate data possible collected.

However, human is to error, and there was need for data verification and validation after data entry was completed. SWALIM field liaison's officers were engaged in checking the spelling of source names entered into SWIMS to ensure they are the correct Somali names. Reports generated from the database in Excel were plotted and overlaid with administrative maps of regions, districts and settlements to check on the location of the water sources. The coordinates of sources found to lay outside the indicated location were re-checked to establish whether the error might have occurred during data entry. Corrections were made where applicable.

Photos taken during the survey were used to further validate the data. The photos had the date and time when they were taken. It was therefore easy to identify, using photos, the water sources visited before and after to estimate the location of the source under question.

4.3 Data Analysis and Spatial Presentation of Results

Some analysis was done on the survey data extracted from SWIMS in Ms Excel format. It should however be noted that the analysis done were basic, and agencies using the data can do much more in line with their organisation requirements. The analysis done by SWALIM were mainly on the following:

- Spatial distribution of water sources and utilization of this sources by different users
- Operational status of water sources
- Variation in water characteristics and physical parameters
- Supply and distribution
- Water Source management

For all analysis done, the results were displayed on maps based on the administrative units of regions and districts. District maps and related Ms.Excel Fact Sheets prepared after the analysis are attached as annex A.3 of this document.

4.3.1 Distribution and use of strategic point water sources

A summary of the number of strategic point water sources assessed is presented in Table 1 below. A total of 1609 sources were assessed, with dug wells recording the highest number, 864. Only a few sources termed as other sources (such as small sand storage reservoirs) were assessed since they were not considered strategic.

Table 1: Total Strategic Point Water Sources Assessed

	Number of Source Types					
Region Names	**Dam**	**Borehole**	**Dug well**	**Other**	**Spring**	**Grand Total**
Awdal	14	25	104		37	**180**
Bari		53	127		108	**288**
Mudug		41	25			**66**
Nugaal		48	115		55	**218**
Sanaag	2	32	107	1	30	**172**
Sool	2	18	86		3	**109**
Togdheer	19	40	86	31	20	**196**
Woqooyi Galbeed	87	43	212	4	34	**380**
Grand Total	**124**	**300**	**862**	**36**	**287**	**1609**

The results were matched with the number of different users utilizing the sources. The users of these sources were categorized as urban, rural and nomadic users. Results on the usage of the water sources are presented in Figures I and II as well as Table II below. The rural users of all sources surveyed amounted to 71.41%, Urban 20.51% and Nomadic 50.78%. Some sources are used by both nomadic and rural users. Dug wells are highly utilized by rural and nomadic users, with boreholes in high preference among urban dwellers.

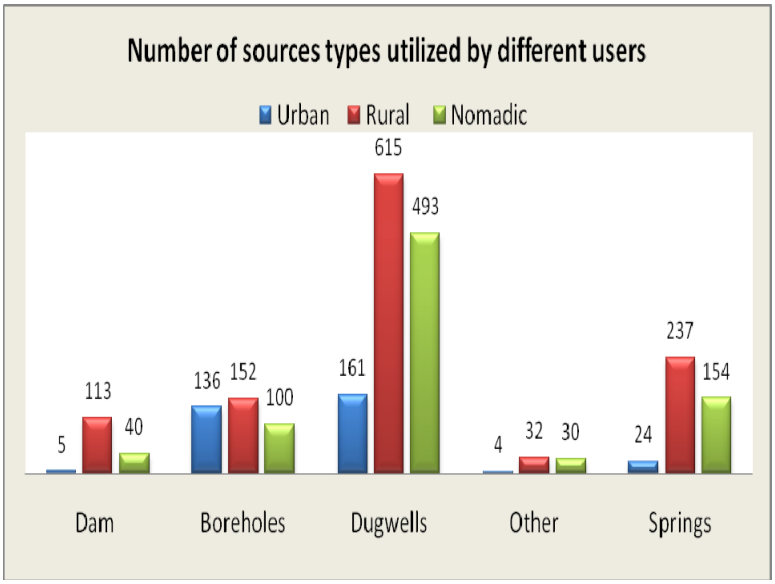

Figure I: Number of Source Types Utilized by Different Users

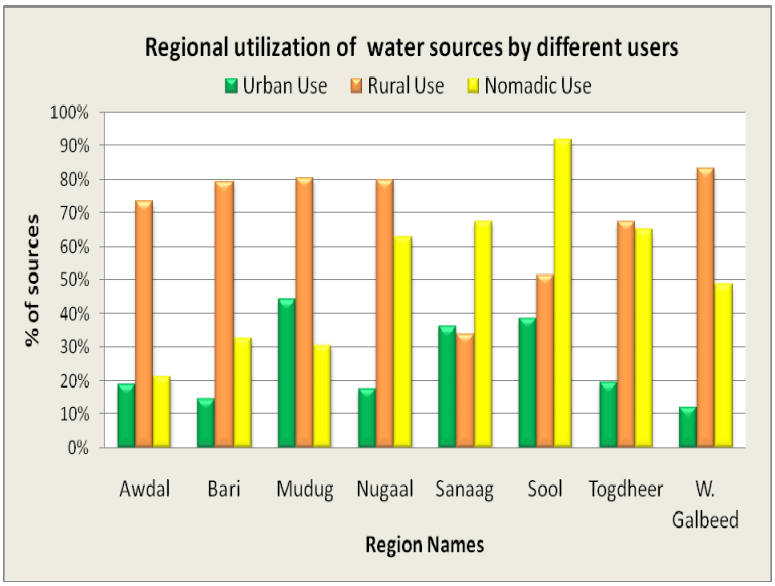

Figure II: Regional Utilization of Sources by Different Users

Table II: Number of Users for the Source Types

	Number of Source Types per Users														
	Dam			Boreholes			Dug wells			Other			Springs		
Region	**Urb**	**Rur**	**Nom**	**Urb**	**Rur**	**Nom**	**Urb**	**Rur**	**Nom**	**Urb**	**Rur**	**Nom**	**Urb**	**Rur**	**Nom**
Awdal	2	12	2	15	11	4	17	79	24					30	8
Bari				11	31	9	21	98	35				10	99	50
Mudug				29	31	8		22	12						
Nugaal				13	38	30	21	88	74				4	48	33
Sanaag	1		2	22	4	15	33	39	77	1		1	5	15	21
Sool		1	2	10	8	16	29	47	79				3		3
Togdheer	1	16	15	21	8	5	15	63	62	1	28	27		17	18
W.Galbeed	1	84	19	15	21	13	25	179	130	2	4	2	2	28	21
Total	**5**	**113**	**40**	**136**	**152**	**100**	**161**	**615**	**493**	**4**	**32**	**30**	**24**	**237**	**154**

4.3.2 Operational status of water sources

The operational status of water sources was categorized into four

- Operational sources
- None operational sources
- Abandoned sources
- Unknown operational status

Each source type was analyzed under the above categories. From the analysis, it was found out that 88% of the sources were operational, 7.06% not operational, 1.28% abandoned and the status of 3.66 % sources is unknown. It should be noted though that these percentages apply to the strategic water sources surveyed, and not all the water sources in Somalia.

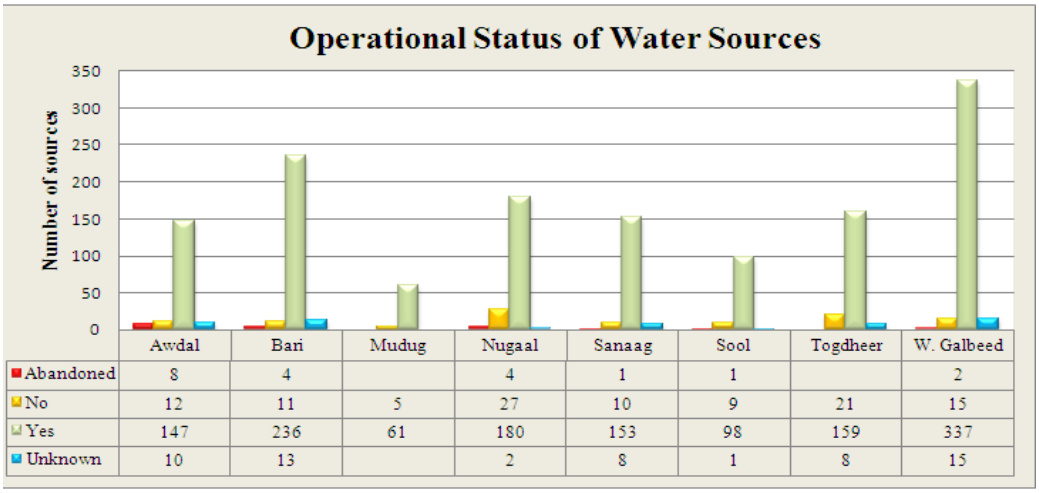

Figure III: **Operational status of strategic point water sources assessed**

Table III: Operational status per number of source type

	Operational Status			
Source Type	**Yes**	**No**	**Abandoned**	**Unknown**
Drilledwell	193	66	16	5
Dugwell	765	38	4	36
Dam	117	1		5
Spring	268	1		9
Other	28	4		2
% representation	**88%**	**7.06%**	**1.28%**	**3.66%**

Dugwells had the highest number of operational sources, though this could be because it is one of the preferend source types mainly to the rural and nomadic users. The other factor could be the relatively cheaper repair and maintence, as compared to boreholes, which are occasioanlly abandoned incase of a major break down due to the cost implications.

4.3.3 Reliability of water sources

Since reliability of water sources is of key importance to the user in addition to its operational status, information on the basis of whether the water is available all year round or only for some months of the year was analyzed based on Permanent, None Permanent and Unknown status of the water sources. Results of this analysis are presented in the table below.

Table IV: Reliability of water sources according to the number of source types

	Number of Permanent and Not Permanent water sources													
Source type	**Dam**			**Borehole**			**Dug well**			**Other**		**Spring**		
Permanent status	**UN**	**NP**	**P**	**UN**	**NP**	**P**	**UN**	**NP**	**P**	**UN**	**P**	**UN**	**NP**	**P**
Number of sources	13	53	57	30	28	222	66	27	750	8	26	14	8	256
P-Permanent, NP-Not permanent and UN-Unknown														

4.3.4 Current state of water sources

This was analyzed based on the conditions surrounding the assessed water sources; in terms of the general conditions, sanitary conditions, environmental conditions and the intervention requirements on the water sources.

Environmental conditions: It came out from the analysis that 41% of the total assessed sources were in good environmental conditions, with 17% being in poor conditions, while 42% of the sources are of unknown environmental conditions.

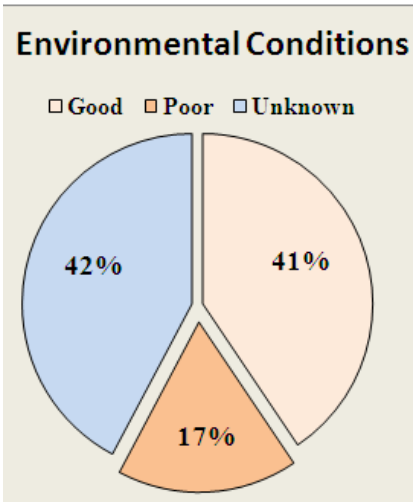

Figure IV: Environmental Conditions

Sanitary conditions: This was analysed in close relation to whether the source was protected,so as to prevent litter ,dust,human and animal waste from contaminating the water.it presented that 31%of the sources were in good sanitary conditions and 27% and 19% in fair and poor conditions respectively.This raises great concerns of risk of contamination of the water ,with adverse effects on the health of humans and animals utilizing this sources.

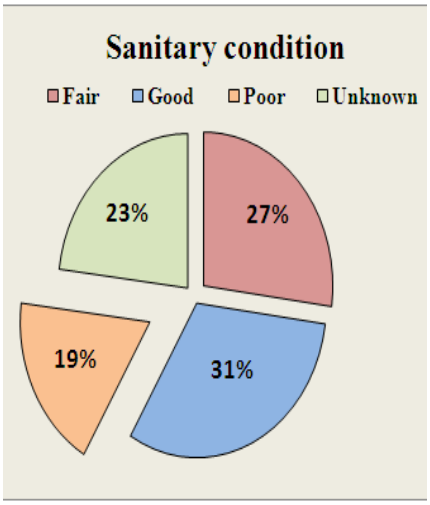

Figure V: Sanitary Conditions

Source protection: 91% of drilledwells and 41% of dugwells assessed had their well heads protected. 16% of dams, 13% of springs and 99% of other sources assessed were fenced both as a precaution measure to avoid accidents and improve sanitary conditions.

Intervention requirements: It came out from the analysis that only 3% of the total water sources assessed are currently not in need of some form of intervention. The other sources require interventions, with 25% requiring to be developed, 13% to be improved, 12% need to be rehabilitated, and 47% require one or more interventions and are thus termed to be of unknown intervention requirements.

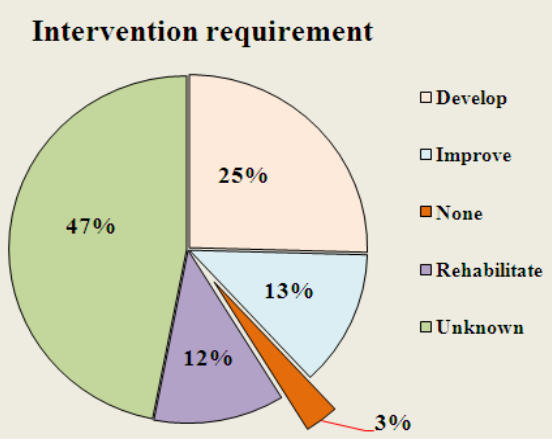

Figure VI: Intervention Requirements

General condtion: This was analysed as perceived by the users in terms of functionality, reliability and water quality. It presented that 40% of the source were in good condition, 22% in fair condition, 23% of unknown condition and 15% in poor condition.

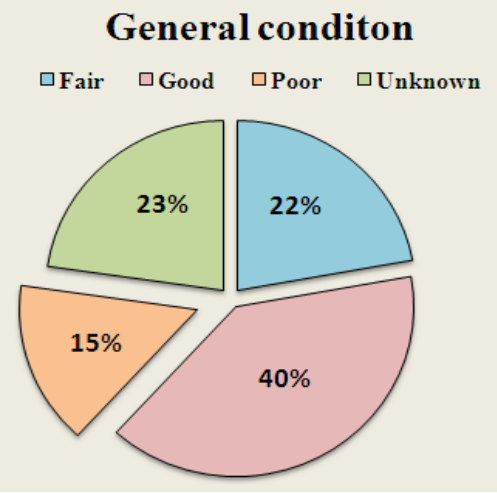

Figure VII: General Condition

The environmental conditions are known to greatly contribute to the sanitary conditions around a water source and consequently to its general condition in terms of reliability functionality and water quality. Intervention requirements in any of these should therefore consider the related aspects.

4.3.5 Variation in water characteristics and physical parameters

The water characteristic of the sources was analyzed, based on pH, EC, Temperature, and Turbidity, and contour maps were generated from these results.

Table V: Water quality parameters of assessed water sources

	Water Quality Parameters					
	Temperature(^{0}C)		pH		EC(µS/cm)	
SOURCE TYPE	Min	Max	Min	Max	Min	Max
Drilled well	19	38.00	6.00	9.8	370	5280
Dug well	7.5	40.00	6.00	9.6	250	8380
Dam	18	36.40	6.70	9.5	100	2080
Spring	26.7	40.00	6.30	9	326.5	5235
Berkad	25	29.00	7.20	8	130	370
Other	28	31.00	7.10	8	340	1891

The depths and static water levels for dug wells and boreholes were similarly analyzed and contour maps generated, however other physical parameters specific to certain source types were analyzed based on that particular source type and the spatial distribution.

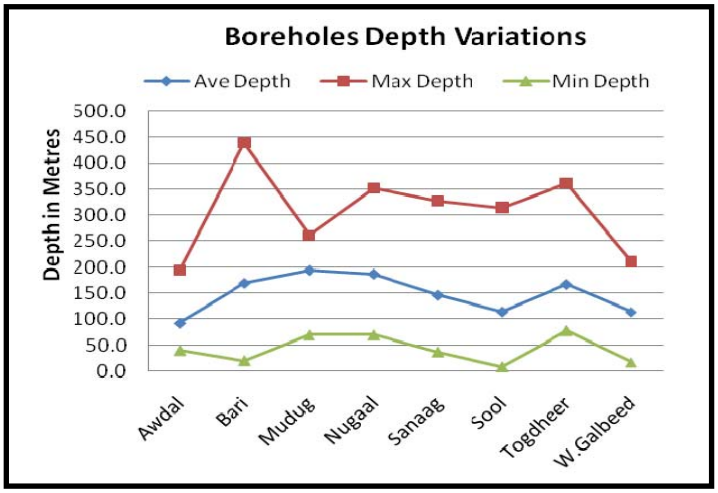

Figure VIII: Variation in Borehole Depths

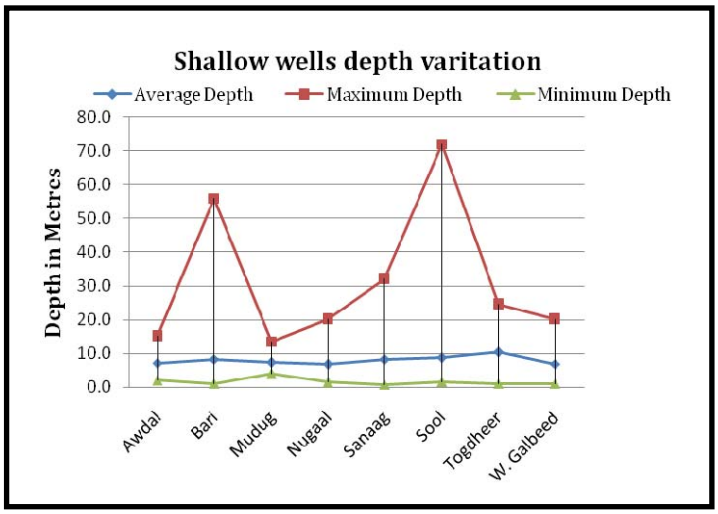

Figure IX: Variation in Shallow Well Depths

4.3.6 Supply and distribution

A considerable amount of water contamination may occur from the mode of supply and distribution of water. In order to capture this, analysis on the water lifting technologies in use, in addition to the supply system condition and the storages tank condition was analysed.

4.3.7 Water Source management

Management of the strategic water point was analyzed based on three categories

- Privately owned
- Communally owned
- Others

This gave a clear indication of the accessibility of this water sources by different users. Communally owned sources are more accessible to the local communities as opposed to the private sources where the owner might not be willing to share water with the community.

5.0 SURVEY CHALLENGES

The water sources inventory survey could not have gone on smoothly without challenges. The teams experienced a lot of challenges in reaching the water points. In many cases they had to walk long distances on bad terrain to get to a water source. Some of the major challenges encountered during the survey are highlighted below:

5.1 Technical challenges

(i) The high prices of fuel during the survey increased the transport costs tremendously. This limited the number of days for the survey as the budget was over stretched by the high costs. To cut on the cost, the teams used local guides to identify the shortest routes to the water sources.

(ii) Remoteness of some strategic water sources in mountainous areas limited their access by the survey teams. Representative sources were visited where accessing a particular source would compromise time for visiting other sources.

(iii) In some regions such as Togdheere, there are many settlements with no permanent water sources. The local communities rely on very shallow wells, mainly dug by hand on the river beds during the wet season. The survey teams spent a lot of time moving around searching for strategic water points.

(iv) The presence of land mines in some areas of Awdal and Woqooyi Galbeed regions near the border with Ethiopia rendered some sources inaccessible. The survey teams were warned by the locals against traveling to the land mine prone areas.

(v) Tension between clans in some districts occasionally threatened to disrupt the survey. In such cases, the survey teams had to move in the company of local leaders or guides to avoid conflicts.

(vi) Use of GPS for tracking and transfer of internal memory to external card was not familiar to the teams at the start of the survey, causing some delay in the confusion. A technical support from SWALIM staff solved the problem.

(vii) The extremely high water quality values in some sources posed a challenge to the survey equipment. The multi meter used by the surveyors had a limitation in measuring EC values above 3999 µS/cm. As it came out during the survey, there are sources with EC higher than this value. The survey teams had to carry samples of the high EC water for further analysis in the lab.

5.2 Logistical challenges

(i) The Puntland regional coordinator resigned after the training of the surveyors, just when the survey was about to start. This created a gap in the coordination of the teams, and since it was too late to look for a replacement, the liaison officer was capacitated to coordinate the survey. One of the enumerators also resigned halfway the mission, and a replacement had to be done immediately for smooth running of the survey.

5.3 Other challenges

(i) The area coverage for both Somaliland and Puntland are large and many of the feeder roads are in bad state, making movement across the region difficult. The teams were faced with a big challenge of trying to reach all strategic water points within a limited time.

(ii) Some of the water points and settlements pre-loaded into GPS or printed on maps to guide the survey teams have been abandoned. This was costly to the survey teams in terms of time and other resources as they would travel long distances only to find the sources no longer exist.

(iii) The surveyors stayed for long periods away from their families, and in difficult conditions, posing a challenge to their private and social lives.

6.0 CONCLUSION AND RECOMMENDATIONS

The water sources inventory survey for the Northern Somalia was a success, despite the many challenges faced in undertaking the activity. The hard work and determination by the survey teams is commendable.

A lot of data was collected during the survey. The primary data collected is for essential information of the water sources including location, functional status, use, physical parameters, water characteristics, supply and distribution and ownership of the water sources. A photo gallery was also made from the digital stills taken for all sources visited during the survey.

The survey teams collected secondary information as they went along visiting the water sources. Such information includes the roads network, which is equally important in updating the existing information on roads in the country. This type of information was collected through GPS tracking everywhere the survey teams went.

The water sources database for Somalia benefited a lot from the inventory survey. The previous database consisted of a small number of sources, with limited piece of information. In this survey, many parameters were monitored as the time and resources could allow. The current database is a great improvement to the previous after all the surveyed data were added to the database using SWIMS software.

The inventory survey concentrated on the strategic water points, as the resources available could not allow complete coverage of all water sources. There are many seasonal water sources, mainly berkads and some shallow wells, in Northern Somalia. However, these sources do not last long into the dry season, hence the reason why they were not prioritized in trying to make the best use of the available resources for the survey.

Agencies working in the water sector in Somalia can make good use of the survey data in making decisions on what kind of intervention they need to undertake in their project areas. The data collected during the survey is baseline which agencies can analyse or investigate further in order to come up with conclusions which guide their cause of action. SWALIM has done some very basic analysis of the data, but depending on their specific needs, agencies can do further analysis to be able to answer different types of questions regarding the water sources.

The characteristics of the water sources are expected to vary seasonally. The water level of a borehole for example would vary from wet to dry season, same with water quality, users and other parameters. Considering that the survey was just a one time event, general conclusions on the status of the water sources cannot be drawn from the collected data. Continuous monitoring of the water sources would be recommended for better analysis of the water sources.

APPENDICES

A.1 SURVEY TEAM MEMBERS

Team	Surveyors
Somaliland	
Team I	Mohamed Jirdeh Mohamed (TL)
	Osman Mohamed Osman
	Abdillahi Ali Obsieh
Team II	Saeed Duale Mohamed (TL)
	Osman Abdillahio Ali
	Mohamed Ali Adan
Team III	Abdirahman Farah Omer (TL)
	Khadar Ali Hassan
	Mustafe Isse Hussein
Team IV - SRCS	Yassin Osman Jama (TL)
	Ahmed Mohamoud
	Zeinab Abdirahman Mohamoud
Regional Survey Coordinator	Mohamud Hussein Egeh
MW&MR Survey Sensitizer	Abdirahman Abdisalam Sheikh
Puntland	
Team I	Abdi Hassan Musse (TL)
	Abdullahi Farah Isse
	Eng. Mohamed Abdi Musse
Team II	Hassan Mohamed Awisse (TL)
	Hirsi Hassan Yusuf
	Abdirahman Mohamed Nor
Min. of Interior Survey Sensitizer	

TL: Team Leader

A.2 FIELD DATA COLLECTION GUIDE

Data collection in the water sources inventory survey will follow the standardized SWIMS data collection sheets. The SWIMS data collection sheets contain two categories of information: *Essential* and *Detailed* information. The essential information represents the minimum data required by SWIMS to complete an inventory of the water sources for Somalia, while detailed information provides additional information required to do statistical and spatial analysis of the water sources regarding the water quality, socio-economic parameters, users, management and operation of the source. The essential information is bold in the data sheets, making it easy to differentiate from the detailed information.

The SWIMS data sheets consist of five major water source types in Somalia: boreholes, shallow wells, dams, springs and berkads. Source types that do not fit any of these categories are classified as "other". For each source, the data forms are divided into seven sections: Data Management; Location; Function and Use; Physical Parameters; Water Characteristics; Supply and Distribution; and Source Management. All these sections are the same for the different sources, apart from the physical parameters.

For every water source visited, the following information was be collected:

i) GPS coordinates of the water source. The coordinates (Northings, Eastings and Elevation) should be saved in the GPS handset in addition to recording in the data sheets (*see GPS quick ref. manual*)
ii) Physical parameters of the water source: - depth, static water level, protection etc
iii) Water quality: - pH, EC, smell, colour etc (*see Multimeter quick ref. manual)*
iv) Other parameters: - users, supply and distribution, management, cost etc
v) Photo of the source (*see Camera quick ref. manual)*

The team leader has the responsibility to:

- Distribute specific roles to the team members to ensure accurate information is collected and recorded in the shortest time possible.
- Check the filled data form before leaving the source to ensure all information is correctly entered.
- File the filled data sheets in the provided folders before leaving the source
- Ensure the data sheets are kept clean and submitted to the regional coordinator in the best possible condition.

Filling Data Collection Sheets

When filling the field data collection sheets the following should be noted:

i) Use permanent ink such a ball point and not pencil
ii) Writing should be neat and legible, preferably block capitals
iii) Use a tick ✓ when filling in check boxes
iv) Where information is not available leave the field blank
v) Maintain the data sheets as clean as possible

The SWIMS data collection sheets are comprehensive, but due to the time constraints in this survey, not all parameters in the data sheets can be collected. The parameters that are not easy to identify have been shaded, and the survey teams should not spend a lot of time on them. They should instead concentrate more on the remaining parameters to ensure they collect as much information as possible. Below is a brief description of what is required in each field.

Data Management

- Source in SWIMS?: Does the source already exists in SWIMS database?
- Date: The date the location was visited and the form filled in.
- Inspected by: The name of the team leader visiting the source.
- Entry Agency: The name of the agency who entered the data on the SWIMS Software – *SWALIM in this case*
- Inspecting Agency: the name of the agency responsible for physically collecting the data - *SWALIM in this case*

Location Section

- Region: The administrative region that the source is in.
- District: The administrative district that the source is in.
- Source Name: The local name for the source. Where there are a number of sources with the same name in an area, for example a well field, then each individual source should be given a numeral label (e.g. SOURCE1, SOURCE2……..).
- North: The latitude (x) coordinate of the source, reported to a precision of 6 decimal places.
- East: The longitude (y) coordinate of the source, reported to a precision of 6 decimal places.
- Elevation: the elevation of the source in meters above sea level, reported to a maximum precision of 1 m.
- Nearest Settlement Name: the nearest permanent settlement.
- Nearest Settlement Distance: The distance to the nearest permanent settlement.
- Users: The predominant users of the source as Rural, Urban or Nomadic, or all three.

Function and Use Section

- Functioning: The current operational status of the water source?
- Operator: Does the water source have a trained, permanent operator?
- Permanent Use: Is the water source used throughout the year?
- Distance to nearest permanent source: A water source such as a borehole, spring or stream that, in a normal year, provides water at all times throughout the year.
- Description of permanent source: Name or GPS coordinates of the nearest permanent water source if known.
- Settlements served by the source: Number of settlements served by the source.

Water Characteristics

- EC @ 25° C: The electrical conductivity of a sample from the source, corrected to the reference standard of 25° Celcius
- EC Make and Model: the name of the manufacturer of the EC meter and the manufacturer's model number.
- Calibration date: the date that the EC Meter was last calibrated.
- Temperature: The temperature, reported to a maximum precision of 0.5° Celcius, at which the pH measurement was made.
- pH: The pH, reported to a maximum precision of 0.1 pH
- pH meter Make and Model: the name of the manufacturer of the pH meter and the manufacturer's model number.
- Colour: the colour of a water sample from the source
- Smell: the smell of a water sample from the source
- Taste: the taste of a water sample from the source

Supply & Distribution

- Supply system condition: The condition of a distribution network, including animal troughs, if applicable.
- Water lifting technology: The type of water lifting technology at the source (multiple choices are valid)
- Pump Make: The name of the pump manufacturer
- Pump Model: The pump manufacturers model number
- Pump serial number: The pump manufacturers serial number.
- Date installed: The date, in ddmmyyyy format, that the pump was installed.
- Head: the delivery head of the pump, reported to a precision of 100 mm (0.1 m), at which the flow rate is achieved.
- Engine Make: The name of the engine manufacturer.
- Engine Model: The engine manufacturer's model number
- Engine Serial: Number: the engine manufacturer's serial number
- Date Installed: The date, in ddmmyyyy format, that the engine was installed.
- Engine Output: The engine output, reported to a precision of 1 Watt.
- Generator Make: The name of the generator manufacturer.
- Generator Model: The generator manufacturer's model number.
- Generator Serial Number: The generator manufacturer's serial number.
- Date installed: The date, in *ddmmyyyy* format, that the generator was installed.

Source Management

- Owner: Indicate whether the source is privately owned, community owned or other.

Physical Parameters: Drilled Well

- No. of wells in cluster: How many drilled wells are there in that area?
- Depth: The vertical distance in meters from the surface to the bottom of the drilled well.

- Static water level: The vertical distance in meters from the ground surface to the water surface.
- Pump casing type: what material is the pump casing constructed from?
- Pump casing size: the internal bore, reported to a maximum precision of 1mm of the pump casing
- Well head protected: Does the well have a sanitary seal?

Physical Parameters: Dug Well

- No. of wells in cluster: How many shallow wells are there in that area?
- Depth: The vertical distance in meters from the surface to the bottom of the shallow well.
- Static water level: The vertical distance in meters from the ground surface to the water surface.
- Apron: Does the well have an apron?
- Soak away: Does waste water from the well drain into a soak away pit?
- Infiltration Gallery: Does the well have an infiltration gallery?
- Operating Yield: What is the extraction rate from the well in m3/hr under normal operating conditions.
- Pump level: What is the level of a pump if there is one installed.
- Well head protected; Does the well have a sanitary seal?

Physical Parameters: Spring

- Seasonal deviation in discharge: The magnitude of fluctuation in the volumetric flow rate of the spring between wet and dry seasons
- Source Protected: Has the source been protected from contamination?

Physical Parameters: Berkad

- No. of Berkad in Cluster: The number of berkads in the same area.
- Reservoir Capacity: The usable volume of the berkad.

Physical Parameters: Dam

- Type of dam: Choose a description for the type of dam.
- Number of dams in cluster: The number of dams in the same area.

Physical Parameters: Other

- Type of Source: Provide a description of the source type.
- Source Protected: Has the source been protected from contamination?

A.3 DISTRICT MAPS AND FACT SHEETS FOR WATER SOURCES